

Chapter 3

Rescuing Paper Materials

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Introduction

The paper materials covered in this chapter refer to records generated and accumulated by people during their lives. These materials, mainly written records, are made of various types of paper depending on the period and purpose, ranging from old documents with recognized historical and cultural value to everyday memos and journals. A vast, diverse group of materials remains across Japan.

While many public institutions such as museums, libraries, and archives hold paper materials, individuals have enormous materials at home, which they have inherited from ancestors to convey the history of the community and the family. They come in records maintained by organizations, personal diaries, writings, and books. However, in most cases, the owners treat them as a group, so in a disaster, those who rescue them must handle a massive amount at once; in such cases, they must accurately identify and treat water-damaged materials.

1. Rescuing Damaged Paper Materials

If a disaster damages the storage space, materials not contained in containers are at risk of being scattered. In addition, a tsunami or torrential rains can deteriorate paper materials—easily contain water—due to decay and mould, destroying some of the text and other material information, and even the materials themselves [Fig. 1: Materials damaged by tsunamis (rescued on 23 March, 2012)].

Letters and documents are sometimes stored as a group of several items, tied together with string or in envelopes and bags. The custodian may have organized them by age and contents when storing them. In a regular organization of materials, the practitioner needs to record the condition and structure of the materials before transportation; it is fundamental to organize the materials while retaining their original shape and arrangement, as the storage space per se is essential information.



Fig. 1

However, it is difficult to make such detailed records following these basic principles in a disaster because of the need to transport materials rapidly within a limited time. Therefore, it is desirable to record the on-site removal process with photographs or videos and keep them as reference information for later organization work. As for paper materials, it is not easy to determine whether they are historical at the on-site work stage. Usually, it is impossible to immediately grasp information on materials at the disaster site due to water damage or mud stains. Saving as many materials as possible requires removing them first and then sorting them out while grasping their contents during the first aid phase.

When handling, the practitioner should be careful to avoid damage or dissipation of the materials, as they are vulnerable when wet. Since most paper materials are groups of records accumulated by a house or organization, they are generally stored as a single group, often in boxes or containers. When transporting, it is necessary to keep them together as much as possible, and if stored in a container, move the container itself; if not, the practitioner needs to put them into plastic bags or cardboard boxes before transportation. The order should be maintained, but it is challenging to maintain detailed order under limited circumstances, so it is necessary to record the condition with photos or videos before transferring.

2. Condition Assessment and Temporary Storage

2.1. Grasping the Condition

Dealing with damaged paper materials requires the practitioner to confirm the presence or absence of breakage and water damage. Earthquakes can tear or break the paper materials, while water damage by rainfall, storm surges, and tsunamis sometimes destroy them, too. We should not leave them unattended, or water damage will lead to decay and mould, making it impossible to maintain and pass on the materials as historical ones. Therefore, the practitioner must check the following points.

(1) Approximate Number of Materials

Precisely counting the number of materials at the rescue stage is almost impossible: check the approximate number of items for planning the work process. Paper materials are usually lie in containers, so it is necessary to carry them as they are. Otherwise, put the materials into containers like cardboard boxes and count the number of the containers. In addition, check the forms of materials (books, documents, letters, postcards, coated paper) as best as possible.

(2) Water Damage

Determine the cause of water damage: rainfall, storm surge, tsunami, river, or moisture or leakage at the storage location. We can focus on dealing with the water in the case of rainfall or moisture. However, river or sea water may contain contaminants which need work other than drying.

Check the extent of the damage, whether entirely or partially, and see whether the water is so wet that it is dripping or has already started to dry.

(3) Damage level

Confirm mould, rot, odour, and paper adhesion. However, at this point, see only the extent of the damage seen by surface observation. Mould, decay, and odour can pose health hazards, so avoid putting your face too close to the material. Adherence can break the material if wet. Do not separate the sheets forcibly.

2.2. Temporary Storage After Transportation

Storing water-damaged materials at room temperature will cause them to rot; dry them as quickly as possible. If the total number is under 100, it may be possible to dry them immediately after transportation. However, many items need preparations for treatment, and immediate response becomes difficult. Frozen storage using a freezer is sometimes necessary during the preparation for treatment [Fig. 2: Frozen-stored water-damaged materials].

