DOCUMENT RESUME

ED 369 401 IR 054 968

AUTHOR	Sparks, Peter G., Ed.
TITLE	A Roundtable on Mass Deacidification. Report on a Meeting (Andover, Massachusetts, September 12-13, 1991).
INSTITUTION	Association of Research Libraries, Washington, D.C.; Northeast Document Conservation Center.
SPONS AGENCY	Andrew W. Mellon Foundation, New York, N.Y.
REPORT NO	ISBN-0-918006-21-X
PUB DATE	92
NOTE	139p.
AVAILABLE FROM	Association of Research Libraries, 1527 New Hampshire Avenue, N.W., Washington, DC 20036 ($20).
PUB TYPE	Collected Works - Conference Proceedings (021)
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	Administration; *Books; Cost Effectiveness; Economic Factors; Evaluation Methods; Financial Support; Higher Education; Library Materials; *Library Planning; Library Technical Processes; Pilot Projects; *Preservation; *Program Development; Program Evaluation; Records Management; Repair; Selection; Workshops
IDENTIFIERS	Library Funding; *Library Materials Conservation; *Paper Deacidification; Paper Deterioration

ABSTRACT

In September 1991 an invitational roundtable met to discuss issues in mass deacidification of books. The meeting was prompted by the significant increase in mass deacidification activities in recent years and libraries' interest in applying these processes. Contributions included: (1) "Opening Statement" (Duane Webster); (2) "The Institutional Context for Mass Deacidification" (Richard De Gennaro); (3) "Management Issues: The Director's Perspective" (Scott Bennett); (4) "Recent Developments at the Library of Congress" (Gerald Garvey); (5) "Institutional and Management Issues" (a panel session); (6) "Selection for Mass Deacidification: The Collection Development View" (Eugene L. Wiemers, Jr.); (7) "Institutional Selection Strategies: Case Studies" (Ed Rosenfeld, Jan Merrill-Oldham, and Carolyn Clark Morrow); (8) "Funding Strategies and Public Relations" (William J. Studer); (9) "Funding Strategies" (panel session); (10) "Cooperative Approaches to Mass Deacidification": (Carole Moore, Scott Bennett, and Richard Frieder); (11) "Special Collections, Special Challenges" (James Stroud); (12) "Toxicological Issues Related to Treatment Processes" (Michael Placke); (13) "Toxicological Issues and the Institution's Responsibility" (James Bukowski); (14) "Results of Independent Laboratory Testing of Deacidified Books" (Donald K. Sebera); (15) "Evaluation of Mass Deacidification Processes" (Helen D. Burgess); (16) "Experiences with Trial Treatments" (Carolyn Clark Morrow, Sue Himelick Nutty, Robert Milevski, Ed Rosenfeld, Jan Merrill-Oldham, and James Stroud); and (17) "Conclusion" (Jutta Reed-Scott). (SLD)

A Roundtable on Mass Deacidification

Report on a meeting held September 12-13, 1991 in Andover, Massachusetts

Edited by Peter G. Sparks

Sponsored by the Association of Research Libraries and the Northeast Document Conservation Center

A Roundtable on Mass Deacidification

Report on a meeting held
September 12 - 13, 1991
in Andover, Massachusetts

Edited by Peter G. Sparks

Co-sponsored by

Association of Research Libraries
Northeast Document Conservation Center

Association of Research Libraries Washington, DC 1992

The Asssociation of Research Libraries
1527 New Hampshire Avenue, N.W., Washington, DC 20036

The paper used in this publication meets the minimum requirements of the American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984

Publication of this report was supported by the Andrew W. Mellon Foundation

ISBN 0-918006-21-X

Price: $20.00

Contents

Contents

Foreword

Peter Sparks
Preservation Consultant

On September 12-13, 1991, an invitational roundtable met in Andover, Massachusetts, to discuss developments in mass deacidification that had taken place over the past year. The driving force for this meeting was both the significant increase in mass deacidification activity among research libraries, and interest by other libraries in how these "leading" institutions managed the decision to begin treatments and the outcome of their work to date. The goal of this meeting was to stimulate institutions that had shown an interest in mass deacidification to consider moving forward with limited production treatment. There were many common concerns, and it was a time and opportunity to come together and share experiences and information.

Invitations went out to ten institutions, asking each to send a three-person management team consisting of the Director, the Head of Collections Development, and the Preservation Officer. Observers were invited from the Commission on Preservation and Access; the National Endowment for the Humanities, Division of Preservation and Access; the National Archives; and the Connecticut State Library. The invitees' response to the invitation was excellent, with 21 library and archive institutions represented by either their management teams, speakers, or observers.

We were lucky indeed to have staff from the Library of Congress participate at the very last minute, to tell us firsthand why they could not bring their procurement effort to a successful contract to buy deacidification services. Gerald Garvey's remarks clarified the situation, and Donald Sebera's technical discussion presented some very useful technical evaluation data.

A very important event, which was not part of the official program, should be mentioned here. On the first day Michael Placke, Vice President of Battelle Memorial Institute, Columbus Division, pointed out that in the industrial research world, when there is a significant developmental challenge similar to the adoption of mass deacidification, companies form a development group that works as a team to solve pressing problems. He suggested that this might be a good approach for libraries that are developing mass deacidification programs to consider. Further discussion led to enough consensus on the cooperative idea that Duane Webster agreed to put it on the agenda of the Association of Research Libraries' Committee on the Preservation of Research Library Materials, and to work towards setting up a formal group of eight to ten institutions that want to move forward in 1992 with their own treatment programs and to share their own experiences with the others in the group. As of this writing, ARL has moved positively to set up a mass deacidification development group.

Acknowledgements

Many persons and organizations contributed to the success of this roundtable. The Northeast Document Conservation Center (NEDCC) and the Association of Research Libraries (ARL) agreed wholeheartedly to co-sponsor the event. Ann Russell, Director of the NEDCC, and Duane Webster, Executive Director of the ARL, contributed generously of their own time and also of staff time and resources from both organizations that allowed the event to run smoothly. Carolyn Morrow and Jan Merrill-Oldham deserve special thanks for input on the design of the program. During the meeting, the staff of NEDCC helped in many ways, with special credit going to Gail Pfeifle for handling endless details and to Sherelyn Ogden for operating the transcribing equipment without a hitch.

The publication of the roundtable proceedings was also a team effort. A great deal of credit goes to our speakers, who made the extra effort to get their papers to the editor on time. These papers were organized and edited by the roundtable coordinator, Peter G. Sparks, former Director of Preservation at the Library of Congress and now an active consultant in the library preservation field. Jutta Reed-Scott of the ARL played a key role in getting the edited document ready for printing and also coordinated all the efforts with the printer and with distribution.

Funding for this roundtable was provided by the Andrew W. Mellon Foundation. We are deeply indebted to James Morris, former Program Officer at the Andrew W. Mellon Foundation, whose understanding of needs in the library preservation field led not ony to this meeting but to a number of successful projects over many years that have contributed to the progress of library preservation.

Thursday, September 12

2:00 - 2:10
Welcome
Ann Russell, Executive Director
Northeast Document Conservation Center

2:10 - 2:20
Opening Statement
Duane E. Webster, Executive Director
Association of Research Libraries

2:20 - 2:40
The Institutional Context for Mass Deacidification
Richard De Gennaro, Roy E. Larsen Librarian of Harvard College
Harvard University

2:40 - 3:00
Management Issues: The Director's Perspective
Scott Bennett, Sheridan Director of the Milton S. Eisenhower Library
The Johns Hopkins University

3:00 - 3:20
Break

3:20 - 3:35
Recent Developments at The Library of Congress
Gerald Garvey, Mass Deacidification Program Manager
Library of Congress

3:35 - 4:05
Panel Session on Institutional and Management Issues
Paul Fasana, Andrew W. Mellon Director of The Research Libraries
New York Public Library

Gerald Munoff, Deputy Director
University of Chicago

Daniel Richards, Collection Development Officer
National Library of Medicine

4:05 - 5:00
Questions and Discussion

6:00 - 7:30
Dinner at the Andover Inn

7:30 - 8:00
Selection for Mass Deacidification: The Collection Development View
Eugene L. Wiemers, Jr., Assistant University Librarian for Collection Management
Northwestern University

8:00 - 8:30
Institutional Selection Strategies: Case Studies
Ed Rosenfeld, Associate Director for Collection and Reader Services
Milton S. Eisenhower Library
The Johns Hopkins University

Jan Merrill-Oldham, Head, Preservation Department
University of Connecticut

Program

Carolyn Clark Morrow, Malloy Rabinowitz Preservation Librarian in the Harvard University Library and the Harvard College Library

8:30 - 9:00
Questions and Discussion

Friday, September 13

8:30 - 8.50
Funding Strategies and Public Relations
William J. Studer, Director
Ohio State University Libraries

8:50 - 9:30
Panel Session on Funding Strategies
Richard De Gennaro, Roy E. Larsen Librarian of Harvard College
Harvard University

Donald E. Riggs, Dean
University Library
University of Michigan

Paul H. Mosher, Vice Provost and Director
University of Pennsylvania Libraries

Joseph A. Rosenthal
University Librarian
University of California, Berkeley

9:30 - 9:45
Questions and Discussion

9:45 - 10:00
Break

10:00-10:40
Cooperative Approaches: Case Studies
Carole Moore, Chief Librarian
University of Toronto

Scott Bennett, Sheridan Director of the Milton S. Eisenhower Library
The Johns Hopkins University

Richard Frieder, Chair, CIC Task Force on Mass Deacidification and Head, Preservation Department
Northwestern University Libraries

10:40-11:00
Special Collections, Special Challenges
James Stroud, Chief Conservation Officer, Henry Ransom Humanities Research Center
University of Texas, Austin

11:00-11:25
Toxicological Issues and Testing Related to Treatment Processes
Michael Placke, Vice President
Battelle Memorial Institute - Columbus Division

11:25-11:45
Toxicological Issues and the Institution's Responsibility
James Bukowski, Industrial Hygenist
Office of Safety and Environmental Health
The Johns Hopkins University

11:45-12:00
Questions and Discussion

12:00-1:15
Tours of NEDCC and Buffet Lunch

1:15 - 1:55
Testing Protocols

Donald K. Sebera, Preservation Research Scientist
Library of Congress

Helen D. Burgess, Senior Conservation Scientist
Canadian Conservation Institute

1:55 - 2:00
Questions and Discussion

2:00 - 3:05
Experiences With Trial Treatments

Carolyn Clark Morrow, Malloy Rabinowitz Preservation Librarian in the Harvard University Library and the Harvard College Library

Sue Himelick Nutty, CIC Mass Deacidification Coordinator
Northwestern University

Robert Milevski, Preservation Officer
Princeton University Library

Ed Rosenfeld, Associate Director for Collection and Reader Services
Milton S. Eisenhower Library
The Johns Hopkins University

Jan Merrill-Oldham, Head of the Preservation Department
University of Connecticut

James Stroud, Chief Conservation Officer
Harry Ransom Humanities Research Center, University of Texas, Austin

3:05 - 3:25
Questions and Discussion

3:25 - 3:30
Goodbye

Ann Russell, Executive Director
Northeast Document Conservation Center

List of Participants, Speakers, and Observers

Association of Research Libraries
Duane E. Webster, Executive Director
Jutta Reed-Scott, Senior Program Officer for Access and Collections Services

Battelle Memorial Institute
Michael Placke, Vice President Battelle Columbus Division

University of California, Berkeley, Libraries
Joseph A. Rosenthal, University Librarian
Barclay Ogden, Preservation Administrator

Canadian Conservation Institute
Helen D. Burgess, Senior Conservation Scientist

Commission on Preservation and Access
Maxine K. Sitts, Program Officer

University of Chicago Library
Gerald Munoff, Deputy Director
Barbara Van Deventer, Assistant Director for Collection Development, and Humanities and Social Science
Sherry Byrne, Preservation Librarian

Columbia University Libraries
Carol Mandel, Director, Technical and Networked Information Services
Janet Gertz, Preservation Administrator
Anthony W. Ferguson, Director, Resources and Special Collections

Connecticut State Library, Preservation Office
Lynne Newell, Director

University of Connecticut Library
Jan Merrill-Oldham, Head, Preservation Department

Harvard College Library
Richard De Gennaro, Roy E. Larsen Librarian of Harvard College
Carolyn Clark Morrow, Preservation Librarian

The Johns Hopkins University
Scott Bennett, Sheridan Director of the Milton S. Eisenhower Library
Ed Rosenfeld, Assistant Director for Collection and Reader Services
James Bukowski, Industrial Hygienist

University of Kentucky, College of Library and Information Science
George M. Cunha, Preservation Consultant

The Library of Congress
Donald K. Sebera, Preservation Research Scientist
Gerald Garvey, Mass Deacidification Program Manager

University of Michigan Library
Donald E. Riggs, Dean
Carla Montori, Preservation Librarian

National Archives and Records Administration
Lewis Bellardo, Director, PPS Division

National Endowment for the Humanities
George F. Farr, Jr., Director, Division of Preservation and Access

List of Participants, Speakers, and Observers

National Library of Medicine
Margaret Byrnes, Head of Preservation Section
Daniel Richards, Collections Development Office

The New York Public Library - The Research Libraries
Paul Fasana, Andrew W. Mellon Director
Rodney Phillips, Head of Collection Management
John Baker, Preservation Administrator

Northeast Document Conservation Center
Ann Russell, Director
Peter G. Sparks, Mass Deacidification Roundtable Coordinator
Karen Motylewski, Director of Field Services
Sherelyn Ogden, Director of Book Conservation
Mary Beth Nelligan, Field Service Representative

Northwestern University Libraries
Eugene L. Wiemers, Jr., Assistant University Librarian, Collection Management
Richard Frieder, Head of Preservation Department
Sue Himelick Nutty, CIC Mass Deacidification Program

Ohio State University Libraries
William J. Studer, Director

University of Pennsylvania Libraries
Paul H. Mosher, Vice Provost and Director
Carton Rogers, Preservation Administrator

Princeton University Library
Robert Milevski, Head of Preservation

Stanford University Libraries
Constance Brooks, Preservation Administrator

University of Texas, Austin
James Stroud, Chief Conservation Officer

University of Toronto Libraries
Carole Moore, Chief Librarian
Karen Turko, Head, Preservation Services

Yale University Libraries
Marcia Watt, Preservation Librarian

Opening Statement

Duane E. Webster
Executive Director
Association of Research Libraries

The Association of Research Libraries (ARL) is pleased to be a joint sponsor, with the Northeast Document Conservation Center, of this roundtable on mass deacidification, and we appreciate the essential financial support of the Andrew W. Mellon Foundation. I also want to acknowledge, at the outset of our discussions, the important contributions of Peter Sparks and Jutta Reed-Scott in planning and conducting this roundtable.

I would like to begin by describing briefly ARL's Preservation Agenda. In 1990, resources of ARL members in the aggregate included 356 million volumes, $1.9 billion in annual expenditures, with $503 million allocated for library materials and $66 million for preservation. Over more than a century, ARL libraries have invested billions of dollars in building, organizing, and maintaining comprehensive research collections. Yet a significant part of this investment is threatened by the chemical deterioration of the paper on which post-1850 volumes are printed. The magnitude and the dimensions of the preservation problems facing research libraries make preservation of our intellectual heritage a high-priority responsibility of research libraries.

ARL's preservation agenda supports a multi-faceted approach of new and traditional technologies, physical conservation, reformatting, and preventive measures. Strategies for pursuing ARL's preservation agenda include:

- advocacy for strengthening and encouraging broad-based participation in national preservation efforts in the U.S. and Canada;
- support for development of preservation programs within member libraries;
- support for effective bibliographic control of preservation-related processes;
- encouragement for development of preservation information resources; and

Duane E. Webster begins the conference with his opening remarks.

- monitoring of technological developments that may have an impact on preservation goals.

ARL operates the Committee on Preservation of Research Library Materials, which was established by the ARL Board of Directors to help the Association promote and coordinate member libraries' programs to preserve their collections. The Committee has advanced ARL's preservation agenda on many fronts. One critical concern over the past five years has been monitoring developments relating to mass deacidification.

Pursuit of a Mass Deacidification Strategy

For research libraries with millions of acidic books, mass deacidification of acidic books while they are still physically sound and not yet brittle will play a critical role as a cost-effective corrective technique and as a means to preserve research materials in the original format. But mass deacidification is also a technology beset by rapid reversals of fortune.

The impetus for planning this roundtable was the need for assessing the combined experiences of several research libraries that have started to plan or implement mass deacidification programs. The recent announcement by the Library of Congress that LC has turned down the proposals from three companies to undertake the task of mass deacidifying millions of books in LC's collections has suddenly added a further dimension to this roundtable. I am very pleased that Gerald Garvey, LC's Mass Deacidification Program Manager, is able to join us and provide information on LC's decision and future plans. A new and critical goal of this meeting will be to assess the implications of the LC decision. This meeting also offers an opportunity to explore closer cooperation between LC and ARL libraries that are actively engaged in planning mass deacidification programs. There are several areas where LC and other research libraries might join forces toward the common goal of making available affordable, technically effective mass deacidification technologies.

ARL and its Preservation Committee are very interested in finding solutions to the issues that remain to be resolved and in making mass deacidification a reality. The challenge before this meeting is to chart a course for action. I am delighted to participate in this effort.

The Institutional Context for Mass Deacidification

Richard De Gennaro
Roy E. Larsen Librarian of Harvard College
Harvard University

Ten years ago, I published an article entitled "Matching Commitments to Needs and Resources".[1] It is one of my favorite articles because what I said then about libraries and setting priorities never seems to go out of date. I will take the liberty of quoting a few paragraphs in order to set the stage for what I want to say this afternoon.

> *There is a chronic fiscal crisis in libraries which comes from a growing imbalance between the commitments that librarians make and the resources they have to fulfill those commitments. Even during the affluent 1960s—the golden age of education and libraries—libraries never really overcame their poverty. This was because the demands made on them by users and the commitments they willingly and eagerly accepted always exceeded their resources. The chronic imbalance between commitments and resources threatens to become a vast gulf with the soaring inflation and declining budgetary support that will likely characterize the 1980s* [read also 1990s]. *The reach of librarians far exceeds their ability to deliver and this leads to failure and frustration.*

After describing the financial crisis that was devastating libraries at that time, I then went on to say:

> *It should be clear to all of us by now that what we are experiencing is not just a temporary or cyclical decline in support levels, but a serious long-term reduction in our ability to maintain the kind of research collections, services, and facilities that scholars have traditionally demanded and that libraries have tried to provide. The financial pressures we are facing come largely from inexorable economic, social, and demographic trends over which university administrators and librarians have no control. And they will undoubtedly get worse in the decade ahead . . . few, if any, large research libraries will be able for long to maintain their traditional exponential growth rates or remain immune to the economic inflation and depression in higher education that is upon us.*

There is a lot more, but you get the idea. It all sounds very fresh and familiar, doesn't it? Libraries are always in depression. The only change since 1981 is that we are suffering an even deeper depression in our universities today. And librarians are making even more extravagant commitments. Here is how I described the current state of libraries in a recent speech.

During the last four decades, a number of powerful economic, social, and technological forces have been at work on libraries. Now, in this last decade of the 20th century, the cumulative effect of those forces is causing a discontinuity in the history and traditions of large research libraries. Libraries are at a turning point. They have come to the end of an era of growth and are now entering an era of change. They are facing enormous financial problems, overwhelming demands, and unprecedented technological change. The old familiar paradigm does not work anymore. We have to develop a new paradigm for the information age. We have to reinvent and reposition our libraries for the next century.

Academic libraries do not exist in a vacuum. They are created by and exist to serve a parent institution. The higher education industry was vastly overcommitted and over-extended during the last three decades. Now it is being put through the same economic wringer that business, industry, and government were put through in the 1980s. Government support has plummeted, tuition increases are being capped to inflation, and there is a growing competition for students. Colleges and universities are in financial crisis. They are going to have to balance their budgets by getting serious about management, by setting priorities, and by redefining their missions. They are going to have to get meaner and leaner. And their libraries, which are equally over-extended and over-committed, are going to have to do likewise.

We have to come to terms with a new reality. We have come to the beginning of the end of the era of geometric growth of collections. Growth will continue, but it will no longer dominate. The word that will best characterize successful libraries in the next century is change. Implementing and coping with change has already become the main job of librarians during this transition decade of the 1990s. Library directors will succeed or fail on their ability to manage change—to set priorities and to make agonizing choices.

My main purpose today, according to the title that I was assigned, is to put mass deacidification into an institutional context. I am about to get to that, but I wanted first to put the library institution into the larger context of higher education and the economy. And we cannot limit ourselves exclusively to mass deacidification. Mass deacidification is an aspect of preservation, and preservation is an aspect of collection development and public service, and all these and more are parts of the library. Everything is connected to everything else.

Mass Deacidification

A wise man, or maybe it was a wise guy, once said: For every complex problem there is a simple and obvious solution—and it is always wrong.

In the collection area the simple solution is to collect it all. In the preservation area the simple solution is to preserve it all. In the mass deacidification area, the simple solution is to deacidify it all. If my life's experience has taught me anything, it has taught me that we cannot do it all. We have to set priorities and make choices. If we want to do everything, we will not do anything.

Librarians have been hearing the news about the coming of mass deacidification systems for at least twenty years. We have tried to follow the claims and counter claims put forward by the proponents of DEZ, Wei T'o, and other systems. Some of us thought that if we waited a few more years a technology would come along that would deacidify and strengthen already brittled paper at the same time. Two years ago the British Library issued a press release promising a soon-to-be-available system that would do just that; it has not been heard of since.

The quest for the perfect mass deacidification system reminds me of the similar quest for the perfect optical character recognition system that would automatically and accurately scan our enormous and complex card catalogs and convert them into machine-readable form. The latest sighting was a small company in Switzerland. I wish them luck, but I am not waiting anymore.

It is my conviction that we cannot operate a library in our information society with a catalog that is half manual and half online. I have, therefore, committed the Harvard College Library to full-scale retrospective conversion of its remaining three million manual catalog records using the existing imperfect means available. And I have managed to convince the University to put up the money that is needed to do the job.

I do not yet have a similar burning conviction to embark on full-scale mass deacidification project for the millions of at-risk volumes in my library. My hesitation comes not so much from my concerns about the capabilities of the available mass deacidification systems, but rather from the lack of resources to do the job. At Harvard, we are simply not ready to put massive resources into mass deacidification or reformatting. This is a problem that is not ready, and may never be ready, for that level of commitment. We have other and far more pressing priorities, such as converting our catalogs and solving our massive and urgent space problems. We would, of course, gladly welcome mass deacidification funding or more reformatting funding from federal or foundation sources, but I do not see it coming soon. Meanwhile, we are not neglecting preservation. On the contrary, we are making a significant and increasing commitment to mass deacidification, preservation reformatting, conservation, and the transfer of at-risk materials to the secure environment of the Harvard Depository, our new state-of-the-art off-site storage facility. The most cost-effective preservation strategy we have is to transfer at-risk materials to the depository. This gives us the greatest return on the dollars spent and also helps solve our space problem at the same time. Similarly, retrospective conversion of our card catalogs has a multiple payoff. It makes our collections more accessible at the same time that it gives us a capability for transferring and retrieving materials from storage and keeping a record of preservation decisions.

It strikes me that the term "mass deacidification" has come to mean a process universally applied to the acidic paper problem, when what the chemist meant, of course, was "whole book" rather than one page at a time. How and when to apply this new preservation tool, and how to begin to develop programs and pay for them, is the subject of this conference. Clearly, mass deacidification is another important weapon that is available to us in our war on decaying materials. Like microfilming, it must be used appropriately. It is not a magic bullet.

The dream of a cheap, mass solution to the acidic paper problem is really only another aspect of the larger fantasy of maintaining and preserving, intact, traditional comprehensive collections of printed materials—even as we acquire and propose to preserve, in perpetuity of course, a variety of new formats and media. Our library users share a similar fantasy. If our fantasy as library administrators is to find a global solution to collection management problems, so that we can continue to "do it all," our users' fantasy is a library of four walls, containing a comprehensive collection with everything they might ever need, browsable and fully accessible. We held on to this fantasy at Harvard long after the collections were decentralized and long after the brittle book crisis had overtaken us and rendered a significant percentage of materials unusable in their original paper format. These changes are finally forcing us to reexamine our concept of the traditional research library and accept new assumptions such as:

- A single research library, no matter how large and comprehensive, will never be able to meet all of the information needs of its local users.
- Space problems brought on by relentless growth necessitate the use of secondary storage facilities. Such facilities raise selection and access issues.
- Interdisciplinary research is commonplace and research trends capricious, making it impossible to predict how or when scholars will make use of retrospective materials.
- Online catalogs, electronic publishing, and the Internet will profoundly affect the way research is conducted and library service will evolve in response.

By accepting these new assumptions, we are gradually letting go of the old fantasy of larger and larger buildings and collections. Instead, we are working to make library walls less limiting. In short, we are after unified and coordinated library *service* with effective connections to the world of information beyond our individual institutions.

This last year, the Harvard College Library conducted a seven-month strategic planning process. We worked hard to involve the faculty and the library staff in a process to refocus the library's mission and formulate a common vision of its future. Along the way, many individuals holding on to the "four-walls" fantasy were encouraged to accept the reality of our present library and help shape a new library that will better serve its users. Our strategic plan, incorporating the recommendations of the various library task forces and faculty advisory groups, is in final draft form. The process of developing a strategic plan also revealed a number of strategic elements in our preservation efforts. I believe that we share these with other research

Richard De Gennaro of Harvard University addresses the roundtable.

libraries and that they will have an effect on the development of mass deacidification programs.

Most significantly, increased use of the Harvard Depository will allow us to store lesser-used materials in an optimum preservation environment. We can then concentrate our preservation resources on more heavily-used portions of the research collections. Core collections remaining on-site in open stacks are suitable candidates for mass deacidification.

Likewise, off-site storage can be a powerful preservation tool. The paper chemists tell us that a volume transferred to the Harvard Depository's environment of 50-60°F and low humidity will have its useful life extended some tenfold.[2] Off-site storage also reserves more expensive space for other purposes and ensures that a book will really be there when it is recalled for use. In addition to sending lesser-used materials to the depository, we expect to send materials that have been microfilmed at Harvard and elsewhere (particularly serials), duplicate copies of important works, and variant editions that may need to be consulted only rarely. Our goal is to transfer a million volumes from Widener to the Harvard Depository in the next three to four years.

Another high priority for the Library is the retrospective conversion of the remaining two-thirds of the manual catalog, so that the entire holdings are represented in HOLLIS, Harvard's online catalog. HOLLIS is much more than a computerized version of the card catalog, however. It is a powerful and versatile tool that enables browsing of the collections wherever they are located, efficient transfer of materials between locations, and the recording of holdings, format, and management information. We will use HOLLIS to note that another library has produced a master preservation copy of a title held by Harvard, to indicate that preservation treatment or special handling is required of a particular copy if it is recalled for use, and to record relevant preservation action, such as reformatting or deacidification. When an online record exists, all preservation action is facilitated.

Greater cooperation and coordination with the library and information world beyond Harvard is another major recommendation of our recent strategic planning process. This is a familiar refrain among all research libraries. Nowhere are the benefits more evident, however, than in the nationwide brittle book program. When I walk through the stacks of the Widener Library and see the extent of the brittle book problem, I cannot conceive of any response that does not seek to share the burden or look beyond an individual decaying volume in an individual library. Perhaps as much as a quarter of our collection is already too far gone to benefit from mass deacidification. It may be sitting quietly intact on the shelves, but only because it has not visited the photocopy machine—yet. Mass deacidification will not help these volumes. They are the living dead.

We do not yet know much about how to incorporate mass deacidification technology into library service—in theory or in practice. Where does mass deacidification fit into a comprehensive preservation program? How do we determine the balance of activities? This meeting is an attempt to begin to fill the management gap for library administrators. The Library of Congress has given us one the .etical mo.lel—to deacidify everything that is acidic. Only one practical model exists—the National Library of Canada's ten-year-old program to deacidify Canadiana using their small-scale pilot plant. More models and plans are needed that link the benefits and costs of this new preservation technology with library service. We look forward to learning from Scott Bennett's courageous initiative at Johns Hopkins University.

Mass deacidification is going to be a hard sell for hard-pressed library directors. Why? Because mass deacidification asks us to look at a perfectly usable book and imagine it crumbling, pay for something that looks exactly the same after treatment as before, and spend today's scarce resources to solve what would be our successor's problem—if only we waited. The possible thanks of future scholars will hardly compensate for the criticism of current faculty for diverting acquisitions dollars to other uses.

The per-item cost of mass deacidification treatment may seem relatively low, but the cost of a deacidification *program* will be substantial. For example, if Harvard followed the Library of Congress model and deacidified all new and retrospective materials over a twenty-year period, it would cost the Harvard College Library (with its collection of nearly 8 million volumes) approximately $100 million, or $5 million per year.[3] Fortunately, our Preservation Librarian tells me that she could "make do" with $2 million per year. This fiscal year we will spend $75,000. I expect the outcome of this modest operational experience to be a plan to build an appropriate-size program gradually based on needs assessment and the Library's overall priorities.

In the twenty years since I first heard of mass deacidification, a lot has changed. First of all, we have preservation librarians always at the door demanding preservation's fair and ever-increasing share of resources. The preservation librarians among us have been busy these last twenty years laying the foundation for preservation programs with policies and standard practices. Now they want us to increase the *size* of these multifaceted programs commensurate with the need. Once in the door, they demonstrate the urgency of the problem by crumbing pages, laying warped and sad-looking books on the table, and talking huge numbers of unusable library materials. But library administrators are asking for more. We want a phased plan and some hard-nosed justification. Preservation, like collection building and cataloging, is only a means of serving users, not an end in itself.

Some preservation librarians have been busy on the home front, building local programs designed to avoid needless damage, retard deterioration, and keep materials physically available for use. Others calculated the size of the problem on a national scale, and began to define a national strategy. The first result was a cooperative approach to the brittle book crisis. At the time we started, microfilm seemed only the lesser of the two evils—the discomfort of using microfilm versus crumbling pages. Many of us now accept that microfilm is an effective archival storage medium. It results in a master copy for all, and it can be stored indefinitely at very low cost. But we will be expecting more of our nationwide preservation program. We expect eventually to achieve comprehensiveness in subject coverage, and we expect microfilm to be used as an intermediate technology. Digital imaging technology will provide a more attractive means of distribution and output than microfilm.

Librarians are faced with a double challenge. At the same time that we are trying to implement new technologies like digital imaging and online distribution and print-on-demand, we must also develop workable and pragmatic approaches to today's problems. Today's problems include the management of very large collections of deteriorating research resources which today's users continue to need.

As our understanding of the complexity of the preservation problem facing the nation and the world increases, so has the recognition that there is no panacea for insuring that the printed legacy of the past will be preserved for the future. Mass deacidification is not the simple solution we may have once hoped for, but it is a powerful new preservation capability that will takes its place along with low-temperature storage and microfilming.

Conclusion

I want to conclude on a cautionary note. We have to keep the preservation problem in perspective. Preservation is a serious problem, but it is a problem of the past—of the traditional library. We cannot afford to foreclose the library's future by giving excessive priority to preserving our deteriorating print-on-paper collections at the expense of positioning our libraries to cope with the opportunities and demands of the new information technologies. The future of the library, if it is to have one in our increasingly technological society, will depend on our ability to respond to the challenge of the new information technologies. The libraries that were blessed with large retrospective collections in the past will be burdened by having to preserve and service those same collections in the multi-media technological world of the twenty-first century. Preserving our past is important, but assuring our future is vital.

1 De Gennaro, Richard, "Matching Commitments to Needs and Resources," *Journal of Academic Librarianship*, March 1981, p. 9-13.

2 Sebera, Donald K., "A Graphical Representation of the Relationship of Environmental Conditions to the Permanence of Hygroscopic Materials and Composites, " *Proceedings of Conservation in Archives*, an international symposium held May 10-12, 1988.

3 Six million acidic but not yet brittle books divided by twenty years equals 300,000 books per year plus 100,000 new acquisitions multiplied by $12 (selection, treatment, recordkeeping, shipment) equals $4.8 million per year.

Management Issues: The Director's Perspective

Scott Bennett
Sheridan Director of the Milton S. Eisenhower Library
The Johns Hopkins University

I believe there are only two responsible positions for a research library director to take regarding mass deacidification. One of them is that of informing oneself about this new treatment option in order to make a decision about it. I call this "beginning to decide." The second position follows the first. It is the position in which Richard De Gennaro and I find ourselves—the position of "deciding to begin." I am in this position because last spring my library, the Milton S. Eisenhower Library of The Johns Hopkins University, signed a contract under which we are routinely shipping books to Akzo Chemicals, Inc. for mass deacidification. We are convinced this is good preservation practice and a good investment of library funds.

"Beginning to decide" and "deciding to begin" are positions in a sequence through which libraries considering mass deacidification will pass. I want especially to emphasize the role of conviction in this decision-making sequence. Mass deacidification is a subject about which much is still to be learned, about which certainty is unattainable, but about which we must make decisions today. In such a situation, the facts matter greatly. But individual conviction can matter as much or more, because something must be decided now.

I will describe two matters: the sources of my conviction about mass deacidification and the action that has followed upon that conviction. I will end by commenting on what remains to be done to build conviction further and to shape future action at the Eisenhower Library.

Sources of Conviction

My conviction about mass deacidification springs from my experience both as an historian and as a librarian. As an historian, I have been profoundly indebted to decisions made, sometimes more than 200 years ago, to save the material with which I work. In a few cases, I was the first person or one of very few persons to have worked with this material. Often I do not know why archivists and librarians had the foresight to save this material, but they did. By preserving their present, they literally gave substance to the future. Such decisions made their present intelligible, and the future possible.

As a librarian, I have endeavored to understand what is at stake in preservation decisions and to make a full range of preservation treatments available to those who must make fateful decisions about the future. We know the verbal record of human experience over the last two-hundred years is imperiled by many factors. The most pervasive of these is the high acidity and chemical instability of the paper which carries that record. We have recognized this problem at least since 1824; we have known about it with certainty since W. J. Barrow published his landmark research on paper a generation ago. We also know the extent of the problem is immense. Acidic paper constitutes about 80-90% of our collections. If we are to avoid losing the voice of humanity, which has been carried on this paper over the last two hundred years, we must act now and act on a massive scale.

As both a librarian and an historian, I am mindful that paper can in fact be an excellent medium for the very long-term preservation of human thought and action. It is because this is so that I am interested in mass deacidification, which is simply a way to enhance the inherent, but too-little acknowledged advantages of paper as an archival medium. Most paper manufactured before 1800 that has survived the ordinary risks of water, insects, war, and human carelessness promises to continue to survive in good condition. We prize pre-1800 books and documents made of paper in part because we know their paper is stable and enduring. If we can complement the inherent archival advantages of paper with favorable environments for use and storage, we know these paper products will continue to survive long into the future.

Finally, as both a librarian and an historian, I know that if directors of research libraries, of archives, and of national libraries do not preserve the verbal record, it will not be preserved. No other organizations hold that record whole; no one else has the responsibility for preserving it. I also know that now is the time for us to act. Parts of our collections are crumbling in readers' hands. If we do not act now, we will be unable to do so in the future, except at cripplingly high costs. If we do not act now, we will have been bad stewards of the material placed in our care by those who went before us.

While there is much about paper as an archival medium of which I am relatively confident, there is much of which I am quite uncertain. These uncertainties, however, have less to do with paper and mass deacidification than they do with the overall management of our preservation programs. Two things particularly concern me.

- How much time do we have left for preserving the verbal heritage of the last 200 years? How fast, therefore, do we have to act? There is no very good answer to these questions. For the relatively small part of our collections that is actively used and brittle, we are already nearly out of time. There still is time—potentially a great deal time—for the much larger part of our collections that is little-used and brittle, or the part that is acidic but not yet brittle.
- Because nothing is permanent, we are necessarily committed to reformatting material we want to save. What is uncertain is the durability of preservation media (we know best about paper and film), the half-lives of various reformatting technologies, the long-term demand for the material we preserve, and the economics of various conservation treatments. It is possible to compare the direct costs of some treatments, but no one has yet modelled the costs, especially the costs over very long periods of time, for the permanent retention of our documentary heritage. It is important for the library community to acknowledge frankly the lack of a reliable economic model for preservation. (We should also, of course, regard the creation of one as a matter of some urgency.)

Action Resulting from Conviction

I have described the environment both of knowledge and uncertainty in which I operate as a library director, when confronting programmatic decisions about mass deacidification. I want to describe next how the Eisenhower Library is acting in that environment, what we are doing, and how our mass deacidification program relates to the convictions I have just described.

Mass deacidification is one element in the Eisenhower Library's comprehensive collections conservation program. By design, we give most attention to the circulating collections and to materials that are in active use. Where we must make choices, we choose to treat large numbers of items inexpensively, employing treatments that lend themselves to a high volume of production. We thereby ensure that the material actually needed and used by our readers will remain fit for use. We treat existing problems; we employ preventive measures when we can predict use with some confidence; we are willing to leave conditions untreated that time or expected use will not exacerbate. Such phased treatments enable us to stretch limited resources and to deploy those resources in line with actual reader needs. In this way, we make time an ally in our preservation work, rather than our enemy.

Mass deacidification is critically important to such a program. There is no less expensive way to stabilize the condition of great quantities of books, journals, and other paper materials, thereby vastly lowering the future need for and cost of reformatting. By dramatically reducing the need for reformatting, we ensure that it can and will be done in response to actual levels of use that justify the high costs involved. I believe mass deacidification is a strategically important means of enhancing reformatting programs. But more fundamentally, it is a means of ensuring that we will have time enough to save everything we want to save, freeing us and those who come after us from having to say that we do not have what readers want because we ran out of time and money to preserve it. With so much to recommend mass deacidification as a critical part of a collections conservation program, there are still some significant uncertainties and risks to be considered. How does a library director help manage those uncertainties and reduce the risks? How does one avoid being paralyzed by them or reduced to action so modest that the real preservation needs of readers are not met?

Uncertain outcomes are, of course, characteristic of most important management decisions. Some of the uncertainties regarding mass deacidification are quite ordinary and respond to ordinary management practices. For instance, in selecting a vendor, the director should look for a company that can deliver the specified service dependably, a company that understands and can support the library's need to handle material efficiently and reliably, a company that has a significant commitment to the further development of mass deacidification.

To monitor the vendor's service and the effectiveness of the product, the library must institute ongoing quality assurance measures. These measures will include at least:

- A review of the vendor's processing data and any test material included in each production run, to determine that the run conformed to contract specifications.
- A visual inspection of all processed material for any unwanted effects or damage.
- A test of sample material from each production run for the pH level and the deposition of a buffering material.

In many cases, these tests can be performed in the library, using simple, inexpensive techniques. The library will need to decide how much it will use more expensive, formal laboratory procedures to secure comprehensive quality assurance measures.

Some further requirements relate specifically to the reduction of risk.

- The director must be confident that mass deacidification poses no significant threat to human health and safety or to the environment. This is a weighty responsibility and a threshold condition for action.
- The director must be confident that mass deacidification actually produces the benefits sought. This confidence can be secured only through testing, experimentation, and product development, as part of a wide and shared experience among libraries with mass deacidification programs.
- Especially because the library community has so little collective experience with mass deacidification, any contract for services must be easily terminated if the process does not meet expectations in routine production or should evidence arise of a significant threat to human health and safety or to the environment.
- For the same reasons, the library will want contract provisions that equitably distribute between the vendor and the library the liability for damage to library materials arising from mass deacidification.

Finally, and not least important in this list of management tasks, it is the director's job to fund what she or he believes in. Happily, there are good reasons for a modest beginning. Starting small minimizes the uncertainties accompanying this new technology, and puts relatively few materials and relatively few dollars at risk. Even so, when conviction is weak, we act as if new programmatic activity can be undertaken only with new funding. This is usually a way of transferring the cost of conviction and of decision elsewhere.

By contrast, when conviction is strong, we find ways to fit the new activity into our existing budgets. Much of the cost of automation in our libraries has been met this way, because our conviction about it is strong. Many of the preservation programs we have nurtured through the last decade or more also reflect strong conviction. Accordingly, I expect mass deacidification to start showing up in our budgets through the processes of reallocation. This seems especially likely because alternative sources of funds—the National Endowment for the Humanities and private foundations—have been cautious about mass deacidification (especially in contrast to reformatting). It appears to me that individual libraries and library directors will be acting ahead of national consensus. Here again, conviction counts.

Building Conviction and Shaping Future Action

Action may require conviction, but conviction does not require that all of one's uncertainties about mass deacidification be fully resolved. The Eisenhower Library has gone ahead with its contract for mass deacidification, intending to explore several matters about which we remain uncertain. We will work with Akzo and possibly with other vendors on these issues. We hope to pursue the following questions cooperatively with other libraries, as well.

- When dealing with individual treatments and preservation bench work, we have little tolerance for damage to library materials. It is unlikely that this unforgiving standard can be applied to large masses of heterogeneous material subject to a single treatment. What kinds of damage will be acceptable in mass deacidification? What incidence of damage will be acceptable? How will unacceptable damage be avoided or repaired? How will the cost of damage avoidance and repair be factored into preservation budgets?
- How does coated paper, which is chemically and structurally more complex than uncoated paper, respond to mass deacidification? How urgent is the need to treat coated paper? Is it necessary, desirable, or practical to separate coated and uncoated paper for treatment? Do different processes for mass deacidification pose different sets of issues with regard to coated paper?
- As the price for mass deacidification falls and our capacity to use the treatment increases, how will our decisions about selection change?
- What are the costs of mass deacidification, both direct and indirect? Is it possible to construct a financial model of our preservation alternatives, a model that not only takes into account the direct and indirect costs of various treatments but also attributes a value to access, to likely usage, and to readers' preferences among formats? Can such a model have any validity over the long periods of time that preservation decisions govern?
- How and for what purposes should a bibliographic record include the fact that an item has been deacidified? What would constitute cooperative action in mass deacidification? What might be the benefits of cooperative action, and how would the bibliographic record

help secure those benefits? What opportunities are there for avoiding the cost of duplicate treatment in mass deacidification?

