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ABSTRACT

This paper presents the results of disinfecting treatment of more than 200,000 documents damaged by microorganisms in connection with moving the documents from depositories to a new building of the National Library of Russia. For disinfection, a preparation Metatin GT made by a Swedish firm ACIMA was applied. Metatin GT meets three basic requirements of the agents intended for document protection: minimum toxicity for people; ability to be kept for a long period of time in paper; and lack of negative influence on paper. An another advantage of Metatin GT is that its biocide effect does not decrease during long-term document storage. The chemical and microbiological analysis of dust from depositories were carried out. The normals of biocide and material consumption and time expenditures were developed. Every week, microbiological samples (400 in total) were taken and tested to prove the effectiveness of disinfection; results indicated 97-99% effectiveness. Statistical estimation of data and accumulated practical experience gave an opportunity to carry out the method of mass document treatment. (Author/MES)

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Mass disinfection of documents affected by Microorganisms: one practical experience

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Abstract

The paper presents the results of disinfecting treatment of more than 200 000 documents damaged by microorganisms. For disinfection a preparation Metatin GT made by a Swedish firm ACIMA was applied. Metatin GT meets three basic requirements to the agents intended for document protection: minimum toxicity for people, ability to be kept for a long period of time in paper and lack of negative influence on paper. An another advantage of Metatin GT - its biocide effect does not decrease during long-term document storage. The chemical and microbiological analysis of dust from depositories were carried out. The normals of biocide and material consumption and time expenditures were developed. Every week microbiological samples (400 in total) were taken and tested to prove the effectiveness of disinfection. It was rather high - 97-99%. Statistical estimation of enormous quantity of data and accumulated practical experience gave an opportunity to carry out the method of mass document treatment

Paper

Nowadays the problem of document biodeterioration under unsatisfactory storage conditions

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(increased humidity, dustiness, temperature fluctuation, insufficient air circulation) remains urgent. Methods of paper protection against damage by microorganisms in case of emergencies when library collections are exposed to water are especially acute. Thereby it is supposed to be of interest and useful to know various solutions of such an acute problem as mass paper damage by micromycetes.

This report presents the results of disinfecting treatment of the documents damaged by microorganisms in two libraries.

The water pipes leak-proofness in the Central Musical Library in St.-Petersburg was broken for two years, which has resulted in the strongest mold damage with significant document losses. More than 3 000 storage units were damaged in total.

In connection with coming into service of a new building of the National Library of Russia (NLR) it was necessary to move about 200 000 documents from depositories on the embankments of the Neva and the Fontanka rivers. The damp climate of St.-Petersburg and closeness of two rivers have stipulated the increased relative air humidity indoors. The pipeline accident has resulted in the additional overdamping of the documents. Consequently, the intensive growth of microorganisms took place.

The paper protection against damages by microorganisms mainly consists in the inhibition of fungus life activity processes. As it is known, it can be realized by various methods with use of various biocides. The problem was in the choice of biocide and method of treatment.

There is a subdivision of prevention and long-term storage of documents in the Federal Conservation Center of Library Funds in the NLR. The members of the subdivision staff fulfill hygienic cleaning and, if necessary, disinfection treatment of documents. Books, coming to the library from private collections, other libraries, and second-hand bookshops are subjected to the obligatory disinfection. Traditionally it is the fumigation in a chamber with gas-vapor mixture on basis of formaldehyde.

The pilot installation with volume of 12 m³ (formaldehyde concentration of 2 g/m³, temperature of 40°C, exposure duration of 24 h) was offered for mass fumigation. However, the complete death of microorganisms takes place on the surface of documents only, but inside (between sheets) it occurs only by 50% under such conditions. The cost of such a mass treatment has been very high. Moreover, it is necessary in any case to wipe the documents after fumigation to remove the thin coating of mold and dust. Besides, the order of document arrangement is disturbed at the loading into the chamber and some time is required to restore this order.

Our investigations have shown that in the course of time the secondary growth of microorganisms on the documents begins owing to gradual formaldehyde desorption from treated surfaces when residual formaldehyde concentrations are low. Formaldehyde concentration in air of depository increases correspondingly.

Formalin is undoubtedly dangerous to the personnel and most of the countries of Europe and USA has already rejected it. Thereby it was necessary to use less toxic biocide but of rather efficient effect on microbiota.

The studies of the preparation Metatin GT of Swiss firm ACIMA were carried out at the Federal Conservation Center for two years. ACIMA Chemical Industries Ltd. Inc. is a producer of organic and organo-tin compounds. Production of this firm is used in restoration practice in particular in Germany.

Experiments have shown that Metatin GT does not reduce brightness and mechanical properties of paper neither right after introduction nor after durable artificial heat-and-moisture

aging. The complete death of spores and vegetative mycelium occurs at Metatin GT concentration is 5-10 times lower as with formalin. Metatin GT falls into the category of low toxicity substances under the international standards Any negative effect was not remarked when working with Metatin GT.

Thus, Metatin GT meets three basic requirements to agents intended for the purposes of document protection: minimum toxicity for people, the ability to be kept long in paper, and lack of negative influence on paper. Metatin GT has another advantage: its biocide effect is kept during long-term document storage. The cost of treatment with formalin and Metatin GT is practically identical.

The following documents affected with microscopic fungi were to be subjected to treatment: illustrated technical journals (including that on chalk-overlay paper) of the middle of the 20th century, magazines of the end of 19th - beginning of the 20th century, reference literature of the second half of the 20th century, and music manuscripts of the 18-20th centuries.

The estimated 20% of music manuscripts had areas with strong paper destruction as well as missing parts on edges and in the centre of sheets. Significant pigmentation (pink, red, yellow) which is the end product of microorganism life activity is visible on some sheets.

