

## Second Generation Wet Paper Pulping

### ABSTRACT

The author has followed the original paper pulp recipe devised by Keiko Keyes in her 1976 publications but has added secondary steps which use a pressure cooker to modify the pulp, rendering it more easily manageable. Several refining steps, dealing with dispersal, application, toning, and storage add more paper pulp information to the paper conservation repertoire.

### INTRODUCTION

Even though pulping is mentioned in the conservation literature as far back as the mid-1950s, it was Keiko Keyes's articles "A Manual Method of Paper Pulp Application in the Conservation of Works of Art on Paper" in the *Paper Conservator* and "A Practical Application of Paper Pulp in the Conservation of Works of Art on Paper" in the *AIC Preprints* from 1976, and her presentation at the AIC meeting in Dearborn, Michigan, in May 1976 that defined the use of pulp for filling losses in paper in a workable manner. I believe the entire field of paper conservation embraced the technique as a timesaving way to fill losses in paper supports from that time.

There have been several modifications of the initial pulping technique as presented by Keiko Keyes. The transfer of paper pulp using a large pipette instead of the spoon or flask refined the filling of the large losses. The use of the mushroom cleaning brush, the complexion brush, or the boar bristle oil painting brush to flatten, spread, and disperse the pulp by a number of colleagues is notable. I found the use of already aged paper enhanced the quality of my pulp, as did other conservators. The use of other supports rather than the wet-strength paper was helpful. I use several non-woven synthetic supports and imprinting

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stamps and have even moved to Mylar, when the artwork was too large to transfer to non-woven synthetic supports. The news of each of these modifications spread through the network of friends and students. But there were two technical questions which were never satisfactorily answered—namely, how to make paper pulp on a large, repeatable scale from any paper and how to tone paper pulp on an equally large scale. I was soon made to address at least one of those points for a very large treatment, and I would like to present my findings and experiments in other areas as well, which I hope you may find useful.

### DESCRIPTION OF WALLPAPER PROJECT

I was approached four years ago regarding a wallpaper conservation treatment on a scenic wallpaper designed by Charles Burchfield and printed by the Birge Co. in the 1920s in Buffalo, New York. Although three scenic papers were designed by Burchfield, none was known to be off the wall and available. This sample of "Country Life" and "The Hunt," which was usually printed and sold as a unit, measured 80 inches high by 35 feet long and was in rather good condition, even though it had been roughly removed from the wall some years ago along with its two linings. There were many losses at the tops and bottoms of the twenty-three panels, long vertical breaks and tears with associated losses where the wallpaper had been wrapped around corners of the room, and large losses where paper had been torn out to accommodate light switches and moldings.

The technique was documented as woodblock by the Birge Co. in its catalogue on its scenic wallpapers, and the characteristic "squish" marks could be detected, which were similar to those found on the French scenic wallpapers. The colors were primarily pastel in nature with some red for the coats of the hunters. However, the plants and trees were pure Burchfield in design, and the colors were wonderful purples, greens, golds, and browns. We ascertained later as the in-painting was proceeding that the paint

for the panels was custom mixed for the day of printing as no set of paints ever exactly matched any other set from other panels.

The medium was not water-soluble and looked similar to matte silkscreen ink; thus, I was able to use water in the treatment. This fact greatly facilitated the treatment of such a large work. Consequently, I considered the use of paper pulp filling for the extensive losses.

Given the amount of pulp I would need for the large losses on the Burchfield wallpaper (I ended up using a two-gallon jar of concentrated pulp stock), I decided to ask colleagues about their pulp recipes. Answers from several colleagues led me to believe that pulping was used sparingly for small losses and possibly not at all by some conservators. The main reason they gave was not being able to make a satisfactory pulp that would look good with a small amount of manipulation.

Certainly, I must say that there were other problems given, which I later categorized as "Pulping/Advanced," which included matching pulp to difficult papers. Thus, I arrived at the subject of my paper, which is making satisfactory pulp, repeatedly. Furthermore, I have designed the pulp to be applied with a small pipette, quickly. Other information includes my work on dispersal, application, bubbles, toning, and storage.