The advantage of frozen storage is that it can control decay and deterioration, including biological damage. During frequent typhoons, high temperature and humidity aggravate the risk of rapid decay; temporary freezing and storage make it possible to adjust work timing, for example, to conduct full-scale work after the weather becomes cooler and drier.

If possible, pack each item in a plastic bag and frozen. However, if the items are in too poor a condition to separate one another, pack them in a plastic bag and frozen as a whole. Since it is not easy to immediately secure a large freezer, it is advisable to identify nearby facilities with large freezers before a disaster and ask them to cooperate in an emergency.

3. First Aid Measures for Damaged Paper Materials

Regarding the first aid measures of paper materials, many practical examples of disaster countermeasures and manuals are available in Japan and abroad, introducing detailed process techniques. This chapter focuses on the required response and the concept of first aid rather than presenting specific techniques.



Fig. 2

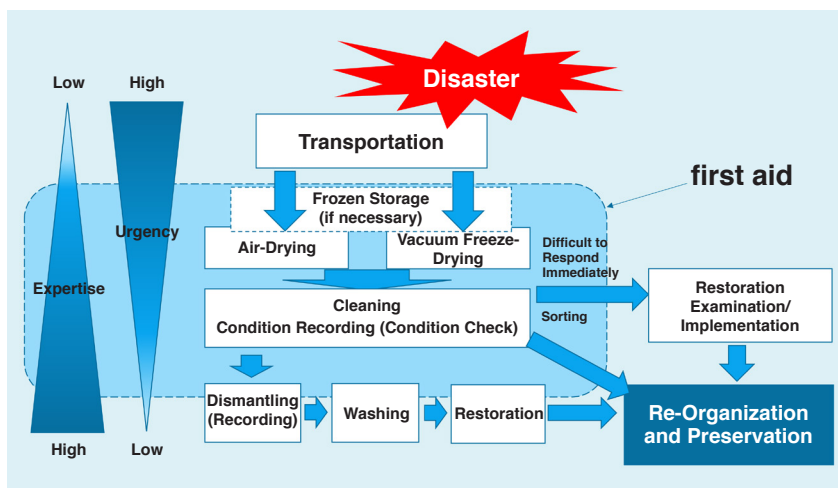
One of the goals of such measures is to prepare for the data recording: count the number of materials and eradicate major concerns—decay, breakage, or mould—about storing and managing at average temperatures. Drying, cleaning, and adherence separation are necessary.

3.1. Drying

The drying process is the highest priority. However, we use different methods depending on the condition and scale of the materials and the number of practitioners. Methods practised or introduced are diverse and come into three patterns regarding methodology and purpose.

The first is air drying [Fig. 3: Air-Drying (Hiroshima Prefectural Archives, 30 July, 2018)]. Practitioners spread the materials in a space out of direct sunlight and dry them with natural air or a circulator. This method is more cost-effective and technically feasible than others. However, considering the risk of spoilage, it is most effective when dealing with materials with only minor mould or stains and just beginning to dry out.

Next comes water absorption drying [Fig. 4: Water Absorbent Drying (1): Wrapping materials in absorbent paper (Hiroshima Prefectural Archives. 11 December, 2018), Fig. 5: Water Absorbent Drying (2): Degassing in a pouch (Hi-



Workflow after rescue



Fig. 3



Fig. 4



Fig. 5

roshima Prefectural Archives. December 12, 2018)]. Some researchers have recently proposed specific processes with various practical examples. However, the basic concept is the same: wrap materials in absorbent paper and squeeze out the moisture by applying pressure. This method is effective for materials containing a large amount of water. It can effectively extract water by wrapping each material or a single mass of materials in absorbent paper and applying pressure.

When handling large quantities, it is possible to squeeze out the moisture by placing the material in a pouch and deaerating it with a vacuum cleaner.

Water absorption drying alone takes a long. Therefore, this method is usually used for the preparation of air drying. When they can open the adhered paper roughly, the practitioners use air drying.