Bound documents were first of all affected outside where oxygen access and relative air humidity are larger. Microbiological damage is clearly visible at a visual survey on the surface of many documents: the thin coating of viable spores ranged from light green to olive green, as well as white, yellow and dark green colonies of living microorganisms. The largest accumulations of micromycete colonies are found outside and inside of book backs (where there is much glue which is a substrate easily assimilated by micromycetes), in sheet bends, in the places of warping, arising at non-uniform drying of pages and in the places of sticking down inventory tags, data card pockets, calico corners, on the first and last sheets of flyleaf paper.

The documents for the treatment were dusted very much and therefore we carried out chemical and microbiological analysis of dust from depositories.

It is known that dust is the main source of microorganisms destroying cellulose. The content of microorganisms in dust was determined by the method of surface inoculation on wort-agar, agarized Czapek medium, and meat-peptone agar. The amount of micromycetes in 1g of dust is about 2mln, that of bacteria is up to 8 mln.

The chemical composition of dust is presented in general with the largest amount of silicon, calcium and nitrogen, as well as with such metals as aluminum, iron, magnesium. Titanium, zinc, manganese, lead, copper, chrome, silver, nickel and tin are found as impurities.

Some of the found metals (iron, copper, aluminum, chrome) are capable to catalyze the oxidizing destruction of cellulose at presence of moisture, other metals (manganese and copper) influence the cellulolytic activity of microorganism ferments ; magnesium, copper, chrome and iron strengthen the formation of coloured substances.

Results of the analyses convince that it is necessary to remove the thin coating of mold and dust from damaged documents before biocide treatment. It is expedient to use for this purpose apparatuses of firm «Rainbow» intended for purifying both surfaces and air. «Dirty» air with dust and microorganisms is filtered through a disinfectant solution; going out jet is uniformly distributed in a room volume, which reduces dust perturbations and creates comfortable conditions in the room. The apparatus tests have shown their high effectiveness for document treatment: the level of mold contamination reduces by 7 to 10 times.

As a result of the treatment of 200000 documents biocide and material consumption and also time expenditures were estimated.

Documents are not of the same size, paper quality, and degree of damage by microorganisms, therefore, norms of time expenditures on treatment of each type were experimentally determined by time study.

The documents were divided into several groups (up to 8) depending on the degree of damage by microorganisms. Various groups required various material consumption and various time expenditures. Besides, we took into account document format and degree of dustiness.

The small-sized documents required the least expenditures provided that treatment was connected only with rubbing of covers, edges, and backs with biocide solution, dry cleaning (dust removing) of sheets not affected by microorganisms. In these cases the norm of time did not exceed 3 min and biocide consumption was 5 ml per a storage unit.

The expenditures increased sharply if it was necessary to remove the deposits inside the documents, to impregnate the areas of microbiological damage with biocide, to remove an excess biocide, and to interlay the sheets with dry material. Average time expenditures were 20-40 min and biocide consumption was 30-50 ml per a document of 20-100 pages. When treating of large-sized publications of 300-700 pages, time expenditure was more than 1 h (2-3 h sometimes), biocide consumption was 70-100 ml. Occasionally the time expenditures differed significantly. For example, it was necessary to treat twice the strongly damaged areas and the real expenditures doubled.

Each week we made a report on microbiological control of treatment quality. The normative conditions of document storage provide microorganism content on the surface of documents usually does not exceed 50-80 CFU/dm². On violation of required storage conditions the microorganism concentration on the surface of library materials increases. Disinfection is obligatory at concentration of microorganisms higher than 100 CFU/dm². Various areas of documents, namely backs (outside and inside), edges, fly-leaves, covers, sheets, were the objects of observation.

We withdrew 76 microbiological samples during our work at the Central Musical Library; 58 of them were taken after treatment with biocide solution, 12 samples were obtained without treatment from documents impaired in various emergencies, and 6 samples were taken from an interior surface of cases covered with oil paint containing biocide. We intended to locate the treated documents in the mentioned cases.

Full (or practically full) disinfection of a surface was detected for 80% of all taken samples. The rather high microorganism content in some cases (about 14%) is because the microorganism content on damaged surfaces before treatment was equal to 500-1 800 CFU/dm². The viable spore concentration exceeded 2 000 CFU/dm² on some areas of documents, which is an inadmissible excess of standards.

More than 300 samples were taken for 10 months of document treatment in the NLR.

The effectiveness of treatment in average was rather high: 99.4% for bacteria and 97.7% for micromycetes. The best results were obtained for smooth surfaces. The mechanical difficulties of treatment of the interior surfaces of backs practically did not lower the effectiveness of treatment. The unsatisfactory results were observed at sampling from edges. It was connected with the significant roughness of the edge surface and, consequently, with the raised adsorption of microorganisms. Therefore, it was necessary to treat edges twice.

Analysis of results of our investigations, the statistical estimation of a huge amount of data and accumulated rich practical experience allow to give the following recommendations.

Before treatment:

- Obligatory cleaning (dust removing) of damaged documents;
- Obligatory drying of documents with a heating fan.

After treatment:

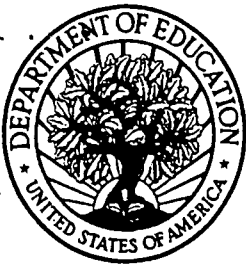
- Obligatory drying of the documents with a heating fan to remove residual moisture;
- Document labelling by special identification tapes of different colours: one colour for documents strongly damaged inside, another colour for ones damaged only outside;
- Control of room and light conditions of document storage;
- Periodic observation and biotesting of various areas of the document surfaces to detect timely the possible secondary micromycete growth.

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