- Is there really a national program or even a national agenda for preservation? If there is, does mass deacidification help advance it?

This is, perhaps, a lot to be uncertain about. I will end by saying that these uncertainties, while they are unquestionably significant, do not seem to me to cripple conviction or prevent action. It is important for the Eisenhower Library at Johns Hopkins, and I believe it is important for the profession at large, to move beyond the uncertainties we faced a few years ago—uncertainties about the value, technical feasibility, and safety of mass deacidification. We now have satisfactory answers to those questions. Now it is time for the us to move on to another set of equally important questions about mass deacidification.

Research library directors must recognize that they stand at a critical decision point. We must accept the challenge of reshaping the future of our libraries by building on the proven strengths and utility of paper as an archival medium. We can do that by beginning now to send material to vendors for mass deacidification. I very much hope that many of us will soon be doing that as a result of this conference. I hope that we will decide to begin.

Recent Developments at the Library of Congress

Gerald Garvey
Mass Deacidification Program Manager
Library of Congress

Richard De Gennaro remarked that libraries are going to have to become lean and mean if they are going to meet the challenges of the new financial realities. Well, I was told before I came to Andover that librarians are already lean and mean. So I have rolled up my sleeves and prepared myself for the very worst as I face you here today. Actually it is quite a surprise to me that I am here at all. I expected to be fully engaged in negotiations for a mass deacidification contract for the Library of Congress' collections. That I am not negotiating is a great disappointment. The solicitation is canceled; there will be no contract. Let me try to shed some light on the Library's decision.

It was not until just last night that I learned how much information I can share with you. All of the offerers have graciously given their permission to the Library of Congress to distribute the data from the Institute of Paper Science and Technology's testing of 500-book demonstration sets they submitted with their proposals. This decision releases Donald Sebera and me to discuss the independent laboratory test results.

In the 1989 Congressional appropriation hearings, the Congress directed a major change in the Library's mass deacidification program. After more than sixteen years of development of the Library's invented and patented DEZ deacidification process, the Library was required to consider for its deacidification services all technologies that could meet safety and environmental needs. This necessitated offering all technologies that are doing mass deacidification the opportunity to compete on an equal basis to provide deacidification services.

The DEZ technology was placed into the private sector when the Commerce Department licensed it to Akzo Chemicals. Akzo Chemicals now has the exclusive right to use the DEZ process, except that the Library reserved its right. The Library of Congress is no longer involved in the development of deacidification technology. We focused our attention on developing performance-based requirements for our deacidification needs—performance requirements that would allow all firms offering deacidification services an opportunity to compete in a fair and unbiased manner. We changed from specifying how to perform deacidification services to what deacidification must accomplish in terms of minimum standards applicable to all potential technologies.

The preparation of the specifications took more than a year. There were multiple reviews. In July, 1989, an early draft specification was made available to all interested parties for review and comment. Information from that process was incorporated into a new draft. A panel of experts from around the world was then convened to review the document. We spent two very exciting days reviewing and perfecting the specifications. The General Accounting Office reviewed the documents to assure there was no bias.

The final document is the first comprehensive set of performance-based specifications stated in terms of minimum requirements. It transferred to those offering their services the burden of proof as to their ability to perform the required services. It is important to understand that, under the federal procurement regulations, all of the minimum requirements must be satisfied at one time.

There were four major components of the solicitation:

1. **Toxicological and environmental safety.** There was no tolerance here. The requirement was that there could be no risk.
2. **Technical requirements.** There were two areas of consideration, preservation and aesthetics. The preservation requirements included completely neutralizing the acid in the books, providing sufficient alkaline reserve, and slowing the deterioration of paper by at least three times as measured by artificial aging and MIT fold testing. Aesthetic requirements included not damaging the books or their covers, no process-generated odor in the treated books, and no discoloration or change to the paper or printing.
3. **Business.** Requirements included consideration of the ability to design, build,

and operate a deacidification facility that would safely meet the Library's preservation needs.

4. **Cost per book.** This information from the proposals was not to be shared with the evaluation board, to avoid prejudicing their decisions on the other aspects of the proposals.

Potential contractors were required to treat a set of 500 books to confirm the technical information contained in their proposals and to show conformance with the Library's specifications. Thus each potential contractor would have to demonstrate its ability to do the job. The Library chose, through a competitive process, an independent testing laboratory, the Institute for Paper Science and Technology, in Atlanta, Georgia, to test the demonstration sets of books.

In March, 1991, a 14-member evaluation board, headed by Peter Johnson of the Office of Technology Assessment, convened to evaluate the written proposals submitted by offerers, the data obtained from the independent testing laboratory, and first-hand information gained from the board's site visits to the treatment facilities.

There were only three library staff on the board. The others were from government agencies or the private sector. Three members of the board were from the Environmental Protection Agency, and there was an industrial hygienist from the Yale University School of Medicine. These four constituted a subgroup of the board that dealt with the important toxicological and environmental safety issues. Other subgroups included preservation scientists and chemists, chemical engineers, industry executives, conservators, and library administrators. The entire evaluation was a very intensive, positive, and even-handed process. I hope to continue this shared decision-making in the future of our program.

The final results of the solicitation were not anticipated. The need to meet all of the minimum requirements simultaneously proved too difficult for the three firms who responded to the solicitation. None was able to meet all of the technical and business requirements. The results of the testing of the demonstration sets was disappointing, to say the least. All of the offerers had trouble with their demonstration sets.

There is some good news, however. The Wei T'o, FMC, and Akzo processes extended the life of paper at least three times. The independent testing laboratory data shows that all of the offerers slowed the rate of deterioration of the tested paper by an average of at least three times. This is very good news.

One of the processes met all of the preservation requirements but had difficulty with some of the aesthetic requirements. There was process-generated odor and iridescent discoloration on some covers and on dark illustrations on coated papers. Two processes had trouble with the completeness of deacidification and adequacy of minimum alkaline reserve. There were aesthetic prob-

From left: Gerald Garvey, Library of Congress; Ann Russell, Northeast Document Conservation Center; and Peter Sparks, Preservation Consultant.

lems with tackiness of covers and some ink and text block concerns. Based on these findings and the business considerations, the Library decided it was not prudent to go forward with a contract at this time.

My assessment of the situation is optimistic, however. Mass deacidification remains an essential component of the Library's total preservation program. The outstanding issues raised by the procurement effort appear to be resolvable. We will move ahead with our program as quickly as possible. The consensus of the evaluation board is that the deacidification technologies will be able to meet the Library's objectives.

Congress, in response to our decision, directed that the unobligated $5.4 million still available in the deacidification account not be obligated without prior approval of the Senate and House Appropriations Committees. They denied additional requested funds for deacidification but encouraged the Library to continue its efforts to identify appropriate, technically-acceptable deacidification technologies for preserving its paper-based collections. They want the opportunity to review with us our plans and the next steps in our deacidification program.

We have committed ourselves to going back to Congress as quickly as possible. The information-gathering phase of the planning is already underway. A comprehensive set of options will be considered before recommending a plan of action to Congress. I can only characterize the plan in broad terms. It will involve a mass-scale process. That is essential to making a meaningful impact on our preservation needs. The program will use a more incremental approach, anticipating rapid but orderly expansion of deacidification services as experience with the program allows. We have a strong commitment to information-sharing and publishing. We will consult actively with many of the major players and institutions who are engaged in exploring these technologies, and we will make every effort to keep all who are interested in deacidification appraised of our progress.

Panel Session: Institutional and Management Issues

Paul Fasana
Andrew W. Mellon Director, Research Libraries
New York Public Library

I have prepared a brief statement which reflects the present attitude and policy of the New York Public Library (NYPL), with respect to mass deacidification. Many of the points address what has been said today by the three previous speakers.

The prospect of this meeting offered us an opportunity to review our stance and to reassess our priorities relative to mass deacidification. NYPL's problems in all areas are different. In the area of conservation, they are probably unique. The result of our recent review is simple and straightforward. We do not believe at this time that it is right for NYPL to undertake a mass deacidification effort. In the few minutes that I have here today, I would like to give you some of the reasons, or at least the flavor of the reasons, that led us to this conclusion.

I may repeat a lot that has already been said, but from a different perspective. The methods that are currently available, at mass production level, mainly stabilize and extend the useful life of paper. A method that would strengthen paper in addition to stabilizing it would be far more desirable and beneficial. Such a process would allow us to address the problem of paper that is already brittle. A number of paper-strengthening processes are now in development, and we are watching these developments with keen interest. We must also recognize that the long-term effects of this type of treatment are still unknown. We have a unionized staff at NYPL, so the problems of odor and skin irritation are of great concern to us. Other concerns are the possible reacidification of treated paper and toxicity to humans.

We looked a lot at the logistics. A decision to undertake a mass deacidification effort is a serious one requiring a long-term commitment and major expenditures. To be cost-effective, as we have heard, a large amount of material must be fed into the process. This means that it will be impossible to select item-by-item for this treatment. At NYPL, our collections, especially our retrospective collections, were built over a long period of time and are housed in closed stacks. Unlike many other research libraries, we have not removed rarities, unique items, and non-book materials from the general collection. I shudder at the thought of trying to approach our curators and asking them to give up their right to do item-by-item review before any sort of treatment. I am convinced that they would be overwhelmingly opposed to any strategy that would force them to accept this kind of approach to our collection.

As for costs, mass deacidification efforts would be costly and would require reallocation of our budget or a new source of funds. Neither, in our estimation, is feasible. Our current budget is extremely tight and fully allocated. In our review, we could find no program that we were willing to give a lower priority so that we could reallocate monies. As for new sources of money, our priorities for fund-raising for preservation are well-defined and well-known. Our highest priority is to ensure that our local efforts will contribute fully to the national preservation program. Mass deacidification, in our judgment, does not satisfy this criterion, at least not directly. Certainly by extending the life of some materials, mass deacidification will save some items for future treatment that might otherwise be lost. Its real immediate value, however, is for local needs. Mass deacidification's importance or priority in the national preservation program is still at best ambiguous. Funding agencies faced with limited dollars for preservation will probably not be willing to allocate money to support efforts which are seen as primarily local. Any institution with a preservation problem larger than its resources must bear this in mind.

In closing, I would like to stress that our attitudes and priorities reflect NYPL's unique problems. We do not argue that no institution should undertake a major effort in mass deacidification. Indeed, our cynical attitude is that we would encourage other institutions to do so, especially if they have simpler collections and more conventional problems, because we want to learn from their experience.

Panel Session: Institutional and Management Issues

Gerald J. Munoff
Deputy Director
University of Chicago Library

I have a variety of thoughts on the two papers we have heard and on mass deacidification in general. Some of my thoughts relate to specific issues of immediate concern, and some are broader and longer-term. I will share them with you as a series of questions. First, however, I would like to give you just a few facts about our situation at the University of Chicago as background for my thoughts.

Preservation is one of the issues in our library demanding immediate special attention. We have done a complete survey of the collections, written a plan for a comprehensive preservation program, and made good progress in implementing that plan. We now spend about $1.3 million a year on preservation. We need to spend approximately $850,000 more per year to implement our plan fully, and we expect to continue making progress on this goal.

In writing the plan, beginning about two years ago, we included a unit for mass deacidification. At that time it was really just a place-holder. We did not know what it would mean to have a mass deacidification program, but we included it to reflect our view that it was a critical component of a comprehensive program. We projected an annual budget of $134,000, which now seems very low. It was a time, however, when we were all talking about less than $5 a volume for treatment. About 93% of our collections, a little over 5 million volumes, are in a very good preservation environment—clean, well-kept buildings with temperature and humidity controls, air filtration, controlled light, and appropriate shelving. The one major negative, from a preservation perspective, is open stacks, but that is an important aspect of access for us. We calculate that probably 1.3 million of our books are brittle; 2.2 million are acidic but not brittle, and so are candidates for mass deacidification; and about .25 million need physical treatment other than mass deacidification.

I would like to offer for consideration a few questions about mass deacidification. I cannot refrain from commenting on my own questions, but please do not interpret my comments as answers to the questions. I intend these to be open questions for which we must seek answers together.

The first question relates to all the commercial processes and the previous comments about moving into production. The question is, "Why not view mass deacidification from a traditional perspective, or historical perspective, of technological or business development?" In most instances, a proposed technology is considered experimental until successful completion of certain activities, then moves into a demonstration phase. Once it is demonstrated as being viable and fully successful, attempts can be made to move it into a production phase. We need to be clear where we are in this process. I believe many of our problems and frustrations are due to a lack of clarity over this.

I do not believe the vendors have yet demonstrated that this very attractive process is practicable. They are running plants which must be considered in the developmental, if not experimental, phase. The plants are carefully watched over, hand-operated, custom controlled, and still unable to process books without significant problems. Yet we talk about being close to production. Many products and processes with very successful demonstration periods never make it into production for business, engineering, or economic reasons. It is a fact of business life. We must first complete the developmental phase successfully if we are to have a production phase.

That raises my second question: "What is our role in the development phase and, if that phase is successful, what is our role as we move into a production phase?" Scott Bennett suggested one model. My concern here would be similar to what Richard De Gennaro mentioned earlier regarding libraries being the victims of our own ambition. How much responsibility should we take on in concluding successful demonstrations and then moving into production? I believe some historic models would show us that the customers of a product or service do not normally play that large a role in moving a business through those processes. It may be in our interest to do so, but it is a question we need to address before we can make sustained and concerted efforts.

This brings me to my third question: "What will we do if we do not have mass deacidification as an option? Should we be doing contingency planning for that possibility?" Chicago has planned on mass deacidification for our preservation program, and we very much hope it is an option. If mass deacidification goes into production, we have planned to approach it as an integral part of our physical treatment processes.

On the other hand, what will we do if we do have mass deacidification as an option? What is the strategy we will use to ensure that mass deacidification is an effective tool for addressing the enormous preservation problems we all face? If we view mass deacidification as just one of a number of physical treatment options that we may choose for individual volumes or even for small parts of the collection, we will probably not do very many volumes. It will not make a very big dent in the problem. Yet if we do large-scale special projects, the costs are really frightening. It would cost Chicago approximately $20 million at current prices for existing collections. If we do go into production, perhaps the cost will significantly drop, but I am also hearing that the present costs are heavily subsidized and will increase steeply. The economics very much influence how we think about these problems and how we will approach them.

I also have a question that was touched on earlier, and that is, "Do we need to accept paper and, consequently, mass deacidification and physical repair to books as a preservation mode, and as part of a national preservation program that yet has to be developed?"

A related question is, "How much will paper be a part of our future?" In spite of acid-free paper and electronic information, I do not believe we will leave printed collections behind us very quickly. Richard De Gennaro pointed out, and quite correctly, if I may paraphrase him, that we cannot mortgage our future to preserve our past, but I believe our future entails paper and probably quite a bit of it. Electronic information will develop at varying rates and to varying degrees for the different disciplines based on the research methodology of individual discipline and on the inherent nature and economics of the discipline. For example, it is no coincidence that law and medicine are two disciplines that are fairly well ahead in developing electronic information. So, we will have not only the printed collections we have now, but considerably more added in the future. All of us here acquire a wide variety of materials from around the world, and it is not likely that much of that information is going to be produced in electronic form soon. It is not likely that we will be able to afford to convert that information into electronic form. We must not underestimate how much printed materials will be a part of our future.

Another question, on an issue that Scott Bennett raised also is, "How accepting should we be of damage resulting from mass deacidification treatment?" Richard De Gennaro pointed out the predicament of taking a book that looks like nothing is wrong with it and doing something to it that does not change its appearance. Unfortunately, all the books I have seen that have been treated have their appearance altered considerably, and I would not term the damage as "only cosmetic." Analogies can be drawn to other physical treatments, but I believe incurring this damage is significantly different. It is a question that must be carefully considered.

My other question touches on Library of Congress' situation and the need for all of us to work together. An earlier observation speculated that the vendors did not have enough experience to address some of the problems we are encountering. This raises the question: "Is it necessary for all of us to send thousands of books to vendors to be used as guinea pigs?" Some of these problems seem to be from an "experimental phase," not even from a "developmental phase," much less a "production phase," and surely they can be solved by the vendors conducting structured projects rather than just processing more and more books in an attempt to get it right. Again, if we understand that we are not in a production mode, but a development mode, we can behave accordingly and work together to solve some of these problems.

I have raised a number of questions I hope we will discuss during the conference. It is important that we address not only specific issues, but also broad concerns that will assist us in developing a balance between mass deacidification and the other demands of a comprehensive preservation program. At the same time, we must also achieve a balance within our libraries generally between preservation programs and the wide array of other programs we must manage. To maintain this balance and not fall off the high wire will be quite a challenge.

Panel Session: Institutional and Management Issues

Daniel Richards
Collection Development Officer
National Library of Medicine

As at other institutions, mass deacidification is one element of the overall preservation program at the National Library of Medicine (NLM). It is not an active element at the moment, primarily because NLM decided several years ago that it would not undertake active research in the area of mass deacidification on its own. Rather, it would support and follow the developmental efforts of the Library of Congress and other institutions, and join with them to maximize the potential of this technology. Such a statement characterizes NLM's position today, and, despite the recent unfolding of events at LC, NLM continues to envision, in the relative short-term, an economical and reliable mass deacidification option available to it and other libraries.

Many of the management issues regarding mass deacidification already raised today are shared by NLM. I have been asked to make brief remarks on a few of those issues in light of Scott Bennett's and Richard De Gennaro's remarks. Let me begin with a few descriptive comments about NLM's preservation efforts generally.

The National Library of Medicine Act of 1956 established the library as a national collection and charged it with the collection and preservation of books, periodicals, and other materials pertinent to medicine. Prior to that date, the library had undertaken a large scale program of conservation of its rare and historical collections including restoration of some of the most valuable holdings. Microfilming began at NLM in the late 1930s and continues today on a broad scale, with a goal to film about 12% (160,000 volumes) of the total collection because the paper is embrittled. In the mid-1980s a senior-level management team was appointed to develop a comprehensive preservation program. In 1985, that group issued a report, *Preservation of the Biomedical Literature: a Plan for the National Library of Medicine*, which recommended establishing a Preservation Section and set out a long-range strategy to preserve the national collection in biomedicine.

The strategy recognized the problem posed by acidic paper and noted that research was underway to address the problem retrospectively through mass deacidification techniques. Part of the plan was to treat, using mass deacidification, 100,000 volumes per year by 1990. Also proposed was a proactive approach to the problem, that is, convincing principal biomedical publishers to change their publication process and to substitute alkaline paper for the acidic paper on which they were publishing. This latter effort has paid substantial benefits and a high percentage (30-40%) of the journal publishers represented in *Index Medicus* have made the switch as a result of NLM's efforts. While this progress is admirable, it represents a small percentage of all biomedical literature published to date. Recent studies have shown that upwards of 85% of the NLM collection is printed on acidic paper. Because ours is a national collection and because NLM plays a significant role as a library's library to the medical field, this statistic is sobering, though not unusual when compared with figures for other research libraries. It illustrates graphically NLM's eagerness for a mass deacidification option in its arsenal of preservation techniques. It also demonstrates a management concern of particular importance as NLM contemplates mass deacidification, i.e., NLM's role as a national repository for a large part of the scholarly record of biomedicine.

NLM as a National Repository

Historically, NLM has served as the library of record in the fields of medicine and allied health sciences. Its central role as a national library has served to provide assured and convenient access to the archival and intellectual resources underpinning the Nation's research and clinical activities in medicine and allied health fields. A consequence of that role is the dependence of other libraries upon the NLM collection. Further, a consequence of NLM's aggressive stance regarding preservation of the scholarly record of medicine has been that other medical libraries have assumed a less active role than their counterparts in other disciplines regarding preservation of local collections. The operating assumption appears to be that "NLM will preserve it all."

While it is true that NLM will indeed preserve that which is within its walls, there lies outside of Bethesda a significant portion of the scholarly record of biomedicine not duplicated at NLM. So, while NLM hopes to use mass deacidification on large portions of its collection, we also need to convince other medical libraries to join the effort.

Viewed in terms of national costs, it is generally more effective for NLM to guarantee preservation of a copy of a resource than for each of several libraries to preserve the same item. Beyond costs, however, it should be pointed out that such a responsibility is consistent with NLM's national health mandate. Though NLM will continue to serve as the library of record for medicine and the health sciences generally and is committed to preserving all important biomedical literature, that responsibility must be carried out with the recognition that no one library owns everything. As NLM has structured its preservation microfilming activity to encourage participation by other medical libraries, a similar approach will likely be undertaken with regard to mass deacidification, especially for those materials that are not part of the NLM collection. How that will manifest itself is yet to be determined, but it is safe to say that NLM will assume some sort of coordinating function among medical libraries and may provide support for that activity in the same way that we have supported preservation and conservation of important and unique biomedical materials under the National Preservation Plan for the Biomedical Literature.

As it has in the past, NLM will continue its leadership role in the preservtation of the biomedical literature and will move to define and implement a comprehensive, coordinated, physically decentralized system for the collection and preservation of medical literature as traditionally defined. To accomplish this goal, we fully expect to use a variety of methods, including mass deacidification.

Other management concerns at NLM include the following:

Funding

Mass deacidification will compete with many other high priority activities for dollars and personnel. At the source of NLM's budget is the Congress, and that source is becoming more and more stringent in its funding of new programs. It may be difficult indeed to mount an effective campaign for additional resources to undertake mass deacidification until more tangible benefits can be demonstrated. It seems quite likely that Congress will fund NLM if it will not fund LC for this activity.

Demand

Related to convincing Congress to pick up the tab for this activity is the fact that there is substantially lower demand for biomedical literature that is older than a few years. The biomedical sciences advance so rapidly that demand for older literature drops dramatically. Roughly 95% of our ILL requests are for works published within the past ten years. While the value of the older literature is certainly not in doubt, it may be difficult to justify spending large amounts of money on materials that are so little used and, for the most part, still in relatively good condition.

Wait or Act Now?

As noted above, it has been estimated that as much as 85% of NLM's collection is on acidic paper but not yet brittle. Digitizing techniques appear to be very promising as a preservation method. Similarly, preservation microfilming has proven itself to be a reliable and safe reformatting technique. Because NLM has an effective and very large microfilming effort underway, should we continue to wait until an effective methodology for mass deacidification has been perfected or should we begin to queue for digitizing or preservation microfilming high-risk or important titles on acidic but not yet brittle paper? This is where the issue of cost makes mass deacidification a very appealing technology. If we can spend $10-12 to deacidify a volume compared with $70 for preservation microfilming or the not-yet-established cost of digitizing whole volumes on a mass scale, mass deacidification may well be the most prudent course of action.

Coated Paper

A very high percentage of the biomedical literature is printed on coated paper. Too little is known at present about the effectiveness of the mass deacidification process on such paper. In fact, too little is known about the longevity of coated paper since it began to be used to a significant extent only in the 1930s. It could well be that NLM has more time than other libraries to reach decisions about mass deacidification and other technologies, if it turns out that coated paper, in fact, deteriorates more slowly. In any case, NLM is especially interested in promoting research in this area. A related point: since the preponderance of medical literature is more recent than is true of many other disciplines, e.g., history or literature, our overall preservation problem may in fact be less urgent. Perhaps we can afford to wait until our books are in much worse condition and digitizing has become cost-efficient and feasible on a large scale.

Personnel

A mass deacidification program of any size will be a complex undertaking. Considerable staff effort will be required to select materials for treatment, to manage the contracts that will be needed, and to monitor the results. While funding for deacidification contracts might be approved by Congress, funding for additional in-house staff is likely to be more problematic.

Damage

Lastly, more work is needed to decrease the damage to covers and bindings that occurs to some volumes treated with existing systems. NLM does not wish to incur the additional costs of repair after treatment and we are concerned about creating irreparable damage to volumes that in future years may become artifactually valuable.

I would like to close with a few comments on some of the observations and suggestions in the presentations by Mr. De Gennaro and Mr. Bennett, focussing especially on how NLM has responded to similar concerns.

Mr. De Gennaro's remarks are sobering when he points out the consequence of our enthusiasm to satisfy library clientele with new services as the gap between our budgets and our commitments grows. The "chronic imbalance" between these is alive and well in medical libraries, including NLM. A recent strategic planning effort produced an impressive list of new services and products for NLM staff to undertake, including several dealing with information in electronic formats. A review of that list, alongside ongoing activities and available resources, resulted in a substantial reduction in the number of "new" ventures and a shift in focus to enhancing or improving existing services.

Though Mr. De Gennaro cautions about getting carried away with the concept of collecting and preserving it all, that continues to be a goal for NLM—at least for the core biomedical literature. So far, we are doing a reasonably good job. Mass deacidification is appealing in light of that goal because of the size of the challenge NLM has undertaken and the fact that mass deacidification is less labor intensive and expensive than the alternatives.

Collection use, Mr. De Gennaro advocates, should be a primary factor in structuring mass deacidification decision making. While that may be appropriate in many libraries, it is not the principal factor at NLM. Instead our approach has been to preserve the biomedical literature based on its perceived importance to the health fields. We began by reformatting brittle periodical literature in core subjects first and then in related subjects Following this, we are reformatting brittle monographs in core and then related subjects. We are not making title-by-title decisions within the core literature, but are handling large groups of titles based on the above priorities. Because of this approach, mass deacidification holds particular promise for us.

Mr. Bennett points out that the motivation for preserving collections in their original formats derives to a significant extent from the strong book-format preference among scholars in the arts and humanities. In the biomedical sciences, researchers are becoming increasingly accustomed to obtaining their information in electronic form. Soon enough, copies of recent articles will be available to them via the networks within minutes of a request being received. NLM needs to consider whether the demand to retain much of its collection in original form actually exists among its primary-user groups.

One of Mr. Bennett's discussion points of special interest to NLM is that of vendor selection and monitoring. Because of NLM's role as a national repository and our large microfilming program, we have developed extensive criteria by which to select contractors and evaluate their work. Since we are likely to use the contract approach to mass deacidification, we will again pay close attention to the requirements and standards of that work.

Conclusion

LC's recent experience has demonstrated the need for libraries to approach mass deacidification in a cooperative way similar to the approach we have taken to a coordinated national program for microfilming brittle books. Only when libraries begin to act in concert to create a viable mass deacidification market will the industry mature to the point that it can provide the services we all need. NLM is most interested in participating with other libraries in discussions to achieve this goal.

Selection for Mass Deacidification: The Collection Development View

Eugene L. Wiemers, Jr.
Assistant University Librarian for Collection Management
Northwestern University Library

Recently, a prominent economist sent us an advance copy of a paper he is about to publish. In it is a dedication to Northwestern's Transportation Library—not to an individual librarian, but to the library as a whole—citing it as a "one of the nation's great resources in transportation economics."[1] My own interest in mass deacidification comes, in part, from my commitment to ensure that this library can continue to merit such acclaim. Its collection dates primarily from the period since the 1950s, and contains an enormous amount of material with low artifactual value, printed on acidic paper. As we are beginning to microfilm the older brittle materials in this collection, mass deacidification promises to provide an economical means to treat the vast majority of the materials in the collection which are acidic but not brittle. Our library has been positioning itself for some time to be ready to take advantage of this option. Our investigation of mass deacidification selection options is part of that positioning process, and has been conducted by a small working group over the past academic year.[2]

Among the aspects of collection development work that I have traditionally emphasized is the practical nature of the work. Selection is an activity of substance and discipline. It derives from principles and has intellectual integrity. It is, however, an activity that must fit into the daily operations of research libraries and be subject to the same constraints that apply to any library operation, including effectiveness, economy, and efficiency. Selection for mass deacidification is no different. It is particularly subject to the constraints of economy and efficiency, since it is intended to be a "mass" process rather than a process in which refined and careful judgments are made on a case-by-case basis. Any consideration of the principles of selection for mass deacidification must be both informed and shaped by the practical necessities of library routines.

Even though mass deacidification is in its infancy, it is clear that it is not a technology that will revolutionize library operations. The future of mass deacidification, as it relates to other library operations, is like Dan Quisenberry's—the ace short relief pitcher for the Kansas City Royals—vision of the future. He said, "I have seen the future, and it is much like the present—only longer."[3] So, unlike some kinds of selection activity, where first we decide what noble good we want, then figure out how to do it, the "how" is fundamental to building an efficient process. If it isn't efficient, it isn't "mass."

The first assumption of mass deacidification selection is that it is a "mass" process. Selection for this kind of activity is unlike most selection processes for preservation or collection building, which are by definition item-by-item. Particularly in preservation microfilming, selection routines have been built to minimize the level of duplication of effort among libraries and produce permanent results. Mass deacidification aims to preserve paper records, which are by definition perishable and duplicated among libraries. In selection, as in other aspects of the process, keeping costs down in a mass project is thus fundamental to its success. A bargain cost of the treatment itself should not be overshadowed by the personnel costs of selecting or handling materials.

Most library selectors are not conscious of the costs of the work they do, and most do not think in operational terms about such costs. Yet when their attention is brought to it, most will respond to the obvious need to make categorical or "block" selection decisions. The closest analogy among other selection processes is an approval plan or blanket order, where systematic thinking about categories is required. The categories derive from the structure of the publishing or information providing industry. In the case of mass deacidification, the categories derive from the structure and characteristics of the library's organization. Some item-level selection may be required, but the goal, to be efficient, should be categorical selection to keep costs down.

The second assumption is in some sense paradoxical: most of us cannot afford "mass" at this point. (We, in fact, have the opportunity to select materials virtually at random.) Systematic thinking about where we want to go, however, and what categories of materials we want to extend the life of, is an essential part of a long-term strategy. So thinking about selection at this point is really defining the first steps—steps that build toward a long-term plan, but which are in themselves potentially insignificant, or even trivial.

The significance of the first steps lies, in fact, in the materials themselves. Our selections at this point should be chosen to provide added knowledge about the appropriateness of the technology and develop added knowledge about users' reactions to scholarly materials treated this way. A successful beginning will help build a constituency for the process, as well as for funding. Like preservation microfilming, the strength of a mass deacidification project is directly proportional to the scholarly significance of the treated materials, and the prospects for funding beyond the first steps—i.e., reaching a "mass" process—depend more on the significance of the materials we treat and the scholarship that material supports than in does upon the technology itself (assuming the technology works!).

Categorical Limitations

There are going to be limits to mass deacidification's efficacy, both for the process itself and for its ability to fit economically into the library's procedures. Planning requires clear thinking about the limits of selection. Since it has to be a "mass" process, thinking about what we do not want to treat has been almost as useful as thinking about what we do. We have also had to consider *who* has the expertise to set the limits of the process, and to organize the workflow to make it happen, implying *technological* limitations as well as *organizational.*

The most obvious technological limit is the effectiveness of the process itself. Preservation specialists will have to determine the kinds of material appropriate to this mass deacidification processes. This is a fundamental limitation, and derives from a body of knowledge that is only in its infancy. Some of the obvious exclusions from the cost point of view are shown below. As our experience grows with the technology itself, this list will undoubtedly grow.

- Exclude brittle materials.
- Exclude materials that are already acid-free.
- Avoid materials damaged by the process.
- Avoid materials that will not benefit from the process.

Organizational limitations are the result of the necessity to fit mass deacidification into existing work patterns. These limitations are summarized below.

- Select materials around existing work.
- Solve technical problems with workflow changes.
- Record circulation status.
- Mark items and/or bibliographic records.

Categorical selections have to be clear enough that library staff can understand them and implement them on a routine basis. Again, the analogy to an approval plan is instructive: approval plans are likely to fail if they are so complicated that all the staff required to administer them, at all levels, do not understand the plan and its exclusions. In procedural terms, mass deacidification may require adjustment of workflow, but it cannot be fundamentally disruptive or intrusive, or it will not be economical. In fact, some technical problems may be solved with practical adjustments in workflow. If there are problems with treatment of certain kinds of labels, then treatment should precede labeling. If there are problems with treatment of commercial binders cloth, then treatment can precede binding. If binding routines are already preservation-conscious, then there is not much point to invest in mass deacidification of the binding materials, and some money can potentially be saved.

Conversely, mass deacidification routines must incorporate the ordinary work of recording the location of materials and the treatment which has been done to them. Mass deacidification is merely one kind of treatment that removes materials from availability. For most research libraries, recording availability of items is a fundamental feature of support to scholarship, and this particular selection/treatment process is no different. This implies that circulation status be recorded. Most libraries record changes in the physical condition or format of materials, and routines for recording the fact that treatment has occurred, whether on the item itself or on the bibliographic record, will need to be developed. We have found in our explorations that circulation and cataloging staff are willing, and often eager, to develop efficient ways of recording information about mass deacidification They record enormous quantities of information about books and journals, much of that information less significant than the acid content of materials. They will approach this as merely one more small item to record, provided that the work is designed to bring the materials to them in a routine way, making the marginal cost of recording relatively small.

Selection Categories

With these limitations in mind, we examined the three selection scenarios shown below, based on treating materials where they *move* or treating them where they *land* in the library. Like fishing, where one can fish the migratory channels and catch them as they pass or fish them where they live, success is defined by understanding what you are looking for, and where you place the net.

1. Treat materials being processed.
   - new materials
   - materials to go to bindery
   - materials from other processing routines
2. Treat collections.
   - subject collections
   - shelf locations
   - special collections
3. Treat materials being used.
   - materials from circulation
   - materials from use-based preservation flows

The first scenario is to treat new materials—place the "net" in acquisitions. In its most complete form, this scenario would mean treating all incoming materials that are acidic and expected to be of permanent value. The incoming book truck is one place where, theoretically, *all* material passes through the net, and in which, theoretically, *all* material is treated item-by-item anyway. To implement this scenario, we would build into the database the information that excludes those things for which treatment is not desired (e.g., this item is replaced by a cumulation in one year, or replaced by microfilm and discarded), build into the workflow the physical test of acidity, deacidify before binding and labeling, and then send the material on to the user. Following the initial movement of materials into the library suggests other places where the net could be placed, such as in cataloging departments, bindery preparation departments, or in marking operations. The key is finding an effective and efficient place to put the acidity test, where it can catch all the materials, and fit economically into other operations carried out at the same stage in processing.

The second scenario is to treat by collection (put the net at the shelf). Everything eventually ends up on the shelf. Here, too, it can be tested for acidity and examined for permanent value. In this scenario, the subject selection criterion is primary—choose *where* to go, then treat. Most libraries do not have routine mechanisms to examine everything at the shelf (except those where inventories are still practiced) so a selection process of this kind will require a specialized set of steps. Yet this is basically the way selection for preservation microfilming proceeds in the so-called "great" collections approach (in the Midwest we would call this the "pretty good" collections approach), so such a mechanism has precedent in many libraries.

The third scenario is to treat by use. Theoretically, everything that gets used moves in some way, so find the net to catch that which moves, and you will find the materials that are most "important" to treat. Selection by use would treat first the items most likely to be worn. The flip side is that those items that do not move will not be worn, and are more likely to stand the test of time, undisturbed, on the shelf. This is analogous to use-based repair systems, and use-based preservation microfilming programs. Implementing a scenario of this kind will require thinking systematically about how to find the places that evidence of use appears, and devising ways to catch and treat the materials that are used.

Pros and Cons

Each of these scenarios has some advantages and some disadvantages. We spent some time in our selection group looking at them, and this is a summary of that discussion.

In the case of treating new materials, there are some clear advantages. This method of selection will snare materials for treatment when they are new, or at least when they are as new as they will be in that particular library. Treatment at that point will assure that any strength advantages that are present in relatively new paper are retained. In acquisitions, materials are already being handled, and staff are looking for a variety of "unknowns" about them, including cost, vendor, and the like, as well as physical characteristics, such as binding and collation. Staff are also already routinely looking at databases for each item, so it is relatively simple to add information to the database about what to treat, and to add the physical test of acidity.

The most obvious problem with this approach is that most libraries will not have sufficient funds to implement it fully. Especially in the early stages of a program with limited funding, going to the shelf for previously acquired material will be more difficult, or at least more remote. Certainly the materials acquired *last* year are just as important and almost as strong as those acquired *this* year, and distinguishing between them is fundamentally arbitrary. Since we cannot do all the materials, the "newness" criterion will have to be combined with others. In this case marking the items and keeping the records are critical for long-term success, as eventually another sweep will take place for preservation purposes, and duplication of treatment will need to be avoided.

In the case of treatment by collection, there are some readily apparent advantages. This scenario makes targeting by strengths of the library relatively easy. There is a high level of consensus in many libraries about the strengths and relative priority of subject collections, as well as an established body of knowledge about their age, physical condition, acidity and brittleness of paper—information used to estimate the costs and impact of preservation microfilming programs. There is also knowledge about the kinds of use these materials are likely to get; the availability of, and preferences of users for paper, film, electronic, and other formats in this particular subject; and the appropriateness of other preservation options for a particular set of materials. A mass deacidification program for a subject collection or shelf location can easily be coordinated with preservation microfilming and/or repair work, and possibly could be *combined* into a comprehensive program. A subject selection scenario has the "coherence" that can make it attractive for external funding purposes (that is, it can be expressed in twenty words or less why these materials are "important"). Finally, a subject approach lends itself to cooperative selection, as the ways materials are described and shelved is fairly consistent from one library to the next, so design of exclusions and areas of responsibility is possible.

The subject approach, however, will leave out everything else the library holds, especially at the early stages. Some materials within any subject area may be well along the road to brittleness, and thus the benefit in terms of longer life is reduced compared to new materials. A program of this kind will require special routines to identify and test materials, and will also require routines to catch materials that happen to be in use at the time of the selection sweep—otherwise the most important materials may be missed because they were off the shelf.

The use scenario has some real attractions. "Things used" are most at risk for wear, and keeping materials from becoming brittle will extend their life dramatically. Use also cuts across the artificial subject distinctions librarians have to make in order to shelve materials, and use makes possible a selection routine based on how scholarship actually works rather than how classification systems work. A use-based approach will get the most important or most immediate things first, and it certainly will not require a "project" to find them.

Use, however, is potentially the most volatile selection criterion in operational terms. The flow of material within a university library is highly dependent upon the time of the year (returns of materials to the library can vary ten-fold in the course of an ordinary academic term). Use is also tied to academic fashion and "popularity." Because use is concentrated in most settings, a review process based on use would tend to turn up the same books repeatedly. Moreover, unlike use-base repair systems, which identify materials in demand that are damaged and may be unusable, a use-based mass deacidification selection system will imply removing materials in demand which are perfectly useable in their current condition. It is likely that "it is at the mass deacidification plant" will have even less credibility to a scholar or student than "it is at the bindery." Finally, a use-based selection system would tend to slow down circulation routines for acid testing, just at the time when circulation staff needs to speed up the work. The goal of assuring permanence directly conflicts with the goal of providing access.

What most libraries will end up with is a mix of these selection criteria—not because compromise and balance is necessary, but because we cannot afford to implement any one of these approaches fully. In our selection group, certain combinations appear fruitful, such as selecting "new African books," which offers potential for outside funding; or "all materials used in a particular destination or subject collection," which would provide a method to get at peculiar pockets of local demand; or "all materials passing through the use-based repair operation," to maximize the benefit of an already labor intensive operation to keep needed books intact.

Whatever the mix, selection criteria require some kind of coherence and some plausible integrity. Mass deacidification selection, to succeed, cannot be seen as merely a drop in a bucket that will not likely be filled. It must be seen as a logical and responsible first step toward the future where increased funding will allow expansion to a "mass" scale. Unfortunately the future of funding will probably look much like the present, so inevitably a selection mechanism will be required. That mechanism ought to be consonant with library priorities, the demands of scholarship, and the availability of other preservation options. It also must be efficient and simple, so that the potential economics of a bulk process are not wasted.

[1]Robert J. Gordon, "Productivity in the Transportation Sector," in *Output Measurement in the Service Industries*, Zvi Griliches, ed., forthcoming from University of Chicago Press.

[2]This paper draws extensively on results of this working group at Northwestern University Library. This group was formed as part of the broad investigation into mass deacidification conducted at Northwestern on behalf of

the libraries of the Committee on Institutional Cooperation (CIC). The group included three selectors (Rochelle Elstein, Bibliographer for Visual and Performing Arts, Jewish and Religious Studies and Journalism; Thomas Mann, Bibliographer for Social Sciences and Slavic Literature; and Robert Michaelson, Head, Science and Engineering Library), and three preservation specialists (Richard Frieder, Head, Preservation Department; Barbara Sagraves, Head, Preservation Office; and Susan Nutty, CIC Mass Deacidification Coordinator), and was chaired by the author. Staff support for this effort was financed in part with funds from CIC libraries and the Council on Library Resources.

[3]Quoted in Roger Angell, *Season Ticket: A Baseball Companion* (Boston: Houghton Mifflin, 1988), 220.

Institutional Selection Strategies: Case Studies

Ed Rosenfeld
Associate Director for Collection and Reader Services
Milton S. Eisenhower Library, The Johns Hopkins University

Before I speak specifically about our selection criteria for mass deacidification at the Milton S. Eisenhower Library of The Johns Hopkins University Library, I would like to discuss our approach to mass deacidification, the principles underlying our selection policy, and how we derived those principles over time.

From the very beginning we viewed our involvement with mass deacidification as a learning experience and the development of a policy on mass deacidification as an evolutionary process. At first, we learned from the experience of others, primarily the Library of Congress and the vendors of commercial processes. But, more importantly, we learned by doing. Since mass deacidification is a new industry, we tested materials and processes and discovered for ourselves what worked and what needed further investigation. Our vendor, Akzo Chemicals, learned with us and tried to adjust its processes to produce better results. Gradually, our selection policy evolved to its current state, and it will continue to evolve in response to further developments in technology and process engineering.

