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ABSTRACT

Library administrators, faced with the problems of acid-paper deterioration, are examining mass deacidification procedures. Mass deacidification of acidic books while they are still physically sound and not yet brittle is the most cost-effective corrective action to extend the life of the paper. There are currently at least five mass deacidification processes available or under development, so that library administrators can begin to plan for the process. A brief and nontechnical description is given of the following five techniques: (1) DEZ (diethyl zinc), a process at the pilot stage; (2) Wei T'o, a liquified gas process that is in use in at least two locations; (3) BPA, the Book Preservation Associates System, currently available in New Jersey; (4) Bookkeeper, a process under development that involves magnesium oxide; and (5) the Lithco process, in the pilot stage. A table summarizes the properties, selection requirements, cycle times, and development stages of each of these processes. Considerations of process use, such as length of time required to treat a collection, potential damage or strengthening effects, and evaluation issues are reviewed. (Contains 103 references.) (SLD)

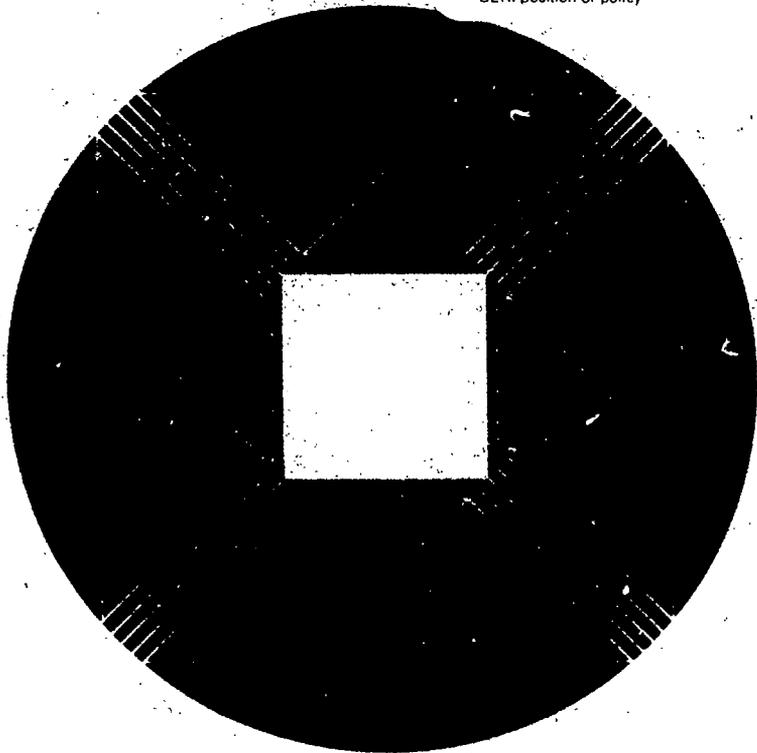
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# MASS DEACIDIFICATION SYSTEMS: PLANNING AND MANAGERIAL DECISION MAKING

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# MASS DEACIDIFICATION SYSTEMS

**MASS DEACIDIFICATION SYSTEMS:  
PLANNING AND MANAGERIAL DECISION MAKING**

by

**KAREN TURKO**  
University of Toronto



**Association of Research Libraries**

**Washington, D.C. 1990**

Mass Deacidification Systems:  
Planning and Managerial Decision Making

by

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## PREFACE

This report was prepared by Karen Turko, Head of Preservation Service, University of Toronto. Written in Toronto during her special assignment as ARL Visiting Program Officer between December 1988 and June 1990, the study was made possible with the support of the University of Toronto Libraries. Ms. Turko also served as a member of the Steering Committee for the feasibility study for the establishment of a mass deacidification center to serve the libraries of metropolitan Toronto. Her report incorporates information and findings from the feasibility study conducted by Lord Cultural Resources Planning and Management, Inc. She would like to thank the members of the Steering Committee, especially Johanna Wellheiser, Conservation Manager, Metropolitan Toronto Reference Library, for their advice and assistance.