The third method is vacuum freeze drying. This method is large-scale, uses vacuum freeze-drying equipment, and effectively handles large volumes of materials (more than several thousand). In Japan, researchers used this method for the first time in 1992 in Soka, Saitama, to dry materials damaged by water due to a private house fire and firefighting activities. Since then, researchers have used this method for large-scale water damage, but it is not a silver bullet because coordination with facilities that own equipment is necessary and the cost is not low. Therefore, when we anticipate a large-scale disaster, we must coordinate in advance with nearby museums and research institutions that own the equipment.

As described above, several methods are available for drying materials. However, selecting a technique that suits the situation and purpose is necessary rather than sticking to a specific one. Generally, when working manually, it is vital to avoid applying heat or other methods that may damage the materials and to avoid rapid temperature changes. In addition, coated paper sheets may adhere to one another too firmly if dried thoroughly.

In any case, it is often difficult to dry the materials completely using only one method. Combining several ways depending on the condition of the materials and the workforce is necessary.

For example, see the practice after the torrential rains in western Japan in 2018. The torrential rains caused water damage to several thousand paper materials (account books, postcards, letters, and paintings) stored in private homes in Hiroshima. The Hiroshima Prefectural Archive accepted these materials and carried out the drying process according to the following procedures.

Selecting an Appropriate Drying Method

	Air-Drying	Water Absorbent Drying	Vacuum Freeze-Drying
Cost	⊙	○	△
Work Efficiency	△	△	⊙
Versatility	⊙	○	△
Anticipated Usage	Minimal mould and staining/minor water damage	Temporary treatment for air-drying; used when the material has a lot of moisture	In the case of extensive damage

(1) Classification

First, they classified the materials by genre (account books, pamphlets, postcards, letters, and paintings).

Then they sorted the classified materials into three categories: (a) those containing a large amount of water and are at a severe risk of decay, (b) those beginning to dry out, and (c) those already dry and with no evidence of water damage.

(2) Treatment

(a) They wrapped each item in a plastic bag, put them in a cardboard box to prevent odour and moisture, and stored them frozen.

(b) They prepared shelves and air-dried the materials in a well-ventilated place out of direct sunlight.

(c) They cleaned the materials after checking the mould and staining. At this stage, they focused on adherence separation described below rather than stain removal, confirming that they are dry to the depths.

(3) Thawing and Drying of Frozen Materials

For (a), since it was summer, they froze 17 cardboard boxes and stored them until when spoilage was less likely to progress. When winter came, they started the drying process.



Work process at Hiroshima Prefectural Archives during the 2018 torrential rains in Western Japan (Amano et al., 2019)

Next, they removed the frozen materials from the plastic bags and wrapped each item with absorbent paper (newspaper).

Putting the materials into pouches, they observed the progress in deaeration. After about 1 to 2 days, the frozen materials returned to room temperature. Confirming that the paper absorbed the moisture, they took the materials out of the pouches, replaced the paper, and degassed them again.

Repeating the process several times to separate the adhered materials from one another, they finally dried them with air.

In this case, they could perform such a work process because they had ample space at the archive and could use freezers, and many workers helped them with the work. Depending on the location, it may be challenging to follow this process as the power supply and pouches may not be available. For example, we can prevent dehydration without pouches by wrapping the materials in absorbent paper, laying them on a flat surface, and placing something on top. The principle is the same, and selecting a method that does not damage the materials is crucial.

3.2. Purpose of Cleaning

Cleaning is necessary to make it possible to temporarily store the materials after drying. We have two options: dry cleaning (done in a dry condition) and wet cleaning (done with water). The purpose of cleaning is to remove any spoilage from the materials, but the extent of the treatment is an important issue. Since most paper materials are documents, the process includes separating the adhered materials to prevent them from sticking to one another.

If wetting causes the adhesion, we can separate them by carefully making a gap in the sticking area with a spatula or tweezers [Fig. 6: Material adhered by water damage (sample)]. This process needs care and time: never run the risk of breakage, and try to open from a different part. The opening can be highly challenging if mud or mould causes the adhesion. It is a good idea to stop the work, document the current situation, pack the mouldy or dirty material to prevent it from scattering and focus on temporary storage to complete the emergency measures. In this case, it is desirable to remember that the first aid is only temporary and to proceed with arrangements for the repair plan.