Naturally, we were concerned about making "good" decisions in selecting materials for treatment. We believed it was unlikely that we would be exactly right in each case, but we did not want to fail to begin. Books are complex structures fabricated from a wide variety of papers and binding materials and do not respond identically and predictably to mass deacidification treatment. We knew that an initial commitment to experimentation and discovery would produce better decisions down the road. If we have any wisdom to impart to others on the verge of deciding to begin, it is this notion of learning and evolving. Do not let the pursuit of perfection paralyze you into inaction.

What are the principles that underlie our selection policy? We see mass deacidification as one component of a comprehensive preservation program based on a collections conservation philosophy. Our preservation program is an effort to manage time to our advantage. We acknowledge that our readers prefer using library materials in paper format, and we want to ensure their ability to exercise that preference as long as possible. We have designed our preservation program around this desire to prolong the life of our paper-based collections. We try to take preventive action where possible and to intervene early when remediation is needed. Our practice is essentially conservative.

At the same time, as managers of limited resources, we are acutely aware of our fiscal responsibilities to maximize the impact of our funds. Our phased approach to preservation attempts, as our policy states, "to lower the overall, long-term costs of preservation . . . and to enhance the cost-effectiveness of annual preservation expenditures . . . " We do this, for instance by reinforcing all new paperbacks we acquire to protect them from rough handling. This "insurance policy" approach enables us to avoid, or at least to postpone for some time, the much more costly process of commercial rebinding. It is cost-effective, because it is a mass treatment, which involves no decision-making at the item level and uses inexpensive, but conservationally sound materials and inexpensive labor (generally students). We see mass deacidification in exactly the same light, or indeed as an even more powerful, more cost-effective insurance policy. By deacidifying paper early in its life cycle rather than being compelled to reformat when, inevitably, paper becomes brittle, we are using our limited preservation dollars to greater effect. We are buying time at lower cost.

Two basic objectives shape our selection policy for mass deacidification. The first is to treat all new acquisitions printed on acidic paper before they reach the shelves. This will enable us "to establish a date after which the long-term survival of [our] collections ... is not threatened by the inherent self-destructiveness of acidic paper." In addition, by treating acidic paper early in its life cycle, we preserve more of its inherent strength and buy more time for our investment.

Our second objective is to treat selected portions of our existing acidic collections where the information is best maintained in the medium of paper. The following list of categories of such material is taken from our *Policy for a Mass Deacidification Program*:

1. Material that does not lend itself well to reformatting. Examples include maps and atlases, publications in art history, archaeology, anthropology, and in many scientific fields where high resolution graphics and/or faithful color representation are critically important to the accurate transmittal of information. Large page size is also often encountered in such publications. These features are often exceptionally difficult or impossible to capture in reformatting the original publication.
2. Material where the artifactual value dictates a decision to retain it permanently and makes reformatting inadvisable. The Lester S. Levy Collection of American sheet music is one example of such material in the Eisenhower Library.
3. Manuscript material which the Eisenhower Library has an obligation to preserve because of its uniqueness, and where mass deacidification is a more cost-effective preservation strategy than reformatting. The Eisenhower Library believes that reformatting (such as microfilming) is an entirely appropriate preservation treatment for many of its manuscript materials, but believes that mass deacidification may be the more cost effective treatment.
4. Material to which readers at the Eisenhower Library will always need access. This category represents the largest part of the approximately 60% of our holdings that are acidic but not yet brittle. The Eisenhower Library believes that nationally coordinated action with other research libraries will be needed to realize the full value of mass deacidification for this category of material.

We regard our first objective—treating all new publications—as a long-term goal. It will take some time for the cost of mass deacidification to fall and for our present budget capacity to rise so that we can fully meet our objectives. But we were resolved at least to begin to act on this goal.

What actually happened when we began? As we know, policy statements are often evolutionary documents which respond to changes in the environment. We developed our selection policy before we began sending material to vendors for testing and before we signed a contract for service. Our original intention had been to maximize the impact of limited funds by selecting new acquisitions from the four categories listed for the treatment of existing collections. But, as we learned more about mass deacidification and considered the operational issues we would have to address in selecting and processing material, we had to modify our policy for the short term.

Specifically, we learned that coated paper is a complex medium made of three layers: a paper core, a binder, and a coating. Generally, the coating is calcium carbonate, an alkaline substance, that acts as a buffer for the paper core, which is generally acidic. At present, there is disagreement in the preservation community about the value of deacidifying coated paper. In fact, we do not know what actually happens to the core when coated paper is subjected to deacidification, because no research on this topic has been conducted.

Another thing we learned from testing is that deacidification can cause color shifting that cannot readily be predicted. Some dyes are acidic; and when the dye is neutralized, the color changes. This means that certain kinds of material such as maps and sheet music present uncertainties, selection difficulties, and costs that we wanted to avoid at the beginning of our mass deacidification program.

Because of these problems, which will require more scientific study, and because we wished to simplify the selection process, we decided to focus on new acquisitions of material printed on uncoated paper or containing very little coated paper (e.g., text with some illustrations). As this material accounts for the bulk of our acquisitions and as we contracted to treat only about 350 volumes per month, we needed to refine our selection criteria. Our new goal was to choose the most "endangered" material we acquired while keeping the cost of selection low. To do this, we settled on a geographic approach which divided the world of publishing into areas of relative endangerment. Asia, Africa, the Middle East, and Latin America were considered the most endangered; the Soviet Union and eastern Europe were next, followed by western Europe (country by country). This ranking scheme considered paper quality and the level of organization or sophistication in each region's or country's publishing and book selling industries. We reasoned that the better organized a country's publishing was, the easier it was to acquire materials and the longer titles remained available. To help rank the different geographic areas we used information, supplied by RLIN and based on our acquisitions over a two-year period, which counted titles printed on alkaline or permanent paper by country.

As we gained experience through testing material, we learned to distinguish between the chemical effects and the process effects of mass deacidification, a difference that has an impact on selection criteria and the selection process. Undesirable chemical effects (e.g., color shifting) result from the chemical reactions which neutralize the acid in paper; and, generally, these cannot be modified. Undesirable process effects result from the delivery of those chemical reactions; and, often, these can be modified. For example, in testing we learned that the deacidification process damaged the Se-Lin labels that we attach to a book and that contain the item's call number. As a result, we altered our selection process to avoid this problem by applying the labels after treatment. We hope Akzo will be able to correct this situation. Another process effect we observed was some damage to certain adhesives used in paperback books. This problem threatened to alter our selection criteria, since many third and second world publications we receive are paperbacks. Akzo has already been able to modify its treatment process to reduce greatly the instances of this problem, allowing us to pursue our current selection policy.

To keep the operational costs of selection low, we designed the process to fit into the cataloging department's normal workflow. Since catalogers must examine the recto and verso of each book's title page, they can easily determine the country of origin and flag the volume for treatment. When a volume is deacidified, this fact is recorded in the MARC record, making the preservation information available locally and on the bibliographic utilities in which we place our records. We believe that sharing information about deacidification is crucial to efforts to promote cooperative activity. The catalogers also record the fact that a book is printed on alkaline or permanent paper. In both cases, before a deacidified or permanent paper book is shelved in the stacks it receives a small stamp (D, or the infinity sign, respectively) on the top of the text block near the spine. This visible indicator may be useful at some point in the future should we decide to treat material already on our shelves.

Mass deacidification is a new industry; it is in the best interests of vendors and libraries to work together to nurture it. Libraries need mass deacidification to be a cost-effective preservation treatment option; vendors need a market to encourage investment in the development of their processes and the delivery of their services. As we gain experience with mass deacidification and the technology improves, we stand ready to modify and expand our selection policy to take advantage of these developments.

Institutional Selection Strategies: Case Studies

Jan Merrill-Oldham
Head, Preservation Department
University of Connecticut Libraries

Most library literature refers to mass deacidification as a prospective preservation treatment, that is, a treatment that blocks deterioration before it occurs. In the beginning phases of the very modest deacidification program newly undertaken by the University of Connecticut Libraries, however, the technology is being employed as a retrospective preservation treatment. (Retrospective treatments are those that restore library and archives materials to usable condition after deterioration has occurred). Initial selection priorities for mass deacidification are based on a commitment to solve preservation problems that present immediate impediments to service. In the past, the University of Connecticut Libraries had no acceptable way to provide access to materials (1) that are either already brittle or are becoming brittle, (2) that must be retained in original format because of colored images or other special physical characteristics that render them unfit for photocopying or microfilming, and (3) for which there is observable user demand. The conservation community has developed an acceptable (but not perfect) method for treating such materials. A typical sequence of procedures for conserving maps, posters, broadsides, manuscripts, and other unbound papers involves cleaning if necessary, deacidification, repair if necessary, and encapsulation between sheets of chemically stable polyester film. Bound volumes are treated in the same way except that they must be disbound, each page encapsulated, and the encapsulated sheets rebound into volumes (either in-house or by a commercial library bindery).

The major drawbacks associated with this process are that each step can be time-consuming (especially in cases where paper is very brittle and must be handled with great care), encapsulated pages are shiny because polyester film reflects a great deal of light, and the sandwiching of paper between two sheets of film approximately triples its thickness. Unfortunately, while a mass technology for paper strengthening may one day emerge and obviate the need for encapsulation, commercial services are not yet available. Severely deteriorated materials must either be salvaged today, using today's technologies, or not at all.

In the Conservation Unit of the Libraries' Preservation Department, paper repair, encapsulation, and rebinding are performed, but a decision was made several years ago to discontinue non-aqueous deacidification. At present the commonly used non-aqueous deacidification solutions are chlorofluorocarbon based, and the Conservation Unit strives to act responsibly regarding the environmental impact of its work.

In the fall of 1990, the University of Connecticut Libraries accepted an offer from Akzo Chemicals, Inc., to undertake a trial deacidification project using the diethyl zinc (DEZ) vapor-phase method. Since that time a second test run has been conducted. The goal of the project was to determine whether commercial deacidification services could help to fill an existing need in the Libraries' conservation program as that program is currently conceived and configured.

Experiments with the treatment of unbound papers were highly successful. Among other materials, 441 acidic, 19th- and 20th-century, black-and-white and colored maps were deacidified. None had significant artifactual value—an important factor since the University of Connecticut Libraries relied exclusively on data from the Library of Congress to assess the risk of damage to materials. The maps were sent to Houston, Texas, for treatment, evaluated upon their return for completeness and uniformity of treatment, mended if necessary, encapsulated, and interfiled with other maps in standard cases in the Map Library. Their chemical and mechanical stability restored through deacidification and encapsulation, they can be handled in the same way as new paper maps in good condition.

For Fiscal Year 1992 the Libraries have committed $5,000 for gaseous deacidification services. The Collection Management Committee (made up of the Associate Director for Collections and Information Services; Heads of the Collection Development, Reference and Information Services, Acquisitions, and Preservation Departments; the Principle Cataloger; and one subject selector—a rotating position) will review proposals from bibliographers and selectors, and set priorities based on intellectual value, degree of embrittlement, user demand, and a willingness to risk damage—particularly to certain covering materials on bound materials. Because paper and inks respond well to gaseous deacidification, emphasis is on the treatment of single sheets of paper, and the treatment of books that will be disbound, encapsulated page-by-page, and bound into new covers.

Should additional resources become available in the future, and deacidification technology be refined so that potential risks are minimized, the Collection Management Committee may begin to solicit proposals for deacidifying various special collections of books and manuscripts held by the Libraries. For the immediate future, however, the Libraries plan to pursue the present course of action. In summary, materials selected for mass deacidification are at risk, cannot be photocopied or microfilmed successfully, and do not have high artifactual value. Used in this capacity, commercial deacidification services will provide the Libraries with new and important capabilities.

Institutional Selection Strategies: Case Studies

Carolyn Morrow
Malloy Rabinowitz Preservation Librarian
Harvard University and Harvard College Libraries

Harvard University's interest in mass deacidification on the institutional level was formalized in 1990 with the appointment of a university library task group that was charged to consider the benefits and costs of mass deacidification, review available treatment processes, and recommend a course of action. The work of the group has been divided into three major phases: assessing available technology for mass deacidification, developing guidelines for the selection of materials suitable for treatment while conducting a pilot operational program, and exploring financial strategies.

The subgroup on technology includes three librarians and two chemistry professors charged to review mass deacidification processes on behalf of the library, investigate the status of paper strengthening technology, conduct site visits to commercial facilities, and recommend the use of a particular vendor. This group completed its work in the fall of 1991 and Harvard signed a contracted with Akzo Chemicals, Inc. to provide deacidification services.

The work of the subgroup on selection has begun to take shape as the result of the initiation of a pilot project to have materials deacidified and thus gain operational experience as a basis for future planning and implementation. The exploration of financial strategies is tied to the larger fund-raising and priority-setting activities underway at Harvard in preparation for a Harvard Campaign to begin within the next two years. While fund-raising will be an important component of the mass deacidification program, the exploration of financial strategies also includes the possibility of working cooperatively with libraries in the region to acquire deacidification services.

The topic of selection for mass deacidification is being considered on two levels: exploration of an overall intellectual approach and the development of an operational model or models based on a pilot project to select, send, and receive back materials that have been deacidified. Eight separate libraries and/or collections are participating in the pilot. A final phase of the pilot program will be to disseminate information about the program throughout the libraries.

The development of an overall approach to mass deacidification at Harvard is reflective of Harvard's decentralized system of research libraries. Decentralization means the distribution of responsibility to autonomous library units to build, describe, service, and preserve their collections. The development of Harvard-wide policies and guidelines for collection development, intellectual control and access, use of off-site storage, and preservation is accomplished through consensus and coordination among the individual libraries. For those of us who are part of the coordinating body called the Harvard University Library, decentralization means that we have a responsibility not to decide for the libraries, but to facilitate and guide decision-making. Therefore, our approach to selection for mass deacidification is to develop consensus among collection managers and the heads of the various libraries about the appropriate use of this new technology as a preservation tool, and its relationship to other preservation options.

If we follow the theme of this conference, that is, libraries beginning to decide, deciding to begin (or waiting for others to decide before they begin!), I would characterize collection managers at Harvard as clamoring to begin. They are not terribly concerned about the details of the technology (although they are very interested) because they know the Preservation Office will worry about the technology for them and keep them informed. They are not particularly worried about the financial aspects, either (although they should be). But they are very keen to consider the strategies for treating the specific collection under their purview.

Decentralization also means that individual libraries are very knowledgeable about and responsive to the needs of their individual library's primary clients and users. They immediately understand the benefits of a preservation technique that will arrest acid degradation of paper because they are interested in retaining materials in the format that their users prefer. They are concerned about the long-term well-being of the collection, that is, beyond their tenure at Harvard. This attitude of acceptance of responsibility for the long-term well-being of the collection is a preservation administrator's dream. Finally, because they are hands-on managers, they are perhaps most concerned about the multitude of operational issues—what materials; what order of priority; how to pack, ship, mark, and track; and quality control.

Harvard's pilot program is building upon these interests. Perhaps its most important aspect is to demonstrate that materials can be successfully treated, get collection managers accustomed to making decisions about what to deacidify, and involve staff in actually sending materials for deacidification and examining the results. However, because of the financial implications of a mass deacidification program for the libraries and the university, the issue of the eventual scale of the mass deacidification program at Harvard is one that will be considered and decided at the institutional level. This is not unlike the decision-making process that accompanied the introduction of HOLLIS, Harvard's online catalog, or the decision to build a shared, off-site storage depository, or place retrospective conversion of bibliographic records as the highest priority for the library.

In the process of developing guidelines for the selection of materials for mass deacidification during the start-up of Harvard's program, we articulated the following four categories of materials:

- materials for which we have special responsibility or special collections;
- materials that rely on original format for effective use;
- materials with graphic or visual images as intellectual content; and
- research collections that are kept on-site and available for browsing.

With the exception of special collections, our pilot program this year is beginning with these four categories. We will spend approximately $85,000[1] to deacidify materials from the Law School Library, the reference and map collections of the Widener Library (humanities and social sciences), the Fine Arts Library, Tozzer Library (anthropology), Loeb Music Library, Kummel Library of Geological Sciences, and the Botany libraries. Of course, there are many other potential libraries and/or collections that could fruitfully participate, but funds are limited and a small group will allow us to work together more easily. Finally, it is no coincidence that most of the participating libraries are also represented on the University Library's Preservation Committee.

If Harvard eventually accepts these four categories as basis for its mass deacidification program, how will we characterize and quantify the need? The first category—materials for which we have special responsibility or special collections—is perhaps most easily identified. As a result of a year-long planning process, the University Library published *Preserving Harvard's Retrospective Collections*[2] and initiated an ongoing process of assembling "preservation priority inventories," brief descriptions of collections in need of preservation. A subset of these will be collections that are suitable for mass deacidification.

The second category—materials that rely on original format for effective use—is also readily identified and quantified. Two examples that spring immediately to mind are maps and reference works which are not superseded.

The third category—materials with graphic or visual images as intellectual content—will be quantified as part of a series of collection surveys that will be conducted in individual libraries. We are interested in the type and format of the illustrations or graphic material and their relationship to the text and how it is used. To begin to capture this information and quantify it, the Preservation Office hired a team of three consultants (preservation, statistics, and programming) to design a survey methodology with particular emphasis on illustrated materials and test the survey methodology in the Design School Library.

The characterization and quantification of the fourth category of materials—core research collections that we expect to keep in open stacks—will be longer in coming. The issue is not so much one of what materials we will send to off-site storage, but the nature of the on-site collection. These decisions are beginning to be made in the libraries that are out of space.

Materials stored on-site will be candidates for more intensive preservation activity. They will not benefit from the retardation of acid degradation that is the result of low-temperature storage, and they can be expected to receive more frequent and more intensive (photocopying) use. Although materials stored off-site in lower temperatures[3] would also benefit from deacidification, the reality is that Harvard University is unlikely to allocate the $6.84 million per year[4] that would be needed. Therefore, we expect to use the low-temperature environment of the Harvard Depository as our primary preservation method for lesser-used library materials.

Mass deacidification is a powerful preservation tool for libraries. If we are able to combine deacidification on a routine basis with preservation options to reformat (capture images through microfilming and the newer digital technologies) and store materials at lower temperatures in the Harvard Depository, we should be able to combat the uncontrolled erosion of our collections through acid degredation. Harvard is happy to be at the stage that it can begin to take advantage of this new technology in order to facilitate the use of library materials, and the learning and scholarship that ensues.

1. Although this is a handsome sum for a pilot program, in contrast, we spend approximately $1 million each year on library binding.
2. A report of the Harvard University Library Task Group on Collection Preservation Priorities, April 1991. The 74-page report is available for $15 from the Harvard University Library Publications Office, 25 Mt. Auburn Street, Cambridge, MA 02138.
3. 65° F in the summer and 55° F in the winter.
4. Nine million acidic but not yet brittle books deacidified over a 20-year period=450,000 books per year plus 120,000 new acquisitions X $12 (selection, treatment record-keeping, shipping)=$6.84 million per year.

Funding Strategies and Public Relations

William J. Studer
Director
Ohio State University Libraries

North American production of alkaline paper has become more widespread more quickly than anyone would have predicted even five years ago, with the happy consequence that a large percentage of hardcover books and a growing percentage of trade paperbacks published in the past few years are printed on alkaline paper. It seems evident that by the mid-1990s, 90 percent or more of domestic fine paper production will be alkaline, so the ratio of alkaline books should rise steadily.

Table 1 profiles some recent results at Ohio State University (OSU) Libraries from testing 1989-91 monograph imprints with the Abbey pH Pen, and results in other ARL libraries would likely parallel the OSU experience. Even a good number of OSU theses and dissertations now show use of alkaline paper. Surveys of 1987-88 U.S. imprints conducted at Columbia and Brigham Young Universities found that about two-thirds to three-fourths were alkaline.[1]

We can also be encouraged by developments at governmental levels. U.S. Public Law 101-423 (passed in October, 1990), mandates that "federal records, books, and publications of enduring value be produced on acid free permanent paper." Several states have passed similar legislation, and in spring 1991, the National Commission on Libraries and Information Science (NCLIS) wrote a letter to all

Table 1
Alkaline vs. Acid Paper in 1989-1991 Imprints

Country	Hardcover Alkaline #	Hardcover Alkaline %	Hardcover Acid #	Hardcover Acid %	Paperback Alkaline #	Paperback Alkaline %	Paperback Acid #	Paperback Acid %	Total Alkaline #	Total Alkaline %	Total Acid #	Total Acid %
USA												
1991	128	95%	7	5%	49	66%	25	34%	177	85%	32	15%
1990	35	90%	4	10%	43	75%	14	25%	78	81%	18	19%
1989	2	50%	2	50%	12	48%	13	52%	14	48%	15	52%
England												
1991	37	88%	5	12%	5	62%	3	38%	42	84%	8	16%
1990	17	81%	4	19%	6	75%	2	25%	23	79%	6	21%
1989	7	87%	1	13%	2	100%	0	0%	9	90%	1	10%
Germany												
1991	13	93%	1	7%	15	88%	2	12%	28	90%	3	10%
1990	5	42%	7	58%	15	79%	4	21%	20	64%	11	36%
1989	7	78%	2	22%	2	50%	2	50%	9	69%	4	31%
USSR												
1991	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
1990	2	11%	16	89%	0	0%	21	100%	2	5%	37	95%
1989	0	0%	1	100%	0	0%	3	100%	0	0%	4	100%
All--28 Nations												
1991	204	93%	14	7%	85	74%	30	26%	289	67%	44	33%
1990	76	65%	40	35%	93	64%	53	36%	169	64%	93	36%
1989	27	69%	12	31%	28	50%	28	50%	55	58%	40	42%
TOTAL	307	82%	66	18%	206	65%	111	35%	513	74%	177	26%

governors and state librarians asking for information on progress in the use of permanent paper and urged compliance with the new national policy. Germany has also seriously taken up the challenge, having held a permanent paper symposium in February, 1990,[2] and counting at least one major paper manufacturer (PWA Grafische Papiere) converted to alkaline production in fall 1990.[3] Very recently, the European Librarians and Publishers (ELP) Working Group has averred that "it is urgently necessary from now on to use acid-free age-resistent paper and to support initiatives and strategies leading to such use."[4]

Based on all of the above, and including some admittedly superficial testing of current serial or journal issues, I would estimate that about two-thirds of the volumes added annually by the members of the Association of Research Libraries—9.65 million in 1989/90—are now alkaline, and that percentage can only rise.

Thus the problem of adding acidic materials to our collections has lessened dramatically and will continue to diminish in the near and long term, as the availability of cost-competitive alkaline paper spreads and as the understanding and determination to use it grow. Nonetheless, we need to continue to press noncompliant publishers of all stripes. Never has the aphorism, "an ounce of prevention is worth a pound of cure," had greater applicability!

But at the same time, a significant portion of foreign publications, which ARL libraries acquire in great numbers, may well continue to be acidic for years to come; and the number of acidic volumes resident in the aggregate collections of ARL members at the end of fiscal 1991 is staggering, not to suggest that the issue beyond ARL isn't also of great dimension.

The approximate 1990/91 volume count for the 119 ARL members is 365 million. Let us presume conservatively that, on average, 60 percent of these materials could benefit from mass deacidification, which is about 219 million volumes. At the current vendor-estimated cost of $6-$10 a volume, the fiscal commitment to deacidify this behemoth mass is between $1.314 billion and $2.190 billion. These are breathtaking numbers until one considers them in the context of the total value of ARL collections, which Billy Frye recently estimated between $25-$35 billion.[5]

How do we begin to eat this elephant during a time of particularly stringent economic reversal which besets most of us? (Only the Library of Congress has mass deacidification start-up funds set aside, with very good prospect for continued funding.) An important partial answer is, I believe, to reduce the size of the elephant.

"Size" here is directly related to the unit cost of mass deacidification, and this figure can be greatly reduced by providing capital for plant construction and contracting for operation with a viable mass deacidification provider. Richard Miller of Akzo Chemicals indicates that a plant with a half-million volume per year capacity can be built for $8-$10 million; and, if Akzo did not have to bear the construction expense, he estimates that the unit cost for mass deacidification would decrease by 50 percent ($3-$5 instead of the $6-$10 estimate), which begins to feel comparatively affordable. When extrapolated to the 219 million ARL volumes mentioned earlier, the associated mass deacidification cost range recedes to between $657 million and $1.095 billion.

Is it realistic to believe that libraries can join together to adopt this library/vendor cooperative model in order to lower cost dramatically? I believe so; and the ARL libraries of the Committee on Institutional Cooperation (CIC), consisting of the Big Ten plus the University of Chicago, intend to seek foundation/grant funding for this very purpose, once a mass deacidification process is selected.

The 1990/91 volume count of these 13 CIC libraries is about 55.6 million, with 60 percent representing 33.4 million candidates for mass deacidification. Picking $4 as the mid-point of the $3-$5 range and $8 for the $6-$10 range, the cost variance is between $133.6 and $267.2 million—a difference providing more than enough incentive and rationale to raise capital funds, even if it were judged necessary to construct a million volumes per year plant at $16-$20 million.

Given the urgency to get the mass deacidification job done vis-a-vis complicating factors such as possible plant capacity limitations, the need to factor in new acquisitions yearly, the not insignificant overhead costs involved beyond the articulated unit treatment costs, etc., not to mention the restrictiveness of major investments in a single mass deacidification technology, this library capitalization scenario is obviously incomplete and perhaps too simplistic. But I believe the approach is worthy of very serious consideration because to deacidify our collections is imperative, and the enormous costs are inhibitive, if not prohibitive.

Even if unit costs for mass deacidification treatment can be brought into the $3-$4 range, can we effectively begin to confront the sheer magnitude of the fiscal challenge posed in light of the current funding crises facing most ARL libraries and their parent institutions? I will venture a qualified yes, but must add—with great difficulty, involving very tough decisions, development of multiple strategies, and cultivation of additional resources.

There could hardly be worse timing for a major new funding need to arise. To begin, library directors simply must evidence their conviction and commitment by both reallocating internal funds and reassigning operational staff needed for selection, various aspects of physical handling, inspection, record modification, etc. In a context of steady to shrinking resources, the library is increasingly left to demonstrate its sense of priorities by how it directs scarce budget resources. If mass deacidification is of vital interest, library dollars must be first on the ledger. At the same time, redirected existing library funds can be only a partial solution. We must turn outward for the substantial bulk of the money needed over an extended period, which of course means establishing a convincing case for mass deacidification at many levels and in many venues.

To be sure, the library's parent institution needs to own up to some of the obligation. Institutional wells are near dry, but winning institutional support is a next step toward success. I do not believe it will be difficult to establish credibility for the problem and sympathy for its necessary solution. Using video aids like *Slow Fires* and *Turning to Dust* along with various extant background or analytical documentation, oral and written personal presentations, and, most of all, sample victims of acid decay, can readily bring understanding of the issue to a variety of audiences that control or influence funding. In the university setting these would include upper administration, deans, faculty, governance bodies, library advisory and friends groups, development and alumni association personnel, etc. We must gain the serious attention of these groups and persuade them to become resource providers and/or advocates, as the roles best fit. However, the fact that funds to deacidify will be in direct competition with both other university priorities and other universal library "goods" such as new acquisitions, information technology, and expanded services will not be a trivial challenge to negotiate.

Beyond our institutions we must also think of turning to state and federal governments, and to any potential sources that private philanthropy and foundations have to offer. If we accept that comprehension of the technical nature and scope of the problem, as well as its dire consequences, are not difficult to impart to given audiences, what arguments can be evidenced to make the case for mass deacidification so persuasive that it becomes an imperative, a *sine qua non*? What cogent associations can be drawn? To what lofty sense of obligation and noble instincts can we appeal, especially in a time when the fiscal docket is overloaded with good causes?

At the institutional level, a collections condition assessment is highly advisable in order to give specificity to the generically described problem. One can then emphasize the gargantuan investment and irreplaceable asset that library collections represent, and how integral and essential this resource is to the university's missions of teaching, research, and service. One can further accentuate the irreparable harm done to scholarship if wholesale self destruction is permitted through inaction. Mass deacidification is indeed nothing short of an investment in ensuring access for future generations of scholars, and equating failure to act with dereliction of responsibility is not too strong an evocation.

Most of ARL's libraries are associated with flagship institutions of higher education in the various states and tend to represent the states' major information resource(s). Thus it can be validly posited that the states, which have funded the acquisition of the collections in question, should also be expected to assist with ad hoc support for the extraordinary preservation effort needed to conserve these vital resources. Here we are calling up a sense of obligation to preserve and protect public property, which could play positively in the political arena. Working with university legislative liaisons would be a starting point.

The U.S. Congress has already shown its understanding of and commitment to preservation through funding of the national Brittle Books Program, and has also acquired an appreciation of the compelling rationale for mass deacidification through the Library of Congress program. Indeed, Congress has demonstrated funding commitment to help develop a viable mass deacidification process, and will surely fund the deacidification of LC's collections when a process or processes have been certified.

That research library collections are recognized by Congress as a form of national asset has long been established, and what is now required is for us to convince executive and congressional leaders that preserving the nations' research print collections in kind is truly in the national interest. Our foot is in the door, but given the different nature of preservation through mass deacidification, i.e., more than a single copy will be preserved, I believe it is requisite that federal dollars be solicited on the premise of a shared responsibility that presumes matching commitment by the institutions themselves, by state government, and/or by the private sector. There is reasonable prospect for success on this basis, given that a program is thoughtfully, creatively, and realistically articulated. In this quest we must have the endorsement and active support of the Commission on Preservation and Access, which has been an indispensable force and advocate in winning federal funding for the Brittle Books Program.

Can a cooperative program model for mass deacidification among research libraries be convincingly formulated? It would be a real challenge, and may even contradict, to a degree, the "mass" concept inherent in mass deacidification. But the potential of this approach should be given careful consideration in discussing any national program plan.

Let's look at the potential of mass deacidification, philosophically and pragmatically, in comparative context with the Brittle Books Program, whose goal over 20 years is to preserve, through cooperative preservation microfilming, a select 3 to 3.3 million titles from the estimated 10-12 million unique titles extant among 80 million volumes currently at risk (i.e., embrittled) in U.S. research libraries—at a projected cost of about $300 million to be provided by the federal government via the National Endowment for the Humanities, Division of Preservation and Access.

Clearly, this is a praiseworthy and landmark cooperative program that is successfully operational and that guarantees the ongoing availability of some core materials for scholarship; but mass deacidification has the potential to preserve many, many more millions of titles in multiple copies at a probable unit cost of no more than a fifth of that for microfilming and in the original format that users vastly prefer. Mass deacidification precludes the necessity for reformatting, at least for a few hundred years, when presumably there will be technological solutions not even yet conceivable. But the fact is, it is not an either/or situation; we urgently need both a mass deacidification and preservation microfilming program operating in tandem.

Many good points and pointers relevant to mass deacidification flow from the thoughts of an Australian librarian, Karl G. Schmude, in his article, "The Politics and Management of Preservation Planning"[6], and I believe they are very worth noting.

It has been easy to postpone serious consideration of mass deacidification, because our profession has taken the position that no process has yet been fully "proved"; but that will soon change, and then the political will and funds to act will follow. Future access to current and historical information, which is overwhelmingly print-based and likely to remain so, demands that we give due attention.

Preservation should be touted as a cornerstone of future library services; and it is by ensuring physical durability of collections that long-term access is guaranteed. "The engines of our society—economic, educational, political, technological, and cultural—will only be able to function on condition that information is preserved. The alternative is a form of collective amnesia as society loses the sources of its memory."[7] Schmude goes so far as to encourage drawing a strong analogy between the critical importance of preserving our heritage of recorded knowledge and the essentialness of saving of the natural environment. He views cultural preservation "as a necessary extension of the preservation of nature."

Regarding funding, libraries must be clear about the priority they give to preservation against other necessities such as new acquisitions and access to new information technologies, and will surely be forced to divert funds from existing budgets. The challenge is to develop criteria that strike a balance between preserving the old and covering the new. We should more and more consider preservation a form of "re-acquisition," (defined as a confirmation of the value of materials by preserving them into the future). Institutions, government agencies, and foundations must of course also be tapped for added funding.

Schmude firmly believes that library preservation must be comprehensive in nature, i.e., it must include "the ordinary," not merely the rare and manifestly valuable, because "preservation is about the basic informational needs of society. ... It is about the survival of cultural heritage in the broadest sense."[8] This principle is certainly a good fit with the application of mass deacidification.

Cooperative endeavors within a context of "library interdependence" are seen as intrinsic to a successful preservation plan, one that would set commitments for libraries "to preserve certain portions of their collections—pertaining to a particular subject field, [etc.] which will enable other libraries to plan the development and management of their collections in a complementary way."[9] Obviously, shared responsibility means less cost overall, but, again, is the end purpose of preserving masses of printed materials through deacidification consistent with such a cooperative approach?

In conclusion, the problem in ARL terms is 219 million or so treatable acidic volumes in retrospective collections, with about 3 million currently being added each year; mass deacidification is the solution. Validation of the enabling technology is nigh, and with it disappears the reason long used for delay of action.

Definitive unit treatment costs are yet to be determined but may well approximate the current cost of commercial binding (on which ARL members colively spent $23.6 million in 1989/90), or even be less, depending on vendor/client arrangements. In any event, the unit cost will add only a small fraction to the overall cost of a book or bound journal volume, while adding tremendous value in extended lifetime. The major challenge is the overwhelming quantities of material to be treated and the magnitude of funding needed to sustain steady progress at a time of serious financial constriction, for which there are no easy answers or pat prescriptions. Funding must be found, and multiple sources are out there. In many compelling ways the problem argues its own case very persuasively, and given this, together with ingenuity, belief in the cause (perhaps a touch of missionary zeal), good planning and the forging of strategic support alliances, I am confident we can succeed. We will not allow a broad base of our heritage contained on the printed page to be lost to posterity.

[1] Curtin, Bonnie Elaine Harger, and Akio Yasue, "The pH of New Library Books: Monitoring Acquisitions at Columbia University," *Alkaline Paper Advocate*, 1:30 (Oct. 1988);
McCrady, Ellen, "Why Collections Deteriorate: Putting Acidic Paper in Perspective," *Alkaline Paper Advocate* 1:31 (Oct. 1988); and
Butler, Randall R., "Here Today and Gone Tomorrow: a pH Investigation of Brigham Young University's 1987 Library Acquisitions," *College & Research Libraries* 51 (Nov. 1990): 539-551.

[2] Commission on Preservation and Access, *Newsletter*. No. 23, May 1990, p. 3-4.

[3] Commission on Preservation and Access, *Newsletter*. No. 31, Feb. 1991, p. 4.

[4] Commission on Preservation and Access, *Newsletter*. No. 37, Aug. 1991, p. 3

[5] Commission on Preservation and Access, *Newsletter*. No. 33, April. 1991. Special Report Insert

[6] Schmude, Karl G., "The Politics and Management of Preservation Planning," *IFLA Journal* 16 (1990): 3, p. 332-335.

[7] Schmude, Karl G., "The Politics and Management of Preservation Planning," *IFLA Journal* 16 (1990): 3, p. 334.

[8] Schmude, Karl G., "The Politics and Management of Preservation Planning," *IFLA Journal* 16 (1990): 3, p. 335.

[9] Schmude, Karl G., "The Politics and Management of Preservation Planning," *IFLA Journal* 16 (1990): 3, p. 335.

Panel: Funding Strategies

Richard De Gennaro
Roy E. Larsen Librarian of Harvard College
Harvard University

I will use this opportunity to make a few comments on fund-raising and the politics of getting federal money for mass deacidification. It isn't going to be easy to raise money for mass deacidification from individual donors or from the foundations. The best source is probably Congress, and as you all know, Congress is not in a giving mood these days.

When I stand back and look at the preservation scene, I see a certain amount of unhealthy competition and rivalry. I am glad that, in his paper, Bill Studer did not push mass deacidification at the expense of the Brittle Books Program. The politics of getting federal money for any library cause takes coordination and unified support from the field. A good lesson can be learned from the time the Association of Research Libraries and a number of library groups got behind the concept of a National Periodical Center (NPC). We lobbied, and Congress was all fired up to support a proposal. The Information Industry Association was the chief and natural opponent to such an initiative, but they did not sink the NPC by themselves. They got help from the librarians who broke ranks and started fighting among themselves—just at the critical time when the project was succeeding. Congress was getting different messages from the different library groups: some were saying that the NPC was absolutely essential; others were saying that it was a very bad idea. Congressmen like to do good things for their constituents, and if they get confusing messages from the field, they turn their attention to something else, which is precisely what happened in the case of the NPC. They could understand the opposition of the Information Industry, but they could not understand the mixed messages they got from the rival library groups. In the end, the NPC went down the drain, much to the detriment of the library profession—we all can agree that we wish that we had a National Periodical Center now with the rising price of journals.

So what does all this have to do with mass deacidification? Obviously what I am saying is that we should not try to get federal support for a new preservation effort like mass deacidification by undermining existing organizations and programs like the Commission on Preservation and Access and the Brittle Books Program. The Commission on Preservation and Access has played a critical role in the preservation movement. The Commission produced the film *Slow Fires*, and convinced Congress to recognize the problem and to fund a major program to address it. Fortunately, Congress still finds preservation a worthy cause. But if we now tell them that the money that they put into the Brittle Books Program was a mistake and that they should have funded mass deacidification or mass digitization instead, we run the risk of turning them away from the whole field of preservation. Brittle books is our first and most effective preservation effort. Let's build on it and add other good programs to it.

Panel: Funding Strategies

Donald E. Riggs
Dean, University Library
University of Michigan

It is my understanding that this panel's assignment is not to debate whether mass deacidification is the best approach for preserving library materials, but to address how to find money for mass deacidification and to delineate strategies for funding mass deacidification.

First, I want to define a strategy as "a course of action" for achieving goals and objectives. Goals and objectives follow the mission statement. The most recent version (August 1991) of the University of Michigan's Mission Statement reads, "To serve the people of Michigan and the world through pre-eminence in creating, communicating, preserving and applying knowledge and academic values, and in developing leaders and citizens who challenge the present and enrich the future." The "preserving. . .knowledge" part of the mission statement is appropriate to this morning's discussion.

Assuming that mass deacidification is a high priority for the library and that saving the human record in the original format is of vital importance, it is prudent to formulate thoughtful and results-oriented funding strategies. They could include the following examples:

- If one's campus is engaged in a major fund-raising campaign, the library's preservation needs should be reflected in this endeavor.
- Attention-getting news items could be placed in widely distributed publications. This fall a full-page article on Michigan's critical preservation problems will be carried in our alumni magazine. (Michigan has about 340,000 living alumni.)
- Special efforts should be made to get other campus units to assist with the preservation challenge. For example, the Athletic Department at Michigan is splitting the proceeds realized from the sale of the former football field's turf with the library. Proceeds will be used for our preservation activities. During a nationally televised football game between Michigan and the University of Notre Dame, a spot announcement about the sale of coasters and floor mats made from the turf will be carried (with mention noted about the proceeds helping to preserve books).
- A convincing case (with examples) can be made for retaining a book in its natural form. Few people "love" using microfilm, and the cost for microfilming a volume is more expensive than deacidifying one (e.g., at Michigan, the average cost for microfilming a volume is $75.00).
- The library should consider getting an effective spokesperson in the local community to champion the preservation cause. Michigan has engaged the assistance of a well-known attorney in the state who is calling and writing to his wealthy friends for money.
- The possibility of asking individuals for matching gifts should be explored. A 1921 graduate of Michigan has given the library a $500,000 gift for preservation with the expectation that we match the gift dollar-for-dollar.
- Exhibits can be erected in prominent places on campus and in the local community depicting books which have been destroyed by high acidic content.
- The state legislature should be educated on the importance of deacidifying the treasures held by the local universities.

Due to the time limitation, the foregoing remarks have been focused on the local environment. The creation and achievement of regional and national funding strategies are as important as local ones. The duplication of effort (i.e., deacidifying the same books among different libraries) will be perhaps a concern of some national foundations and funding agencies.

With at least 30 of the 50 states currently having a difficult financial time and some of the better endowed universities experiencing a downturn in their investments, getting new funds for mass deacidification will require greater creativity and a spirit of entrepreneurship.

Panel: Funding Strategies

Paul H. Mosher
Vice Provost and Director
University of Pennsylvania Libraries

William Studer's paper suggests that proactive preservation, as well as retroactive preservation, is under way, and that is very good news indeed. He has confronted most of the issues, and his advocacy of the technique and of funding strategies is practical as well as visionary. My comments, representing concurrence on most points, are a gloss rather than a challenge to his ideas.

There is a danger in assuming that the preservation issue is too vast—a huge crisis. Libraries have led the world toward an understanding of the issues, their consequences, and their costs, and, for the most part, there is good evidence that the message has been heard—at least domestically. The National Endowment for the Humanities, the Commission on Preservation and Access, the Association of Research Libraries, the American Library Association, the Research Libraries Group, and various other consortia have sensitized the nation and have gained significant federal and foundation support for the issue. And finally, local library efforts to build new funding bases, organizations, facilities, and programs to achieve the mandate of preservation and conservation have been revolutionary and heroic in their successes.

Libraries have also learned to shrink the vast fiscal mountain of preservation by approaching it collectively, cooperatively, and programmatically. The early wave of panic at the vastness and costliness of the web of preservation issues has succumbed to study and analysis, collaborative and distributed project initiatives, and a parsing or parcelling out of pieces of the greater problem for solution over time. We are learning to use time to our advantage, instead of allowing problems to accumulate over time in ways that have appeared overwhelming.