Preparation of this report over the past year has been a challenge. As the work progressed, it became clear that mass deacidification technologies are changing at a rapid pace and that there is a critical need for additional testing and evaluation of processes currently available or under development. There are still many unanswered questions and a broad range of issues calling for decisions and action by research library leaders in the near future. The report necessarily reflects the uncertainties surrounding technological developments and the evolving decision making processes. Only a few ARL libraries have embarked on a planning process for the deacidification of their collections on a large scale. While the challenges facing libraries are substantial, limited progress has been made in resolving basic managerial and operational issues. During this critical transition period, it is important to identify and examine these issues and to analyze different available options. This report is intended to aid in that process by looking at mass deacidification from a management perspective. It explores issues such as selection of material for treatment, collection management, and financial considerations.

Throughout the investigation and preparation of this report, many individuals provided invaluable help and support. The members of the ARL Committee for Preservation of Research Materials reviewed drafts of the report and provided thoughtful suggestions. The chair of the Committee, Carole Moore, Chief Librarian of the University of Toronto Libraries; and the vice-chair, William J. Studer, Director, Ohio State University Libraries, provided advice and encouragement throughout the project. Several preservation administrators gave professional advice and assistance, and their suggestions have been incorporated into the report. Jan Merrill-Oldham, Head of the Preservation Department at the University of Connecticut and Consultant to the ARL Committee on Preservation of Research Materials, was especially helpful in clarifying the key issues and in providing additional background information. Richard Frieder, Preservation Librarian at Northwestern University and Chair of the CIC Task Force on Mass Deacidification, contributed much useful information and a special perspective. We would like to extend thanks to them and to Carolyn Morrow, Preservation Librarian at Harvard University, and Wesley

Boomgaarden, Preservation Officer at Ohio State University, for reading and commenting on various drafts of this report.

Lastly, special appreciation belongs to Diane Harvey, of the Johns Hopkins School of Advanced International Studies Library, who served as editor of the report. She brought to this task extensive library and research experience, and made valuable contributions to the report.

**Jutta Reed-Scott**  
Program Officer  
Association of Research Libraries  
August 1990

## MASS DEACIDIFICATION SYSTEMS PLANNING AND MANAGERIAL DECISION MAKING

### INTRODUCTION

Library administrators, faced with the "slow fires" of acid-paper deterioration, are examining mass deacidification processes. Mass deacidification is one of a range of strategies library directors must consider to address a problem that affects, by one estimate, 80 million books in North American research libraries.<sup>1</sup> Surveys confirm that books printed on acidic paper deteriorate over time. A significant percentage of the paper-based research collection are in danger. Yale University estimates that over 80 percent of its libraries' collection is printed on highly acidic paper,<sup>2</sup> while 60 percent of Johns Hopkins University's collection is acid but not yet brittle.<sup>3</sup>

Mass deacidification of acidic books while they are still physically sound and not yet brittle is the most cost-effective corrective action to extend the life of the paper. The causes of deterioration of paper used in book production since the nineteenth century have been well summarized elsewhere.<sup>4</sup> The search for a low-cost mass deacidification process began decades ago. Only within the last few years has significant progress toward technological solutions been made. There are currently at least five mass deacidification processes available or under development. Library administrators can now begin comprehensive planning to address the crisis.

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<sup>1</sup> Association of Research Libraries. *Preserving Knowledge: The Case for Alkaline Paper*. Rev. ed. (Washington: ARL, 1990)

<sup>2</sup> Gay Walker, "The Yale Survey," *College and Research Libraries* (Chicago: Association of College and Research Libraries) 46 (1985):120.

<sup>3</sup> Milton S. Eisenhower Library, Johns Hopkins University. *Policy for a Mass Deacidification Program at The Milton S. Eisenhower Library of The Johns Hopkins University*. (Baltimore: The Library, 1990), p. 3.

<sup>4</sup> U.S. Congress. Office of Technology Assessment. *Book Preservation Technologies*. (Washington, DC: Government Printing Office, 1988).

George Martin Cunha, "Mass Deacidification for Libraries," *Library Technology Reports* 23 (May/June 1987):363-477.

Chandru Shahani and William K. Wilson, "Preservation of Libraries and Archives." *American Scientist* 75 (May/June 1987):240-251.

