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How to handle and preserve microfilms and photographs in libraries and archives: from the preservation and conservation training program of the National Diet Library

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Contents

1 Purpose of training

Microfilms are great media for long-term storage, but it is necessary to maintain an appropriate storage environment to get full performance out of them. Librarians, as users as well as managers of materials, are required to judge comprehensively what kind of measures are practical for long-term storage of microfilms. After all, this is a more substantive question of preservation, deciding where to put attention in the library's policy; how to keep a balance between preservation of original materials and media conversion such as microfilming and digitization, within the limitations of a library's budget and staff.

On June 30 2011, the National Diet Library (NDL) held a training session, "Handling and preservation

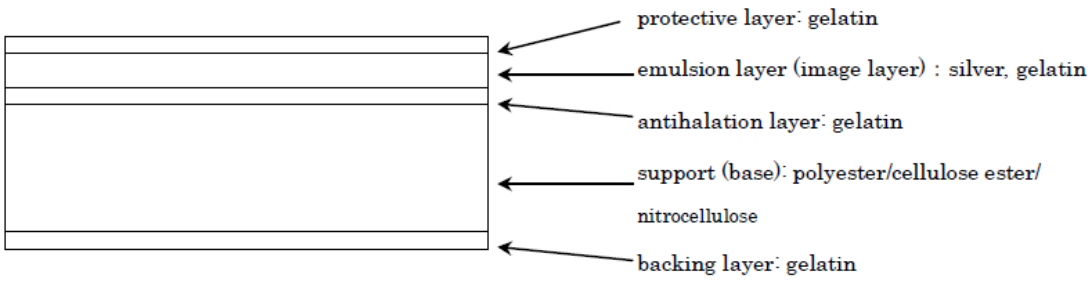
of microfilms and photographs in libraries and archives." The purpose of this training session was to support librarians so that they can actively handle individual problems with a view to long-term storage of microfilms by acquiring basic knowledge, understanding and learning conditions necessary for long-term storage, such as recommendations when producing microfilms, daily handling, regular maintenance and storage environment. The following is a brief overview.

2 Deterioration cases and conditions for long-term storage of microfilms

Mr. Nobuhiro Kuroki, member of the Qualification Program Committee of the Japan Image and Information Management Association, gave a lecture on deterioration cases and the mechanism of microfilms. He explained the basic knowledge of the structure and handling of microfilms and the mechanism of deterioration caused by them, and important conditions necessary for long-term storage with concrete examples of deterioration.

2.1 Structure and main component materials of microfilms

Microfilm is constructed as the following figure shows: from the top, protective layer, emulsion layer (image layer), antihalation layer, support (base) and backing layer.



<<Structure and main component materials of microfilms>>

If the right conditions are missing, each component material can undergo change and this leads to deterioration.

2.2 Main deterioration cases of microfilms

Microscopic blemishes and yellowing are cases of deterioration of developed silver. This occurs when oxidized developed silver transforms into silver ions which move within the emulsion layer and become minute yellow or reddish spots. This oxidization is caused by humidity and oxidized gas such as peroxide, ozone (O3), sulfite gas (SO2), hydrogen sulfide (H2S), nitrogen oxide (NO) and others in the air. Oxidized gas is considered to be derived from some sorts of building materials, plastics, gum,

acid paper and emission gas as well as fixing defects or lack of water washing during the image processing procedure.

Crack, mold and sticking are cases of deterioration of gelatin. Humidity is the key element for each case. Cracks may occur when the relative humidity becomes lower than 15%. Mold may occur when the relative humidity becomes higher than 50%. Sticking may occur when the relative humidity becomes higher than 60%.

Deterioration of support, especially a cellulose ester base, is well known as vinegar syndrome. Ingredients of a cellulose ester base are cellulose triacetate itself and plasticizer for flexibility. Vinegar syndrome is caused by acetic acid produced from hydrolyzing of the cellulose ester base, and its deterioration symptoms are seen going through the following process.

1) Hydrolysis occurs through incomplete drying of films during image processing procedure, and moisture from the humidity of the storage environment.

2) Acetic acid of the base splits off by hydrolysis.