Fortunately, in the proactive sphere, paper manufacturers discovered that production of alkaline paper for book and journal publishing was only marginally more expensive—perhaps even cheaper in the long run—than rosin-sized paper production. The sulphuric acid that librarians and archivists hate proved to be no gentler to paper making machinery than to books. Thus, as Bill Studer has pointed out, preservation issues of the future are being reduced by concerted and widespread effort in the present. A lot has been learned.

Bill Studer's concern over the more resistant issue of foreign publications acquired by US libraries for research purposes is one shared by most of us here. For larger research libraries with significant foreign language and area studies programs, 40 to 60 percent of the titles acquired each year are published abroad. We are presently having to deal with the vast issues of retrospective preservation of these materials, and we are learning to deal with the fact that deterioration which has already taken place has created real deprivations. A major reason the University of Pennsylvania has decided to include mass deacidification as a major component of our preservation program is Bill's argument that it will be the major available tool in the next decade to deal with non-U.S. titles proactively. It is not a cheap solution, but it is a lot cheaper than the alternatives, if we are serious about foreign language collecting.

It will also be important to continue direct and indirect efforts through the International Federation of Library and Information Associations (IFLA), international scholarly associations, and our contacts with publishers and vendors abroad to urge the same transition to alkaline paper in publishing that we are seeing domestically. This may be one area where the development of international publishing conglomerates can have a positive effect. We have worked through a member of our board of overseers who is an executive of Penguin USA to see if the entire Pearson Publishing Group might not be encouraged to champion the use of alkaline papers; not long ago, the company decided to publish all Penguin and Pelican titles on alkaline paper—a good sign!

There seem to me, in response to Bill's accurate analysis of the mass deacidification issues, two areas where policy changes or shifts are vital, if we are to be able to add this useful tool to our preservation arsenal.

- Nationally, we must add mass deacidification to the recognized arsenal of necessary preservation techniques. While microform reformatting has proved to be an invaluable tool, it is not the only viable or desirable option for all cases. It is technologically a 19th-century solution to a 20th-century problem. Furthermore, it is one disliked by the vast majority of scholars on our campuses because it is inconvenient to use. I do not argue that we eliminate reformatting as a solution but that we recognize that it is not the only solution and that other alternative means, such as mass deacidification, are preferable in some situations.

- We should build mass deacidification into our own local planning and funding programs as appropriate. While we will need external support for the bulk of our mass deacidification needs as much as we need it for reformatting, we will need a local revenue stream to provide testing, seed, and matching money, and we will need to include it in our training and awareness programs. Mass deacidification is an investment that can help to reduce future preservation costs, if appropriately applied as a solution. It is also an alternative that can help to preserve certain parts of our collections in codex format—a popular solution for our users. The method is not without its space implications, but for many of us, it will be, nonetheless, a vital addition to our arsenal of preservation techniques.

The only addition to funding strategies I can add to Bill's useful list is one we are using locally with some success. Like many of us, the University of Pennsylvania Library is an active fundraiser, and our library endowment now exceeds $15 million. Much of that is for collection development, and we have brought off a very small revolution by adding the phrase "and preservation" to the usual phraseology about book and journal purchase in our book endowments. In practice, we are finding this a useful way to supplement our preservation war chest.

Note: Dr. Mosher's paper was presented by Carton Rogers.

Panel: Funding Strategies

Joseph A. Rosenthal
University Librarian
University of California, Berkeley

William Studer and the other panelists have covered the ground pretty well, so my function is mainly one of reinforcement for various ideas. I will do a slight bit of nitpicking. Bill's estimate that two-thirds of the material being added to research library collections is alkaline seems to me a little high, particularly for those libraries that are acquiring very high percentages of materials from overseas, especially from third-world countries. It is important to remember that part of the target for preservation consists of archival and manuscript collections, which generally have not been figured into the volume counts that have been presented, and in some of our libraries they are indeed very extensive.

Another low estimate is Billy Frye's estimate of the value of research materials in collections at $25 to $35 billion. This seems to me an understatement regardless of how you figure the value, whether you do it on the costs that were incurred in building those collections or on replacement value. The value of the collections is a point that needs to be made with our institutions and our institutional managements. Even though the costs that had been projected for preservation as a whole, and for mass deacidification as a part of a preservation program, seem very large, they are relatively small when compared with the value of the collections that are addressed.

During the past five or ten years, preservation and conservation have become a growth industry. We have momentum and the realization on the part of a large number of people that it is important to preserve our cultural and societal heritage. We need to push as far as we can, not simply for mass deacidification but for preservation of that heritage. Looking at the various possibilities for funding sources, such preservation does have an appeal. It has an appeal as we have heard from some of the panelists in their success stories. It has an appeal for private donors, for foundations as well as for governmental funding sources. But I would recommend that mass deacidification be viewed as one component of a preservation program, just as Richard De Gennaro argued that preservation itself is one component of library operations and services and of the information resources that are purveyed and made available through libraries.

Viewed in this way, mass deacidification needs to be incorporated by the conservation managers, the preservation administrators, into their own programs as one component along with reformatting, attention to security, repair, and other technologies that are available to preserve the collections. Funding sources are more likely to respond positively if the institution and the requester have a plan and a program that makes sense. Now I would argue that plans and programs that make sense are best seen as part of an overall institutional program: the library's plan should relate to the institution mission, and the preservation program should relate to the overall library program.

In that same vein, it is important for funding agencies to recognize that mass deacidification and other technologies are important parts of comprehensive preservation efforts, and that our efforts incorporate this view as a working philosophy. It is not that the present programs and the achievements to date should be disparaged, but mass deacidification should be considered as part of our total preservation needs.

It seems to me that we have made a great deal of progress in the work that has gone into this meeting and the discussion that has ensued. I sense a fair degree of consensus in terms of the kinds of materials that may be most desirable to preserve through mass deacidification. Also, some of us have viewed mass deacidification as something that can be applied on a grander scale than others would try. Nevertheless, the kinds of materials that we will be starting out with in terms of available resources will be similar. There seems to be a growing pattern here of the materials that we might tackle first, and this I would submit is a desirable outcome.

I view the programs for mass deacidification as eminently suitable for cooperation. In other words, not all material needs to be preserved by all 119 members of the Association of Research Libraries. But with the idea that cooperation is valuable, it seems to me that we must realize that any cooperative activity involving a group of libraries—such as the Committee on Institutional Cooperation or other groupings that may be natural in terms of geography or institutional commitment—is going to involve additional cost. Cooperation is not a freebie.

Part of the cooperative efforts need to be addressed to state governments. They are legitimate funding sources, and it seems to me that they can be induced to provide funding for both public institutions and privately supported institutions in a cooperative mode.

Cooperative Approaches to Mass Deacidification: Toronto Area Libraries

Carole Moore
Chief Librarian
University of Toronto Libraries

The primary rationale for a cooperative approach on mass deacidification is simple: a common need and a lack of resources to address that need in individual institutions.

The directors of Toronto's major university and public libraries meet occasionally to discuss issues of common concern. In 1988, we began exploring ways to move our preservation efforts ahead. At that time, at least three institutions had strong preservation staff already. Their efforts, however, were frustrated by lack of funding. A Steering Committee consisting of directors and preservation staff was formed. Our University of Toronto Preservation Librarian, Karen Turko, was a tireless leader in the effort to explain the acid paper problem and the need for preservation funding to politicians and the public in general.

Two city politicians took a personal interest in the problem. Their support has been key to the progress of our local effort so far. For this reason, I will describe their personal interest in deacidification.

The first is a city councillor and library board member who takes great pride in the preservation of his own and other cultures' heritage. It was with his help as Chair of the Economic Development Committee that we were able to get the City of Toronto to support an initial feasibility study for a cooperative mass deacidification center. When the Mayor commented that it seemed like a good idea but why should he be paying, our councillor presented an interesting economic case, based on the number of outside visitors to Toronto research libraries. They were estimated to benefit the economy by $200 per day each. Without the books, this benefit would be lost. This model apparently is or has been used to support other public sports and cultural facilities. Later, we were able to interest the Ontario government in sharing costs of the study, and by this time, the area archivists had become partners in our work.

Lord Cultural Resources Planning and Management, a consultant firm with experience in libraries and museums, was chosen to carry out the study, with assistance from a paper conservator. The terms of reference were:

1. identification and scope of the problem (based on information supplied by the institutions involved);
2. examination of available deacidification technologies including costs, scale of operations, and health and safety aspects, both of the process and the product;
3. recommendation of a deacidification technology for bound and unbound materials;
4. impact of the technology and operation on the service delivery of the institutions;
5. study of the economic feasibility of one or more deacidification centers;
6. recommendation of an operational model, i.e., co-op, public/private, wholly commercial;
7. recommendation of potential site;
8. business plan including potential sources of private and public sector funding; and
9. strategy for implementing the study.

In retrospect, these terms of reference were perhaps overly ambitious.

The primary conclusion of that 1989 study was that there was then no single proven method that would meet all of the treatment criteria identified, but that technology was rapidly evolving. A second finding was that there was a need for independent evaluation and testing of the most promising methods to ensure that they would meet performance objectives and to ensure that there are no lingering concerns over environmental health and safety issues. Disappointing as this result was to some, the study provided some helpful analysis in all the areas concerned and pointed to the next steps required.

By this time another key politician had taken up our cause, a former history teacher, now Chairman of Metropolitan Toronto. As a new politician he had been horrified to find the papers of one of the founding fathers of our country stuffed in boxes on the basement floor of his first office. His firm commitment is demonstrated by his support of a new and separately housed Metro Archives with impressive conservation facilities.

Under his office, I chair a new and expanded committee which has its own five-year plan aimed at providing a local facility for deacidification by 1995. Called the Metro Chairman's Committee on Preserving Documentary Heritage, its work is progressing through three subcommittees.

First, the Technical Subcommittee is overseeing the essential task of answering the primary question—is there a safe, reasonably priced technology which will preserve acidic books and paper longer than if we did nothing? This subcommittee has been the driving force, together with Helen Burgess from the Canadian Conservation Institute, who is actually carrying out the testing. A wide range of libraries, including our National Library and major research libraries, have provided support for these tests, the results of which should be available by next summer. Helen Burgess' paper at this roundtable should cover details of what the tests cover. Simultaneously, a second group, the Collection Evaluation Subcommittee, is working to help our local institutions refine estimates of what materials need to be deacidified, while a third group, the Public Awareness Subcommittee, is working on a long-range strategy to keep the public informed, to gain support, and to develop a larger funding base.

Conclusions from our cooperation so far are:

1. Cooperative strategies do provide possibilities beyond the capabilities of our local institution. These possibilities include funding, expertise, and wider public support.

2. The technical questions are still unresolved, but we are advised by our expert who has been conducting paper-aging tests for over a decade that mass treatment of some types of materials will be of benefit.

3. Keeping public support is key, especially in the current economic environment.

4. Preservation professionals and directors have to keep individual goals clear. The individual institutions involved in our group have quite different collections and objectives for what they want to deacidify. Generally institutions want to preserve that which is unique in our country.

Although much remains to be done, I am still optimistic that because the outside public interest is there, external funding will emerge if a satisfactory technology is demonstrated. We are getting closer to seeing that demonstration happen.

Cooperative Approaches to Mass Deacidification: Mid-Atlantic Region

Scott Bennett
Sheridan Director of the Milton S. Eisenhower Library
The Johns Hopkins University

Mass deacidification is a new technology. It is not particularly expensive, especially when compared to library automation, but any new technology poses uncertainties, and any new expense is burdensome in the drum-tight budgets of our libraries. There are also significant operational issues that must be worked through in starting a mass deacidification program. In this environment, where any beginning is problematic, my colleagues and I at the Eisenhower Library have learned much and have gained confidence from exchanges with others interested in mass deacidification.

But as we have moved from the "beginning to decide" position to that of "deciding to begin," discussions with our colleagues have taken on a different character. We have explicitly urged other libraries to adopt mass deacidification as a means of extending the useful life of their collections. We have done this with three specific objectives.

1. We want to help create a viable marketplace for mass deacidification. We want vendors to see that they can prudently make the substantial investments necessary to develop and to market mass deacidification services. Hundreds of millions of books in North America alone would arguably benefit from mass deacidification, but in truth there are only a handful of likely customers for such services. And even in the best of economic times, few companies are likely to make the expensive and risky business decision to develop mass deacidification technologies, to undertake extensive assessments of safety, health, and environmental issues, to build large-scale treatment facilities, or to support the marketing costs of these activities. Realistically, *no* company will do these things unless it believes libraries are genuinely committed to spending money on mass deacidification.

A few companies are today making significant investments in mass deacidification. If libraries are to preserve their collections, it is essential for them to respond to these entrepreneurial ventures by demonstrating a willingness to purchase services that perform well and lend themselves to further development.

2. The Eisenhower Library encourages other libraries to begin mass deacidification programs in order to bring down costs and to help secure affordable mass deacidification for the entire library community.

Libraries have been deacidifying individual books and paper items at high unit costs for many years. What is new is the possibility of deacidifying large quantities of material at unit prices that are low precisely because of mass scale treatment. How can we move to this scale of treatment? No one library (except perhaps the Library of Congress) can by itself generate enough business for a vendor to reach mass-production levels. It is only when many libraries commit themselves to deacidifying significant quantities of material that any of them will realize the full cost advantages of mass deacidification.

3. Cooperative action in mass deacidification obviously depends on a number of libraries using this treatment. But it may well be asked: Is cooperative action in mass deacidification meaningful or useful? Are there really ways in which one library can benefit from the decision of another library to deacidify a part of its collection? I believe that there are positive answers to these questions. Indeed, I believe that cooperative action will enhance the cost effectiveness of deacidified paper as an archival medium, much in the way that cooperative measures have enhanced the cost effectiveness of film for archival purposes. But it will be impossible to give life to such cooperation unless a significant number of libraries institute mass deacidification programs.

At the Eisenhower Library, we believe that now is the time to decide to begin the mass deacidification of library collections. We have shared this conviction with a number of research libraries in the mid-Atlantic states that are looking for opportunities to enhance cooperative action among themselves. I am pleased to report that last spring several of these libraries registered their commitment, in principle, to begin to purchase mass deacidification services in the coming year. This resolve to begin is most welcome, because it is only through the action now of many libraries that a market for mass deacidification can be created, treatment costs lowered, and the benefits of cooperative action realized.

From left: George M. Cunha, University of Kentucky, Barclay Ogden, University of California at Berkeley, and Ann Russell, Northeast Document Conservation Center.

Cooperative Approaches to Mass Deacidification: CIC Libraries

Richard Frieder
Head, Preservation Department
Northwestern University Libraries

Background

In 1986, the Northwestern University Library completed the ARL Preservation Planning Program. In the course of producing a five-year plan for preservation, we realized that roughly sixty percent of the Library's book collection was acidic but not yet brittle. Gaining access to mass deacidification has been at or near the top of our preservation priority list ever since.

As we went about educating ourselves about mass deacidification and its state of development in 1986, we saw that much remained to be done, both in developing processes and in preparing libraries to use them. It seemed that a group of libraries would have more leverage on the situation than Northwestern would alone, and the Committee on Institutional Cooperation (CIC) Libraries, of which Northwestern is a member, were already establishing a track record in preservation activity. So we began working to build interest in mass deacidification within the CIC.

After a couple of years of educating and consciousness raising, it became apparent to the CIC Libraries that an investigation of the various mass deacidification processes would be necessary. A variety of claims were being made, and we had no way to evaluate them. The CIC Task Force on Mass Deacidification was born in 1989 and was charged to perform or encourage others to perform the necessary evaluations and to position the CIC Libraries to take action. Five members of the Task Force are at this roundtable: William Studer of Ohio State University, Carla Montori of the University of Michigan, Gerald Munoff of the University of Chicago, Eugene Wiemers of Northwestern University, and myself. Scott Bennett of Johns Hopkins University is a former member.

The Task Force had extensive discussions with Battelle Research Laboratories in 1989 regarding the performance of a full evaluation of the processes then under development. We learned that this evaluation would be very costly (at least $500,000). At the same time, the Library of Congress (LC) and the Canadian Conservation Institute (CCI) began their evaluation work on chemical issues (i.e., treatment effectiveness and side effects; toxicology). As a result, we decided to focus CIC efforts on organizational and logistical issues and rely on others to evaluate chemical issues. We believed that in order to enable the CIC Libraries to act, both chemical and organizational issues would have to be adequately investigated. One without the other would not do.

In 1990 the CIC Libraries, with support from the Council on Library Resources, created a half-time, one-year position at Northwestern to pursue the organizational and logistical issues of mass deacidification on behalf of the thirteen CIC Libraries. That position is held by Sue Nutty, who is also a speaker at this roundtable. Sue's work at Northwestern is now almost complete. We have explored selection strategies, issues of treating and preselecting alkaline paper; marking treated material, either directly on the item or in the bibliographic record; and looked at the issue of quality control. We have begun to identify in-house costs, investigated contractual and treatment cost issues, and done a series of test runs aimed primarily at exploring organizational and internal workflow issues (Sue will discuss the test runs later). At times Northwestern has been a laboratory for the CIC, and at others each CIC Library has been directly involved. For instance, we investigated selection issues by forming a discussion group at Northwestern. This group's work was written up and shared, to be used as a starting point for discussion in the other CIC Libraries. Each CIC library, however, had an opportunity to be directly involved in the test runs by sending materials for treatment, giving them some hands-on experience. The Task Force is now writing its final report. Although much of the information will be specific to the CIC Libraries, some of it may be useful to others. We intend to make the report generally available.

The Task Force has not yet arrived at its conclusions, but I can offer you some of my own impressions. I believe we have now investigated organizational and logistical issues fully enough to proceed with mass deacidification. We have plenty more to learn, but having done the series of test runs, the only way to learn more is to do it.

Chemical issues are a slightly different story. There appears to be enough toxicology data available on both the Akzo and FMC processes to permit a thorough evaluation. We at Northwestern have obtained that data, and our University research and safety office is evaluating it. Many of you have comparable offices on your own campus that can perform this kind of evaluation.

Regarding treatment effectiveness, we still do not have the kind of detailed, independent, evaluative data is needed to proceed with large-scale mass deacidification programs. When LC releases the Institute of Paper Science and Technology (IPST) data and when CCI completes its work, we will have it. In the meantime, I believe we have enough data from the vendors to proceed on a small-scale with any process that passes a toxicology evaluation.

Again, I cannot at this point speak for the CIC Libraries, but I hope and expect that some of them will begin seriously discussing small-scale service contracts with vendors in the next several months.

Potential of Cooperative Activity

Having described the history of collective activity among the CIC Libraries, I would like to conclude by commenting on what has driven this as a cooperative venture. The CIC has approached mass deacidification cooperatively for the same reasons that libraries do anything cooperatively: to gain some kind of advantage in dealing with a large problem, or to achieve synergy. Mass deacidification was too big for any one CIC Library to tackle for two reasons. It was and still is risky; it is a great unknown in which libraries have little expertise. Second, it is potentially expensive due to the sheer numbers of materials in need of treatment. So, it made sense for the CIC to cooperate.

There are several areas in which CIC cooperation on mass deacidification has been useful or has further potential.

1. **Investigation/education/confidence-building process.** This clearly has been the greatest benefit of CIC cooperative activity thus far. By combining the needs, thoughts, and resources of thirteen libraries we have made more progress for less investment than would have occurred had we been operating individually. These thirteen libraries are now completing a basic investigation of mass deacidification that will provide a tangible starting point for those that wish to proceed. In the process we have become better educated and at least begun to build the confidence needed to take on this new venture.
2. **Contracting for services.** There may be advantages to the CIC in contracting for deacidification services as a group. We have the potential to generate considerable volume, and this may be attractive to one or more vendors.
3. **Building a treatment plant.** In the future, there is excellent potential for the CIC to either build or be a primary client of a regional treatment plant in the Midwest. Pooling the needs and resources of thirteen libraries will give us options we would not have individually.
4. **Fund-raising.** Here again, we are likely to have opportunities as a group that would not be open to us as individuals.
5. **Contribution to the greater community.** As a collective the CIC has been able to participate in furthering mass deacidification for the benefit of the entire library community. Thirteen libraries are now "ready" to varying degrees to use mass deacidification, and this is more than the total number of "ready" libraries in the rest of the country. Because we are thirteen libraries, we perhaps have played a role—and have a role yet to play—in making mass deacidification a reality, in demonstrating to corporations that libraries are serious about mass deacidification, in making it a cost-effective process, and in showing the vendors and the library community that, important as LC is to the future of mass deacidification, it is not the only game in town.
6. **Selection.** Although the concept of cooperative selection for mass deacidification is a long way from reality, the environment of the CIC Libraries would be an excellent place to explore it.

Of course, there are disadvantages to cooperative mass deacidification activity just as there are potential disadvantages to any cooperative library activity. I believe the greatest is that it often takes longer for thirteen libraries to do something than it does for one. The key is to cooperate only where it makes sense to do so, and to leave members free to act individually where that is most effective. One of the strengths of the CIC as an organization is its flexibility that allows this kind of give and take.

To any of you who are now contemplating how to begin mass deacidification activity, I highly recommend that you consider pursuing it in cooperation with other interested institutions. The ingredients for a successful cooperative effort are there.

Special Collections, Special Challenges

James Stroud, Chief Conservation Officer
Harry Ransom Humanities Research Center
University of Texas, Austin

I believe most of us in this room have long been in agreement that the availability of an effective mass deacidification technology could provide libraries and archives with a valuable preservation alternative to either traditional conservation treatment or reformatting of collections. But now we are in a strange position. After twenty years of efforts in their development, we have three potentially viable mass deacidification systems from which to choose. And we have done very little about it.

Because of the lack of knowledge, experience, and well-defined benchmarks for evaluating these processes, the library and archives communities at large have found it difficult to respond to the efforts of mass deacidification vendors to establish a dialogue about the concerns and needs of the communities regarding their processes. Uncertainty about the costs, safety, complexity, and effectiveness of mass deacidification, as well as a very limited body of documented practical experience, are factors that have caused institutions, which might benefit from the availability of a mass deacidification process, to be reluctant to commit not only their funds and their collections, but more importantly, their support and their willingness to enter into the discussion. This lack of tangible participation on the part of the potential users of these processes has driven at least two major corporations, Hercules and Union Carbide, from the marketplace, claiming that there was too little support to justify the expense of process development. Other key developers of these processes are also beginning to report significant frustration at the lack of real involvement from the library and archival communities. The recent decision of the Library of Congress to recall its RFP can have done little to reduce these concerns.

We are all aware that many issues surrounding the available processes are not fully resolved. Nonetheless, we must demonstrate to the vendors of mass deacidification technologies that we are prepared and willing to participate in investigations and experiments to further the development of safe, practical, and effective mass deacidification treatments. And we need to do so soon, before the opportunity disappears completely.

The Harry Ransom Humanities Research Center (HRHRC), as most of you know, has substantial holdings of 20th century literary archives and manuscript collections. As you may also know, the Center maintains an active program for the conservation treatment of its collections. This commitment to conservation emerged from an overwhelming desire of past and present management of the Center to preserve its collections for use in their original format. The limitations of traditional conservation treatment, however, are strikingly apparent in the face of over 14,000 linear feet of archival and manuscript holdings, of which few could be described as chemically stable and a majority of which, because of the sensitivities of modern writing inks, cannot be treated for acid deterioration by traditional aqueous or solvent-based conservation techniques.

To meet the challenge of the long-term preservation of such collections (and forty years of conservation research has clearly shown that this, in essence, means deacidification and good storage), it is essential to have effective working methods for mass deacidification. Archive and special collections conservators are generally heartened by developments in the past two decades that have led to the availability of at least three potentially useful commercial mass deacidification systems. Conservators prefer options. They are trained to understand that no class of treatment is applicable to all situations and that the selection and the effectiveness of a treatment depends on the compatibility of the procedure with the physical nature of the item being treated.

To move to that position where an institution can place, with confidence, large quantities of its high value cultural holdings into a chamber, lock the door, and then fill it with solvents or gases, takes more than a mandate to preserve and a spirit of optimism. The risks must be well understood. Conservators are trained to evaluate and balance risk. A conservation treatment (and it is important to remember that mass deacidification is a conservation treatment) might be performed with the advance knowledge of an adverse reaction, if the overall benefits of the treatment balance favorably against the negative effects. With traditional conservation treatment, there exists a substantial body of practical and dependable experience on which to make this evaluation. With the exception of the Wei T'o process used for the mass deacidification of books at the National Archives of Canada (a process that requires individual pre-treatment testing of items for sensitivity), the effects of current mass treatment procedures on bound materials is somewhat poorly documented, and those effects that are documented are very poorly disseminated. The experience-based knowledge of the effects of current mass deacidification processes on the full range of archives and manuscript materials is almost nonexistent. The one constant that seems to emerge from what we do know, however, is that there is no process on the market that will be free of the need to cull sensitive items prior to treatment—that is, if we are concerned with visual change in treated items. This may not be an issue with regard to the change in color of a library-bound book cover, but it is a strong concern when part of the intellectual meaning of a collection is embodied in the visual appearance of its component parts, as is often the case with materials in Special Collections. Knowledge of the levels of visual disturbance or change that will occur during any conservation process is critical to the decision to submit unique records and manuscripts of intrinsic historic and scholarly value for treatment.

If we accept that removal of items unsuitable for mass treatment is a necessary part of the deacidification process, then we must establish criteria and guidelines that will ensure cost effectiveness in the culling process and safety of the treated items. What do we need to know to be able to look at 100 linear feet of manuscript collections and evaluate the risks of a given mass deacidification treatment to individual items or categories of items within the aggregate? If, for example, we do not want to treat photographs, it is one thing to remove a number of file folders known to contain photographs; it is quite another to look through the contents of every folder to ensure that all photographs are removed. Overarching this decision is the essential need to know whether we want to treat photographs at all. And, if we do not, what will happen if we accidentally do? And, finally, will the potential damage of such a mishap be so severe as to preclude the effort to deacidify the entire 100 feet of manuscripts?

At the American Institute of Conservators (AIC) Annual Meeting in Albuquerque this year, Chandra Reedy from the Art Conservation program at the University of Delaware and Eric Hansen from the Getty Conservation Institute presented a report on the work of the AIC Task Force on Conservation Science. The report recommended the use of treatment trials modeled on the practice of the medical profession to examine new procedures and research within the context of field-based clinical applications. Operated under stringent guidelines, these real-life clinical trials provide a practical opportunity for the medical practitioner to evaluate new procedures and current research. The practitioner's feedback to the medical research community as a result of these trials is a critical component of the development of improved medical procedure.

With regard to mass deacidification, the library, archives, and conservation communities are now at a stage where the clinical trials must go forth. Many of us, of course, are beginning now to send test materials for treatment. But how are we evaluating the results? How are we focusing these experiences towards the needs of our end-users? Are our conservators spending huge amounts of time comparing treated materials with controls to determine color shift in paper, only to find that the end-user is not particularly concerned with color change? Are we prepared to dump effective mass deacidification systems simply because they do not simultaneously strengthen brittle paper when, in the case of single sheet collections, the strengthening process is not nearly as critical as it is for paper in bound formats?

The Harry Ransom Center perceives its own set of requirements for a mass deacidification process. It has participated in a trial run using the diethyl zinc process. This experience will be discussed later today in the session on trial treatments. The Center has also agreed to provide a test sample for deacidification by the FMC Lithco process later this year. Ransom Center conservators tailor their test samples to reflect materials typical of the 20th century holdings of archives and manuscripts in the Center's collections. Our concern, however, is that there is something almost too tailored about the test samples. They do not truly reflect real collections or real selection processes. A body of eight conservators can play some pretty serious hard ball when asked to put together a 35 cubic foot test sample.

The results from the Ransom Center's DEZ trials highlight a number of potential problems. Subsequent to this test, no one at the Ransom Center or at Akzo would say that culling is not a major factor in planning treatments with DEZ. Nobody really believed it would be otherwise. Nonetheless, as a result of this trial, we believe much valuable progress has been made in understanding the effects of the DEZ process on archives and manuscript collections. We are presently planning to begin an extended evaluation of the effects of DEZ treatment on real collections from the Center. We view this project as a clinical trial.

During the next two years, the Ransom Center is planning to submit for diethyl zinc deacidification 350 linear feet of archives and manuscripts selected from six 19th and 20th century HRHRC collections. In doing this, the Center is confident that a practical experience-based body of knowledge will emerge that will be of value to other institutions considering the mass deacidification of their collections. It is intended that this experience will result in guidelines broadly applicable to the identification of collections appropriate for mass deacidification; to the removal of materials from those collections that would be damaged by the treatment; and to the development of quality assurance protocols and procedures for the evaluation of treatment effects.

It is also intended that these guidelines will address logistical issues pertaining to record keeping, inventory, and monitoring of collections being processed; transportation and security for collections while off-site; and post-treatment processing and re-integration of treated collections into storage.

The Ransom Center has not selected collections of high monetary worth or preeminent research value for this trial. It will focus instead on those of lesser monetary value and lower conservation priority. Since the project is, in part, an experimental evaluation of the effects of the DEZ process on archives and manuscript collections, the Center presently views the mass deacidification treatment of its more intrinsically valuable collections as premature. In the context of the project as a development of recommendations and working guidelines based on real treatment experience, the Center plans to treat collections and groups of items from its holdings which represent a broad spectrum of the types of materials typically stored in archives and manuscript repositories. Test samples suitable for destructive evaluation will be included in the treatment runs.

Using the experience gained through its past cooperative relationship with Akzo Chemicals Inc., and information gained from its recent evaluation of experimental materials treated by the diethyl zinc deacidification process, the HRHRC has postulated three broad objectives toward which to direct the project.

Our primary objective will be to establish functional and practical guidelines, based on experience gained from this project, that may be applied by other institutions seeking to have archive and manuscript collections deacidified in mass, irrespective of the chosen process. To do this we will investigate a variety of quality control practices in an attempt to establish sufficiently basic procedures that may be applied routinely by non-technical library and archives staff to evaluate treated materials for pH change, alkaline reserve, and the effects of treatment on visual appearance. We will closely examine administrative, financial, and procedural concerns associated with the selection, control, movement, and security of archives and manuscript collections that are sent to off-site facilities for mass deacidification treatment.

Our second objective is to support current efforts to assess mass deacidification processes through the experimental evaluation of the effects of diethyl zinc deacidification on the wide range of materials found in archives and manuscript collections, including photographs, inks, dyes, pigments, binding materials, storage materials, adhesives, and paper. We believe this will provide knowledge essential to the selection of collection materials for treatment.

Finally, because of an institutional need to focus occasionally on the bottom line, our third major objective will be to provide preservation treatment to approximately 250,000 leaves of manuscript and archives which, because of bulk and low conservation treatment priority, cannot be expected to be given timely traditional conservation treatment by the Center's Conservation Department. Through this we will assess the desirability, practicality, and safety of the application of diethyl zinc deacidification to the high priority and high value collections of the Ransom Center.

Toxicological Issues and Testing Related to Treatment Processes

Michael Placke
Vice-President
Battelle Memorial Institute, Columbus Division

There are currently several chemical-based processes, in different stages of commercial development, for mass quantity deacidification of valuable and historic paper documents (books, manuscripts, etc.). Each of the processes provide for a chemical reaction within the paper fibers that neutralizes the acid content of the paper and then deposits varying amounts of residue within the paper that act as a continuous neutralizing buffer. Each of the processes differs slightly in that some are liquid-phase while others are vapor-phase treatments, employing a variety of different chemicals and physical treatment procedures. As with all chemical treatments, there are certain health and safety concerns associated with each deacidification process. The toxicology associated with the application of some of the base chemicals and reaction products of mass deacidification have been investigated to different degrees. My purpose is to summarize the procedure one uses to assess the potential health effects of any chemical exposure, not to review specific procedures.

This discussion is not a survey of the detailed technical issues and data associated with the toxicology and safety evaluations of any of the deacidification processes or chemicals involved. Rather, it examines the steps that should generally be taken in conducting a toxicology evaluation and risk or hazard assessment of any deacidification process. The conventional approach used to conduct a risk assessment is outlined, and then the DEZ-vapor phase deacidification process is used as an example to model selected steps in the process.

Toxicology risk assessment of any process is an activity that goes on everyday over an entire spectrum of intensities. Within most industries toxicology assessment is the primary driver for product development, be it a drug, a chemical, or a consumer product. Most of this motivation is provided by Federal Regulatory Agencies, like the Food and Drug Administration (FDA) or the Environmental Protection Agency (EPA). Most risk assessments are conducted by a scientific council (either industrial or government representatives) that gathers the available data at the end of the laboratory evaluation phase and reviews the benefits of the products. There is rarely complete consensus or definitive answers from these assessments. None can guarantee the safety of a material measured against the potential risks that someone will challenge or sue the library twenty years from now because they believe they have lung cancer as a result of handling a treated book. Cause and effect relationships can rarely be definitively identified. But the risk assessment process involves a risk/benefit analysis, following five basic steps.

The first step of the process is to identify what toxic substances are involved or generated. This includes the potential chemical residues that are inherent in the process carried through in the treated material housed in the libraries that could represent some individual hazards.

Second, the exposure hazard is estimated. For example, the potential thousands of pounds of zinc oxide (ZnO) that a library could have within their halls (from deposits within treated paper); is it available in a form to which people will be exposed, or is it going to be retained in paper fiber? How much of that material is truly going to be released? If it is released, how much are people going to breath or come in contact with? Third, once that information is identified then the toxicity evaluation, using standard and traditional toxicology study designs and accepted animal models is conducted. Kinetic and mechanistic studies may be performed to understand any tissue reactions that are identified and the interactions that may occur within a living system. Fourth, once that data are gathered, then the issue of quantifying the real risk associated with exposure to this particular chemical at the concentrations expected to be either in the work place or in consumer based environment is examined. And fifth, if there is a risk, systems and procedures are designed to mitigate that risk.

Toxic Substance Identification

Potential toxic substances generated during any given process can generally be grouped and evaluated according to various classes of chemicals. Common classes of chemicals often have similar hazardous effects. Solvents and vapors are generally of concern. Metals and metal oxides, especially heavy metals, have different toxic effects and represent different potential health concerns. Highly acidic or basic compounds can be quite caustic, while complicated organic chemicals have a broader spectrum of biological reactions, which is frequently the most difficult category of chemicals to assess.

In identifying the potential toxic substances inherent in the process, the physical and engineering elements relative to the process should be considered. Understanding these features will provide a better prediction of where the potential exposures are likely to occur. The physical nature of each compound is critical: will it be a vapor, a solid, or a liquid particle; of large size, or fine minute airborne particles that one would likely inhale? Most substances are not totally inert. Many materials may react with air, with water, with the inks on the paper, with the bindings, the glue, or the coatings that are used in the paper. These are all important considerations in identifying the residual chemical substances. The final residual chemicals in the paper represent the relevant potential exposure hazards for libraries and users of treated books, while the base chemicals used in the process are more relevant to assessing the potential workplace exposure hazard.

Exposure Hazards

After all potential toxic substances are identified, with the chemical and physical properties of each substances understood, the most likely route of human exposure should be determined (i.e., oral, dermal, inhalation, etc.). If there is a respiratory threat, the potential for aerosolization and the particle size distribution should be assessed (considering if the material fall within the respirable range). One of the more important messages in this discussion is to understand the relationship between the range of concentrations and associated potentially delivered dose of any potential toxic substance, to the dose or the concentration of that substance which causes a negative health effect. For example, what are the concentrations of the materials emitted while reading a book, relative to the concentrations that are known to cause a negative health effect? This is an important question, and we will come back to it.

Once the potential toxic substances and exposure hazards have been identified, classic toxicity evaluations can be conducted. One may be as complete and as conservative as they wish in this process, taking the position that it is necessary to examine every organ, all potential scenarios, and the entire range of concentrations and exposure repetitions possible from acute through lifetime studies. A more prudent and certainly more economical approach would be to gather as much scientific data as there is available and initiate a toxicology review of that data. Compounds for which there are adequate databases are segmented from those for which there is little to no toxicity data. If there are sufficient data already on the potential toxicity of a chemical, one may proceed with a particular risk assessment.

If the toxic effects are present only after exposure to very high concentrations or doses, and one has demonstrated from field studies that those concentrations are never going to appear within the library stacks, then further laboratories studies may be an academic exercise. But if there are not adequate data or if there are equivocal conclusions, then it is probably necessary to begin a standard toxicity evaluation.

This evaluation routinely begins with the acute toxicity of the compound being determined after a single exposure over a range of concentrations. This is followed by a series of exposures of a few days, weeks, or months. The absorption, tissue distribution, metabolism, and excretion profiles of the chemical are experimentally determined. This includes identifying organs in which the chemical is concentrated, metabolized, and stored. The systemic toxicity must be evaluated. Does the chemical cause effects only at the site of contact or entry to the body, or does it effect distant organs. It may be necessary to conduct special organ system or functional studies. For example, neurotoxicity, reproductive toxicity, and development studies are frequently specialties that are required. Lastly, any chronic exposure potential in humans may dictate the need to evaluate the carcinogenic potential of the chemical substances using lifetime treatment studies in rodent models.

All toxicity studies should be conducted using the most relevant routes of administration and concentrations. For example, concerns about zinc oxide (ZnO) or other paper residues in the library stack that could become airborne, indicate an inhalation study is appropriate, rather than an oral feeding study.

Risk Assessment

Once all toxicity and kinetic studies have been completed, the next task is to compare the results from the toxicity evaluation to the exposure hazard information that was developed in the initial phases of the risk assessment process. If the chemical in question only has toxic effects at very high concentrations and the field data show that there is a wide difference between exposure levels and concentrations that cause adverse effects, then there is little potential risk. This may not prevent someone from suing, but the scientific data will not support a cause and effect claim, and the institutions has demonstrated sufficient diligence in its risk assessment.

In the workplace, numerous approaches are available to mitigate exposure hazards. In contrast, the options are more limited in controlling general exposures. In a consumer setting, the first thing to do is to establish safe exposure levels. With toxic chemicals, the EPA tries to establish safety factors that are at least a 1,000 times or more greater than the toxic level compared to likely exposure levels. When dealing with drugs and therapeutic compounds—compounds that have some potential for therapeutic value—the safety levels can be narrowed considerably. For a patient with cancer or AIDS, it might be considered acceptable to treat with doses that are known to be toxic because the risk/benefit analysis indicates that no treatment means an earlier death. Drugs intended for non-life-threatening diseases have much wider safety margins between efficacious levels and toxic doses, and environmental contaminates often are regulated at even greater margins between toxic levels and allowable exposures.

Finally, educate the consumer and the users of the libraries. Help them understand the process and help them understand the technical toxicity evaluations, keeping it all in perspective. The most important correlation should be the relationship between potential exposure concentrations and the toxic concentration or dose.

The final aspect of this discussion is an illustration of this risk assessment process as it applied to one specific mass deacidification procedure. The DEZ processes and ZnO studies will be used as the example.

In the DEZ process, what are the potential toxic substances? This is a vapor phase form of deacidification, using diethyl zinc. DEZ is a metal alkyl which is in liquid form with a high vapor pressure. The deacidification reaction is rather simple. DEZ neutralizes all the acids present in the paper of treated books and also reacts with the water held in the paper forming ZnO and ethane. The ZnO is deposited in the paper fibers, and remains within the paper as a buffer against future acid. The ethane is vented away at the end of the reaction. Based on this reaction, there are four potential chemical substances to consider: DEZ, water, ZnO, and ethane.

The most significant residual compound is ZnO, which is inherent in the design of the process to provide the acid buffering substance. There also appear to be several exposure hazards when the chemical and physical properties of these chemicals are examined. Liquid DEZ is pyrophoric and when exposed to air it ignites and decomposes. This means it is highly unlikely anybody is going to inhale pure DEZ, making DEZ exposure an unlikely toxic threat. There is a threat of fire with the handling of liquid DEZ in the treatment plant, and this must be considered as a plant safety issue. Water is generally recognized as a stable liquid with very limited toxic properties. ZnO is a solid particle in this process and has a resulting particle size distribution of between 0.5 to 20 microns as individual particles, which can become airborne under certain conditions or come in contact with skin while handling treated paper. Ethane is a volatile, low molecular weight, light hydrocarbon that is usually completely contained during the treatment process, with no residual carry-over.

Reviewing the potential exposure hazards, only ZnO appears to have any significant exposure potential. There have been a number of studies done to measure the range of concentrations of ZnO associated with the deacidification process, including measurements in a processing plant, static displays of books on stacks and ZnO emissions while using treated books. In the treatment plant, the concentrations range from 1 to 4 micrograms per cubic meter of air. Experiments have been conducted to calculate ZnO concentrations emitted while flipping through a book at both slow and fast speeds. The range was between 100 to 1,500 particles per cc of air, placing the mass aerosol concentration in the very low microgram per cubit meter of air range. This was an increase in background particulate values of only about threefold, using the same flipping mechanisms with untreated books. Because cellulose fibers, dust, and dirt are also emitted from the books, the threefold increase was attributed to the presence of the ZnO. Electron microscopy coupled with X-ray diffraction was used to verify that the additional particles were ZnO. Ethane and light hydrocarbon concentrations of approximately 1 to 30 parts per billion have been measured in the processing plant, which are lower than or consistent with normal background values in ambient urban air environments.

The literature on ZnO indicates that it can produce a condition known as "metal fume fever." These were studies done using zinc metal turnings, under high temperature generation, producing a particle size distribution that was in the sub-micron range. This form of ZnO is not similar to the ZnO produced during deacidification and emitted from treated books. The latter are larger particles, ranging in size from 1 to 3 microns in diameter. Nevertheless, based on the metal fume studies, there has been established regulatory threshold limit value (TLV), which is an allowable exposure limit for workers in any zinc related operation plant. The TLV for ZnO is 5 mg/m^3. The allowable mg/m^3 concentration exposure levels are a thousand fold or greater than the $microgram/m^3$ concentrations measured in the field and book evaluation studies.