Deacidification is essentially the neutralization of acids in paper and the depositing of an alkaline buffer that acts as a reserve to neutralize any subsequent acid formation. Deacidification is not a new process. Single-sheet, manual processes have been used for preservation for some time. These manual processes involve time-consuming disbinding, dipping or spraying, and drying. They are not feasible for treating the large number of threatened books in research libraries.

Development of mass deacidification systems using chemical processes that involve minimal handling of the books have created the opportunity for the library community to focus on broad preservation needs. Mass deacidification cannot be thought of, however, as the single comprehensive solution. Rather, mass deacidification should be viewed as part of the continuum of preservation strategies available to libraries. The Office of Technology Assessment, in its study of book preservation technology, identified several approaches to preserving library collections: the use of acid-free paper; preservation techniques such as conservation of individual works, environmental controls, micro-formatting, and optical disk formatting; mass deacidification; and paper strengthening.<sup>5</sup> A recent report from the Commission on Preservation and Access cites three principal approaches: transfer of text onto other formats such as microfilm, magnetic tape or optical disk; reprinting of text; and preservation of books in their original form (including through deacidification).<sup>6</sup> It is important to view these approaches as complementary, rather than alternative, strategies. For certain categories of material, preservation of the information content may be sufficient. For others, such as books with illustrative material critical to the content (e.g. color plates or maps), preservation in the original format may be very important. For still others, one or more preservation options may be more economically feasible, depending on the material's condition, anticipated use, or other factors.

Several distinctive characteristics of mass deacidification should be kept in mind by library decision makers. First, mass deacidification should be viewed as a preventive technique to preserve material which has not yet become brittle. Although it can arrest the process of acid hydrolysis (and subsequent deterioration), it cannot restore brittle material to a non-brittle state. Deacidification is one method of preserving material in its original format. Items that cannot be so preserved, and are essentially unusable, may be candidates for techniques such as preservation microfilming or optical disk formatting to preserve the informational content.

Second, use of the term "mass deacidification" implies a large-scale process. The potentials and limitations inherent in a mass technology must be considered in the decision-making process. While mass deacidification allows the library to treat significant portions of the collection, the financial commitment will be substantial. The impact of such a program on library

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<sup>5</sup> U.S. Congress. Office of Technology Assessment. *Book Preservation Technologies*. (Washington, DC: Government Printing Office, 1988).

<sup>6</sup> Peter Schwerdt, *Mass Deacidification Procedures for Libraries and Archives: State of Development and Perspectives for Implementation in the Federal Republic of Germany*. (Washington, DC: Commission on Preservation and Access, May 1990).

operations must also be considered.

In summary, mass deacidification can be viewed as:

- a preventive technique,
- a means to preserve material in its original format,
- a large-scale process, and
- one of a spectrum of preservation strategies.

Library decision makers must realize that a mass deacidification program is a potentially complex, large-scale and long-term undertaking. Because mass deacidification is a sophisticated chemical process, selection of a particular system will necessitate evaluation of engineering, safety, and environmental factors. As a large-scale program that will entail a significant commitment of funds, it demands that library directors consider collection management, financial, and related operational issues as part of the decision-making process.

Development of alternative mass deacidification systems is moving rapidly. The lack of independent testing of the various processes has meant that comparative evaluation remains difficult, if not impossible. Recently, several vendors have moved beyond the laboratory stage to the construction of pilot plants. This should make realistic capacity, safety, and cost evaluation possible. The Library of Congress is developing a testing program as part of its evaluation of mass deacidification processes, and system evaluation studies are underway in Germany and Canada. The Commission on Preservation and Access has published a paper on the technical aspects of the processes.<sup>7</sup> Although institution-specific factors will always guide the choice of a process, these evaluations will be very useful.

Selection of a particular mass deacidification process is only part of the decision-making process. An equally important decision is the selection of material to be treated. Library administrators can begin now to develop decision-making models and action plans to consider the place of mass deacidification in their institutions.