Depending on the damage, the dried materials may still have mud, mould, or other contaminants [Fig. 7: Material adhered by mould]. Therefore, it is necessary to remove mould spores on the surface by removing the mould with a cloth or paper dampened with ethanol. We can remove mud stains so that the process does not damage the materials, but dry cleaning has a limited effect. Moreover, brushing can run the risk of scattering. Therefore, during the dry cleaning stage, opening up adherence is better than struggling to remove all the stains. Health



Fig. 6



Fig. 7



hazard measures are necessary for this work: wear industrial masks with high dust-proof performance and high particle collection efficiency to prevent inhalation of mould and other contaminants. In Japan, DS2 masks meet the National Inspection Standards set by the Ministry of Health, Labor and Welfare, as do N95 masks American standards and FFFP2 masks European standards, respectively.

Even if most of the work is adherence separation, mould and contaminants scatter to some extent, so sufficient ventilation is necessary. Install air purifiers to keep the work environment clean.

The first aid measures for paper materials aim to grasp the overall condition of the materials; completely separate the adherence caused by water damage; and prevent odour, mould, and stain spreading for temporary storage. As forcible attempts may result in large-scale damage, if even simple repair afterwards seems impossible, adherence separation should be temporarily suspended. Sometimes, wet cleaning may also be effective as an emergency measure to remove contaminants and odours. Usually, however, water-based cleaning requires the disman-

ting of the materials. In this case, too, it is a prerequisite to have the technology and equipment to handle the materials after cleaning. Depending on the damage, the dried materials may still have mud, mould, or other contaminants. In rescuing documents, we tend to focus on bringing the textual information to a readable state as quickly as possible. However, from a long-term perspective, it is effective for the preservation and inheritance of the materials to proceed in a step-by-step and systematic manner.

Conclusion

Paper materials remain in vast quantities throughout Japan, and when rescued, they are damaged, and the items come in large quantities. They are vulnerable to water and breakage and require an extremely rapid response from the rescue to the drying. Many practical reports are available, including those on familiar materials (refer to them for specific techniques and information). However, it is important to note that the work process should be simple and that the first aid should have specific goals. Thus, it will be essential to keep the following basic objectives in mind: (1) dry the materials to get out of the immediate crisis, (2) open the materials to get an overview, and (3) manage the materials to proceed toward a full-scale response. See the work mentioned in the reference for specific and simple ideas and methods in this process (YAMAGUCHI, 2022).

References

- AMANO Masashi, YOSHIKAWA Keita, KATO Akie, NISHIMUKAI Kosuke, and SHIMOMUKAI Yuko. “Nishinihongou de suisonhigai wo uketa monjoshiryo kansho no kento [Drying Methods for Water-Damaged Documents in Heavy Rains in Western Japan]”. Poster presentation at Japan Society for the Conservation of Cultural Property 41st Conference, 2019.
- MASUDA Katsuhiko. “Suigai wo uketa tosho monjono shinkutoketsukanso [Report on Vacuum-Freeze Drying of Books of Japanese Handmade-Paper]”, in: *Hozonkagaku* [Conservation Science], 31, 1992.
- National Institutes for Cultural Heritage founded the Cultural Heritage Disaster Risk Management Center (ed). *Fuyukabito karano jintai no bogo ni kansuru manyuaru* [Manual

for Human Protection against Floating Mould]. <https://chdrm.nich.go.jp/facility/2022/03/post-49.html> (last visited 25 Dec 2023)

NISHIMUKAI Kosuke and SHIMOMUKAI Yuko. “Hiroshima kenritsu monjokan niokeru 'Heisei 30 nen 7 gatsu gou' hisaibunsho no resukyu to hozenkatsudo [Rescue and Preservation of Materials Damaged by July 2018 Heavy Rains at Hiroshima Prefectural Archives]”, in: *Bulletin of Hiroshima Prefectural Archives*, 15, 2020.

YAMAGUCHI Satoshi. “kamiseichiikishiryō wo nokosu gijyūsu [Technologies for Preserving Paper-Based Local Materials]”, in: AMANO Masashi and GOTO Makoto (eds). *Chiikirekishibunka keisho gaidobukku* [Guidebook for Inheritance of Local Historical Materials]. Bungaku Report, 2022.