Known toxic effects that high doses of ZnO may cause include gastric distress and anemia at concentrations greater than 4 ppm in diet. There is little to no dermal toxicity associated with ZnO. ZnO is used in many cosmetic products, sun screens, and some pharmaceutic preparations. Until the deacidification issue surfaced, there was not a great deal of relevant data on the potential toxicity of inhaled ZnO. Therefore, the Library of Congress commissioned a series of detailed safety evaluations. The studies were designed to understand the range of potential toxic effects caused by inhalation of ZnO particles, understand the concentration response, identify target organs, determine the no effect level, and document if any of the identified toxic effects are reversible.

The studies were conducted on rodents, exposing animals to aerosols of ZnO particles. The concentrations selected for these studies were based on some range studies that were from 0 to 2000 mg/m³. (Remember that in the book flipping experiment the concentration of aerosolized ZnO was tens of thousands of times lower than what was used in these studies.) In the inhalation toxicity studies, clinical evaluations were conducted, along with body weight measurements, food consumption measurements, complete clinical pathology studies, full urinalysis, reproductive function studies, immunotoxicity studies, pulmonary function evaluations, and complete anatomical pathology assessments, with every major tissue in the body microscopically examined.

Toxic effects were seen in the rodents only after repeated exposure to high concentrations of ZnO dust. The toxic effects, however, were not severe in nature, indicating that ZnO is not a highly toxic material, nor were any of the effects immediately life threatening. At concentrations of 50 mg/m³ and higher, there were some clinical changes that indicated that animals were annoyed by the presence of the high concentrations of the dust. Their appetites appeared depressed and therefore, their food intake was reduced causing slower body weight gains. The animals were reluctant to groom themselves, so that their coats were a bit untidy. However, even at these concentrations, there did not appear to be any effect on blood chemistry or hematology parameters, no significant changes in pulmonary function, immune function, or reproductive capacity. Anatomically the animals exposed to 50 mg/m³ or higher, did have increased concentrations of ZnO particles throughout the respiratory track. The primary sight of deposition was in the alveolar spaces in the lung. There was a limited amount of inflammatory reaction, and that which was present was typical of a foreign body response. This indicates that the body was simply trying to remove the foreign particles. There was no evidence of fibrosis or abnormal cell formation, which would be a more serious consequences of exposure to the dust. Clearance mechanisms remained intact and animals that were held following the end of the exposure period showed markedly reduced amounts of ZnO in the lung. This latter fact was verified during quantitative distribution studies conducted in which the primary site of ZnO deposition during the exposure period was in the lung with total ZnO concentrations in the respiratory system returning very close to normal levels after several weeks of non-exposure. There were also increased concentrations of ZnO in several other organs, indicating that the ZnO was systemically available (these included liver, kidney, pancreas, and bone). But in each case, except bone, the ZnO concentration again returned to near normal values at the end of the non-exposure period. It appeared that the ZnO concentrations in bone, however, remained relatively constant after the post exposure period indicating that once deposited in bone, the ZnO remained relatively stabilized in the mineral complex of the tissue and would not likely be excreted. However, there were no adverse effects identified in the bone as a result of the long-term deposition.

Therefore, the conclusion from all these evaluations is that toxic effects occurred only after very high concentrations of ZnO—concentrations several orders of magnitude greater than even the highest exposure level that one would expect, either in a deacidification processing plant, within library stacks, or while library users were handling the treated material.

Toxicological Issues and The Institution's Responsibility

James Bukowski
Industrial Hygenist
Office of Safety and Environmental Health
The Johns Hopkins University

The Johns Hopkins University Office of Safety and Environmental Health (OSEH) is responsible for providing information, training, and technical assistance to the Johns Hopkins Hospital, School of Medicine, School of Hygiene and Public Health, and the Homewood Campus of The Johns Hopkins University in matters relating to occupational and environmental health. The OSEH is divided into the following functional divisions: Occupational Safety, Biological Safety, Environmental Health, and Radiation Control. In the summer of 1990, Scott Bennett, Director of the Milton S. Eisenhower Library at The Johns Hopkins University, requested that the OSEH evaluate the potential health hazard posed to library staff and patrons from the zinc oxide residue on material that had been deacidified with the DEZ process. This evaluation consisted of a review of the scientific literature including the studies funded by the Library of Congress.

A cursory review of toxicology and occupational health references indicated that zinc and zinc oxide are relatively non-toxic. Zinc is a nutritionally essential metal; the average daily intake of zinc is 12-15 mg.[1] Because zinc is an essential constituent of the human diet, the likelihood of occupational poisoning is reduced[2]. Patty[3] states that "aside from their irritant action, inorganic zinc compounds are relatively nontoxic by mouth."

The malady most commonly associated with zinc oxide is metal fume fever. Zinc oxide fume, which is smaller and more biologically reactive than zinc oxide dust, is produced by welding and smelting operations. The American Conference of Governmental Industrial Hygienists (ACGIH) in the 1980 *Documentation of the Threshold Limit Values*[4] notes that metal fume fever has been described in the scientific literature as "temporary and never serious," "of brief duration and without serious after effects," "never fatal," and "without medical evidence of chronic effects."

In determining the potential health hazard of a substance, one must examine how the substance will enter the body. In general, there are three routes of exposure—inhalation, absorption, and ingestion.

Inhalation

The U.S. Occupational Safety and Health Administration (OSHA) sets legal limits on occupational exposure to hundreds of chemicals. These exposure limits are known as PEL's (permissible exposure limits), and they represent the airborne concentration to which workers can be exposed eight hours per day, forty hours per week, over the course of a working lifetime without suffering adverse health effects. The ACGIH also conducts research into work place exposure to chemicals. They publish a similar list known as TLV's (Threshold Limit Values)[5]. The PEL and TLV for zinc oxide dust is 10 mg/m^3, which is the same value as for nuisance dust[6, 7]

As part of the environmental assessment funded by the Library of Congress, Battelle Laboratories conducted two studies[8] that examined the effects of various concentrations of zinc oxide on rats. In their subchronic study, rats were subjected to concentrations of 1, 3, 10, 50, and 200 mg/m^3 five days per week, for thirteen weeks. The no-effect concentration level was 3 mg/m 3.

Northrop Services conducted studies to determine the concentration of zinc oxide to which library staff and patrons could be expected to be exposed. In one study[9], they measured the airborne concentration under simulated stack conditions comparing treated books with untreated books. No differences were found between the two groups.

In a second study[10], they sampled the air in what would be the user's breathing zone while the pages of a treated book were riffled. The average airborne concentration was 0.01 mg/m3. This level is 1/1000th the level of the OSHA PEL and 1/300th the level found in the aforementioned Battelle study.

OSEH also conducted personal exposure monitoring at Johns Hopkins. Two library employees were monitored while unloading a shipment of treated books. The filters were analyzed by an independent AIHA accredited laboratory for total zinc. Because the filters were analyzed for total zinc, the result would actually be an overestimate of zinc oxide concentration. Both samples were below detectable limits.

Absorption

Litton Bionetics conducted two studies to determine the dermal toxicity of zinc oxide. In the first study[11], DEZ treated paper, untreated paper, and zinc oxide powder were applied to the backs of rabbits at a dose of 500 mg/site for 24 hours. None of the materials caused irritation.

The second study[12] examined the toxicological effects of treated versus untreated paper applied at a dose of 1000 mg/ kg body weight for six hours each day for 21 days. No toxicological effects were observed for either treatment group. Both of the doses used in the studies—500 mg. site and 1000 mg. kg body weight—are much greater than the doses to which library staff or patrons would be exposed.

Ingestion

A well-established indicator of a compound's oral toxicity is its LD50. The LD50 is the dose of a substance, expressed in mg/kg body weight, that is lethal to 50% of the test animals within a specified period of time. The LD50 of zinc oxide for mice is 7950 mg/kg. The LD50 of sodium chloride, table salt, is 4000 mg/kg. If you consider the low oral toxicity of zinc oxide along with the low probability of ingestion (people generally do not eat books), it is clear that treated books pose no health hazard via ingestion.[13 14 15]

Conclusions

Based on our review of the LC-funded studies and the scientific literature, and after conducting personal exposure monitoring, the OSEH concluded that the zinc oxide residue on the DEZ-treated books posed virtually no health hazard to either library staff or patrons. No personal protective equipment is needed to handle treated material. After handling treated material, staff and patrons should wash their hands before eating, drinking, or smoking — the same procedures that should be followed after handling untreated books or newspaper.

1 Klaassen, C. D., M. O. Amdur, and J. Doull, eds. *Casarett and Doull's Toxicology*. 3rd ed. (New York: Macmillan, 1986)

2 Hamilton, A., H. Hardy, and A. Finkel. *Hamilton and Hardy's Industrial Toxicology*. 4th ed. (Boston: John Wright-PSG Inc., 1983)

3 Patty, F. A. *Industrial Hygiene and Toxicology*. 3rd ed. Col 11a. (New York: John Wiley and Sons, 1981)

4 American Conference of Governmental Industrial Hygienists. *Documentation of the Threshold Limit Values*. 4th ed. (Cincinnati: ACGIH, 1980)

5 American Conference of Governmental Industrial Hygienists. *Threshold Limit Values and Biological Indices for 1989-1990* (Cincinnati: ACGIH, 1989)

6 Hamilton, A. H., et al. *op. cit.*

7 Klaassen, C. D., et al. *op. cit.*

8 Battelle Memorial Institute. *Repeated Exposure Inhalation Study of Zinc Oxide in Rats: Final Report.* Project G1265-0400.

9 Northrup Services, Inc. Environmental Sciences. *Evaluation of Diethyl Zinc-Treated Paper: Final Report.* 1985.

10 Northrup Services, Inc. Environmental Sciences. *Quantitative Evaluation of Potential Particulate Emissions from Diethyl Zinc-Treated Books Under Simulated Library Stack Conditions: Final Report.* 1987.

11 Litton Bionetics. *Primary Dermal Irritation Study in Rabbits DEZ (diethyl zinc) Treated Paper/Untreated Paper/Commercial Zinc Oxide: Final Report.* LBI Project No. 22275-01. 1984.

12 Litton Bionetics. *21-Day Repeat Dose Dermal Toxicity Study in Rabbits DEZ (diethyl zinc) Treated Paper and Untreated Paper: Final Report.* LBI Project No. 22275-04. 1985.

13 Patty, F. A., *op. cit.*

14 Sigma-Aldrich Corporation. *Material Safety Data Sheet—Zinc Oxide.* 1991.

15 Sigma-Aldrich Corporation. *Material Safety Data Sheet—Sodium Chloride.* 1991.

Results of Independent Laboratory Testing of Deacidified Books

Donald K. Sebera
Preservation Scientist
Library of Congress

In his paper, Gerald Garvey reviewed the Library of Congress' actions in soliciting bids for the mass deacidification of books in its general and law collections. The various steps and procedures followed in preparing the solicitation, evaluating various major components of the solicitation, and ultimately making the decision to cancel the solicitation were described. The major focus of this paper is a brief description of the analytical results obtained on the demonstration set of 500 books, which all offerers were required to treat and submit for testing. These test results were of crucial importance in the procurement cancellation decision. Several of the test results contained in the report of the independent testing laboratory will be interpreted and summarized.

Converting Preservation Goals into Testing Protocols

Each institution has individual preservation results it seeks to attain through deacidification of its books, but there are general, if idealistic, goals which are almost universally desired.

1. The deacidification process should be able to neutralize all the acids present on every page of every book treated, and to deposit an alkaline reserve material uniformly on all pages of all books to prevent future formation of acids.
2. The process should be capable of treating all books, without preselection, with total safety to process workers, readers, and library staff, and without harmful effects to the environment.
3. The treated books should be indistinguishable from their appearance prior to treatment but now have a lifetime of 1,000 years or more.
4. Ideally, it should be possible to carry out the process without removing the books from the shelves or at worst treatment should be conducted at the library location.
5. Finally, the cost should be very low, perhaps $5 to $10 per volume initially, with lower cost later on as experience and competition come into play.

Clearly, such goals cannot be achieved by any currently available deacidification process, and indeed they are so ideal as to be unattainable.

Recognizing what we would like to attain, however, is the first step in developing deacidification process requirements. The second step is to convert these goals into minimum requirements. These minimum requirements, though based upon goals, differ in important respects. They must be realistically attainable, which requires not only an understanding of what the underlying goal attempts to achieve but also knowledge of—or least an estimate of—what the presently available processes are capable of providing.

The minimum requirements must also reflect an assessment of the cost/benefit ratio. Using estimates of cost—which should include not only treatment costs but in-house costs of time, staff, disruption to user service, etc.—one must reach a value for the benefit which justifies the cost. One must also keep in mind that almost certainly the contractor for deacidification services will provide benefits just at or only slightly greater than the specified minimum because in most cases an additional level of benefit results in an increased cost to the contractor. Finally, the minimum requirements must be stated in a form capable of being universally understood and agreed upon by the library and suppliers.

As an example, consider the goal of life extension. In the Library of Congress procurement, this was stated as a minimum average increase in paper lifetime by a factor of three as measured by a decrease in the rate of strength loss of the paper. This minimum requirement recognizes that not all papers can reach some arbitrary lifetime (however defined) but that the deacidification process should reduce the rate of deterioration of all acidic papers by a significant amount. The efficacy of the process for different papers of different acidity levels and paper characteristics will differ, and therefore an average value of life extension must be used. The minimum requirement is also based upon knowledge and experience with deacidification processes, which indicates that a strength loss rate change by a factor of three is attainable by known process(es) and that this minimum value is economically justifiable.

Finally, focusing on the rate of strength loss separates the effects of deacidification, which is the service being procured, from ancillary strength increases or decreases associated with the deacidification process. As a protection against processes that significantly weaken the paper though reducing the rate of strength loss, the Library of Congress procurement has a requirement limiting strength decrease associated with processing. Each of the requirements contained in the Library of Congress' *Request for Proposals for Deacidification Services* was similarly related to goals. In addition, all the minimum requirements, which, like the goals themselves, are interlocking and interdependent, had to be carefully reviewed for assurance they were mutually compatible and attainable.

The next major step is to define procedures by which the characteristic attributes of the minimum requirements can be assessed as measured. In general, one tries to use methods that are objective, using instrumental means of measurement rather than subjective judgements and evaluations. And where objective tests are suitable and av... .., one tries to select those which have general concurrence, such as ASTM, the Technical Association of the Pulp and Paper Industry (TAPPI), or International Standards Organization (ISO) procedures. Considerations of familiarity of the testing method by the library (and scientific) community plays some part in selecting a test method. Finally, consideration of the cost of testing, the time required for testing, and when tests results must be available become important considerations in any real-world procurement process.

Again using a minimum of three times life increase as measured by decrease in the rate of strength loss as an example, it was decided that strength would be measured by MIT fold value (at 0.5 kg load). Though not universally accepted as the sole or even best measure of strength, it was chosen partly because the technique was a familiar one to most librarians but mainly because the Library of Congress had the most experience with this method and was confident it was a technique suitable to measure differences in different strength papers with adequate accuracy and reliability. Within the constraints of cost and time, strength was also measured by other methods. These results can be used to compare test methods, but only the MIT fold test was used to evaluate treatment processes.

To obtain results in the time available, it was necessary to measure strength loss under accelerated aging conditions. Largely because of cost and equipment constraints, it was decided that only TAPPI humid aging would be employed, and a maximum accelerated aging of 30 days was established. Slopes were to be determined by standard least squares recursine formulas from plots by the logarithm of the MIT fold plotted against days of accelerated aging (plots were truncated when fold values reached 3 or less to eliminate the larger experimental variation in low fold values).

The sample papers were tested in random order to limit errors of instrumental or operator drift over time and the tests (as all in the procurement) were conducted "blind," i.e., the operator did not know which paper or process a sample represented (only code numbers were used which were later used to collate data.) This example has been described in considerable, but by no means complete, detail to illustrate some of the considerations involved in unambiguously (and legally) characterizing and measuring a minimum requirement.

As Gerald Garvey has already noted, the minimum requirements are fully described in the Library of Congress RFP 90-21. Measurement protocols are described in RFP 90-32 and were made by the Institute of Paper Science and Technology (IPST) in Atlanta, Georgia, with the results made available to the Procedure Evaluation Board in a report. It should be emphasize the IPST provided only raw data and results in its report; all evaluation of the 500 book demonstration set test results were made by the Evaluation Board.

Turning to some of the results, I will discuss first the results obtained on the primary technical preservation requirements, and then how to interpret some of the technical aesthetic (or appearance) charts and graphs. Only results will be described here; the reader must make his own inferences. The graphs presented are taken directly from the IPST report; the only change is in some cases to overlay the graphs reported for the different processes in order consolidate the results in a single graph.

Extension of Paper Life

Figure 1 (page 72) shows the decrease in MIT fold value for a particular acidic paper (Clear Spring Offset) contained in the test books included in the 500 book demonstration set. The untreated paper (control) drops from about 3,000 folds to about 30 folds in 30 days of accelerated aging. The same paper after deacidification treatment would be expected to lose its strength more slowly. This paper, when treated by Akzo, FMC, and Wei T'o Associates processes, loses strength more slowly; their slopes relative to the control paper are factors of 4.5, 5.5 and 3.2 less respectively (pages 73-75).

Figures 2, 3 and 4 display the strength loss behavior before and after treatment of three other papers by Akzo, FMC, and Wei T'o. Once again the slope reduction values for each paper type are shown on the graph. Finally, Figure 4 shows test results for an alkaline paper, i.e., the paper is already alkaline before treatment. As might be anticipated, deacidification does not reduce the rate of deterioration of already alkaline paper.

As expected, different papers respond differently to a given deacidification process, and the minimum requirements must recognize these differences and utilize an average value in evaluating compliance with the standards established.

Alkaline Reserve

The Library of Congress determined that treated papers must contain an alkaline reserve to protect against future acid development in the paper from chemical reactions or atmospheric pollution. The amount of alkaline reserve was measured by a standard acid-base titration technique. Since different processes employ different chemical compounds to provide the alkaline reserve, the minimum requirements stated that the amount of alkaline reserve shall be expressed in terms of the equivalent amount of calcium carbonate. The treatment was required to deposit (again an average) a minimum of deacidification compound equivalent to 1.5% calcium carbonate. It should be noted that this is a requirement only for the amount of the chemical, not of its effectiveness; its effectiveness is, in fact, measured by the decrease in strength upon aging. Related to this minimum concentration requirement were those describing the uniformity of its distribution on individual pages in books and the degree to which it is retained under accelerated aging conditions.

Figures 5, 6, and 7 (pages 76-78) display the concentration of alkaline reserve (expressed as equivalent calcium carbonate) for the three acid papers treated by Akzo, FMC and Wei T'o. The initial values of the Akzo treatment exceeded 1.5 wt % $CaCO_3$ equivalent and decreased in amount as accelerated aging continues. These figures also show FMC and Wei T'o treatment results in initial alkaline reserve values of about 1.2 and 0.6% wt % $CaCO_3$ equivalent which vary somewhat with different papers. Again, both processes display a loss in alkaline reserve as accelerated aging progresses. Alkaline reserve in the FMC process is seen to drop to essentially zero in less than 22 days.

Other Physical Attributes

Figures 8, 9, 10, and 11 (pages 79-82) are included only as examples of additional data and results contained in the IPST report. The brightness of various papers treated by the three processes, both initially after treatment and upon accelerated aging, are compared with untreated (control) paper in Figures 8 and 9. Brightness change had to meet specified requirements in the procurement. Figures 10 and 11 display changes of the solubility in NaOH solutions of various papers upon accelerated aging; in this case NaOH solubility was not a procurement requirement but was included in the testing to provide comparative data.

Completeness of Deacidification

This requirement addresses the goal that all portions of every sheet of paper in every treated book have the acid that is already present completely neutralized. It is not sufficient to take a whole page of a book, for example, into an aqueous suspension and measure the pH (or the alkaline reserve). Such a technique would not detect areas that were not neutralized so long as the total amount of alkaline reserve (which may exist locally in high concentrations and be totally absent in others) exceeds the total amount of acid on the page. There was concern at the Library of Congress that these non-neutralized acid areas would not benefit from the deacidification treatment.

No convenient ASTM or TAPPI tests were available to test for completeness of neutralization or deacidification. Measurements employing a glass electrode to measure pH at many places on a page are possible but for the many samples involved in the procurement were excessively costly and time-consuming. Instead a test similar to that familiar to librarians as the archivist's or abbey pen was used. A solution of an acid-base indicator was applied in three strokes of a cotton swab in a geometrical pattern encompassing major areas of a page. One page from each of the 500 books was tested. A yellow color denoted an acid area with a pH less than 6.5 ; other colors (including the purple-red of moderately and strongly alkaline pH's) denoted neutralization.

Figure 12 (page 83) shows the IPST results in two forms. On the left for each process is shown the percent of the books that showed an acid (yellow) area when tested — however small the area. The right hand of the graph is the meaningful portion. The IPST technicians conducting the indicator striping test estimated the fraction of the total striped area for each book which was acid (yellow) and computed the average for all 500 books in each of the treated books in the demonstration set. The right-hand graph shows the extent of incomplete neutralization without the exaggerated results arising from minor local differences in paper, application of indicator, etc. It can be seen that processes differ significantly in the degree to which they provided complete neutralization of the acids present in the papers.

Appearance and Condition

We now enter the realm of subjective evaluation: no satisfactory completely objective means of assessing the appearance or condition of books before and after some process is available. The test protocol and IPST report describe in detail the condition panel composition and its rating factors and procedures. Composed of individuals intimately familiar with books, i.e., librarians and book conservators, they evaluated randomly selected books identified only by code number according to the factors shown on Figure 13. After these individual blind assessments, the data from the worksheets were collected into grouping by the three processes and the untreated (control books).

Figure 13 (page 84) shows that all the processes have visually observable effects in nearly all categories. Even the untreated control books were reported to have some visual changes; these changes may indicate the degree of error inherent in the subjective evaluation process or may in fact describe the change in appearance resulting from the shipment of books from the Library of Congress to the IPST. We can gain some confidence in the reliability of this subjective test by observing that the control books show dramatically lower rates of appearance change than the treated books.

This confidence is further increased by the data in Figure 14 (page 85) in which treated and untreated halves of books were directly compared. Now, as expected, a higher incidence of change in appearance is noted for the treated books with little change in the data for control books. One can conclude that the test method, though subjective, can effectively discriminate among the type of appearance change and the extent of their occurrence.

Odor Evaluation

Evaluation of odor in materials is one of the most difficult assessments to make. Almost no instrumental or other fully objective methods can be generally employed to detect, characterize, and quantify odors. They can be detected and are often offensive at the limits of instrumental detection even when (as is rarely the case) their chemical identity is fully known. Humans differ enormously in the ability to detect odors and in their physiological and physiological reaction to them. Finally, the conditions under which the odor evaluation is made—both environmental and psychological—can dramatically affect the perception of odor. To reduce this variability, standard odor evaluation methods have been developed and were employed by the IPST according to the procurement protocol. For the present purpose the main features were the use of a four-member odor panel and a "blind" test with odor panel members smelling books from all of the processes (and control) intermingled.

Figure 15 (page 86) shows some of the panel results. An important fact is that all of the panelists reports some degree of nasal or lung irritation during the testing. The effect was transitory with a short absence from the testing site clearing up the discomfort. The panelists could group the odors into categories or types, which later were found to be associated with specific treatment processes. Because the tests were blind and the books intermingled, it was not possible to identify the physical discomfort effects with specific treatment process(es). It also is not possible to determine whether the effect is truly the effect of book treatment (or non-treatment of control books) or physiological effects such as hyperventilation during odor evaluation.

Figure 15 illustrates a number of features already described. First, it can be noted that the four odor panelists differ greatly in sensitivity to odor. Panelist F reports little odor in any of the books, whereas A shows great sensitivity. Moreover, Panelist A shows the ability to characterize and discriminate odors—control books are found by A to have very little out-of-the-usual book odor. The use of the group average to compare results among processes is probably the best measure of how library staff and patrons would respond to treated books.

It can be concluded that all processes result in some discernible odor, but additional remarks are needed here to indicate their magnitude. Details are contained in the IPST report; only a brief outline is given here. Figure 15 shows odor rating for a random sample of 25 books from each process and control. Each book is given a rating by each panelist of 0 to 4. An individual score of 0 indicates no odor other than that of a normal, untreated book; a score of 2 indicates a readily discernable odor characteristic of a given process; a score of 4 denotes a very strong, very offensive smell characteristic of the process. Thus, for an individual scoring 25 books, a total score of 0 indicates no books have any non-book odor, while a score of 100 denotes the observation that each and every one of the 25 books tested by that panelist had a strongly offensive odor. The average rating score would have the same interpretation for an average panelist.

But what of ratings between 0 and 100? Here the results must be used with caution and some degree of uncertainly. For example, what does a score of 50 mean? It could mean that all 25 books had a score of 2, i.e., each and every book had a just perceptible process-characteristic odor. Or it could mean that half the books had no non-book odor at all and scored 0 each, while the remaining half had very strongly offensive odors. Or it could mean, of course, some other combination of scores which total 50. Examination of individual scoring sheets suggests that all treated books had some degree of odor characteristic of a given deacidification process.

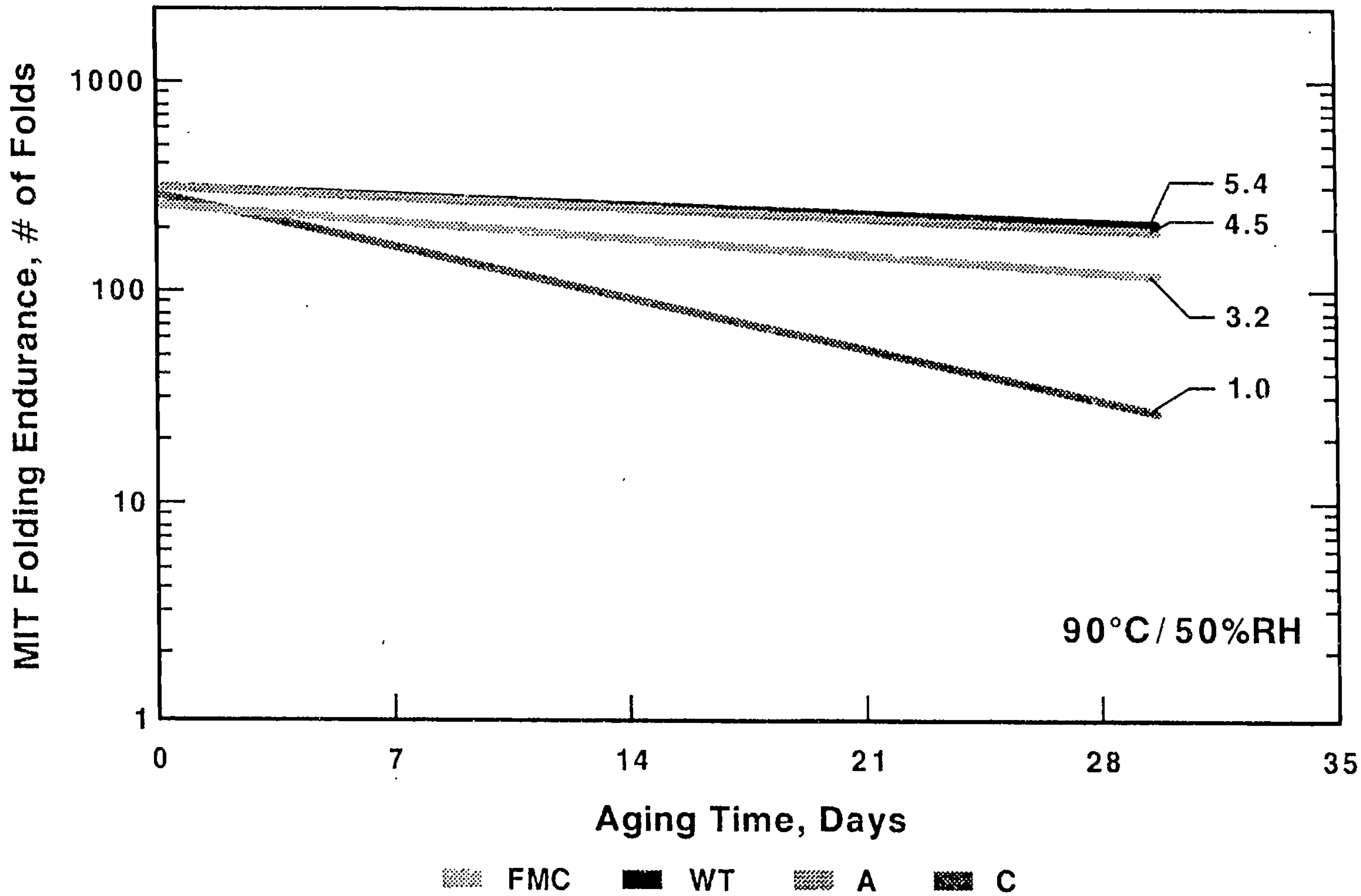
Conclusions

It requires considerable thought and effort to design a test protocol that can increase the degree to which deacidification processes approach a library's minimum requirements and goals. Many groups and individuals both from within and outside the library should be brought into the process. Adequate time and funds must be made available to carry out the test protocol and evaluate the results obtained.

[1]Since one mole of ZnO (the alkaline reserve material in the Skzo process weights 81.5 grams compared with 100 grams for $CaCo_3$, 1.5% $CaCo_3$ (stoichiometrically) equivalent to 81.5 divided by 100 times 1.50 equals 1.22 wt % ZnO.