## SCOPE OF THIS PAPER

This paper identifies issues that library administrators must consider when making decisions about the selection, implementation, and operation of a mass deacidification system. It will:

- provide a brief, non-technical description of mass deacidification technologies currently available or under development,

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<sup>7</sup> Peter G. Sparks. *Technical Considerations in Choosing Mass Deacidification Processes*. (Washington, DC: Commission on Preservation and Access, May 1990).

- outline the key characteristics of a mass deacidification system in order to identify process evaluation issues, and
- discuss issues relating to selection of material for treatment, collection management, and financial considerations.

## MASS DEACIDIFICATION PROCESSES

Technical evaluation of mass deacidification processes is not within the scope of this paper. Peter Sparks has recently written a paper for the Commission on Preservation and Access which outlines technical considerations. A brief discussion of five mass deacidification systems follows a glossary of commonly used terms. The processes to be considered are: DEZ, Wei To, BPA, Bookkeeper, and Lithco. Issues for consideration in evaluating a process will be discussed in terms of key system characteristics as enumerated in several recent reports.

## GLOSSARY<sup>8</sup>

**acidic paper:** paper that has a pH of less than 7.

**alkaline reserve (buffer):** any stable substance deposited in paper for the purpose of counteracting acids that may form in the future.

**benign (to books, paper, etc.):** deacidification processes and materials that do not cause deleterious effects to paper, books, bindings, labels, inks, or other material.

**deacidification (neutralization):** process of reaction between acidic or alkaline substances such that the pH of the resultant material approaches 7 (neutrality).

**environmentally benign (safe):** process that does not release chemicals into the environment that have been shown to, or are suspected to, harm the environment.

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<sup>8</sup> Terms taken from:

U.S. Congress. Office of Technology Assessment. *Book Preservation Technologies. Feasibility Study for a Mass Deacidification Centre for Libraries and Archives in Metropolitan Toronto.* Prepared by Lord Cultural Resources Planning and Management Inc., in association with Murray Frost: Cultural Building Consultant, Inc. (1989).

"Glossary of Selected Preservation Terms." *ALCTS Newsletter* 1:2 (1990).

**postconditioning:** processes such as rehydration of paper after deacidification treatment.

**preconditioning:** processes such as dehydration of paper before deacidification treatment.

**preselection:** screening to determine which books can be safely treated.

**strengthening (of paper):** restoring the mechanical stability of brittle paper through chemical means.

## **PROCESS DESCRIPTIONS**

The following descriptions of mass deacidification technologies are brief summaries of the current status of five processes and their basic chemistry. Other, more technical studies should be consulted for more thorough descriptions. Table 1 on page 6 provides a means for comparing the various systems.

### **DEZ**

The DEZ, diethyl zinc, process was developed by the Library of Congress in the early 1970s. It is currently licensed to Akzo Chemicals Inc., which operates a pilot plant near Houston.

The nonaqueous process permeates paper with diethyl zinc gas, which neutralizes the acid in paper. DEZ also reacts with moisture in the paper to form zinc oxide, which remains in the paper as an alkaline reserve.

### **WEI T'O**

The Wei T'o Nonaqueous Book Deacidification system has been used at the National Library of Canada since 1979. Wei T'o has signed an agreement with Union Carbide Paper Preservation Services to develop and market the process.

In this liquified gas process, methoxy magnesium carbonate, dissolved in a solvent, reacts with water from air to form magnesium compounds. These compounds react with acids in the paper to form neutral salts. Subsequently, basic magnesium carbonate is formed and remains in the paper as an alkaline reserve.