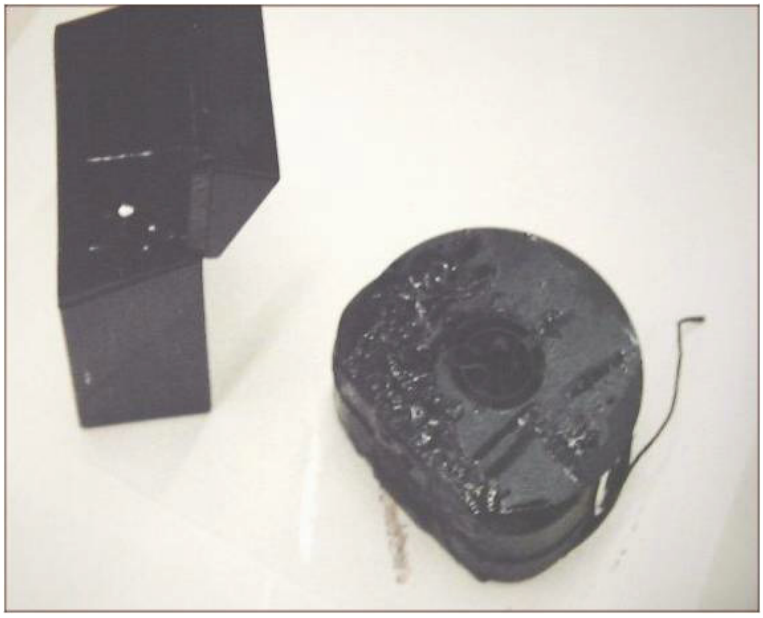
3) Acetic acid promotes resolution and deterioration proceeds. When deterioration reaches a certain level if increases in speed.

4) At the same time, plasticizer separates. Melted plasticizer crystallizes and when the crystals get larger, they push the gelatin aside which leads to distortion and destruction of images and finally the images become unreadable. Films which have lost plasticizer lose flexibility, and shrinkage and ruffling of the base occurs.

<<Ruffling>>

5) When deterioration proceeds, the plasticizer resolves. Resolution of the plasticizer produces acid

materials, the pH level falls and deterioration proceeds faster. Gelatin resolves and it becomes a black mass exuding from the edge of films together with plasticizer and developed silver, or turns into black spots on the surface of the films. Sometimes even spools are dissolved.



<< Melted spool >>

2.3 Storage conditions for microfilms

What is necessary to prevent the kinds of deterioration mentioned above and to store microfilms for a long time? Microfilms are recorded media with a long history and measures for long-term storage are defined by standard. For this reason, it is important to observe the standard for processing and storing microfilms.

Proper control of temperature and humidity is an essential condition to prevent deterioration of microfilms and for long-term storage. In the Japanese Industrial Standards (JIS), JIS Z 6009-1994 “Silver-gelatin type microfilms – processing and storage” is defined as follows:

Condition of relative humidity and temperature

Storage conditions	Relative humidity (%)			Temperature (℃)
	Maximum	Minimum		Maximum
		Cellulose ester	Polyester	
Conditions for medium storage[1]	60	15	30	25 (4)
Conditions for permanent storage[2]	40	15	30	21

note 4: Ideally, temperature must not be over a 25℃ for a long time and it should be under 20℃. The peak temperature fora short time should not exceed 32℃.

Recital 1. The conditions of temperature and humidity shall be maintained 24 hours a day.

2. For permanent storage of cellulose ester base film and polyester base film in the same place, the recommended relative humidity is 30%.

To meet these conditions, measures such as setting up special storage, using cabinets with a function to control temperature and humidity, or using humidity control materials can be taken. In the International Standard, ISO 18911-2010, maximum temperature for the cellulose ester base is set extremely low.

For other conditions, it is necessary to keep down dust and gaseous impurities in the air and to pay attention to enclosures such as paper and plastics which are in contact with films.

Mr. Kuroki concluded that deterioration of microfilms is caused by three factors, materials factor, process factor and storage environment factor, and for long-term storage of microfilms, it is necessary to remove completely these causes of deterioration.