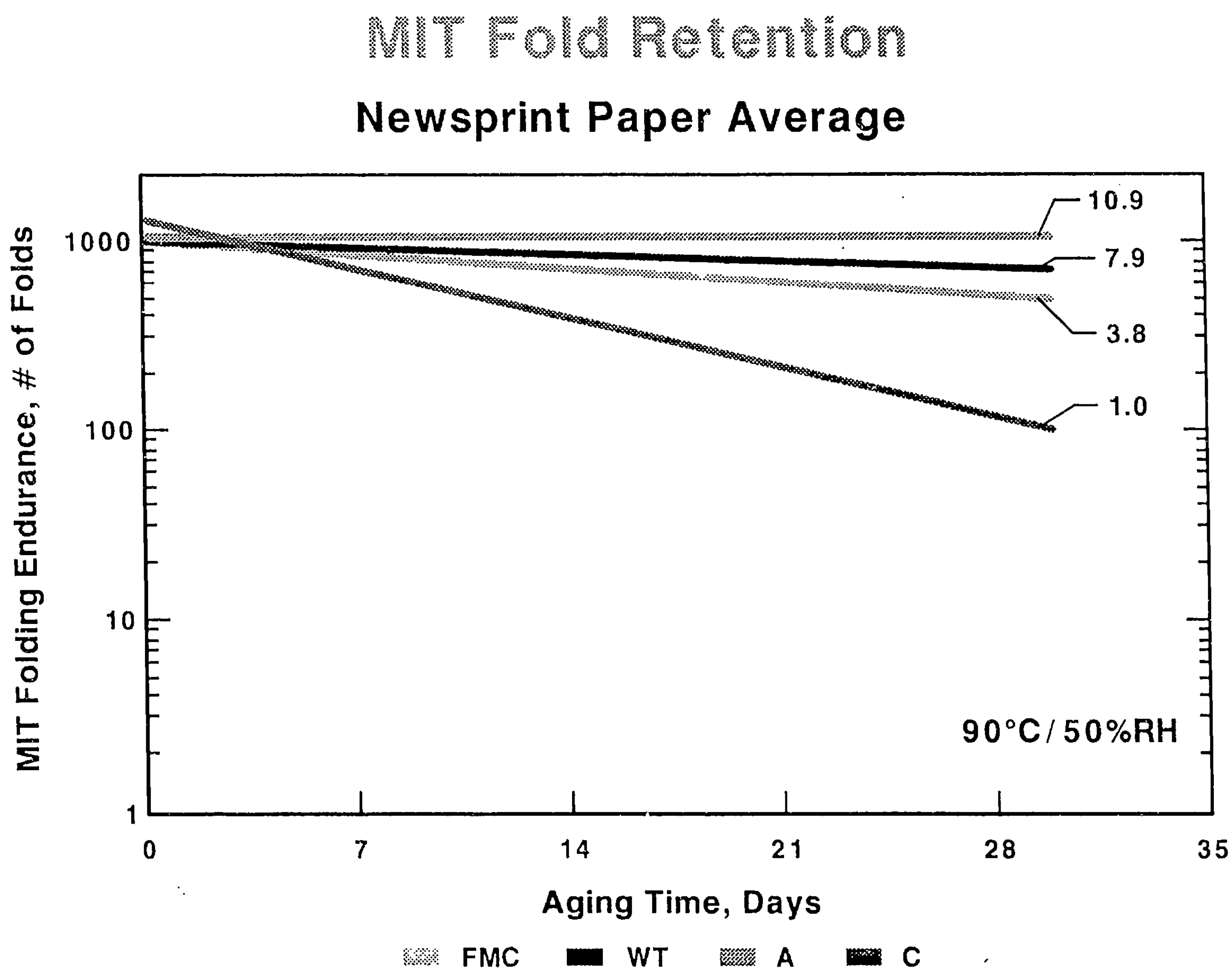
MIT Fold Retention

Clear Spring Offset Paper Average



IPST 1991

Figure 1

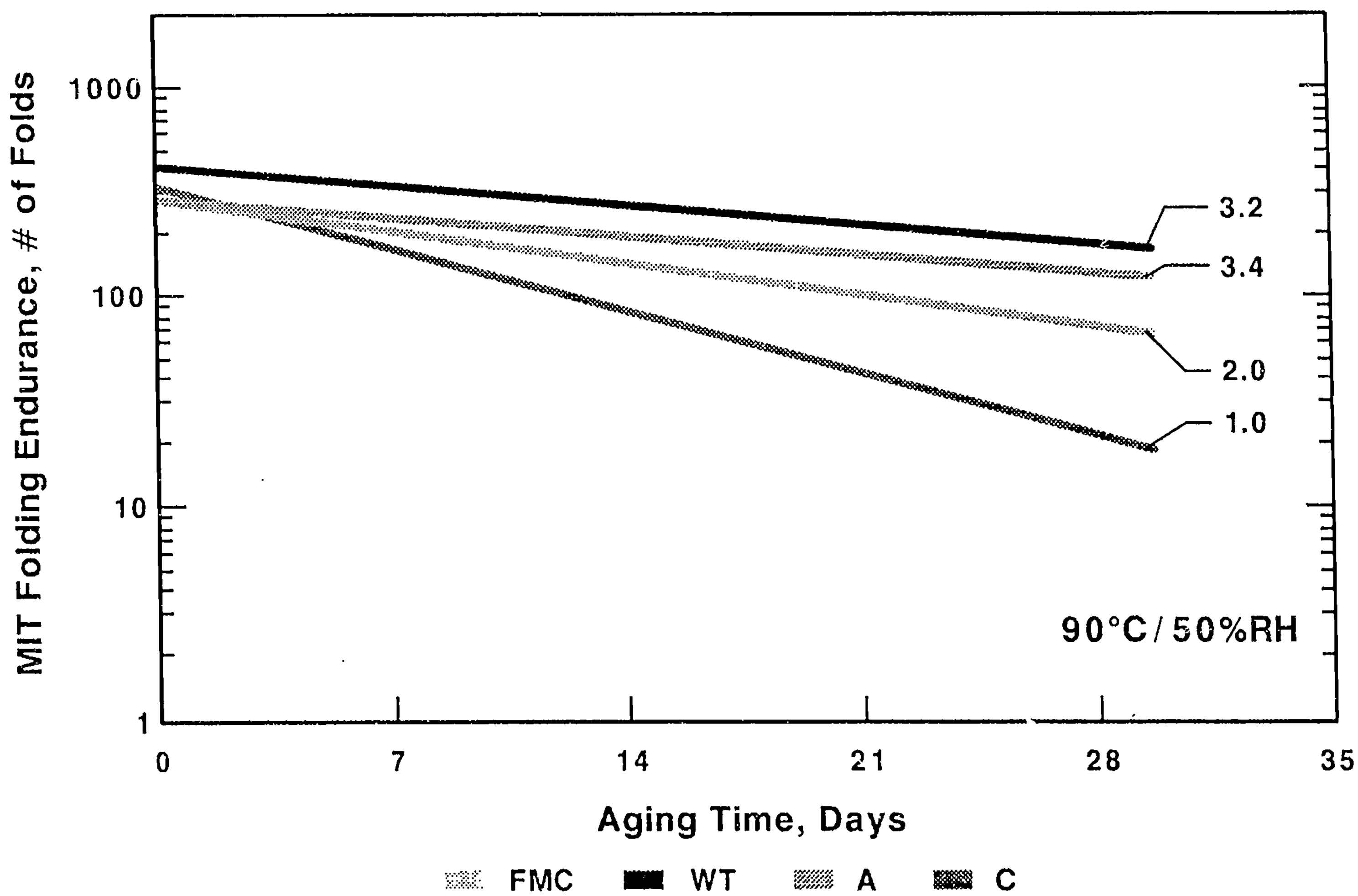


IPST 1991

Figure 2

MIT Fold Retention

Alum-Rosin Paper Average



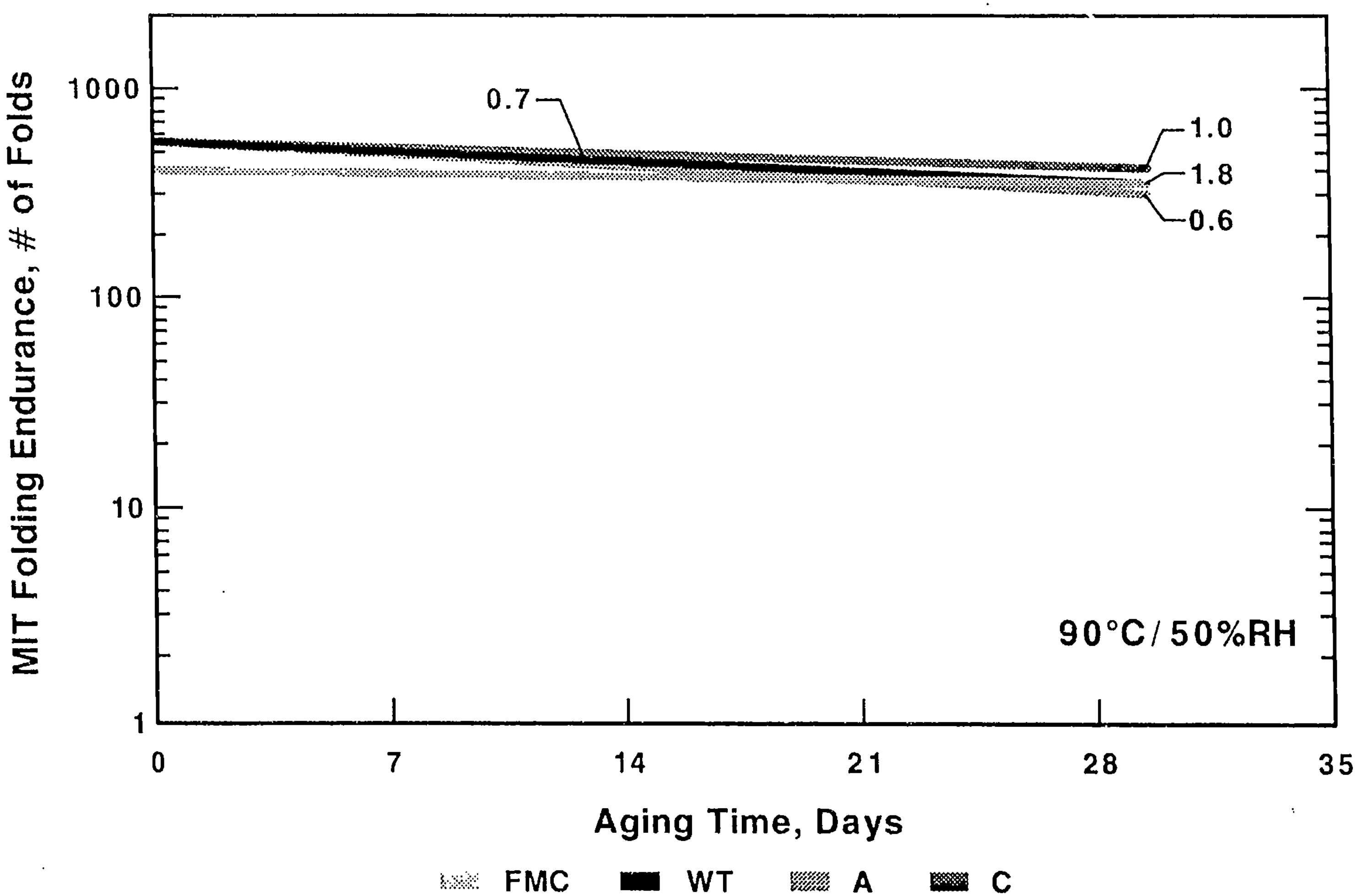
IPST 1991

83

Figure 3

MIT Fold Retention

Alkaline Paper Average



IPST 1991

84

Figure 4

85

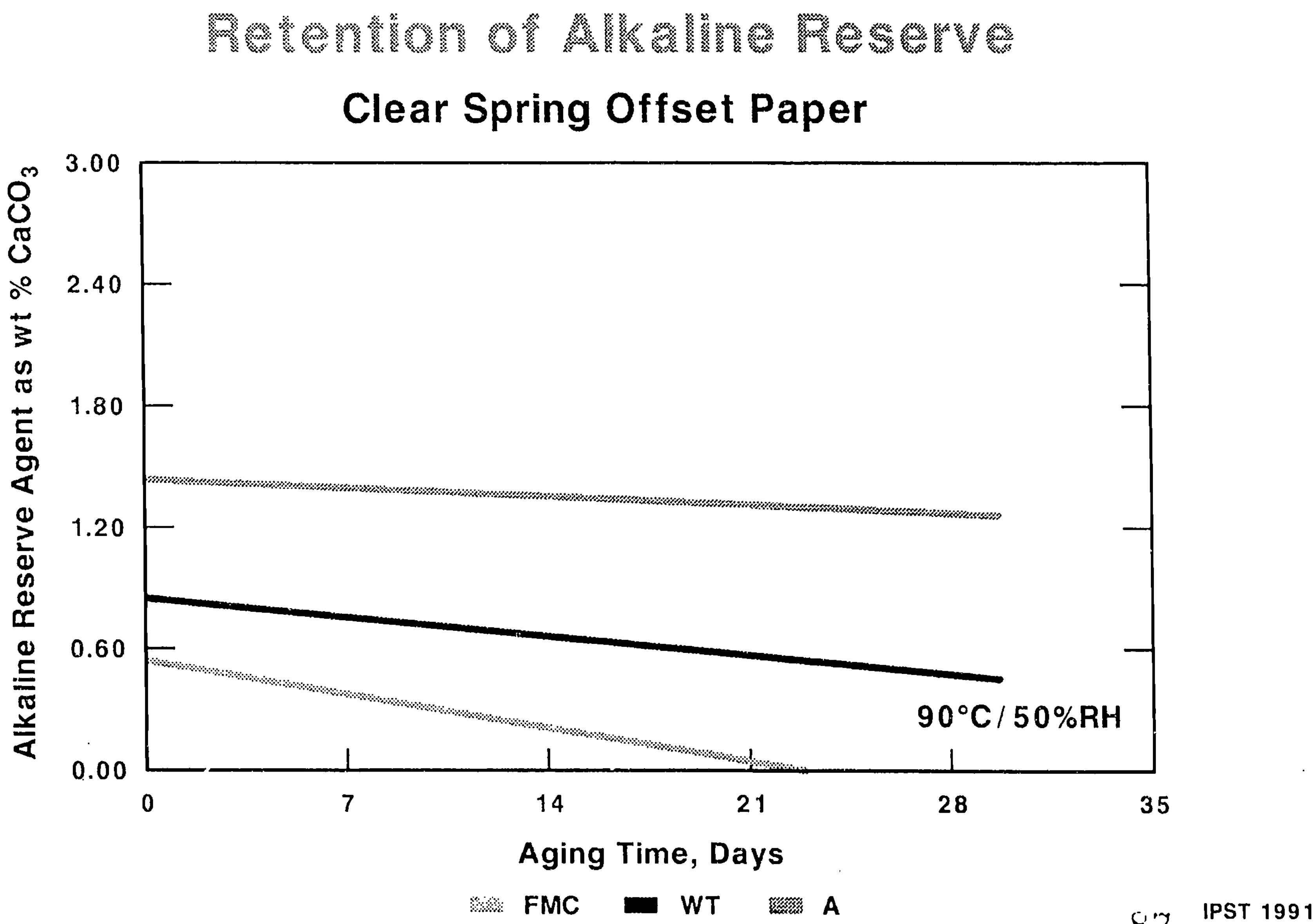
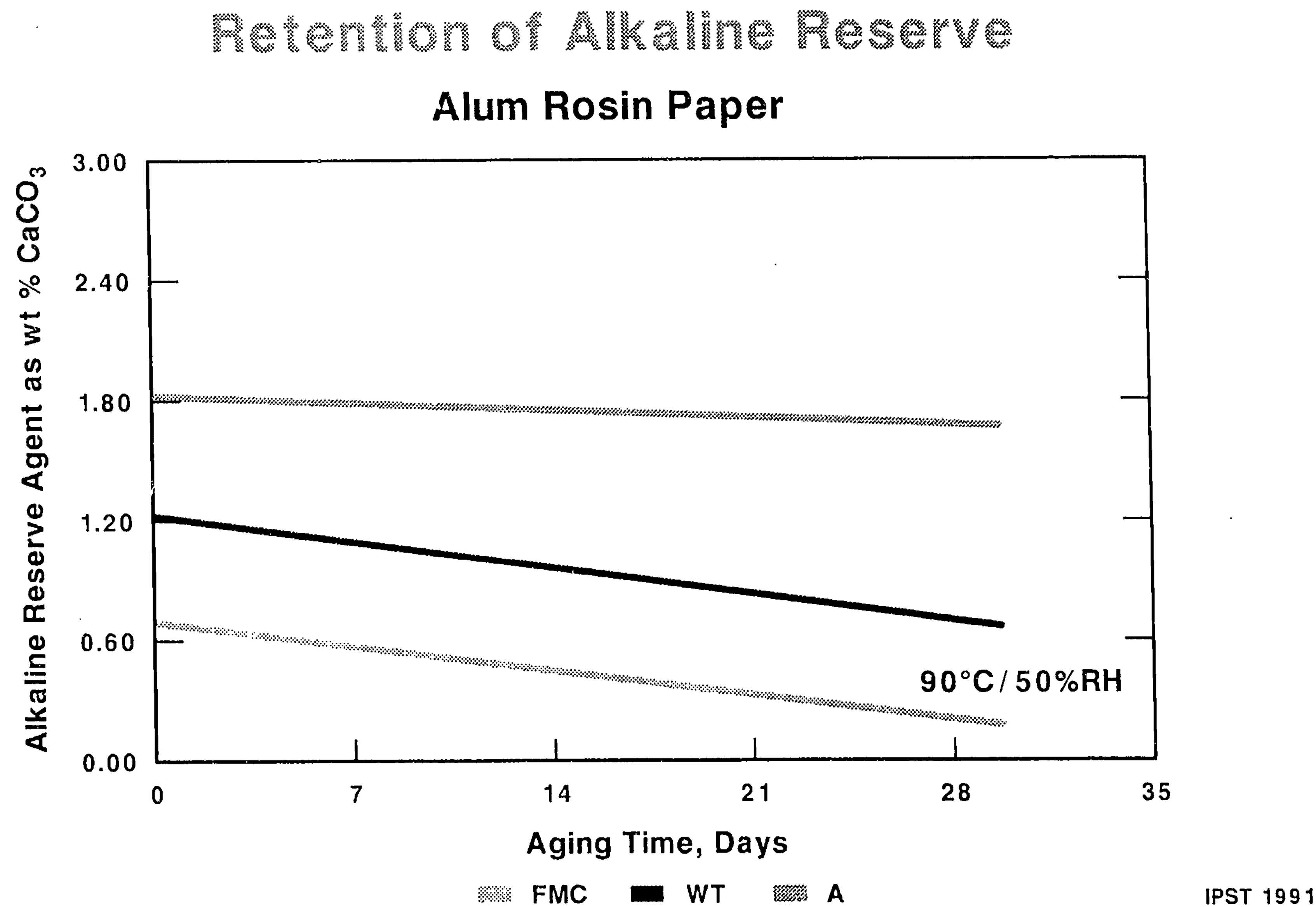

Retention of Alkaline Reserve
Clear Spring Offset Paper
Alkaline Reserve Agent as wt % CaCO3
3.00
2.40
1.80
1.20
0.60
0.00
0
7
14
21
28
35
90°C / 50%RH
Aging Time, Days
FMC
WT
A
IPST 1991

Figure 5



Retention of Alkaline Reserve
Alum Rosin Paper
Alkaline Reserve Agent as wt % CaCO3
3.00
2.40
1.80
1.20
0.60
0.00
0
7
14
21
28
35
90°C / 50%RH
Aging Time, Days
FMC
WT
A
IPST 1991

Figure 6

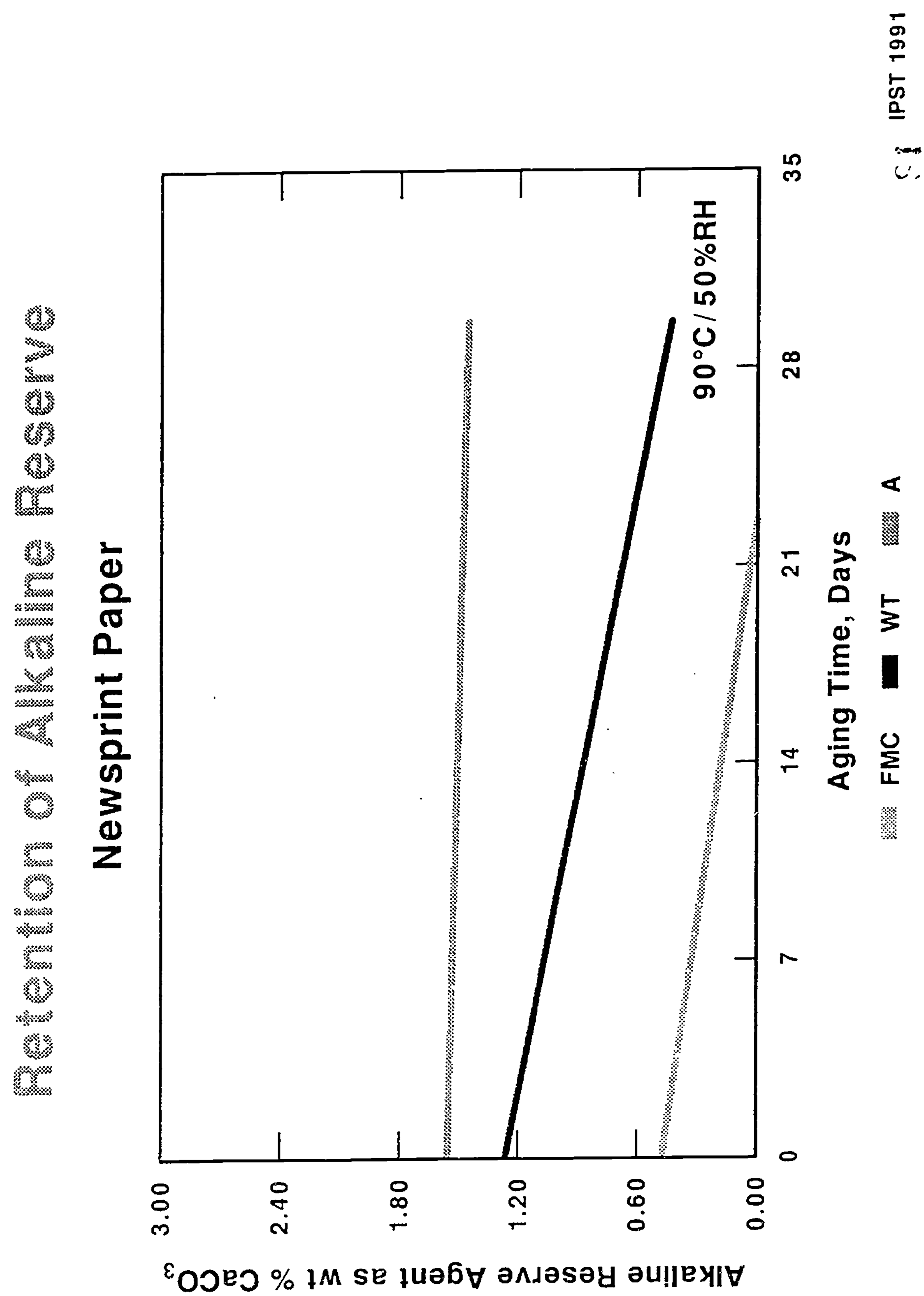

Retention of Alkaline Reserve
Newsprint Paper
90°C/50%RH
Alkaline Reserve Agent as wt % $CaCO_3$
3.00
2.40
1.80
1.20
0.60
0.00
0
7
14
21
28
35
Aging Time, Days
FMC
WT
A
IPST 1991

Figure 7

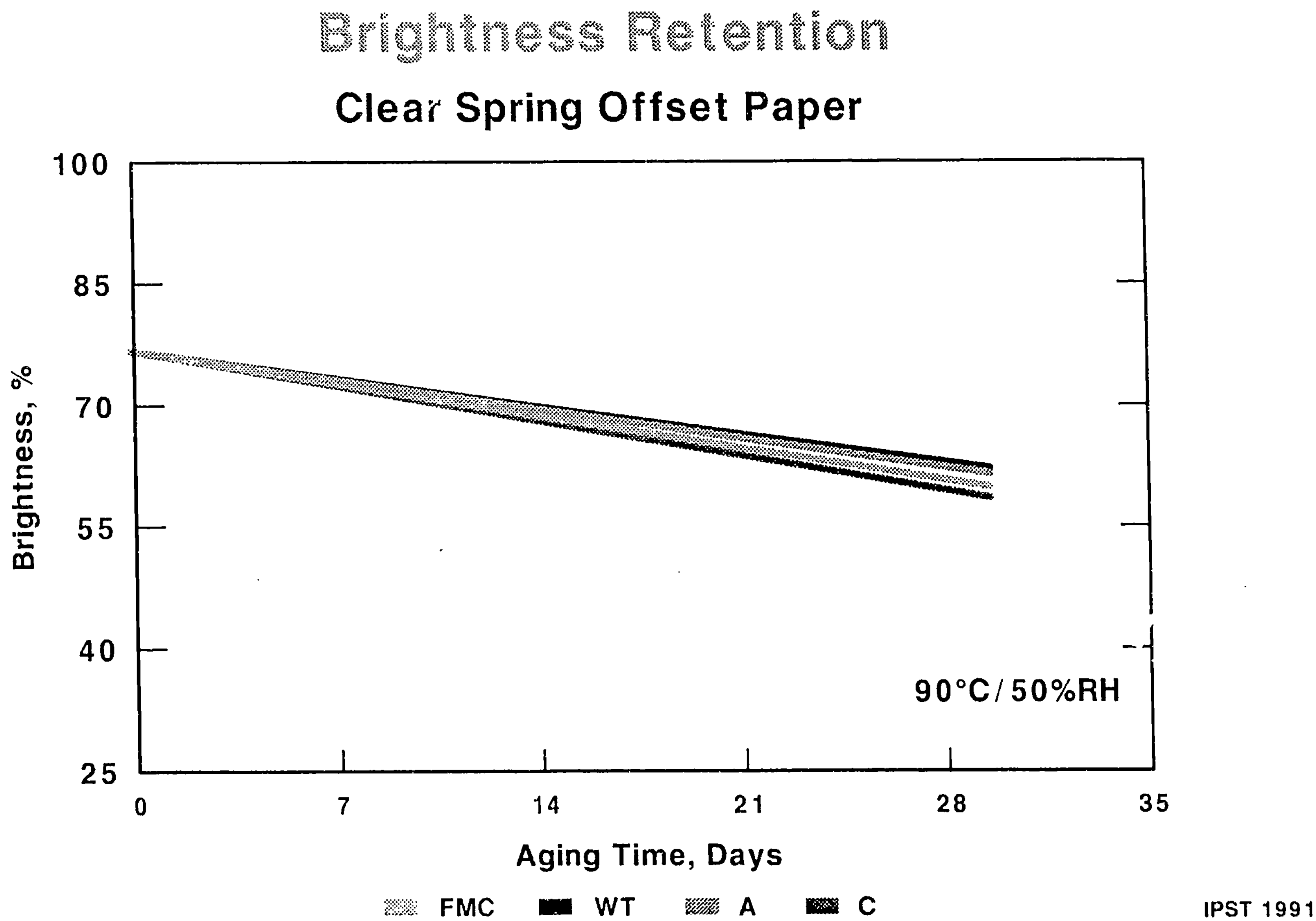

Brightness Retention
Clear Spring Offset Paper
Brightness, %
100
85
70
55
40
25
0
7
14
21
28
35
Aging Time, Days
90°C / 50%RH
FMC
WT
A
C
IPST 1991

Figure 8

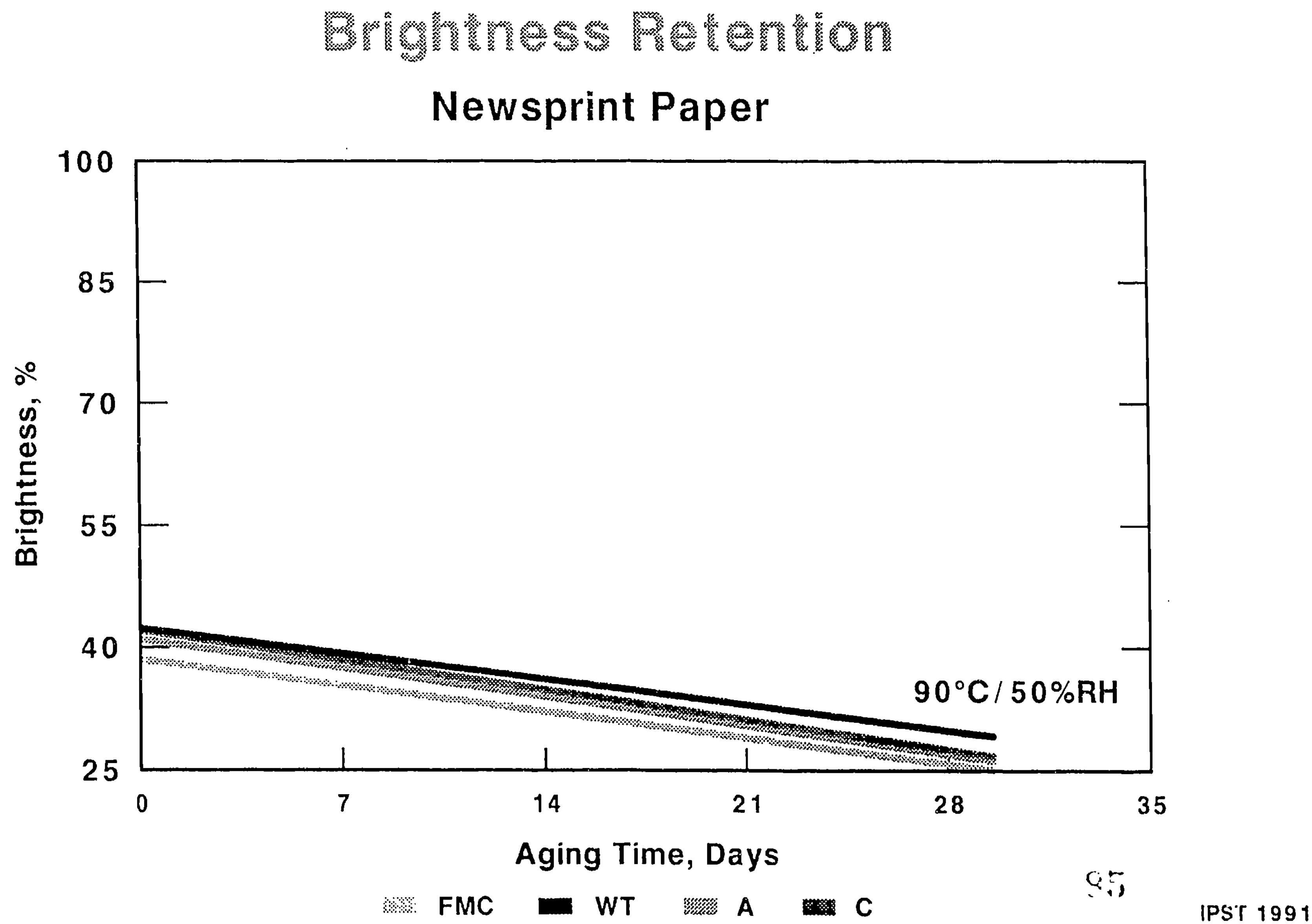
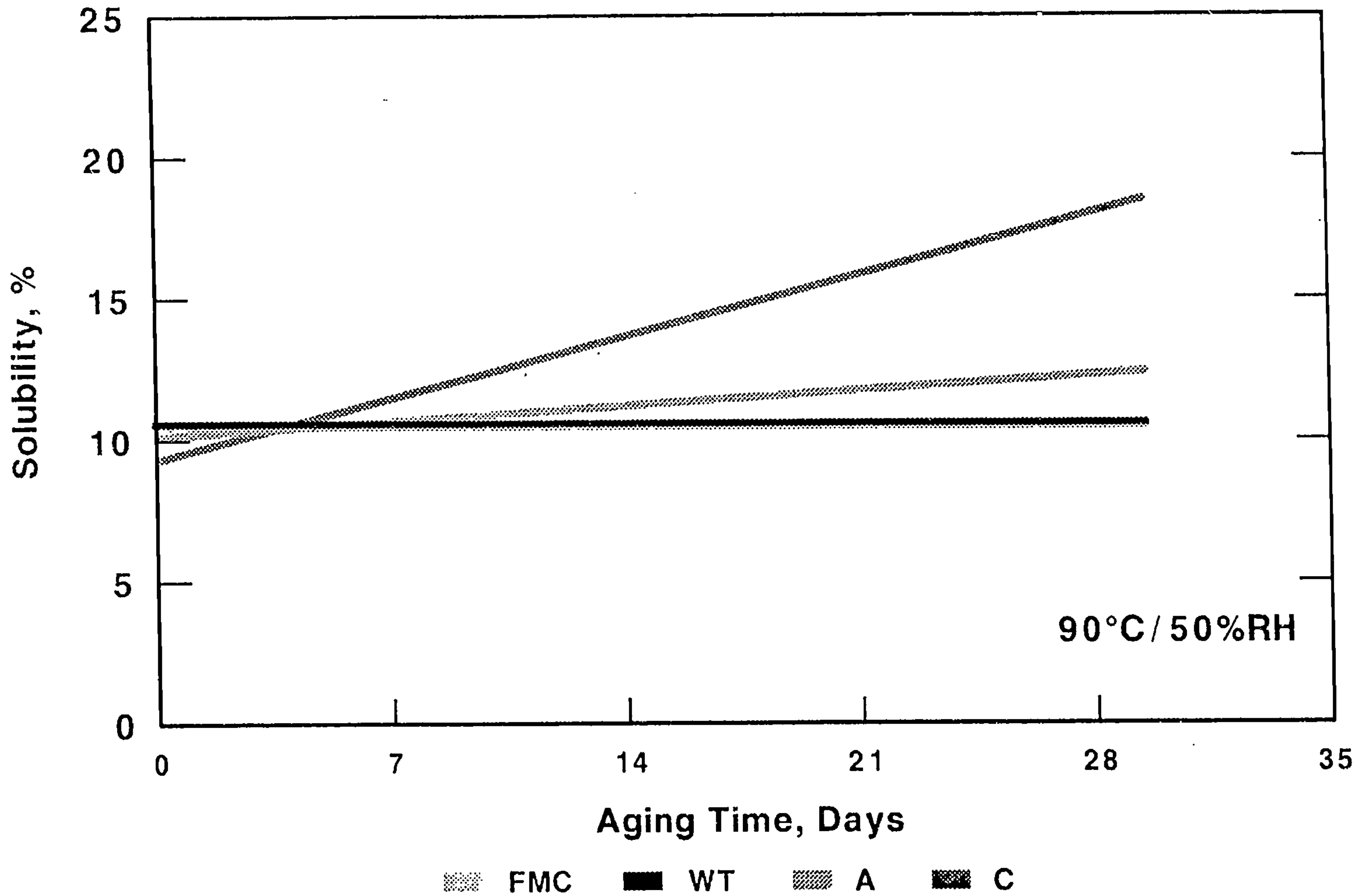

Brightness Retention
Newsprint Paper
Brightness, %
100
85
70
55
40
25
0
7
14
21
28
35
90°C / 50%RH
Aging Time, Days
FMC
WT
A
C
IPST 1991

Figure 9

Sodium Hydroxide Solubility

Newsprint Paper



IPST 1991

96

Figure 10

97

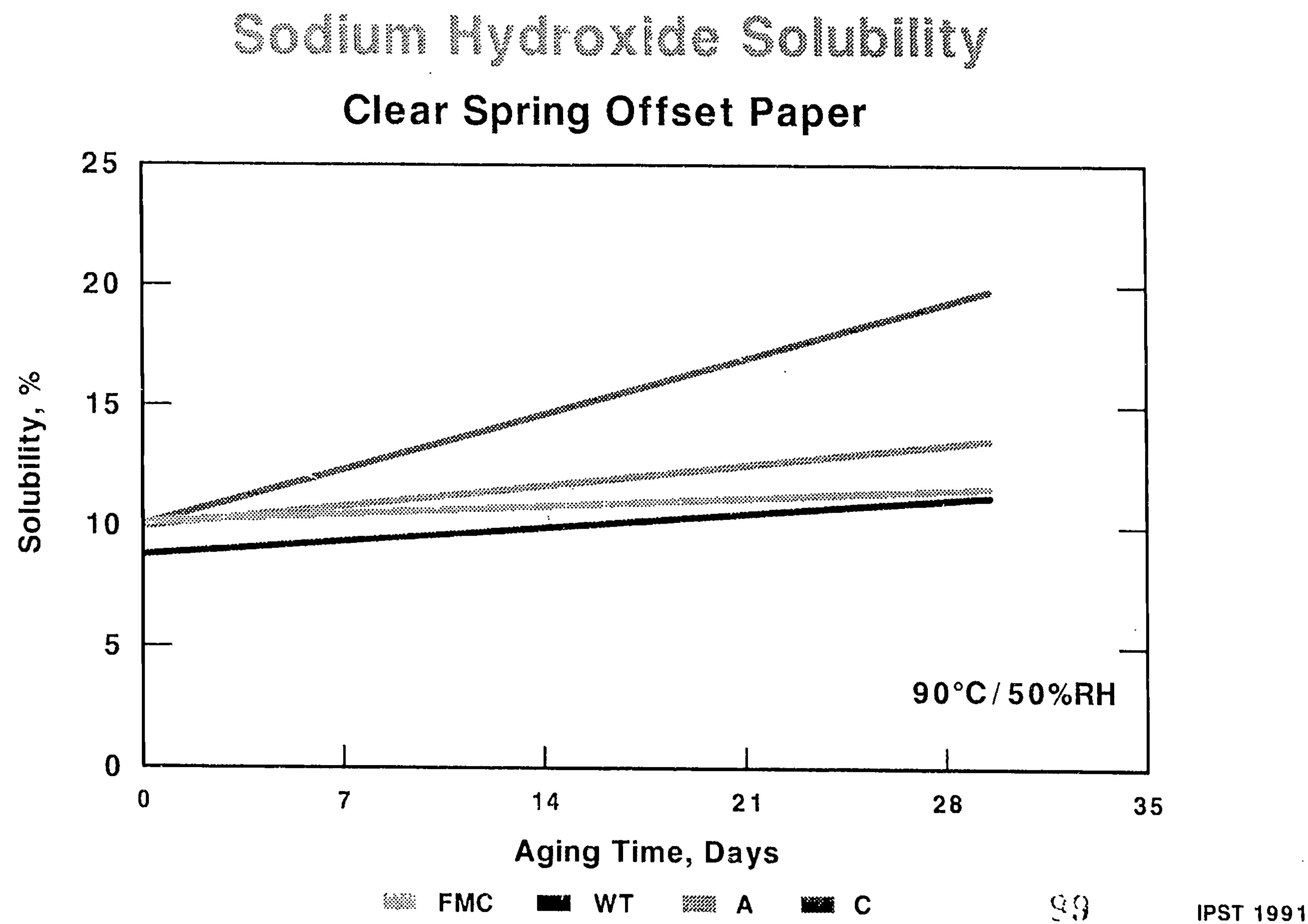
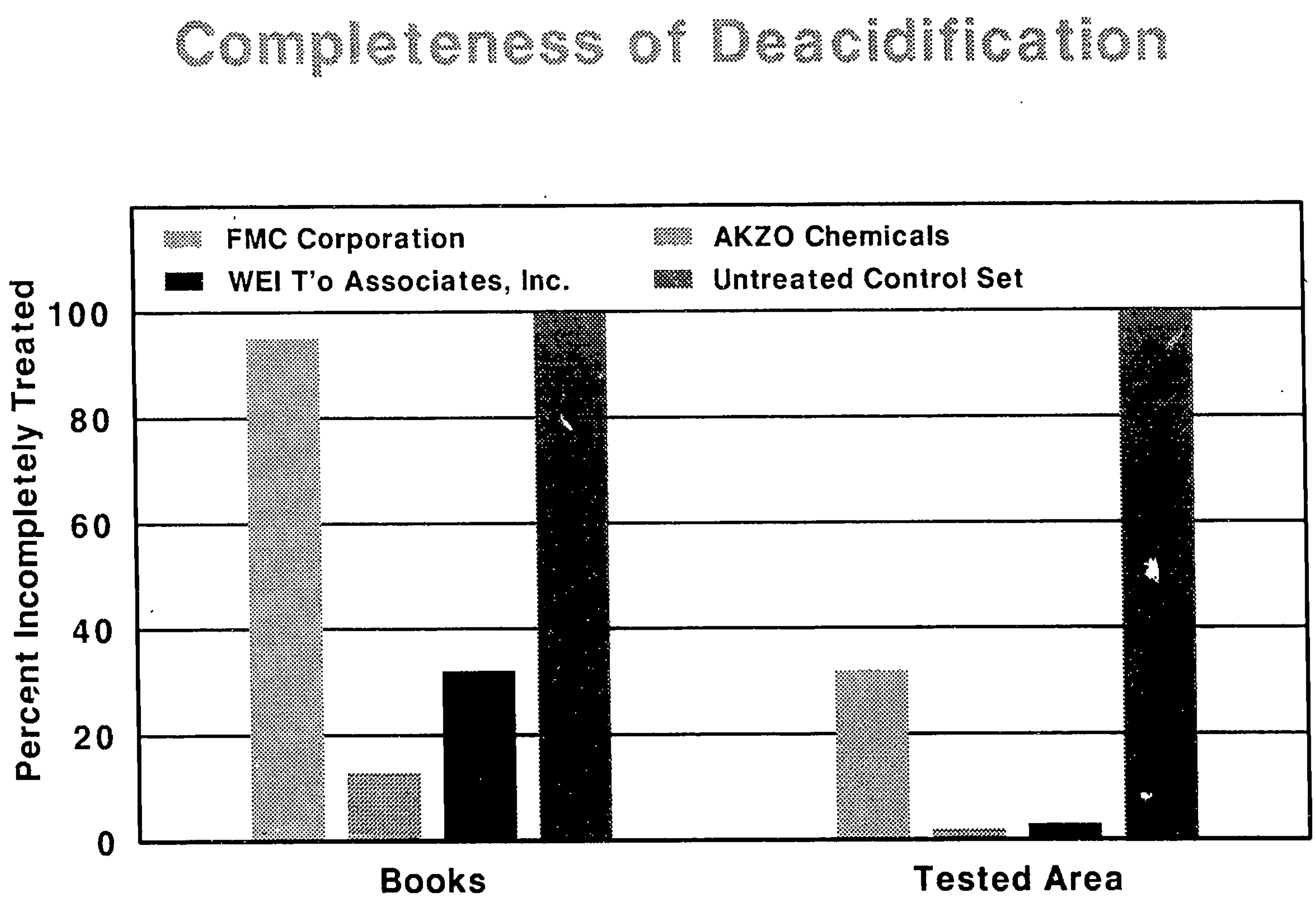

Sodium Hydroxide Solubility
Clear Spring Offset Paper
Solubility, %
25
20
15
10
5
0
0
7
14
21
28
35
Aging Time, Days
90°C / 50%RH
FMC
WT
A
C
IPST 1991

Figure 11



IPST 1991

100 Figure 12 101

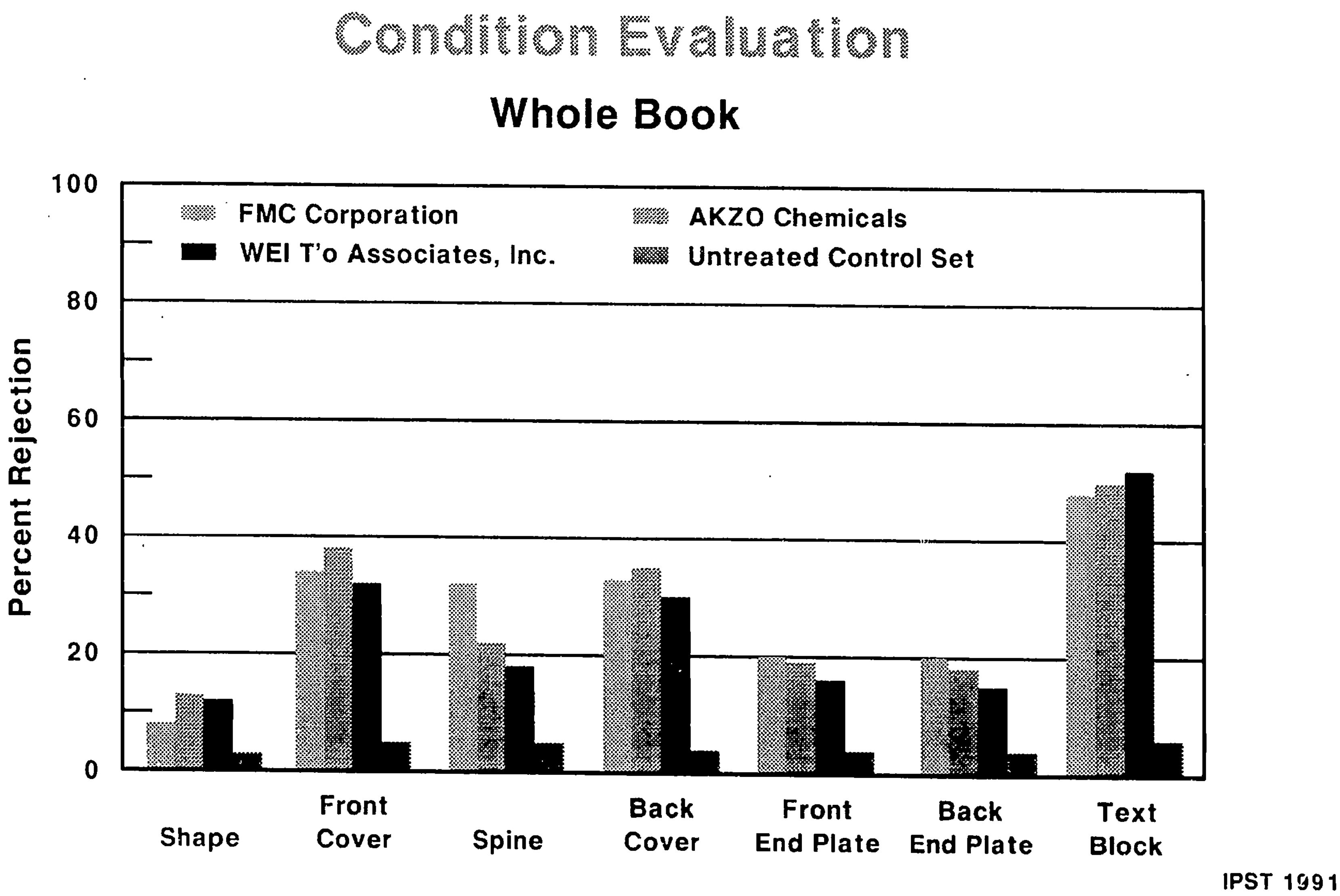
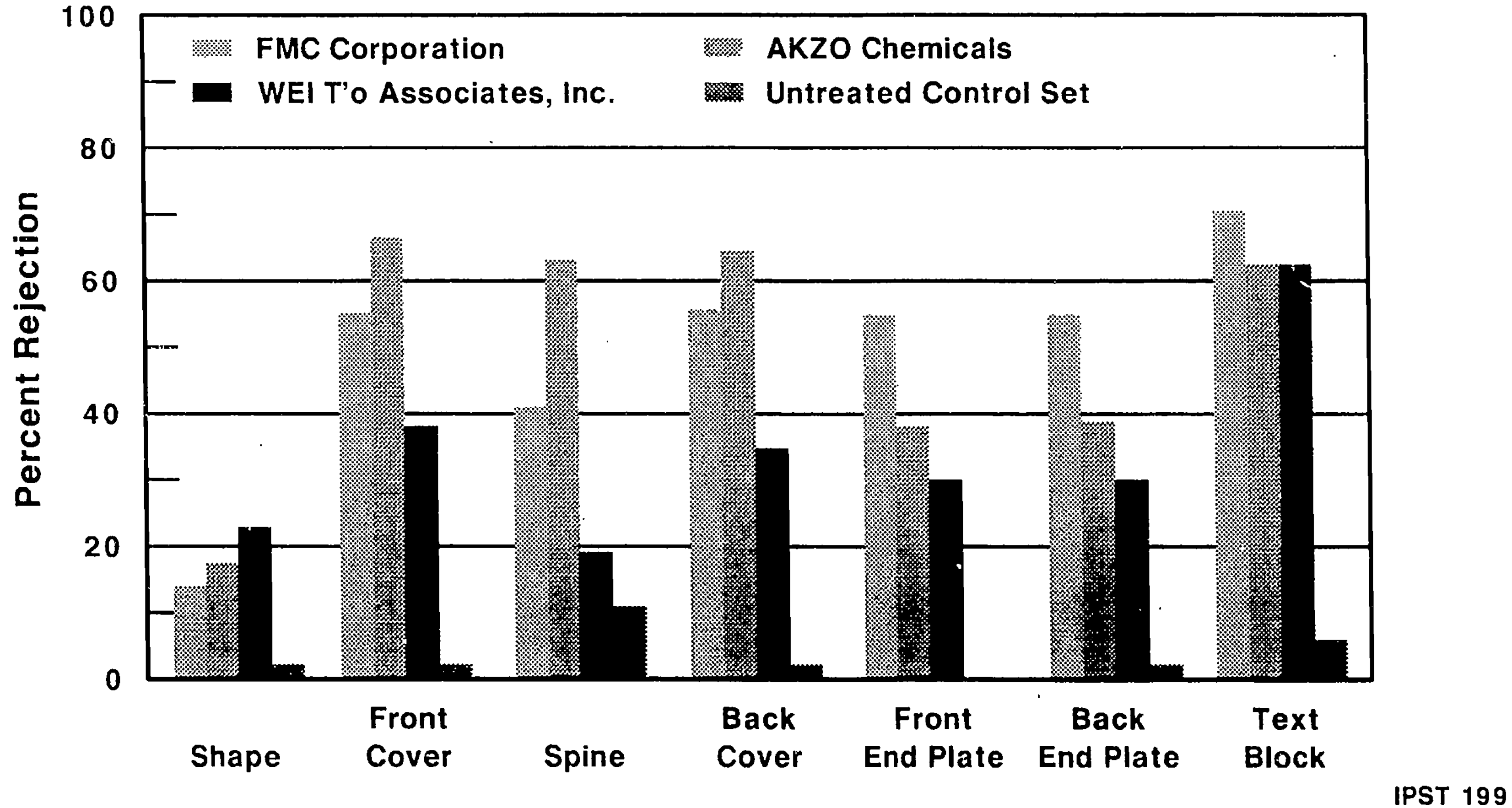

Condition Evaluation
Whole Book
Percent Rejection
100
80
60
40
20
0
FMC Corporation
AKZO Chemicals
WEI T'o Associates, Inc.
Untreated Control Set
Shape
Front Cover
Spine
Back Cover
Front End Plate
Back End Plate
Text Block
IPST 1991

Figure 13

Condition Evaluation

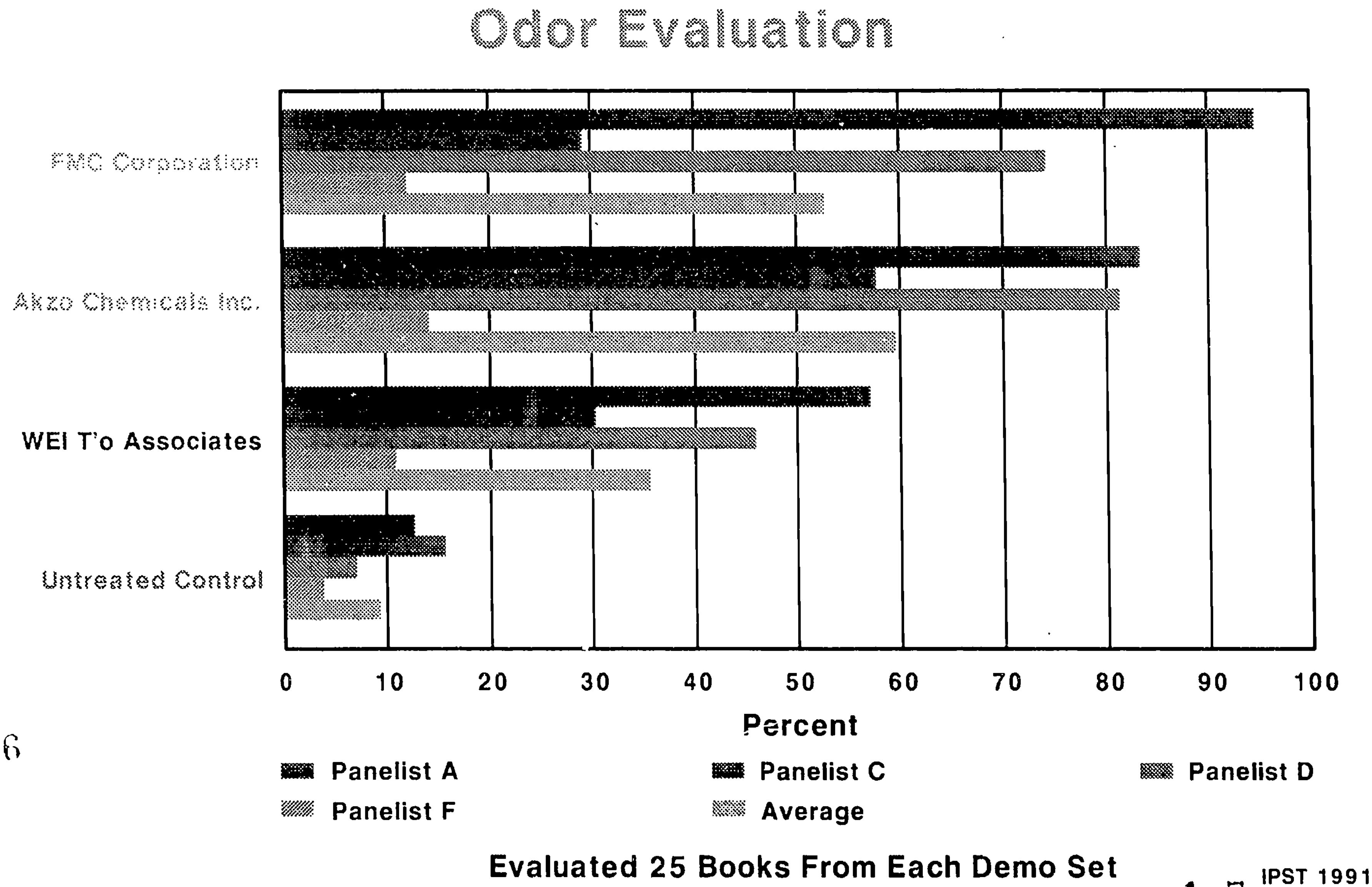
Half Book



104

Figure 14

105



1:6

1:7

Figure 15

Evaluation of Mass Deacidification Processes

Helen D. Burgess
Senior Conservation Scientist,
Canadian Conservation Institute

Periodically, the Conservation Research Services of the Canadian Conservation Institute (CCI) carries out a comprehensive examination of what research projects will most benefit the public collections of Canada. The review performed approximately five years ago identified research into alkalization as being of top priority for paper conservators across the country. In the following year, CCI began its research program in this area. Scientists in the Conservation Processes Research Division of CCI have investigated a number of questions, involving a range of chemicals at concentrations appropriate for both washing and deacidification of paper. The focus of much of this work has been on what types of papers are most stabilized by alkalization and what degree of alkalization is required. A large part of this investigation has been carried out with the financial assistance of the Canadian Council of Archives.