Table 1. Description of Deacidification Process

Process	Developed by	Vendor	Deacidification agent/propellant if applicable	Strengthening properties	Degree of pre-selection required	Cycle time	Development stage
DEZ	Library of Congress	Akzo Chemicals, Inc.	Diethyl zinc gas		Heavily coated paper, as in serial runs, may need to be treated separately	60 hours	Pilot plant
Wei T'o	Richard Smith/Wei T'o	Union Carbide Paper Preservation Services	Liquified gas methoxy magnesium methyl carbonate dissolved in methanol and mixed with Freon 112 and Freon 113		Pre-selection required as some colors bleed, certain inks run, and plastic covers cannot be treated	48 hours	Facility at National Library of Canada. Similar plant at BN de France
Book Preservation Associates		Information Conservation Inc.	Ethylene oxide and ammonia	Said to strengthen some materials	Leather materials not suitable for treatment	36 hours	Available commercially
Bookkeeper	Koppers	Richard Spatz, Preservation technologies, Inc.	Magnesium oxide in Freon 113	Said to strengthen some materials	Minimal	Under 3 hours	Laboratory stage
Lithco	Lithium Corporation of America	Same	MG-3, a Lithco proprietary compound + Freon 113	Said to strengthen some materials	Minimal	Under 8 hours	Pilot plant

## **BPA**

BPA, the Book Preservation Associates system, now marketed by Information Conservation Inc. is currently available at their BPA plant in Carteret, NJ. It utilizes an industrial process that has been used for mass sterilization of such materials as medical equipment.

In this gaseous phase process, ammonia and ethylene oxide form ethanalamines, which permeate cellulose fibers to neutralize acid and remain in the paper as an alkaline reserve.

## **BOOKKEEPER**

Originated by Koppers Company in the early 1980s, the Bookkeeper process is now being developed by Preservation Technologies Inc. of Sewickley, PA.

A suspension of submicron particles of magnesium oxide, the deacidifying agent, is dispersed directly onto paper fibers. The magnesium oxide reacts with moisture in the paper to neutralize acids, while surplus magnesium oxide remains in the paper as an alkaline reserve.

## **LITHCO**

Lithium Corporation of America, which developed the process in 1987, has completed construction of a pilot plant, replacing a demonstration unit.

The process uses a proprietary Lithco product, MG-3. This magnesium compound is deposited on the paper and reacts with cellulose on a molecular level to neutralize and act as an alkaline reserve.

## **PROCESS EVALUATION ISSUES**

Although there are no universally accepted standards in place by which to evaluate mass deacidification processes, several reports that delineate key process characteristics are available.<sup>9</sup>

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<sup>9</sup> See, in addition to the Library of Congress report cited in note 10, the report by Schwerdt cited in note 6.

In 1989, the Library of Congress, in its draft procurement document for a mass deacidification facility,<sup>10</sup> formulated the following criteria:

1. The process must reliably deacidify the paper in books and documents in a thorough and safe manner, and also stabilize the cellulose with a permanent and uniformly distributed alkaline reserve.
2. The process must have no chemical interactions that damage the cellulose in the paper; that damage the inks, dyes, colors, etc. on the paper; that damage the document or any of its components; or that result in any undesirable side effects.
3. The process must have the capability of universally treating the Library's heterogeneous book and document collections.
4. The process must require minimum pre-selection and no pre-testing of the books.
5. The process must have no engineering requirements that damage the physical structure of the pages in the book; that damage the binding structure of the book; or that damage a document or any of its components.
6. The process must require minimum pre-selection and no pre-testing of the books dictated by process engineering.
7. The engineering must adapt with relative ease to the effective treatment of other paper formats such as large and small maps, boxed manuscripts, music scores, prints and drawings, and large books and folios.
8. The process must work at the pilot plant level and have a capacity for scale-up that will permit treatment of all of the Library's collections in a period of 20-25 years.
9. The process must have no materials handling requirements that damages library materials or that requires the contractor to handle individual collection objects.

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<sup>10</sup> U.S. Library of Congress. *Performance Specifications and Information Requirements for a Process to Deacidify the Library of Congress Collections*. Draft Document, July 6, 1989.

10. The process must have no significant environmental impact.
11. The process must have a low toxicological risk in relation to the humans who operate the facility and who use the books in the Library.

As the draft document notes, LC's experience may be useful to other large research libraries. Library administrators can use these criteria, modified to meet institutional needs, when evaluating mass deacidification processes.

Issues to consider when evaluating mass deacidification processes include, but are not limited to:

**Deacidification reliability.** Will the process deacidify evenly throughout the book? Is there a potential for reacidification of treated materials? Will the final pH be higher than acceptable?