3 Approach of the National Diet Library

At the end of the training session, Shigehito Hisanaga, Preservation Division, Acquisitions and Bibliography Department, NDL, reported on the approach of the National Diet Library to the

1 JIS Z 6009-1994 defines term of medium storage as 10 years or over.
2 JIS Z 6009-1994 defines term of permanent storage as permanent.

preservation of microfilm materials.

3.1 Microfilm collection of the National Diet Library

The NDL holds 8.93 million microfilms (as of the end of March 2012). There are 590,000 microfilms, 8.04 million microfiches and 300,000 micro prints. Certain parts of them were microfilmed by the NDL and others were acquired by legal deposit, purchase, donation and international exchange. The NDL makes both negatives and positives at once and basically, negatives are for preservation and positives are for use. It keeps the films for preservation in a dedicated microfilm storage. The temperature and relative humidity in this storage are maintained at 18℃ and 25% in general with 24-hour air conditioning. The use of films for preservation is limited to recreating damaged positives, for digitization, etc. On the other hand, films for use are stored in the usual stacks along with paper materials such as books and periodicals. Temperature and relative humidity in the ordinary stacks are maintained at 22℃ and 55%, and it is air-conditioned only during daytime.

3.2 Project of preservation measures for microfilms

The NDL organized several preservation teams in 1983 according to types of materials and causes of damage and each team tackled a specific problem such as the physical damage caused by the increase of copying, the acid paper problem, etc. The NDL has preserved microfilms in the above-described environment, based on the results of discussion by the microfilms preservation team.

After that, the NDL conducted two big projects for preserving microfilms. One was the project of recreating Japanese newspaper microfilms of the 1990s. The other was the urgent countermeasures against deteriorated microfilm materials in fiscal years from 2004 to 2008.

3.2.1 Project of recreating Japanese newspaper microfilms of 1990s

Phenomena such as acetic acid odor, deformation, tackiness, etc. were found in the Japanese newspaper microfilms (created from the 1950s to 1960s) in 1989. The NDL established an investigation committee including outside experts and investigated causes and discussed countermeasures. As a result, it was found that rapid deterioration happened the so-called “vinegar syndrome,” caused by an inadequate environment for preservation of cellulose ester based films. Therefore, countermeasures such as setting up the microfilm storage as noted above, recreating polyester base films, etc. were implemented. The target Japanese newspaper microfilms numbered over 30,000, so it was impossible to recreate them all at once. In order to delay the deterioration, we changed the metallic cases used until then to cases made of acid-free paper, and wound the films back to dissipate accumulated acetic acid.

3.2.2 Urgent countermeasures for deteriorated microfilm materials

In 2002, a NDL staff member found sticking microfiches stored in the reading room where the temperature and humidity were not controlled. Staff of the NDL conducted a preliminary investigation to grasp the degree and dimension of deterioration. As the same phenomenon was confirmed in other microfilms, a five-year plan from fiscal 2004 to 2008 for urgent countermeasures against deterioration was decided upon. The target of this project was microfilms acquired by March 1992, which were possibly cellulose ester based. The NDL changed the way it created microfilm from cellulose ester base to polyester base in April 1992, and it was considered that there was no fear of degradation in polyester base film. The amount of the targeted microfilms was estimated at about 5,050,000. At the beginning, the NDL proposed to take the measures for all of them, but in mid-term the number was reduced to about 1,800,000 of cellulose ester base microfilms for preservation.

The urgent countermeasures were implemented in two stages depending on the type of materials (books, periodicals, science and technology materials, rare books and old materials etc.). As a primary measure, replacing acid paper cases with acid-free paper cases, dissipation of acid gas by winding films back, and research of the deterioration level were conducted. As a secondary measure, restoration, recreation, and separation of films were conducted, based on the results of the primary measure.

4 Conclusion

More than 100 people from libraries, archives and museums attended the session. It included some participants from areas afflicted by the Great East Japan Earthquake. Many participants seem to have difficulties in countermeasures against deterioration because of severe budget constraint.

At the end of the session, it was restated that three factors, namely good materials, proper handling and appropriate preservation, are indispensable for long-term preservation of microfilms. The NDL will share experience and knowledge with related organizations and specialists.