All of these studies have involved neutralization and alkalization systems based on water as solvent. These procedures are effective but require tremendous resources for the treatment of relatively few objects. In order to be effective in library collections, treatment programs must be developed that can be carried out on a mass scale. Over the past 15 years, a number of technologies directed at solving this problem have been developed.

In general, institutions across North America have found it difficult to make decisions concerning which processes can be applied to their collections. The need to preserve millions of books at the cost of tens of millions of dollars make it critical that the correct decisions be made. Feasibility studies such as the one carried out by the Metro Toronto group have concluded that there is insufficient technical information available at this time to allow institutions to make these decisions.

What is required is hard experimental data on how the various processes compare in terms of their effectiveness; what degree and type of screening must be performed for the different technologies; and what materials are best treated by what methods. In 1990, I received a request from Jan Michaels, Preservation Coordinator at the National Library of Canada, to submit a research proposal to the National Library on the topic of the scientific evaluation of commercial mass deacidification methods. This was done in August, 1990, with the understanding that CCI would be interested in undertaking an evaluation on behalf of the National Library. At this point, the National Librarian, Marianne Scott, also set aside funding for the research project.

A short time later, interest was shown in the CCI proposal by a consortium of library and archive institutions in the Toronto area. This group, the Metro Toronto Chairman's Committee for Preserving Documentary Heritage, is headed by Carole Moore, Chief Librarian at the University of Toronto. As the needs and goals of the National Library and the Toronto group are very similar, it was possible for the two groups to come quickly to an agreement to become partners in a single research effort that would be carried out at CCI under my supervision. The obvious advantages included avoiding a costly and needless duplication of work and effort. Another important advantage of this cooperative approach is that it significantly broadens the financial base for the project. Therefore, it was possible to expand the experimental plan to cover a broader range of problems than had been addressed in the original proposal. The revised research proposal was completed in November, 1990. The Toronto group took responsibility for soliciting funding from institutions in both Canada and the United States. This operation was very successful, and the target for the funding was reached by the summer of 1991. The number of separate institutions involved in the venture now exceeds twenty.

The Toronto group also has taken responsibility for fiscal management of the project. As mentioned earlier, technical decisions will be made by the Canadian Conservation Institute. Both the Toronto group and the National Library are involved in technical matters through the technical subcommittee of the Metro Toronto Chairman's Committee. Johanna Wellheiser from the Toronto Reference Library is chairperson of this committee. Periodically, CCI will provide reports of the progress of the project to the technical subcommittee. The work began in January, 1991 with the hiring of one contract scientist, Elzbieta Kaminska. A second chemist is slated to begin work at CCI at the end of October, 1991. At this point, the research schedule calls for the first set of experiments to be finished in early 1992. The next section of this lecture will be a discussion of the testing protocol selected by CCI.

The testing program involves the assessment of the three most promising mass deacidification processes. They include the Wei T'o, Diethyl zinc, and that FMC Lithco technologies. The Wei T'o treatments will be carried out at the National Archives of Canada, diethyl zinc at the Akzo plant in Texas, and the Lithco process at the FMC facility in North Carolina. The processes being developed in France and Germany were not included because their chemistry is similar to Wei T'o. Also, the European plants are being developed for specific institutions and probably will not be commercially available. Book Preservation Associates and the Koppers Book-keeper also will not be included. At this point there appears to be significant doubt that their processes are capable, in the near future, of providing the type of large-scale, effective treatments required for mass deacidification.

The Wei T'o and FMC processes are solvent-based and involve the deposition of an alkaline buffer reserve. The solvents used and the chemicals deposited are quite different, and there are strong technical reasons to predict that they will not act in an identical manner on book materials. The diethyl zinc method is gas phase and results in the deposition of a near neutral pH buffer reserve. The FMC process is the only one claiming to strengthen paper directly. All three processes, however, claim that paper stabilized through the application of their technologies will result in paper which in years to come, will be stronger than similar paper that has not been deacidified.

The project to evaluate and compare these three processes covers four areas of investigation. The first and most important part will be an evaluation of the effect of the various deacidification processes on the paper that forms the book block. Attempts have been made to cover as wide a range of materials as is possible within the limitation of time and resources that the project must operate. The paper to be examined falls into three groups: naturally aged paper, paper aged through artificial means, and new paper. The three groups are important for different reasons. Much of the chemical data available on deacidification has been collected through the testing of new papers. This means that relatively little is known about how already degraded paper will react under treatment conditions. As naturally aged and degraded paper forms a very significant portion of most North American collections, it is an important area to investigate.

Naturally aged paper, however, often is not very homogeneous. This creates problems with interpretation of data. Therefore, the decision was made to produce a second group of damaged papers by taking homogeneous new paper and subjecting it to artificial aging. The aging is being carried in a humid oven under the conditions of 80° C and 50% relative humidity. The presence of moisture during aging is critical for paper. The most important mechanism for the degradation of paper is through acid-catalyzed hydrolysis, which is strongly dependent on the amount of water available in the paper substrate.

A third group of papers comprises the new papers chosen for group two. They will act as a type of control for group two as well as provide valuable information about how new papers are affected by mass deacidification. The investigation of the new papers is important for two reasons:

1. Many institutions place priority on the treatment of new paper, as it has more to gain from deacidification than already degraded paper.
2. As yet, there are no published chemical data that allow a direct comparison of the three mass deacidification methods. Information is available on individual processes but there have not been any published studies in which the same paper was used for testing of all three of the processes. The best data from a purely statistical point of view will come from the experiments carried out on new papers.

Both of these points form a persuasive argument for including new papers in the CCI experiments.

Each group of papers includes three types of paper: 100% rag, lignin-free processed wood pulp, and ligneous wood pulp. These papers span the full range of the fiber types common in North American collections. It was considered important to include all these types of paper, because it is likely that mass deacidification will affect each one in a different manner. It is also likely that the type and amount of size and fillers could have an important impact. Time and resources are limited, however, and there are no immediate plans to carry out a comprehensive study in which the type and amount of size and/or filler are principal experimental variables. Instead, CCI chose unfilled papers which were sized with a material that is representative of the type used most often with that particular paper. For example, the rag paper is sized with gelatin, the processed wood pulp is sized with alum/rosin, and the ligneous pulp is unsized. In the past, ligneous wood pulp paper was sized with alum/rosin, but just as frequently was left unsized. Today this type of paper is almost never sized by the manufacturer.

However, even though the mass deacidification study does not include a full examination of the effect of type of size on process effectiveness, this problem is being examined in another part of CCI's research program. The issue is being addressed in CCI's current investigation of aqueous deacidification methods. This study is financially supported by the Conservation Committee of the Canadian Council of Archives. It is anticipated that information gained from the project can be used in the formulation of recommendations for the non-aqueous mass methods. A last point concerning the papers being tested in both the aqueous and the non-aqueous deacidification studies is that they are all uncoated. Research using coated papers involves a large number of experimental parameters and would considerably lengthen the time and effort required to come to any conclusions.

Samples of all of the papers in the various groups will be analyzed before deacidification, after deacidification, and after accelerated thermal aging. Four types of samples will be involved: unaged and aged undeacidified material and unaged and aged deacidified material. The conditions for the artificial aging have been chosen. They are 80° C and 50% relative humidity, the same as that used to pre-age the groups of new papers. The time of aging will vary depending upon the fibre content of the paper and its degree of degradation.

The chemical and physical changes of the samples are being monitored by a number of analytical procedures, including the following techniques.

The first two may be considered to be in the category of quality control.

Cold extracted pH. This will be done according to a standard procedure developed by the Technical Association of the Pulp and Paper Industry. These methods are commonly referred to as TAPPI Standards.

Alkaline reserve. A titrimetric method that involved analysis of the amount of buffering present in the paper. CCI uses a modification of the TAPPI standard in which a back-titration method is used and the end-point is determined with a pH meter and combination electrode. The procedure is more time-consuming, but the results are more accurate than that obtained with the unmodified TAPPI method. The ASTM is even less accurate than the unmodified TAPPI Standard, as it relies on the use of a color indicator that changes before full neutralization of the buffer reserve has taken place.

Two physical testing methods are being used.

Color change measurements. Brightness data will give data about darkening of brightening or paper; L*a*b will describe the type and amount of color shifts which occur; delta E values will give a good over-all estimation of change.

Zero span tensile strength measurements. In a limited number of cases, Instron tensile testing will also be carried out. The tensile method is being used in preference to fold endurance for a number of reasons:

1. zero span is less dependent on small environmental changes and so less data scatter is observed.
2. zero span allows one to analyze papers that are weaker than those which can be tested with fold endurance.
3. zero span is a measure of the intrinsic strength of fibers and hence is better related to degree of chemical degradation; in the strictest sense of the definition, fold endurance is not a strength test, but instead is a measure of other physical properties such as brittleness.
4. zero span requires less sample material than most other physical testing methods.

A number of chemical methods of analysis are being used.

Degree of polymerization is the most important. This analysis measures the average length of the cellulose molecules which are the principal component of paper. Consequently, monitoring changes in degree of polymerization gives an extremely accurate idea of the amount of chemical degradation that a particular paper undergoes during accelerated aging. The method chosen by CCI involves the use of the solvent cadoxen and is based on viscosity. As the paper fibers degrade, they tend to result in a less thick solution when dissolved. The degree of thickness or viscosity of sample solutions is determined and can be accurately converted to a number representative of the average length of the molecules that make up the paper sample.

Carbonyl analysis quantifies the amount of a particular chemical grouping present in the paper sample. These groups, called carbonyls, are formed when oxidation or chain breakage occurs. Therefore, this procedure will be carried out for those samples in which it will be useful to have a measure of the amount of oxidative damage that has occurred. CCI uses a method involving the derivatization of the paper fibers with a phenyl hydrazine compound. It gives more accurate data than other commonly used methods for estimating degree of oxidation.

Estimation of the magnesium or zinc content of the paper is the last chemical analysis. Together with the alkaline reserve, this will give an excellent description of the amount of buffer reserve plus how much acid has already been neutralized in the paper. This will be done using atomic absorption techniques.

The results for the first phase of the project will give data that will allow for an excellent differentiation of the three processes, based on their effect on the chemical stability of paper. The papers chosen, however, will be either new or of an average degree of degradation for their particular age and fibre content. Many of the papers in library or archive collections are especially degraded for one reason or another. Therefore, a second phase was developed in which CCI will investigate what effect mass deacidification will have on papers that are degraded in some pre-determined manner. Four papers will be included in the study. Two of them will be naturally aged rag paper, one of high to medium degree of polymerization, and one of medium to low degree of polymerization. The third and fourth papers studied will be ligneous, one naturally aged and one new.

The four papers will be degraded by two different processes. The first will be extensive exposure to sulphur dioxide and nitrogen dioxide polluted air. The concentrations of the air pollutants will be only slightly above what can occur in a heavily polluted urban area. At this time, it is planned to model the exposure after a similar set of experiments which was sponsored by the Getty Conservation Institute in Los Angeles.

The second degradative treatment will be immersion of the papers in an aqueous oxidative bleaching bath. Alkaline hypochlorite will probably be used as it has been employed, historically, in both the manufacture of paper, as well as in restoration treatments. The accelerated aging and analytical evaluation will be similar to that used for Phase 1.

It is recognized that people in charge of preservation of book collections will need to know more than just how mass deacidification affects the book block. Therefore, a third phase of the project was designed in order to evaluate media and other materials found associated with books. The variation of substrates is tremendous, however, and it will be impossible to carry out a full scientific study of such a wide range of materials. Therefore, analysis will rely mainly on a careful visual evaluation of the materials before and after mass deacidification. This will be followed by identification of problematic material. Samples of these materials will be processed again but with some simple treatment. This phase will also include a few special types of paper such as the coated stocks referred to earlier, which could not be included in the first two phases. The bulk of this work is being carried out by a conservator, Sherry Guild, who has been seconded from the Paper Lab at CCI for the duration of this phase of the project.

The materials to be tested will be taken from a list compiled through suggestions from the participating institutions. This information comes from a questionnaire distributed in June to over a hundred institutions across North America, Europe, and Australia. In the questionnaire, institutions were asked to identify the contents of their collections, as well as give information concerning their preservation needs. In addition to identifying which materials CCI should test, this questionnaire also indicates which institutions are able to donate material for testing. CCI does not have its own collection, and so this cooperation on the part of other institutions is vital to the success of the project. The conservator will also be compiling a list of materials derived from discussions with commercial printers and binders.

An important part of this third phase of the project involves the evaluation of the effect of mass deacidification on protein materials. Protein breaks down easily under alkaline conditions, and so there is much concern over the deposition of an alkaline reserve into book components containing proteins. Leather or parchment bindings, glue adhesives, protein sizes, and the gelatin or albumen layer associated with photographs are the most common sources of protein materials in books. For this part of the study, CCI will evaluate changes in pH, color, polymer length, and the physical strength before and after accelerated aging.

We estimate that the four phases of the project will require around forty person-months of laboratory work. In addition, there has been an initial period of six months covering the selection of the papers to be tested in Phase 1. This has been an extremely important part of the study. The correct papers must be chosen if the data collected is to be interpreted and applied in a meaningful way to actual collections.

The selection process involved the characterization of over fifty different papers. They were careful examined for degree of degradation, fibre content, presence of lignin, starch, rosin, aluminum, and clay filler. Degradation was determined by degree of polymerization; other attempts were made to see if color measurements could also be used as a rough screening measure for degree of degradation. Individual volumes and sets of volumes were studied for homogeneity. In the end, seven papers were chosen.

1. an unbleached linen paper, 18th century;
2. a bleached and very strong linen paper, early 19th century;
3. lignin-free wood pulp paper, early 20th century;

4. ligneous wood pulp paper, mid 20th century;
5. new gelatin-sized cotton paper;
6. new alum-rosin sized lignin-free wood pulp paper used for printing purposes; and
7. new ligneous wood-pulp, unsized.

The books have been made up and bound in a standard buckram library binding. The naturally aged material has been sent to the three mass deacidification facilities and subsequently has been returned to CCI. The books have been cut into two, one half to be analyzed without aging, the other half to be analyzed after artificial aging. These first samples are now in the aging ovens and analysis of the unaged material is beginning. The first data from the deacidification of naturally aged material should be obtained in late 1991 and early 1992.

In conclusion, I would like to note that this project has been planned with the intention that it provide the information needed to formulate realistic recommendations for the mass deacidification of large collections. The purpose of the investigation is to give information that will be helpful in deciding what parts of a collection can be deacidified as well as what process will be most suitable for what material. CCI considers it likely that recommendations will involve the suggestion that different processes be applied to different types of material. Furthermore, it is unlikely that it will be possible to institute any mass deacidification process without at least some degree of selection and screening. The extent and type of the required selection process will become more clear when the investigation is complete.

Experiences with Trial Treatments

Carolyn Clark Morrow
Malloy-Rabinowitz Preservation Librarian in the Harvard University Library and the Harvard College Library

The evaluation of mass deacidification technology at Harvard University is part of an overall assessment of mass deacidification that has three components: technology, selection of materials for treatment, and financial planning.

A technology subgroup was formed out of the larger deacidification task group to examine the multitude of issues surrounding mass deacidification technology. We were particularly interested in taking advantage of the research and evaluation that had been done to-date, and coordinating our own evaluation effort with others that were underway or planned. Finally, we intended to give mass deacidification a Harvard libraries perspective, give it some credibility on the Harvard campus, and disseminate information about this new technology and how we might use it to a wide audience of Harvard librarians.

The subgroup on technology included the preservation librarian from the Law School Library, the University Library Book Conservator, two chemistry professors, and myself. We started out with a review of what had been published about mass deacidification processes. At our first meeting, we agreed to the following assumptions.

> We would concentrate on the three processes with existing pilot plants, e.g. Wei T'o, Akzo, and FMC. We would conduct site visits to the pilot plants. We later decided to concentrate on the two processes that were offering to treat materials for library customers. This was consistent with our desire to begin our program with a pilot operational phase.
>
> We would approach the choice of a mass deacidification process as distinct from the emerging technology of paper strengthening. Mass deacidification would apply to that portion of the collection which was acid, but not yet embrittled. We would assume a later need to treat a portion of the collection that was already embrittled and for which reformatting was either unacceptable or undesirable.
>
> We agreed that rather than putting the burden of proof on the vendor to prove the efficacy of their process, we would have our own materials treated and tested. This was later modified when we decided to contribute to the scientific study proposed by the Canadian Conservation Institute (CCI). The Harvard chemists were put in contact with Helen Burgess of CCI to discuss the testing protocols for the study.

The chemistry professors on our technology subgroup also noted that the published technical information describing the deacidification processes (largely written by the proponents of the processes) was inadequate. This fact made it difficult to compare the processes in any meaningful way. Therefore, in order to inform our planned site visits to the pilot plants, we hired a post doctoral candidate in chemistry to evaluate and compare the published literature. A chart listing "processing parameters" was prepared comparing the processes by a number of categories such as the presorting required, characterization of the drying phase, neutralization source and agent, impregnation temperature, process time, health hazards, environmental hazards, etc. From this list we formed a picture of the major issues that we would want to cover with the vendor during the site visits to the pilot plants.

In conjunction with the site visits, we sent sample batches for treatment to Texas Alkyls (Akzo) and Lithium Corporation (FMC). The sample batches were not chosen on the basis that they would be part of a scientific study (because that was underway at CCI), but we did send of range of materials with different characteristics from a range of decades. Our main objective was to demonstrate to collection managers that deacidification was a viable technique for treating collection materials. They would have the opportunity to handle, sniff, and feel sample materials that had been treated before they sent collection materials. Since the treated books were stored in my office, I joked that, like a canary in a mine shaft, if I lived it would probably be safe to treat library books. The most common reaction from those who handle treated books is that they expect them to look better after treatment. Everyone, including myself, needed to be reminded that deacidification is supposed to be invisible; if the books were old and ugly when they were sent for deacidification, that is how they look when they return.

Although ours was not a scientific sample, we can compare books. We can, for example, pick out books that are part of a volume set that was treated by both processes and compare them to an untreated "control." Finally, because both processes still have some aesthetic problems (that we hope will be fully resolved in the future) we wanted to demonstrate with the sample batches what could go wrong, e.g., effects to book labels, visible rings on coated paper, and alkaline deposits on cloth. It is crucial to the future success of the deacidification program that we be honest about the state of the art of engineering the deacidification process, and that we acknowledge that more experience is needed with treating a wide variety of library materials.

A visit to the site where deacidification is taking place is a crucial precursor to making a decision about deacidification. Seeing is believing. You can assess the competence of the plant personnel and speak to a variety of staff involved in the project from the engineers to company executives. Some issues, such as the safety of the diethyl zinc process being used by Akzo's pilot plant at Texas Alkyls, can be put to rest. Most importantly, however, conducting a site visit is crucial to developing the institutional competence needed to evaluate the technology.

Not only are such visits valuable for gathering information, they are also important for building confidence—among ourselves as customers and between us and the vendors. The site visits and sample batches also gave us an opportunity to know the vendors better and to work with them. We were able to discuss how pricing might be arranged, how treatment schedules could be accommodated, and our highest priority for more information about treatment. For example, we believe that, to-date, not enough is know about the effect of treatment on pyroxylin-coated bookcloth, Se-Lin labels, or leather.

Finally, a rather unexpected outcome to our evaluation of the technology was that a Harvard chemistry professor on our subgroup, Andrew Barron of the Department of Chemistry, decided to conduct some tests of his own using a sophisticated scanning electron microscope (SEM) at Harvard. The results of his testing were shared with the subgroup, the vendors, and Helen Burgess at CCI, and contributed to our decision to contract with Akzo, Inc. for deacidification services. Professor Barron intends to publish the results of his study in a scientific journal.

As an institution making a decision, Harvard has come to partial closure. We have decided on a vendor for our initial pilot operational phase, we are awaiting the outcome of the scientific study underway at CCI, and we have profited from the initiative of a member of our faculty in providing additional scientific information. This is not the last word on our analysis of the deacidification technology. We fully expect that evaluation will be an ongoing aspect of our long-term operational program.

Experiences with Trial Treatments

Sue Himelick Nutty
CIC Mass Deacidification Coordinator
Northwestern University

The investigation of mass deacidification for the CIC, a consortium of thirteen midwestern universities, was begun in 1989 by a task force charged by the library directors. In the second year of this study, a one-year position was created at Northwestern University Library—which agreed to serve as a test site for a program—to explore the selection, organizational, materials handling, and budgetary challenges posed by the implementation of mass deacidification.

One technique of this investigation was the use of test runs. These test runs were not designed with the primary purpose of evaluating chemical issues of treatment effectiveness, but rather the goal was to simulate and measure internal organizational and logistical steps. The first test run consisted of sets of 100 gift and withdrawn books sent to both Akzo and FMC. With the satisfactory results of this test run, a second test run was implemented, consisting of actual library materials, 100 books from the general collection, and 100 books from Acquisitions that had not yet been added to the collection. For the third and final test run, Akzo and FMC agreed to treat a test batch of 50 books each for each of the 13 CIC libraries. The evaluation of this group test run, both by means of a survey of selection and workflow issues involved, and by a check list of treatment side effects, will be included in the report of this project for the CIC.

In considering test runs, a distinction needs to be made between the scientific evaluation of process effectiveness and the empirical, subjective evaluation of treatment results and side effects. It has been the position of the CIC that the former, the evaluation of process effectiveness, is beyond the reasonable means of most libraries. Most libraries do not have the means, in training, staff, or resources, to undertake the kind of scientific testing and evaluation required to completely, accurately, and scientifically evaluate chemical process effectiveness. Even a trained book conservator is not necessarily a paper chemist. Indeed, with the extensive testing undertaken by the Library of Congress, the Canadian Conservation Institute, and several major academic research libraries, it will be reasonable for other libraries to assume that vendors will have had experience treating most types of library materials.

Nor do library testing programs for mass deacidification need to be designed to ensure that every conceivable type and combination of library material that might be treated is included in test runs. Vendors of this technology must be able to demonstrate and substantiate to libraries that they are familiar with the various types of library materials and that these materials can be successfully treated without adverse effects. That said, it is, of course, only prudent for a library to provide test samples of any materials in their collections that may be unusual, or for which the library has reason to have special concerns.

Test programs *can* define the types of internal testing for quality control that may be used to confirm treatment by simple pH testing and, perhaps, some sample testing for alkaline reserve. Test runs will define careful quality control inspection procedures for visual, empirical examination of the books. Such evaluation or inspection, although subjective, may be necessary in a mass deacidification program, much as commercial binding or microfilm is inspected. Through the process of the test runs at the CIC, we have compiled a simple quality control check-in sheet listing all the various side effects we have seen. This list could be used by student workers as the books are unpacked or checked-in. Such a list could be employed to compile statistics on problems, to track a vendor's ability to ameliorate these problems, and as a means of discussing improvements in treatment with the vendor. A side effect that may be tolerable to one library may be totally unacceptable to another library. Perhaps the most beneficial use of test runs, in terms of evaluation of treatment, is the comparison of side effects between the two processes.

Test runs should be seen and used as an opportunity for libraries to investigate selection issues and the various organizational challenges posed by the implementation of a new program. Test runs create a situation in which all parties in the library who will be involved must meet and discuss options and needs, and move beyond the "what if" stage to "when." By actually *doing* mass deacidification through a test run, the implementation of this program becomes a tangible reality. For several of the CIC libraries, the group test run has actually made mass deacidification a higher priority.

A well-designed test run can identify selection issues and a library strategy, staffing needs and the appropriate levels, organizational or workflow steps, added internal costs in staff time, and additional space requirements. The identification of internal costs by hard data will be useful in fund-raising efforts. Test runs can even determine if additional equipment is needed. The answer to the obvious question, "Will we need more book trucks?" will probably be, "Yes."

One added benefit of doing test runs will be the learning process of dealing with the vendors of mass deacidification, at this point—two major, international chemical companies with little experience in providing service rather than products, and with no experience in doing business with the academic library community. Both companies are anxious to learn, and every time one library undertakes a testing program with these companies, all libraries benefit.

In the test runs at Northwestern, preliminary procedures were worked out for treating new materials, books from the retrospective collection, books from the general collection repaired in the conservation lab, and books from a discrete, non-circulating collection. Preliminary recommendations were made for identifying alkaline paper, for marking treated books, both on the book and in the online record, and for quality control procedures.

These test runs at Northwestern and the CIC libraries have provided each library with an opportunity to gain actual experience in the internal, organizational issues of selection and workflow management, and to evaluate treatment effectiveness and assemble statistics on treatment side effects. With the results of the physical observations of the treated books, we have continued discussions with the vendors, working toward the improvement of their processes. These test runs have allowed the CIC to moved forward in the process of the implementation of mass deacidification.

Experiences with Trial Treatments

Ed Rosenfeld, Associate Director for Collection and Reader Services
Milton S. Eisenhower Library, The Johns Hopkins University
and
Robert J. Milevski,
Preservation Officer, Princeton University Library

Over the past 16 months, the Milton S. Eisenhower Library of The Johns Hopkins University has accumulated a significant amount of experience with mass deacidification—perhaps more than any other academic library—based on 1) shipments of test materials to two commercial vendors, Akzo Chemicals, Inc. and FMC, 2) treatment of actual library materials under contract with Akzo, and 3) independent testing of materials treated by both vendors. This paper discusses the effects of both the Akzo and FMC processes on materials treated and presents a decision-making model for dealing with any undesirable effects of treatment.

Mass deacidification offers a preservation treatment option of great potential to academic research libraries in which perhaps 60% of the existing collections, and large numbers of newly acquired materials, are acidic but not yet brittle. At the Eisenhower Library we wanted to avail ourselves of this technology, but we needed to assure ourselves that we could contract for mass deacidification services with a vendor whose product was safe and effective.

In May 1990, we began informing ourselves directly about the viable commercial mass deacidification processes currently available by initiating a program of testing and review with vendors. We recorded our analysis of the treated material and shared this information with the vendors in a collaborative effort to make the vendors aware of any problems that might need to be addressed. At that time we had determined that Akzo Chemicals, Inc. was the only company with a documented, effective process that could treat a substantial number of volumes in one batch. The following February we added FMC's Lithco division to our list of vendors with production capability. Although we had sent three shipments to Akzo and had worked closely with that company to help improve results, we wanted to see for ourselves if FMC's process was more effective than Akzo's before we decided to sign a contract for services. In May 1991, after reviewing one shipment treated by FMC, the library signed a one-year contract with Akzo, effective July 1991.

The objectives of our testing program were to determine that a given process:

1. performed as advertised (i.e., neutralized acidic paper, deposited an adequate quantity of alkaline buffer in the paper, and did both of these things uniformly on each page and throughout a book, so that the treated paper would retain more of its inherent strength and last perhaps three to five times longer than untreated paper);
2. did not produce any undesirable effects on the treated material; and
3. was safe for library staff and users and for the environment.

The first objective required independently conducted scientific testing to corroborate published data about the efficacy of the two treatment processes. The library contracted for this testing with the Institute of Paper Science and Technology, Inc. in Atlanta, Georgia, in June 1991. We did not think it necessary to conduct the independent testing before we contracted for services, because our contract contained a clause which permitted us to terminate the agreement should the process not perform as expected. We did not anticipate unsatisfactory results.

The second objective required empirical testing to identify any physical differences between treated and untreated materials. The library's preservation officer and staff performed a close physical inspection of each piece and conducted some simple tests for zinc oxide deposition using an ultraviolet light and for pH using an indicator pen. These data were recorded for each piece along with other descriptive information, such as date, country of publication, binding format, paper type, and covering material. From these detailed analyses Mr. Milevski produced a set of matrices that categorized and aggregated the data into a coherent picture of the results of treatment.

The third objective required an examination by the University's Safety Officer of the vendors' toxicity studies. Although they are not within the scope of this report, we believe it is important to emphasize the primacy of toxicological and environmental issues in a consideration of any mass deacidification process. The DEZ process was found to be non-toxic and environmentally benign. At the time this report was being written, the library had not yet received information on this issue from FMC.

Make-up of Eisenhower Library Test Materials

Five batches of test materials were treated between May 1990 and May 1991. Akzo treated 667 books in three runs: May 1990 (227 books), August 1990 (236 books), and January 1991 (204 books). FMC treated 495 books in two runs: February 1991 (320 books) and May 1991 (175 books). A total of 1,162 test books were deacidified.

Books selected for treatment for the test runs were representative both of the library's general collections and of its current selection policy for mass deacidification. That policy targets newly acquired books published outside of North America and printed on uncoated, acidic paper. The test runs included books published from the early 19th century to the present. There were hardbacks, paperbacks, pamphlets, and periodicals with sewn, adhesive-bound, and stapled textblocks in a variety of covering materials: cloth, paperboard, leather, and plastic. The majority of the books contained uncoated paper, although a number with coated paper were also selected for separate treatment by Akzo. Each book was cut in half, so that control and treated portions could be compared.

In addition, some other non-book materials were selected for treatment. These included U.S. Geological Survey maps (from the 1940's to the present), 19th- and 20th-century sheet music (with and without chromolithographed color covers), and archives and manuscript materials. Since none of these materials were as thoroughly analyzed as the books, the results of this portion of our investigation are not recorded here.

Independent Testing

The Institute of Paper Science and Technology performed three separate tests on three half-books treated by Akzo and two by FMC. All of the books were similar—hardcovers published in West Germany in the late 1980's. Each test confirmed clearly the claims of the vendors about the effectiveness of their mass deacidification processes.

The test results produced by the Institute are appended to this paper as five sets of figures with each set showing the data collected from the three tests for each of five books designated as #'s 39, 40, 70, 71, and 83. Books #39 and 40 were treated by the FMC process; books #70, 71, and 83 were treated the Akzo process.

These data showed the following:

- The pH of cold extract results demonstrated that all five books were rendered alkaline, and that alkalinity was uniform in the page quadrants and in the three locations sampled in each book. The Akzo process resulted in a pH between 7.55 and 7.87; the FMC process, between 8.07 and 8.61.
- The alkaline buffer results demonstrated that both processes deposited an alkaline buffer in the paper to protect against acid attack from the environment, and that the buffer was distributed uniformly in the page quadrants and in the three locations sampled in each book. The Akzo process resulted in a buffer deposition as a percent of weight of between 1.03% and 1.27%; the FMC process, between .26% and .35%.
- The MIT fold test, performed at set intervals on treated and untreated paper artificially aged in a humid oven at 90° F over a period of 30 days, demonstrated that both processes extended the life of paper by at least a factor of two. Stated another way, both processes enabled the paper to retain much more of its inherent strength over time than untreated paper. It should be noted that the paper was generally weak at the beginning and that, because we used half-books, the MIT fold test had to be done across the grain of the paper, producing lower fold endurance results than tests done with the grain.

Two comments about the testing need to be made to place the results of these tests in the correct context. First, we wanted to test "real" library books, not standardized types of paper, to reflect the realities with which librarians must deal. Second, although we tried to test similar materials, they were not identical, and the results reflect those variations. Nevertheless, we believe that these tests corroborate the claims of the vendors.

Empirical Testing and Effects of Treatment

Our empirical testing consisted of analyzing the treated halves of the books and comparing them to the untreated halves to determine whether we could identify any effects of treatment. Ideally, treatment would have been undetectable to the senses. Our analysis consisted of simple close visual, tactile, and olfactory examination of each item, pH testing with an indicator

Table 1: Combined Akzo and Lithco Trial Shipments

EFFECTS OF TREATMENT: BREAKDOWN BY VENDOR

	Akzo	% of all materials shipped	Lithco	% of all materials shipped	TOTALS	% of all materials shipped
Total Items in Shipment: Hardbacks, Paperbacks Periodicals, Pamphlets	667	57.40%	495	42.60%	1162	
Total Items Affected (exclusive of odor, cockling, and paper yellowing)***	291	25.04%	359	30.90%	650	55.94%
Total Items Affected Which May Require Remedial Treatment	162	13.94%	232	19.97%	394	33.91%

Evidence or Effects of Mass Deacidification Treatment on Bound Materials	Items Affected				Totals	
	Akzo	% of all materials shipped	Lithco	% of all materials shipped		% of all materials shipped
Delamination						
* Cover	27	2.32%	96	8.26%	123	10.59%
* Pastedown	1	0.09%	0	0.00%	1	0.09%
* Plastic Film	33	2.84%	22	1.89%	55	4.73%
* Pressure-Sensitive Cloth	1	0.09%	0	0.00%	1	0.09%
Pressure-Sensitive Tape	2	0.17%	3	0.26%	5	0.43%
* SELIN Label **	68	5.85%	108	9.29%	176	15.15%
* Stamping Ink/Foil Color	1	0.09%	0	0.00%	1	0.09%
Ink Feathering						
Ball Point Pen Ink	0	0.00%	22	1.89%	22	1.89%
Non-MSEL Property Stamp Ink	0	0.00%	34	2.93%	34	2.93%
* Printing Ink	0	0.00%	3	0.26%	3	0.26%
Color Shifting or Discoloration						
Cover Color	73	6.28%	80	6.88%	153	13.17%
Endsheet/Pastedown/Inside Cover	0	0.00%	98	8.43%	98	8.43%
Non-MSEL Security Label	0	0.00%	3	0.26%	3	0.26%
Text Paper Yellowing	16	1.38%	Many Items Affected		16	1.38%
Other Chemical or Process Effects						
Adhesive Effects						
* Adhesive Embrittlement	12	1.03%	0	0.00%	12	1.03%
* Spine Adhesive Expansion/Meltdown	24	2.07%	1	0.09%	25	2.15%
Stiff Adhesive	48	4.13%	0	0.00%	48	4.13%
Chemical Burn	8	0.69%	0	0.00%	8	0.69%
Chemical Residues or Deposits						
Covers	37	3.18%	5	0.43%	42	3.61%
* Sticky Cover	0	0.00%	25	2.15%	25	2.15%
Text Paper	23	1.98%	0	0.00%	23	1.98%
Cockling	Many Items Affected		Many Items Affected			
* Cracked or Spalling Coating	9	0.77%	0	0.00%	9	0.77%
* Curled Paper Cover	0	0.00%	1	0.09%	1	0.09%
* Incomplete Page Treatment	12	1.03%	0	0.00%	12	1.03%
Odor	Many Items Affected		Many Items Affected			
* Polyester Clouding	1	0.09%	0	0.00%	1	0.09%
Staining						
Pastedown Turn-in	2	0.17%	5	0.43%	7	0.60%
Pastedown	1	0.09%	4	0.34%	5	0.43%
* Sticking/Blocking Pages	1	0.09%	0	0.00%	1	0.09%
* Vinyl Covering Shrinkage	1	0.09%	1	0.09%	2	0.17%
Other						
* Missing Item	0	0.00%	1	0.09%	1	0.09%

* Effect Which May Require Remedial Treatment
** Not all items affixed with SELIN Labels
*** Almost 100% of materials were affected by these effects every shipment.

Note 1 Materials selected for these shipments both represented bound materials in the MSE Library's general collections and conformed to the Library's selection policy for mass deacidification

Note 2 No totals are provided at the bottom of this chart because many items exhibit multiple effects.

pen, and inspection of the material treated by Akzo with an ultraviolet light (zinc oxide fluoresces under ultraviolet light).

Any differences between the treated and control halves of an item were classified and recorded as effects of treatment. These undesirable effects were usually attributable to the chemistry or the process (e.g., for Akzo, the phases of dehydrating the paper, permeating the paper with DEZ gas, and finally rehydrating the paper), but occasionally to the physical handling of the materials. Chemically based effects of treatment, such as color shifts resulting from neutralizing acidic dyes, are inherent in the chemistry of deacidification in general or of a particular deacidification process and cannot be altered. On the other hand, process effects can be modified in some cases by adjusting one or more elements in the operation of the system. If these adjustments do not work, then the library can always change its operations or selection criteria to try to avoid the undesirable effect. Handling effects are rare and can usually be avoided through care and attentiveness.

Results of the Eisenhower Library's Test Runs

Published accounts of both processes and conversations with vendors did not lead us to expect any undesirable treatment effects. Nevertheless, in each test run with each vendor we identified a variety of treatment effects which neither we nor the vendors had anticipated. We shared our observations with the vendors and reviewed each shipment thoroughly with them. Our work with Akzo became a collaborative effort to make the company aware of the problems we saw and to help them produce better results.

There are two reasons for the surprise the vendors displayed at our results. First, they had not previously treated books with the wide range of covering materials and adhesives we sent them. They simply lacked experience with bindings, because they had been focusing on paper, the primary target of deacidification. Second, as people from different "cultures," vendors and librarians looked at treated materials differently. The vendors looked at the "positive": deacidification and the deposition of buffer; we looked at the "negative": the treatment effects. The vendors initially gave little attention to the pervasive treatment effects because the effects were temporary (e.g., odor with both processes and cockling with Akzo) or because the effects were regarded as inconsequential (e.g., a slight yellowing of the paper with FMC).

Beyond these widespread, but innocuous, effects we observed a wide range of undesirable treatment effects, some more problematic than others. We were especially concerned with effects on adhesives and plastic films and coatings on covering materials. The solvent-based FMC process softened some adhesives, causing covers to delaminate or detach from paperback textblocks. This appeared to be a chemical effect. By contrast, the effect of Akzo's treatment on some adhesives was process-based. Akzo postulates that incompletely volatilized DEZ trapped in some adhesives reacted thermally with moisture and/or air introduced during the rehydrating phase of treatment. The heat generated caused a number of paperback hot-melt adhesives to soften and sometimes flow. Upon cooling these adhesives became stiff or brittle, and cracked when the textblock was flexed open.

Since hot- and cold-melt adhesives cannot be distinguished visually from one another, it would not be possible to deselect items which we knew would be adversely affected by treatment. On a related matter, both the Akzo and the FMC processes damaged Se-Lin labels. FMC's solvent caused the adhesive backing on the labels to ooze, while DEZ in the Akzo process reacted thermally with residual moisture in the labels' adhesive causing the labels to shrink, blister, or peel. Fortunately, the problems could be avoided by adjusting the library's workflow to apply the labels after deacidification.

Plastic films laminated to some paperback covers were affected by both processes. The films exhibited various forms of delamination from their respective covers. They cracked, "alligatored," became brittle, flaked, bubbled, blistered, puckered, or peeled. Some of them became discolored or translucent. (More than 4% of the combined test materials were affected in this way.) For Akzo's materials this effect was process-based (perhaps heat-related); for FMC, it was chemical-based. As with adhesives, covers with plastic films cannot be easily identified and deselected from a population of potential treatment candidates. Other notable effects on materials included color shifting, chemical residues on paper and bindings, and incomplete treatment accompanied by a "chemical burn." First, cover colors shifted or mottled to some extent on 13% of all materials deacidified by both vendors. These were probably chemical effects caused by neutralizing acidic dyes, and therefore inherent in deacidification. Second, both processes occasionally produced chemical residues on covers or text paper. For FMC's materials the residues were the result of incomplete "rinsing." For Akzo's, zinc oxide residues resulted when excess moisture left in the paper or bindings after the dehydrating phase reacted with the DEZ introduced during the permeation phase. Third, nearly 6% of Akzo's third test shipment was incompletely treated. This was evident under ultraviolet light and after swabbing with pH indicator solution.