**Material selection.** Does the chemical process damage particular kinds of papers, bindings, etc.? Is the method of handling material during treatment potentially damaging? Will pre-selection and/or pre-testing be necessary to screen items before treatment?

**Environmental effects.** Does the process utilize components that are environmentally harmful?

**Effects on humans.** Does the process utilize components that may be harmful to humans? Does the process result in adverse effects, such as off-gassing, which may be harmful or offensive to humans?

## Collection Evaluation Issues

Selection of a particular mass deacidification process is only one of the decisions facing library administrators. Selection of material to be treated is equally important. While use of independent testing and evaluations of deacidification systems may simplify the choice of a treatment method, decisions on how to choose material for treatment will be dependent on factors unique to each institution, for example, the nature of the collections, use patterns, and inter-institutional arrangements. Few guidelines for material selection have been developed, because only a handful of libraries currently use mass deacidification.

Decision making for selection can be conceptualized in several ways. The first model views selection as both "process-driven" and "collection-driven." Some mass deacidification processes cannot be used to treat certain categories of material, such as leather bindings or particular types of plastic. Selection decisions must account for these kinds of process parameters.

"Collection-driven" selection criteria could include: identifying the most heavily-used portions of the collection for priority treatment in order to preserve material with the highest anticipated use, selecting items of particular value to the collection, treating classes of material expected to be permanently retained, or treating portions of the collection according to a cooperative plan developed among several institutions. While "process-driven" selection criteria would apply to any library adopting a particular technology, "collection-driven" criteria will naturally vary from institution to institution.

A second selection model focuses on "macro-level" versus "micro-level" decisions. Decision making at the "macro", or collection, level seeks to keep selection as automatic as possible. Macro-level decisions could include selecting by:

- subject (e.g. heavily-used portions of the collection, in order to preserve items that may receive a high degree of wear and tear),
- format (e.g. maps, atlases, heavily-illustrated works),
- category (e.g. all new acquisitions, all new acquisitions from a particular country), and
- value (e.g. artifactually or economically valuable items).

Conversely, some material can be excluded from treatment on a macro-level:

- portions of the collection with a high percentage of material that is not treatable because of factors such as type of binding or type of paper (this will vary depending on treatment process chosen),
- parts of the collection already too brittle to treat successfully, or
- material not intended for permanent retention.

Decision making on a "micro", or book-by-book basis, is labor intensive and may be both cost-ineffective and incompatible with the philosophy of mass treatment. Retrospective deacidification, as opposed to prospective deacidification of new acquisitions, can become a micro-level process if each item must be selected individually.

These two models of the selection process are not mutually exclusive, but are meant to provide different perspectives from which to view the process. Even before choosing a particular

mass deacidification method, a library can begin to evaluate its collection in order to develop a rational material selection policy.

## OPERATIONAL ISSUES

Like many preservation strategies, a mass deacidification program affects a wide range of library operations. It requires the coordination of internal library activities and resources. Arrangements with the vendor and related services such as transportation companies must be coordinated as well. Initially, the mass deacidification project will be a non-routine undertaking requiring new systems and procedures.

Along with establishing criteria for selecting material for treatment, operational issues should be considered. They include:

**Project duration and scope.** What is the overall plan for mass deacidification in terms of project length and scope? How will the project affect ongoing departmental operations? How will it affect operating budgets?

**Identifying items for treatment.** What library unit will be responsible for identifying material for treatment? At what point in the acquisitions/cataloging/processing operation will new items be selected and treated? How will circulating items be "captured" for treatment? Will material printed on alkaline paper be identified and excluded from treatment?

**Treatment records.** Will the circulation system, or another method, be used to indicate that items are currently being treated (and thus unavailable)? Will bibliographic records indicate treatment has occurred?

**Monitoring and evaluation.** How will deacidified material be monitored and evaluated to determine treatment effectiveness?

**Physical handling.** What internal arrangements (staff and procedures) must be made to ensure smooth systematic material handling?

**Transportation.** If deacidification treatment is to take place outside the library building, what transportation arrangement must be made?

**Security.** What arrangements for security of library material, en route to and during treatment, must be established? How does a deacidification project outside the library building affect insurance coverage?

