

Recovery of Water-Damaged Digital and Traditional Prints

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Abstract. The recovery after flooding of digital prints arranged in albums has been investigated, and compared to water-damage sustained by similarly-mounted black and white, and colour, photographic prints. The effects of water damage on inkjet prints made from dye-based and pigment-based inks on porous and non-porous papers are compared. Advice is given on flood damage recovery of album-mounted digital prints, with an emphasis on the steps which can safely be taken by the home consumer.

1. Introduction

The long time preservation of photographic prints can be seriously threatened by either fire or water. Obviously prevention is the best defence. While recovery from fire is extremely difficult if not impossible, recovery from water damage may be successful in some situations if proper techniques are employed. Unfortunately, water damage to prints is not that uncommon. Major problems are caused by disasters such as earthquakes, floods and broken water mains, while less severe damage results from roof leaks, plumbing problems and spillage. Although there has been considerable experience with the salvage of traditional photographic prints [1-4], there is very little information available on the recovery of digital prints. Consequently laboratory investigations were conducted at the Image Permanence Institute to determine the nature of water damage to the various materials used in digital prints and to provide practical guidance to the home consumer who is faced with the need to wash, dry and flatten water soaked prints.

2. Experimental

Black-and-white photographic, color photographic, dye diffusion transfer and ink jet prints on swellable and microporous paper were placed in albums and immersed in water for times varying from several minutes to 24 hours. River water was used, which contained sedimentary materials. The prints were mounted in albums so that the image layer was either against a blank page, an image of the same print material, or within a plastic page protector. The prints were subsequently examined for distortion, sticking, staining, image transfer, bleeding and flaking. Print recovery was attempted when mounted in albums, when mounted on album pages which were removed from the album, and with unmounted prints which had been removed from the album pages. In addition to an examination of the print damage, various approaches to drying the prints and removal of wrinkling and distortions were investigated.

3. Water Damage of Prints

The nature and the extent of water damage is very dependent upon the composition of the print material. Black-and-white photographic prints consisting of a silver image in a gelatin binder are the most stable and are very resistant to water damage. A slight discoloration in highlight areas may be observed and sticking may occur with a contacting print. The most serious problem is waviness and distortion after drying.

Color photographic prints featuring dye images in a gelatin layer behave similarly to the black-and-white materials. Because they contain a plastic layer between the image and the paper, they have less tendency to discolor and show less distortion after drying. However, sticking to an adjacent print may be a problem.

Dye diffusion thermal transfer prints differ from traditional photographic images in that the dye image is transferred by heat from a donor ribbon onto a paper support. These prints can be produced at photo kiosks and some home printers. These materials are quite resistant to water damage although slight image transfer to a contacting print has been found. Distortion after drying is less severe than with traditional black-and-white photographic materials.

Ink jet prints are the most common materials that are produced by home printers. There are several types of ink jet prints which are available [5]. They differ in both the nature of the colorants and characteristics of the paper. The two types of colorants are dyes and pigments. The types of paper are either uncoated or coated. Moreover, coated paper can be swellable or microporous. Swellable paper features a layer that can absorb moisture and thus absorb the water-soluble dye. Microporous paper has a surface of very small inert particles, and the colorants are deposited in the numerous cavities between them. The nature and extent of water damage is very dependent upon the nature of the material.

Dye images on swellable paper are severely damaged even after very short immersion times. The dyes show extensive bleeding into adjacent areas of the print and also into contacting surfaces. Print distortion after drying is severe and cannot be flattened.

Dye images on microporous paper show a different type of damage. In addition to dye bleeding, a problem of flaking of the paper coating containing the image is observed. This is particularly severe when there is contact with another surface. Distortion is severe and similar to that of swellable paper, but flattening may be possible. Pigment images on microporous paper do not show bleeding. However, flaking occurs when the image is lightly rubbed or when separated from an adjacent print.

The extent of water damage differs between prints from different manufacturers.

4. Print Washing

When prints are exposed to dirty water, washing is required. This must be done when the prints are still wet, otherwise dirt particles will become permanently embedded. Cold water should be used and gentle agitation may be helpful. This must be done carefully to avoid damage to the image. The washing technique may require trial and error.

5. Print Drying

It is important to start salvage treatment as soon as possible. Delay may result in image degradation, paper disintegration and mould growth. The latter can occur if prints remain wet for more than 2-3 days [6-7]. Mold will eventually destroy the image. If drying cannot be started within this time period because of the lack of facilities or the volume of material, the prints should be frozen until salvage can commence.

The best drying results are obtained when prints are dried individually and not mounted in pages. If the prints have been stacked in boxes or tightly packed together, they should be separated while still wet. Prints should never be allowed to dry when in contact with other surfaces. Otherwise separation may not be possible without physical damage.

Black-and-white photographic prints, dye diffusion thermal transfer prints and ink jet prints on microporous paper can be dried by placing them between sheets of blotting paper under uniform pressure. When the blotting paper becomes saturated, it must be replaced. This can be labor-intensive. This approach not only dries the prints but also flattens them. If drying space is limited, the interleaved prints can be dried in stacks.