Almost all incompletely treated books in Akzo's third

Table 2: Combined Akzo and Lithco Trial Shipments

EFFECTS OF TREATMENT: BREAKDOWN BY BINDING FORMAT	Paperback	Hardback	Periodical	Pamphlet	TOTALS	% of all materials shipped
Shipments Breakdown Bound Materials Only	510	482	121	49	1162	
Percent of All Materials Shipped	43.89%	41.48%	10.41%	4.22%		
Total Items Affected (exclusive of odor, cockling, and paper yellowing)***	329	257	35	29	650	55.94%
Percent of Binding Type	64.51%	53.32%	28.93%	59.18%		
Percent of All Materials Shipped	28.31%	22.12%	3.01%	2.50%		
Total Items Affected Which May Require Remedial Treatment	261	102	11	20	394	33.91%
Percent of Binding Type	51.18%	21.16%	9.09%	40.82%		
Percent of All Materials Shipped	22.46%	8.78%	0.95%	1.72%		

Evidence or Effects of Mass Deacidification Treatment on Bound Materials	Binding Formats Affected				TOTALS	
	Paperback	Hardback	Periodical	Pamphlet	Items Affected	% of all materials shipped
Delamination						
* Cover	108	6	8	1	123	10.59%
* Pastedown	1	0	0	0	1	0.09%
* Plastic Film	47	7	0	1	55	4.73%
* Pressure-Sensitive Cloth	0	0	0	1	1	0.09%
Pressure-Sensitive Tape	1	4	0	0	5	0.43%
* SELIN Label **	93	66	0	17	176	15.15%
* Stamping Ink/Foil Color	0	1	0	0	1	0.09%
Ink Feathering						
Ball Point Pen Ink	12	10	0	0	22	1.39%
Non-MSEL Property Stamp Ink	15	17	2	0	34	2.93%
* Printing Ink	1	2	0	0	3	0.26%
Color Shifting or Discoloration						
Cover Color	76	58	11	8	153	13.17%
Endsheet/Pastedown/Inside Cover	2	93	3	0	98	8.43%
Non-MSEL Security Label	0	3	0	0	3	0.26%
Text Paper Yellowing	Many Items Affected					
Other Chemical or Process Effects						
Adhesive Effects						
* Adhesive Embrittlement	12	0	0	0	12	1.03%
* Spine Adhesive Expansion/Meltdown	21	1	3	0	25	2.15%
Stiff Adhesive	35	8	5	0	48	4.13%
Chemical Burn	7	1	0	0	8	0.69%
Chemical Residues or Deposits						
Covers	16	24	2	0	42	3.61%
* Sticky Cover	18	7	0	0	25	2.15%
Text Paper	13	8	2	0	23	1.98%
Cockling	Many Items Affected					
* Cracked or Spalling Coating	0	9	0	0	9	0.77%
* Curled Paper Cover	1	0	0	0	1	0.09%
* Incomplete Page Treatment	7	5	0	0	12	1.03%
Odor	Almost all items affected					
* Polyester Clouding	0	0	0	1	1	0.09%
Staining						
Pastedown Turn-in	0	7	0	0	7	0.60%
Pastedown	1	4	0	0	5	0.43%
* Sticking/Blocking Pages	1	0	0	0	1	0.09%
* Vinyl Covering Shrinkage	1	1	0	0	2	0.17%
Other						
* Missing Item	0	0	0	1	1	0.09%

* Effect Which May Require Remedial Treatment
** Not all items affixed with SELIN Labels
*** Almost 100% of materials were affected by these effects every shipment

Note 1 Materials selected for these shipments both represented bound materials in the MSE Library's general collections and conformed to the Library's selection policy for mass deacidification

Note 2 No totals are provided at the bottom of this chart because many items exhibit multiple effects shipment were also "chemically burned" to various degrees on the exposed edges of their textblocks. This "burning" or, more precisely, thermal reaction seems to have been the result of the interaction of excess water vapor (remaining in the books after drying) with DEZ gas. While these books appeared to be uncoated paper, they behaved like coated paper. Since coated paper retains more moisture than uncoated paper, it takes longer to remove the moisture during the dehydrating phase of the process. As a result, the outer parts of the page near the edges contain more moisture. DEZ is consumed by the moisture and is not available to deacidify the paper fully. A thermal reaction takes place at the edges where the moisture is concentrated. Tables 1 and 2 (on pages 98 and 100 respectively) provide cumulative statistics about the effects of treatment on all test shipments. Each major effect category is broken down more specifically, and the number and percentage of books affected.

Model for Empirical Testing for Mass Deacidification

Having verified the effectiveness of the two commercially viable mass deacidification processes through independent testing and having educated ourselves about any undesirable effects of treatment, we needed to decide how to use this information in writing a contract for mass deacidification services. We wanted to take that next step with a clear understanding of the risks and opportunities . To secure full value from the data we had carefully collected, we created an analytical model that any potential client of mass deacidification services could use. The model is presented schematically in Chart on pages 102 and 103.

Effects of treatment vary greatly, and the strength of this analytical model is its capacity to deal with that variety. Some effects (e.g., adhesive embrittlement, cover delamination, chemical residues on cover or text paper, sticking or blocking pages) require remediation through repair, rebinding, or replacement. Nearly 34% of the test books deacidified by both vendors exhibited effects which we thought might require some degree of remediation. Most other effects (e.g., color shifting, staining, yellowing) were moderate to negligible and require that nothing be done to treated materials other than reshelving. Some process-based effects such as odor and cockling, even though they are temporary, can be ameliorated by the vendor through modification of the treatment process. (We have seen odor reduced dramatically and the cockling reduced significantly by Akzo in the first contract shipments we received.)

Other effects, when observed consistently (e.g., Se-Lin label and clear polyester cover damage) can be avoided by altering selection criteria or library operations. To a certain extent, one's values and aesthetic sensibilities color one's perception of differences between the treated and untreated halves of works and one's decision to remediate or ignore any undesirable effects of treatment. For example, librarians could disagree on whether materials which no longer feel pleasant to use because of chemical residues on bindings or text paper would require remediation.

Each potential client of mass deacidification services has to decide which effects are tolerable when compared to the overall benefits of mass deacidification and when compared to the future cost to the collection and the institution of not deacidifying materials now (i.e., the expense of reformatting brittle materials and attempting to replace out-of-print and unusable titles). After all, the overwhelming majority of items treated showed no undesirable effects, or only minor ones. Assuming that they are willing to accept some degree of undesirable treatment effects that could occur, clients of mass deacidification services will need to determine their threshold of tolerance for damage to their material. One limit can be based on the acceptable cost of remediation in whatever form—rebinding, repair, replacement—per shipment or on the percentage of items which may require remediation. The percentage of materials per shipment which is affected but does not require remediation could also be a consideration. Another important issue when negotiating contracts will be who bears the cost of remediation—vendor, library, or both.

The decision making model developed by Robert Milevski (see Chart 1) can be used for reviewing the empirical data collected by a client or potential client of mass deacidification services to determine the acceptability of one or more treatment effects on the client's materials. Primary decision-making points for determining the acceptability of treatment effects are (1) reversibility or nonreversibility of the effect; (2) type of damage, if any, that occurs; and (3) necessity for remediation to make the item usable. Using this model along with some data collection instrument, such as Tables 1 and 2, will enable a client to develop a clear overview of the effectiveness of any mass deacidification process.

Conclusion

The mass deacidification systems promoted by Akzo Chemicals, Inc. and FMC's Lithco Paper Preservation Systems deacidify, buffer, and extend the life of library materials. But both treatments can also produce undesirable effects. Libraries interested in availing themselves of this technology need to inform themselves about the available processes and determine whether the benefits of a given process outweigh the costs and the inevitable shortcomings. Librarians and

Chart 1: Model for Empirical Testing for Mass Deacidification

Observable Evidence or Effect of Mass Deacidification on Bound Materials	Effect is		Effect is			Effect is		Effect Requires Remedial Treatment *	Effect Requires Materials Processing Change **	Effect Requires Pre-Selection ***
	Reversible	Non-Reversible	Non-Damaging	Structurally Damaging	Non-Structurally Damaging	Acceptable	Unacceptable			
Delamination										
* Cover		x		x			x	x		x
* Pastedown		x		x			x	x		
* Plastic Film		x			x		x	x		x
* Pressure-Sensitive Cloth		x		x			x	x	x	
Pressure-Sensitive Tape		x			x	x				
* SELIN Label		x			x		x	x	x	
* Stamping Ink/Foil Color		x			x		x	x		
Ink Feathering										
Ball Point Pen Ink		x			x	x				
Non-MSEL Property Stamp Ink		x			x	x				
* Text Paper Printing Ink		x			x		x	x		
Color Shifting or Discoloration										
Cover Color		x			x	x				
Endsheet/Pastedown/Inside Cover		x			x	x				
Non-MSEL Security Label		x			x	x			x	
Text Paper Yellowing		x			x	x				
Other Chemical or Process Effects										
Adhesive Effects										
* Adhesive Embrittlement		x		x			x	x		x
* Spine Adhesive Expansion or Meltdown		x		x			x	x		x
Stiff Adhesive		x		x		x				

* Remedial treatment is required, such as commercial binding, repair, replacement, or second mass deacidification treatment, to correct effect of mass deacidification

** In-house materials processing or shelf preparation frequently introduce new materials into a book. Procedures may be changed to accommodate any potential damage which might occur to these materials as a result of mass deacidification E.g., SELIN call number labels can be applied after treatment

*** Binding materials likely to be affected by mass deacidification cannot usually be easily identified and preselected from possible mass deacidification treatment candidates. These problematical materials include: adhesives, plastic films, coatings, inks, and paper types (coated or uncoated)

NB: Chart reflects MSEL judgments regarding the impact of the effects of mass deacidification on the selection, processing, use, life, and soundness of materials.

Chart 1: Model for Empirical Testing for Mass Deacidification

Observable Evidence or Effect of Mass Deacidification on Bound Materials	Effect is		Effect is			Effect is		Effect Requires Remedial Treatment *	Effect Requires Materials Processing Change **	Effect Requires Pre-Selection ***
	Reversible	Non-Reversible	Non-Damaging	Structurally Damaging	Non-Structurally Damaging	Acceptable	Unacceptable			
Other Chemical or Process Effects (continued)										
Chemical Burn		x			x	x				
Chemical Residues or Deposits										
Covers		x			x	x				
Text Paper		x			x	x				
* Sticky Cover		x			x		x	x		x
Cockling	x		x			x				
* Cracked or Spalling Coating		x			x		x	x		x
* Curled Paper Cover		x		x			x	x		
* Incomplete Page Treatment	x				x		x	x		
Odor	x		x			x				
* Polyester Clouding		x			x		x	x	x	
Staining										
Pastedown Turn-in		x			x	x				
Pastedown		x			x	x				
* Sticking/Blocking Pages		x		x			x	x		
* Vinyl Covering Shrinkage		x		x			x	x		
Other										
* Missing Item		x			x		x	x		

* Remedial treatment is required, such as commercial binding, repair, replacement, or second mass deacidification treatment, to correct effect of mass deacidification.

** In-house materials processing or shelf preparation frequently introduce new materials into a book. Procedures may be changed to accommodate any potential damage which might occur to these materials as a result of mass deacidification. E.g., SELIN call number labels can be applied after treatment.

*** Binding materials likely to be affected by mass deacidification cannot usually be easily identified and preselected from possible mass deacidification treatment candidates. These problematical materials include: adhesives, plastic films, coatings, inks, and paper types (coated or uncoated).

NB: Chart reflects MSEL judgments regarding the impact of the effects of mass deacidification on the selection, processing, use, life, and soundness of materials.

vendors can work together to minimize the undesirable effects. The data collection and decision-making models used at the Eisenhower Library have enabled us to understand the issues and to move ahead with contracting for services. We hope other libraries will begin to send materials for testing and will contract for services. Research libraries need viable mass deacidification as a preservation treatment option.

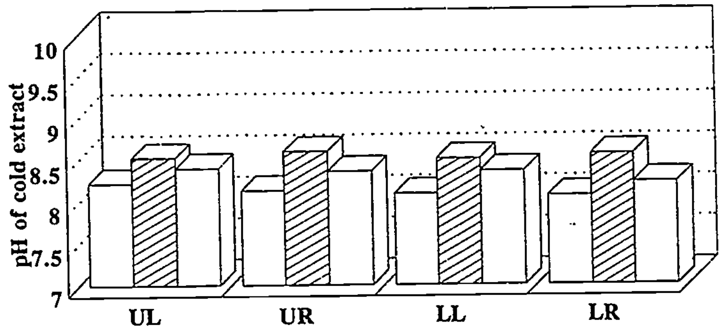
Postscript

This paper reports on a program of mass deacidification testing carried out by the Eisenhower Library over a year's time, beginning in May 1990. Since June 1991, the Eisenhower Library has built substantial additional experience with mass deacidification by sending each month about 350 volumes newly acquired for our circulating collections for mass deacidification. We have adopted the Akzo-licensed DEZ process, and readers will want to know that most of the undesirable effects of that process discussed in this paper have been eliminated or substantially reduced. These good results are the outcome of a commitment the Eisenhower Library and Akzo Chemicals, Inc. made that together they would use the opportunities provided by a production environment for mass deacidification to improve the performance of this critically important preservation treatment.

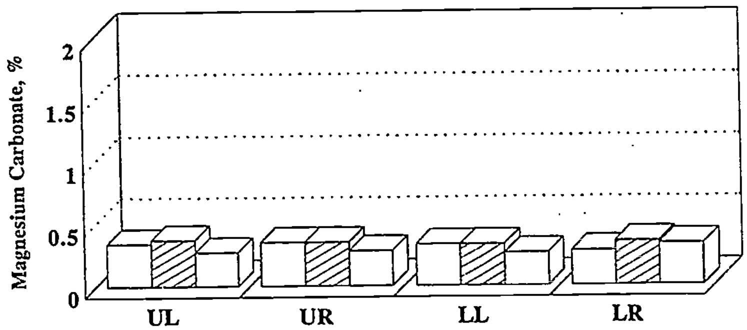
Note: This paper is the product of a collaboration between Robert Milevski, former Head of the Preservation Department at the Eisenhower Library, and Ed Rosenfeld, Associate Director for Collection and Reader Services at the library. Both writers have been directly involved in the library's experience with mass deacidification from the beginning. Mr. Milevski, however, left the library at the end of July 1991 before the library had received both the second half of its first commercial shipment to Akzo and the results of the independent testing.

Book # 39

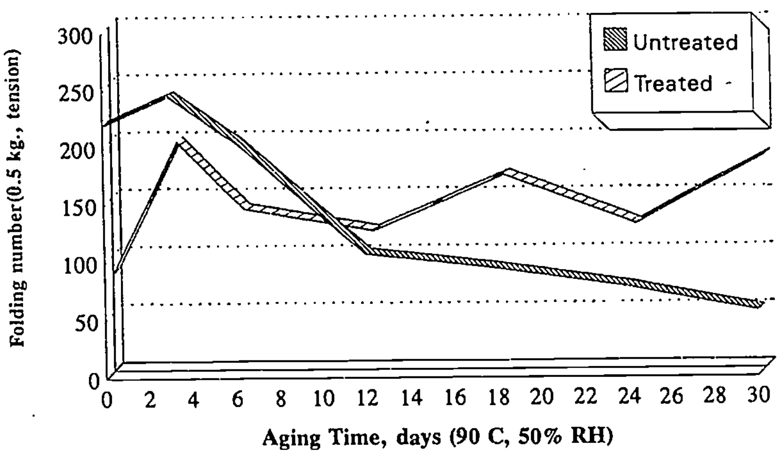
Project 91-70267



	UL	UR	LL	LR
Front ☐	8.23	8.14	8.1	8.07
Middle ▨	8.54	8.61	8.52	8.57
Back ☐	8.41	8.37	8.37	8.23

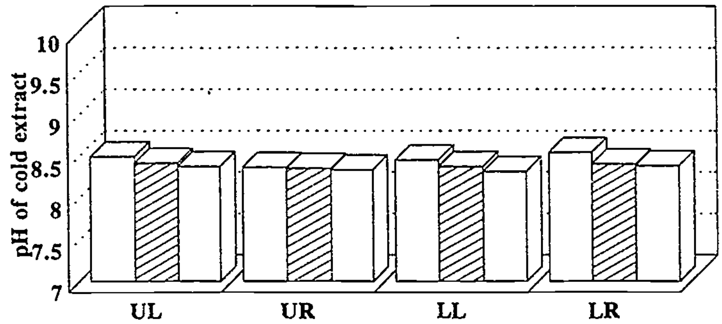


	UL	UR	LL	LR
Front ☐	0.34	0.35	0.33	0.28
Middle ▨	0.37	0.35	0.33	0.35
Back ☐	0.27	0.28	0.26	0.33

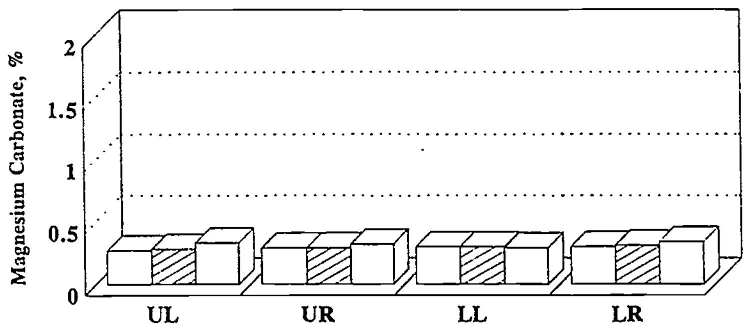


Book # 40

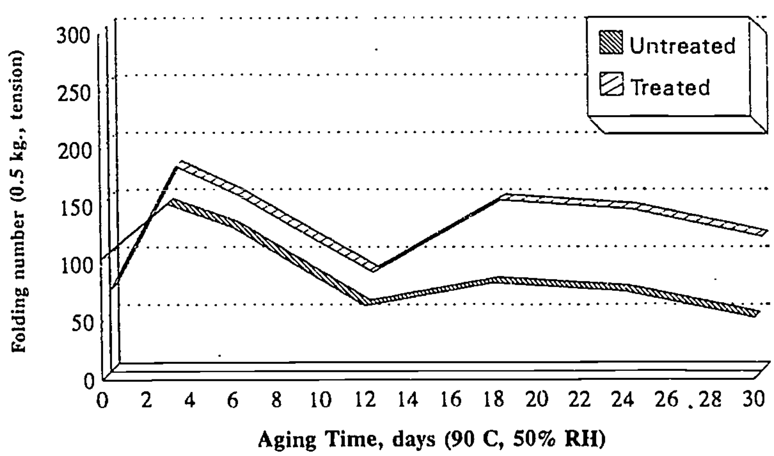
Project 91-70267



	UL	UR	LL	LR
Front	8.5	8.37	8.46	8.55
Middle	8.42	8.36	8.38	8.41
Back	8.38	8.34	8.32	8.39

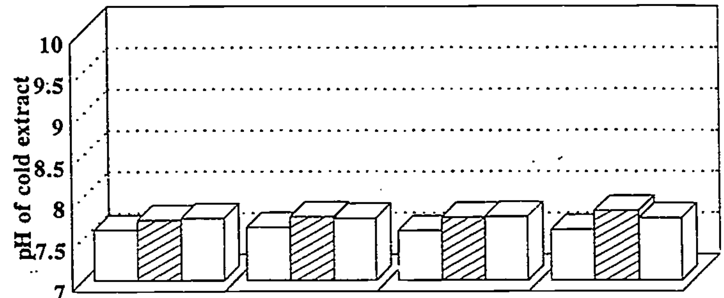


	UL	UR	LL	LR
Front	0.27	0.29	0.3	0.3
Middle	0.28	0.29	0.3	0.31
Back	0.33	0.32	0.29	0.34

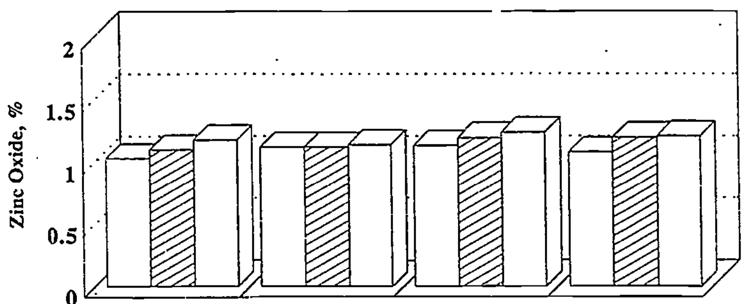


Book # 70

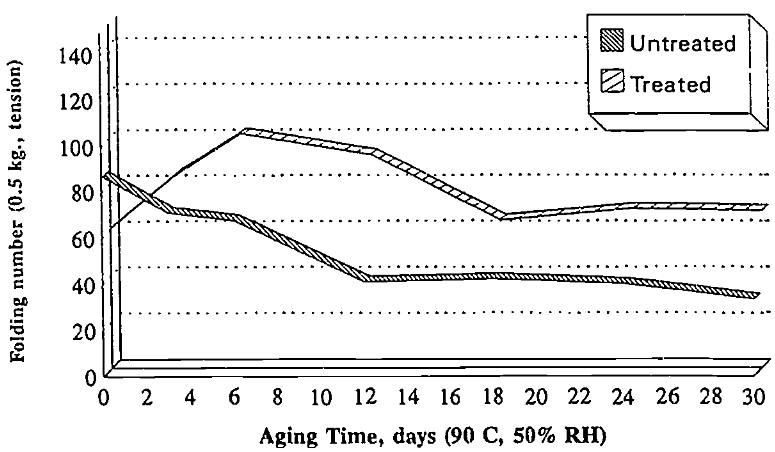
Project 91-70267



	UL	UR	LL	LR
Front	7.61	7.64	7.6	7.61
Middle	7.73	7.77	7.76	7.84
Back	7.75	7.75	7.77	7.75

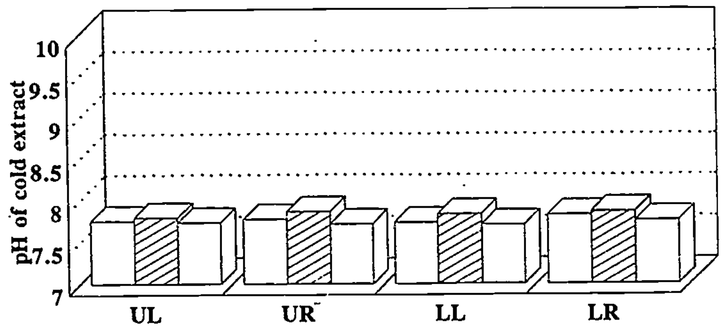


	UL	UR	LL	LR
Front	1.03	1.12	1.14	1.08
Middle	1.1	1.12	1.2	1.2
Back	1.18	1.14	1.24	1.21

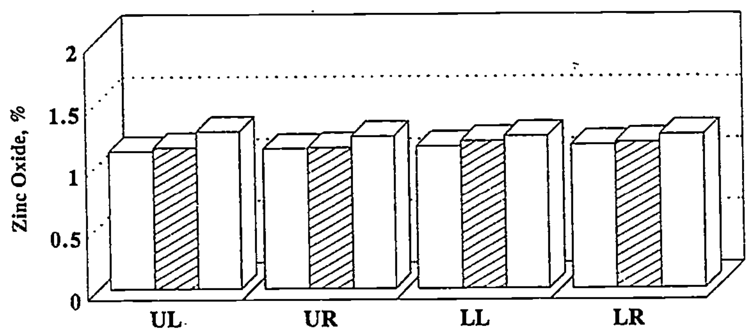


Book # 71

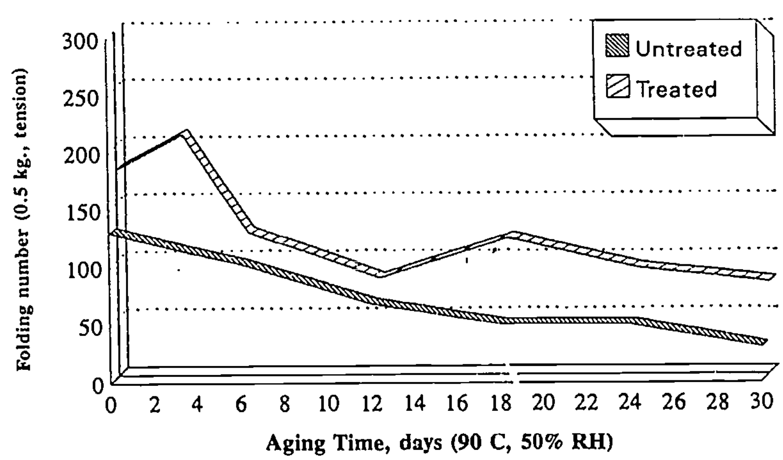
Project 91-70267



	UL	UR	LL	LR
Front	7.76	7.78	7.74	7.83
Middle	7.8	7.87	7.84	7.87
Back	7.74	7.72	7.71	7.76

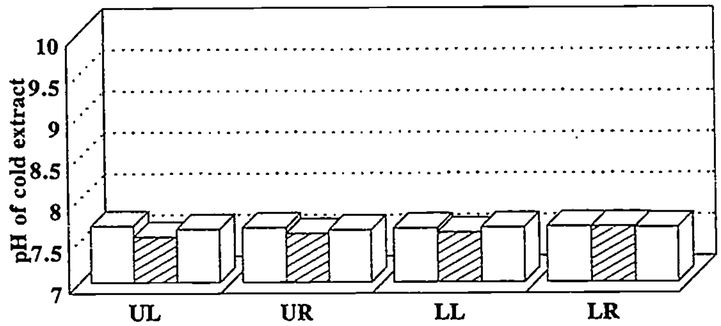


	UL	UR	LL	LR
Front	1.11	1.13	1.15	1.16
Middle	1.14	1.14	1.19	1.18
Back	1.27	1.23	1.23	1.24

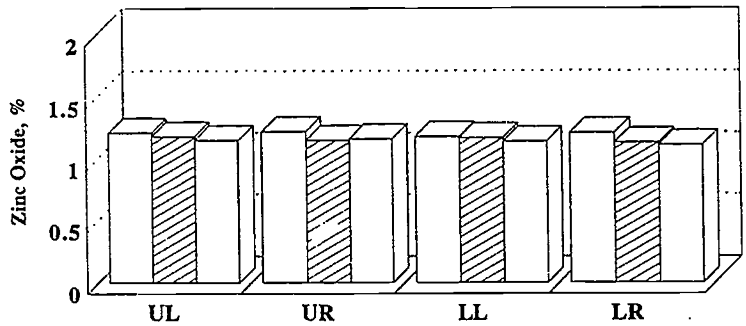


Book # 83

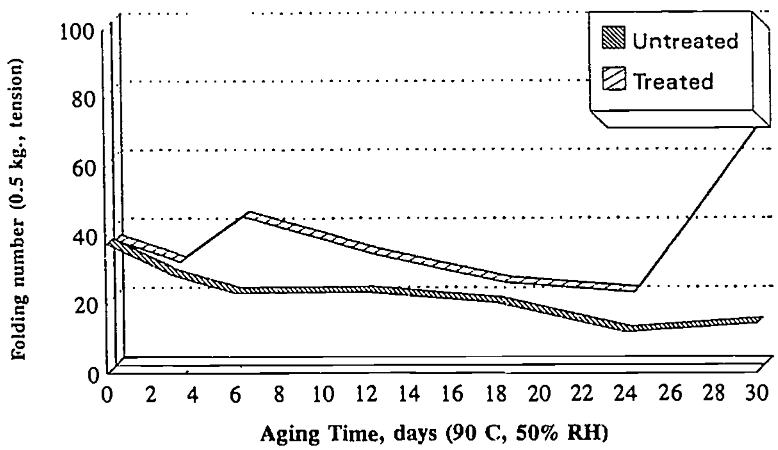
Project 91-70267



	UL	UR	LL	LR
Front	7.68	7.66	7.65	7.67
Middle	7.55	7.59	7.6	7.67
Back	7.64	7.63	7.66	7.66



	UL	UR	LL	LR
Front	1.21	1.22	1.18	1.21
Middle	1.18	1.15	1.17	1.13
Back	1.15	1.16	1.14	1.11



Experiments with Trial Treatments

Jan Merrill-Oldham
Head, Preservation Department
University of Connecticut Libraries

The University of Connecticut Libraries Collection Management Committee is charged with reviewing and implementing policies having to do with the development and preservation of the Libraries' collections. The Committee comprises the Associate Director for Collection and Information Services; Heads of the Collection Development, Reference and Information Services, Acquisitions, and Preservation Departments; the Principal Cataloger; and one subject selector (a rotating position). While the decision to allocate funds for mass deacidication services falls within the purview of the Committee, the group relies almost exclusively on advice from the Preservation Department regarding the appropriateness, effectiveness, safety, and per-item cost of all actions involving treatment of the collections.

Prior to 1990, the Preservation Department had no experience with mass deacidification technologies. Investigation began when the Head of the Preservation Department and Library Conservator undertook a reading program to become fully familiar with available literature on the subject. Subsequently, Richard Miller, representative for Akzo Chemicals, was invited to make a technical presentation to the Collection Management Committee regarding the diethyl zinc vapor-phase method. Following that meeting, Akzo offered to treat, at no cost, a trial shipment of materials, provided the Libraries paid the shipping fees. The Collection Management Committee accepted Akzo's offer.

In a standard commercial binder's shipping carton, the Library Conservator packed a variety of materials typically used to make, repair, and house books and paper; and objects that are likely to be found in unsorted boxes of archives and manuscripts. The shipment included: books covered with starch-filled cloth, pyroxylin-impregnated buckram, acrylic coated cloth and paper, vinyl, polyester-paper laminate, other laminates, and plain paper. Text papers ran from uncoated, to filled, to heavily coated stock; some were in good condition and some brittle.

Also included were board and paper wrappers, pamphlets and paperbacks sewn and adhered in binders, and folded photocopies. Sample manufacturing and conservation materials included various boards (e.g., corrugated, pressboard, phase-box board, binder's board, and foam core); card stock; Japanese and other conservation papers; Mylar; Tyvek; encapsulated papers (sealed on 1, 2, 3, and 4 sides); materials sealed in polyethylene bags; and paper clips, staples, and similar objects.

Relying on the extensive, successful testing that has been done on plain paper over the years at the Library of Congress, the decision was made to treat 441 maps from the Map Library collections. The maps were fragile, acidic, and had low artifactual value, but were judged by the map librarian as having long-term usefulness for University students and faculty.

Evaluation of materials following treatment was modest compared to the testing that has been undertaken by the developers of the various deacidification technologies, but reflects the testing capabilities to date of most preservation departments. The distribution of zinc oxide throughout treated materials was observed using an ultraviolet lamp, and both surface and cold extraction pH tests were conducted. Akzo's test results were reviewed, the company having had permission to test pages from all sample books following treatment. Finally, all materials were carefully inspected for visual and tactile changes, and odor.

The Preservation Department determined, to the best of its ability, that materials were treated effectively. To a large degree, confidence is based on the fact that test results echo those described by other institutions, and by the developers of DEZ technology. The extensive independent analysis of toxicological issues, commissioned by the Library of Congress and Akzo, were deemed sufficient for conducting the test run, although further verification would be required should the University make a commitment to treat large quantities of materials.

Our findings with regard to effects other than adequate deacidification and buffering were less positive. Tested papers had been mended using a wide variety of techniques, and repairs made with some pressure-sensitive tapes showed signs of accelerated aging. One volume with heavily coated text paper developed incandescent rings on the surfaces of leaves (a problem that might have been avoided if the volume had been batched with similar volumes, and the treatment cycle adjusted accordingly). Rings also developed on very dense, calendered board. Se-Lin labels degraded, shriveling and lifting away at the edges. The adhesives that held together pages in some old paperbacks failed, and some covering materials developed visual and tactile changes (e.g., a powdery residue, a slick stickiness). Finally, some materials for the test sample were extreme, and the results were not surprising. The Akzo representative had made clear that we could anticipate problems with certain types of materials, and that others would exhibit no defects. This proved to be true.

Based on the highly successful treatment of uncoated papers, the Collection Management Committee has decided to proceed with a DEZ program that is modest in scope, confining treatment largely unbound papers; paperbacks; and books that will be disbound, encapsulated, and rebound as polyester books. Maps, posters, music scores, and pamphlets are currently regarded as prime candidates for treatment.

Experiences With Trial Treatments

James Stroud, Chief Conservation Officer
Harry Ransom Humanities Research Center
University of Texas, Austin

In January, 1990, Richard F. Miller from Akzo Chemicals, Inc. approached the University of Texas General Libraries and the Harry Ransom Humanities Research Center (HRHRC) with an offer to process a selection of materials at Akzo's diethyl zinc pilot plant deacidification facility in Houston. This offer was accepted.

During the next five months, staff of the General Libraries Preservation Office and the HRHRC Conservation Department assembled 35 cubic feet of discarded and non-collection items representative of typical holdings of archives and libraries. This group of materials was taken to Houston for mass deacidification in July, 1990.

The Ransom Center and the General Libraries undertook this test to study the effects of the treatment on visual appearance and tactile quality of treated materials. It was believed that any visual changes that might occur during the treatment would be related to either the deposition of zinc oxides on exposed surfaces, the pH sensitivity of treated materials, or the heating and cooling cycles that occur during the treatment process. There was no intention to duplicate or critically evaluate the testing done by the Library of Congress on the efficacy of the treatment process in deacidification of paper.

For the trial run, conservators at the General Libraries and the Ransom Center assembled a representative collection of 152 bound books and approximately 20 document storage boxes of other paper-based materials. Each book was cut in half perpendicular to the spine. The top portions were submitted to DEZ treatment. The bottom portions were kept as controls. Some of the treated books and their controls were first subjected to chemical and adhesive applications that might be used in conservation procedures.

The document cases contained materials similar to those found in HRHRC collections. These included:

1. nearly 1,000 samples of 19th- and 20th-century writing inks on a wide variety of papers;
2. over one hundred photographs representative of most of the basic photographic processes;
3. an extensive sample of artist's media, including oils, pastels, colored pencils, chalks, watercolors, marking pens, and acrylics;
4. paper sample books, including over 200 samples of plain and decorated Japanese papers, and an extensive selection of Western papers;
5. a wide range of pressure sensitive tapes and labels attached to a variety of supports;
6. plastic, foam, and paperboard packing and housing materials;
7. cast films of a wide range of traditional and modern adhesives;
8. examples of colored and monochrome printing processes;
9. book cloths, leathers, and other skin products;
10. samples of thermofax and other historic and modern copy processes; and
11. numerous fasteners, clips, pins, and other metal and plastic devices for securing documents.

Control samples of all items sent for deacidification were retained at the Ransom Center for later evaluation and comparison.

Shortly after the return of the treated collection to the University, Richard Miller and staff from Texas Alkyls participated with University conservators in a preliminary examination of the materials. The evaluation of primary interest to conservators and collection staff at HRHRC is the visual comparison of treated materials with untreated samples. Knowledge of the levels of visual disturbance or change that can occur during the process is critical to the decision to submit unique records and manuscripts of intrinsic historic and scholarly value for treatment. Though the HRHRC is relatively certain of the efficacy of the treatment on acid in paper, it is far less confident of the effects of treatment on the range of colorants, dyes, pigments, and binders that have been used in the production of 20th-century writing and artists' media and in modern papers, photographs, and books. Visual comparison of control samples with the wide range of materials submitted during the test run have substantially increased staff knowledge of the types of material adversely affected by the DEZ treatment.

A wide variety of results were observed in the materials subjected to treatment. Most encouraging was the effects of the treatment on writing inks and papers. Of the roughly thousand samples of writing and typing inks submitted, it was difficult to find a dozen that had been visually disturbed. In these cases, which were mostly reds and blues, the color shift was very minor. Black and colored printing inks were similarly unaffected. Generally, there was very little change in the tonality of treated papers. When such shift occurred in whitish papers, it tended towards a slight yellowing. Many of the book papers exhibited this tendency. Colored papers also showed very little change.

Substantially more problems were associated with artists' media, particularly pastels and water based paints, and a wide range of shifts occurred, notably with, but not limited to, reds, browns and yellows. Thermofax and modern fax paper darkened considerably; color xeroxes exhibited serious color shifts; and a few other copy processes blocked together with neighboring sheets.

The appearance of modern bound books was generally unchanged. There was minimal cockling of text blocks and very little warping of the boards. The texture and color of pyroxylin book cloth covers were seriously altered. In books with heat-sensitive adhesives on the spine, the adhesive tended to discolor and pull away from the spine. Older books with leather covers displayed board warpage. Uncut text blocks tended to cockle. Blue colored book covers and book jackets exhibited an abnormal incidence of color change, often severe. This was also noticed on a variety of blue colors produced by offset lithography.

Most of the photographs treated during the tests ended up with a slightly gritty feel. Photographic papers tended, as did other papers, to yellow slightly. The silvery, bluish sheen associated with "silver mirroring" which was present on some of the photographs prior to treatment appeared greenish bronze in tone after processing. The image side of silver gelatin prints on resin coated papers exhibited iridescent interference colors or a slight bluish haze, generally near the margins and in minimum density areas. The back side of these prints exhibited much yellowing. Plastics of many varieties fared, in general, quite poorly. They stretched, yellowed, and darkened. The smooth surface of some rigid plastics became rough. "Saran Wrap" disappeared entirely, leaving only a brown stain around the paper that had been folded inside. Foams shrank and became brittle and powdery. In a tightly packed box, fusion occurred between adjacent sleeves of a non-standard type of polyester film. Subsequent dialogue concluded that, with manuscript and archive collections, attention would need to be given to the issues of pre-selection of materials.

The use of ultraviolet illumination has been valuable in determining the presence and distribution of zinc oxide in treated paper. Although this is not a quantitative evaluation, the characteristic bright orange fluorescence of zinc oxide, when exposed to ultraviolet light, provides a useful tool to assess the ability of the deacidification gas to penetrate enclosed areas such as phase boxes and partially sealed polyester sleeves. Initial tests indicated that such penetration did occur.

HRHRC staff noted a mild odor associated with the treated materials. Some members of the staff mentioned that they suffered various forms of mild olfactory and low-level respiratory irritation after long exposure to the treated materials. In February, 1991, Mr. Miller responded to this problem by bringing an independent consulting toxicologist, Dr. Ralph Freudenthal, and Mr. Doug Klapper, the Manager of Product Safety for Akzo Chemical, Inc., to the Ransom Center to listen to and discuss staff concerns about the odor and to determine if a health problem associated with the process did exist. Dr. Freudenthal, who had reviewed the DEZ toxicology studies, did not believe that the DEZ process posed any toxicological problems for staff members or researchers. Akzo, however, has agreed to continue research on the issue of odor in treated materials and to attempt to determine if any reaction by-products such as the ethane might be contributing to the problem. They are also investigating whether mechanical aspects of the process could be modified to eliminate the problem of odor.

Although the ability of the diethyl zinc process to neutralize acid and impart a zinc oxide buffer in paper has been thoroughly proven by the Library of Congress and others, and although the HRHRC is not in a position to perform the range of testing protocols necessary to replicate the work of these laboratories, the Center's conservators felt that some effort to evaluate the pH of treated materials was appropriate. In particular the HRHRC wished to study the effectiveness of the treatment on materials stored within the various types of paper, board, and polyester housings used for collection storage at the Center.

Initially the department used standard surface pH monitoring techniques designed to obtain pH readings from the surface of wet paper. Though somewhat imprecise, surface pH measurement is often used by conservators to evaluate the relative changes caused during paper conservation treatments such as washing and deacidification. Surface pH readings are not an acceptable analytical technique for analysis of paper. Inconsistencies in obtained results prompted department conservators to use the TAPPI cold water extraction procedure for measurement of the pH of chopped and gound test samples. Results of this testing produced lower pH readings than were anticipated. Readings in the range of 5.9 to 6.4 were common among the treated samples. Mr. Miller returned to the Center to assess the procedures being employed for the pH measurements. He and I replicated the testing procedure and obtained similarly low readings. We postulated that the problem was related to the nature of the pH electrodes used at the HRHRC, which were designed primarily for the measurement of surface pH of paper. We were also concerned about the low solubility of the zinc oxide in water-based extracts. Mr. Miller returned to the Center a few months later with Dr. Dieter Frank, previously Director of Chemical Research of Akzo Chemicals, Inc. Dr. Frank brought several electrodes that were designed for the analysis of solutions. Using these electrodes and adapting the analysis procedure to account for low solubility of the zinc oxide in the cold water extract, pH readings were subsequently obtained which were well within the anticipated range of recommended standards.

During the past year and a half, these and other issues raised between Akzo and the HRHRC have prompted a continuous and valuable dialogue focused on efforts to find solutions to the problems of mass deacidification.

Conclusion

Jutta Reed-Scott
Senior Program Officer for Access and Collections Services
Association of Research Libraries

A central theme that emerged in discussions during the meeting was the need for cooperation among libraries wishing to pursue further action on mass deacidification. The participants concluded that with the current state of mass deacidification technology, a range of challenges are still facing research libraries regarding the implementation of mass deacidification programs. These challenges include:

- operational issues, such as selection of materials;
- treatment side effects, the most serious of which include odors in the treated volumes, damage to some cover materials, and loosening of labels; and
- quality control.

Beyond the chemical and technical issues, many organizational and logistical questions must be explored.

A further need is to facilitate wider learning about mass deacidification. Participants underscored the importance of credible communication on the state of the technology and on library management choices for program implementation. A number of speakers highlighted the need for a mass deacidification treatment plant that is funded in part through a consortium. Mr. Studer made a persuasive case for capitalizing a treatment plant in order to reduce unit costs for treated volumes.

While parts of these tasks are currently being performed by individual libraries, coordination and analytical assessment on a broad level are lacking. To effect solutions to the outstanding problems will require a partnership among a number of libraries and mass deacidification vendors. Mr. Placke described a pattern established in the industrial research community of different groups joining together to work on solving specific problems. In discussing his suggestion, participants recommended that the Association of Research Libraries serve as an umbrella organization and consider ways to support cooperation among libraries that are already using mass deacidification processes. Such consortial action would ensure that the experience gained by these libraries is coordinated and shared widely, and would benefit all libraries. It would also demonstrate a market for mass deacidification while working with vendors to address remaining problems expeditiously.

The roundtable provided an opportunity to assess the combined experiences of research libraries that have started to implement mass deacidification systems. Building on the discussions and recommendations, ARL has begun to develop a cooperative strategy and chart a course of action for making mass deacidification available for use by many libraries for the preservation of paper-based materials in their original format.

Association of Research Libraries
1527 New Hampshire Avenue, N.W.
Washington, DC 20036
(202) 232-2466

ISBN 0-918006-21-X