**User education and public relations.** How will the library's user community be made aware of the deacidification program? What arrangements will be made to deal with the program's impact on users (for example, their need for items that are unavailable while being treated)?

## IMPLEMENTATION MODELS

Library administrators are faced with a new funding challenge: paying for mass deacidification. The scale of a mass deacidification program usually requires the development of a financial structure to support a multi-year undertaking. Commitment to a mass deacidification project may involve the reallocation of existing resources or the development of new funding strategies. Although the long-term benefits of deacidifying a library's collection are widely acknowledged, immediate benefits are less obvious. Without a demonstration of short-term benefits, finding funding support, especially through reallocation, may be difficult.

Specific cost data are not currently available for most deacidification processes. Without this information, financial planning is necessarily speculative. Library decision-makers can, however, consider various implementation models. Four can be identified:

In the **commercial** model:

1. A library would contract with a private vendor for mass deacidification on a fee-for-service basis.
2. A vendor would have to be selected, perhaps through the RFP process.
3. The vendor may require an advance commitment in terms of project size and duration.
4. Because the library would not be involved in capital cost of process development and plant construction, it would retain the ability to use another deacidification process.

5. Some technologies will only be available through commercial vendors, so a library may be limited to the commercial option depending on the process chosen.
6. The library would not have to deal with operational issues such as plant staffing, chemicals, or in-plant safety because it is contracting for service. Conversely, the library would have limited control over these aspects of the treatment process.

In the **library/vendor cooperative** model:

1. A library or group of libraries would provide capital funds, and a vendor would build and operate the facility.
2. The library or libraries may be able to lower their per-unit deacidification costs.
3. Libraries would not have to directly provide ongoing facility operating costs.
4. Contractual arrangements would need to be considered carefully.
5. The library's ability to pursue another mass deacidification process may be limited by its previous capital commitment.

In the **cooperative** model:

1. A consortium of libraries would build and operate a mass deacidification facility.
2. A high degree of control over the system is implicit in this arrangement.
3. Cooperative members would be responsible for all aspects of plant construction and operation.
4. Retention, or replacement, of members would be an ongoing concern.
5. Significant capital commitment may mean that members would be less free to change to another mass deacidification process.

6. Some mass deacidification technologies may not be available for licensing to a consortium, while others may be beyond the consortium's ability to operate.

In the **library** model:

1. One institution would build and operate a mass deacidification facility.
2. Except for factors relating to relationships between cooperative members, the same issues as above would apply.

Because some mass deacidification processes are still under development, reliable cost information is not available. Moreover, the range of implementation models make cost comparisons difficult. Planning and start-up costs may require substantial expenditures before a mass deacidification program is even begun. A library can, however, consider the following factors when attempting to determine the cost of a particular process:

1. Library operations costs
  - collection management (selection decisions)
  - pre-selection (if necessary with particular process)
  - preparation and handling (recordkeeping, packing)
  - shipping
  - insurance
  - post-treatment handling (recordkeeping, shelving, safely monitoring, quality control)
2. Process costs<sup>11</sup>
  - pre-treatment
  - mass deacidification processing
  - post-treatment
  - operating costs (administration, amortization)
3. Capital cost (site selection, land acquisition, building plans, construction, maintenance, amortization, etc.)<sup>12</sup>

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<sup>11</sup> Specific process cost factors would have to be calculated separately for an in-house facility. A commercial vendor would supply a per-unit process cost.

<sup>12</sup> Applies only to models where facility is funded by library or group of libraries.

## CONCLUSION

As independent evaluations of mass deacidification processes are completed, more reliable data will become available regarding process requirements, effectiveness, and costs.

Library administrators should

1. - keep in mind the complex and multifaceted nature of the mass deacidification process;
2. appreciate the institutional commitment it implies;
3. utilize the technical expertise available while becoming familiar enough with the processes to ask the right questions and develop a management strategy;
4. strive to keep up with the rapidly-changing field; and
5. realize that there is not one right choice for every collection.

The key is to evaluate existing technologies in light of the individual library's collection. Technology will continue to evolve, but planning and decision making can begin now.

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