This approach is not recommended for some color photographic prints and for ink jet prints on swellable paper because of possible sticking to contacting surfaces. These materials can be air dried after first draining any excess water. Gentle blotting may be possible with some prints. Prints should then be placed flat with the image side up and air should reach both print surfaces. This can be accomplished by placing the prints on screening material. This is the most benign treatment and the easiest to employ [8]. While this drying procedure is least likely to do any damage, it will not provide any flattening and the dried prints will show cockling, wrinkling and distortion. Microwave and hot air drying is not recommended as it is very difficult to control the application of uniform heat and avoid problems of severe cockling and blistering.

6. Drying of Mounted Prints

Drying of prints while still mounted on album pages has the advantages of less handling and less labor. However, it is not recommended. If prints are dried while fastened to album pages, cockling of the album pages themselves will further distort the prints. Prints are easily removed from pages if water-soluble adhesives were used. When water-insoluble adhesives were employed, great care must be taken to avoid damage by removal, and the work should be carried out by a professional conservator if possible. In the home situation, commercial adhesive removers should only be used outdoors or in well-ventilated areas, as they may be toxic or very flammable.

If salvage of the album pages is important, less page distortion will result if they are dried after the prints are removed. However, if salvage is done only to retain identification information, the pages can be cut from the album and dried.

7. Drying of Albums

Drying of the albums is extremely difficult and is generally not possible in the home situation. It should only be attempted if the album itself is of historical or sentimental value, and should be carried out by a professional conservator. Water damage can be very severe. The fabric, plastic, paper or leather cover may separate from the cardboard core. The adhesive securing the pages within the album cover may dissolve, the album may lose its shape and may disintegrate. Inks used for identification may be water soluble and dyes may bleed and cause print discoloration.

If an attempt is made to recover the album, it should be disassembled and prints removed. The pages should then be air dried and then reassembled. When the album cannot be disassembled, sheets of blotting paper may be inserted between the pages. These must be replaced when wet. However the added thickness may increase album distortion.

8. Page Protectors

While plastic page protectors facilitate the handling of album pages and prevent damage from spilled liquids, they can cause problems when the entire album becomes wet. Sediment can become embedded between the prints and the page protector. In addition, prints - ink jet prints in particular - may stick to the protector. Page protectors do not protect the prints from water contact when the immersion time is longer than about one hour, but they do provide some protection for immersions of a few minutes.

Page protectors should be separated from the album pages as soon as possible after the album has been removed from the water. Otherwise the drying process will be very slow and can result in mold growth.

9. Freezing

Wet prints should be frozen when immediate drying is not possible. As previously mentioned, prints that remain wet are susceptible to further damage and will eventually be destroyed by mold. If the number of wet albums or prints is so large that proper drying procedures cannot be started within 48 hours, or if there are other constraints, the wet materials should be frozen in plastic bags and later thawed and dried when time and facilities permit [1,4]. Further degradation and mold growth are arrested at freezing temperatures. A regular home freezer can be used for this purpose. The disaster recovery plan for many museums would include the hire of industrial freezers. Prints can be kept in a frozen state for a long time. Prints in stacks or in close contact need not be separated prior to freezing. However, plastic page protectors must be removed before freezing to keep them from sticking to some types of print material. Prints should be removed from the plastic bags before thawing to prevent mold growth. Depending upon the contacting surface, freezing can cause a change in surface gloss, although this change is preferable to the damage that can result from prolonged wetting.

10. Print flattening

Curl or distortion is generally the major problem when wet paper prints are air dried. Such prints may require flattening. Wet prints that are dried under pressure will be relatively flat. This procedure can be used for traditional black-and-white prints, dye diffusion transfer prints, and ink jet prints on microporous paper. However, color photographic prints and ink jet prints on swellable paper will stick to the materials used to apply pressure. Color photographic prints and dye diffusion thermal transfer prints can be flattened after they have been dried by placing them under a heavy weight for several days. This is not effective for other materials. It is possible to reduce distortion of heritage black-and-white photographic prints by lightly brushing water on the non-image side or by placing them in a humid environment. The latter can be obtained by running a vaporizer in a small room. The moistened prints may then be dried flat under pressure. This method has been used with marginal success for ink jet prints on microporous paper but flattening has not been successful for swellable paper.

Another technique that has been suggested in publications for the home consumer is heating the prints with a steam iron, but this is not recommended in any circumstances. Applying too-high heat or applying heat for too long can further damage prints.

11. Summary

Optimum results are obtained when new prints can be made and mounted in new albums. However, this is generally not possible. Salvage treatment must be started within 48 hours, otherwise the wet prints should be frozen. Page protectors should be discarded. Soiled prints must be washed after removing them from the album. Black-and-white photographic prints, dye diffusion transfer prints and ink jet prints on microporous paper can be dried between blotting paper. This will also reduce print distortion. Color photographic prints and ink jet prints on swellable paper must be air dried. Distortion of photographic prints is reduced by placing the dried prints under a heavy weight. In the home situation, microwave [9] and hot air should not be used for drying and a steam iron should not be used for flattening.

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