#### A NEW LOOK AT PAPER PULP

My research began by choosing a thin, even paper of good quality—Rives lightweight. I found that other papers could be used, but the thinner and more even a paper found in the Rives LW indicates to you that the fibers are uniform, and it was a good paper with which to experiment as it is found easily at art stores.

I carefully followed the Keiko Keyes recipe. It leaves a few questions: what size blender and what speed were used? Keiko Keyes's students responded that it was a regular blender (not a commercial size) and on medium speed, as they remembered. The pulp was thick as it appears in the *Paper Conservator* article. Keiko Keyes mentioned in her article that longer blending would rid the pulp of knots. Keiko always manipulated the pulp at the pulping site, according to her students, and it was applied using a spoon or poured from a glass flask. The pulp varied, depending upon the paper chosen for making the pulp. Good pulp was very highly regarded. With this technique, good pulping was possible, and our ability to fill losses in a wide range of papers was greatly enhanced. The following is a synopsis of the Keiko Keyes recipe:

#### KEIKO KEYES'S RECIPE

10 to 15 grams dry paper  
Tear and soak for 20 to 30 minutes in deionized water [All

water used is deionized water.]

Change water

Cook paper pieces in 1 liter of water for 30 minutes

Change water

Blend for 2–3 minutes [or longer to rid pulp of knots]

Store in jars with fungicide or freeze

Tone by mixing pulp from various papers

Mix 1/2 fluid ounce of a 1.5% solution of methyl cellulose to 1 liter of fiber mixture before using.

The above recipe provided a pulp that was adequate for most paper conservation needs. However, I required a pulp which could be applied quickly, without manipulation, and I set out to see if that was possible.

My first variation on the Keiko Keyes recipe was to try more blending of the wet pulp. I tried more blending at higher speeds, the use of a food processor, and the use of a high-speed wand blender. I tried various pulp-to-water ratios. I tried longer processing times. Although the greater dilutions seemed to give a slightly better pulp, the pulp was still knotty and still required manipulation. I experimented with other papers in the same fashion as described above and did not achieve a working pulp mixture.

#### THE NEWER PULP

The following recipe is a longer version of pulp making, which I developed for my project, but now use for all my work as it is simply easier to use. It begins with the Keiko Keyes recipe and then it incorporates cooking the pulp in a pressure cooker. The pressure cooker that I use is the 4.2-quart Model #92040 by Mirro. It is their smallest pressure cooker. Cooking under pressure originated with early canning. In the early 1940s, models were made that could be used at home. The major advantage of cooking under pressure is the speed at which something can be cooked: asparagus takes 15 seconds, a pot roast takes 40 minutes, a whole chicken takes 30 minutes. The resulting food is supposed to be moist and flavorful. Cheaper and tougher cuts of meat are tenderized (which is what made me think of it originally). Pressure cookers cut down the cooking time for busier and busier housewives of the 1940s. A four-and-one-half quart pressure cooker at its 10 lb. psi pressure raises the temperature of boiling water to 240 degrees F. Be sure to read the manufacturer's booklet which comes with the pressure cooker you use. There are many stories of the vent tubes of the pressure cooker getting blocked and the over-pressure valve exploding, spraying hot food all over the kitchen ceiling. Don't overload the cooker. The recommended 10 to 15 grams of dry paper is acceptable in the 4.2-quart pressure cooker. Pressure-cooking has recently become stylish, and there are several European brands on the market. Most have safety devices which make them, at least, safer sounding. Their prices are more

than the Mirro brand, which is quite adequate for making pulp. I purchased mine at a good hardware store which sold canning supplies.

#### RECIPE FOR MAKING PAPER PULP USING A PRESSURE COOKER

10 to 15 grams dry paper  
 Tear and soak for 20 to 30 minutes in deionized water  
 Change water  
 Cook paper pieces in 1 liter of water for 30 minutes in regular cooking pot  
 Change water  
 Place pulp in pressure cooker; cook under 10 psi pressure for 20 minutes (following manufacture's directions)  
 Cool for 20 minutes; run cool water over top of pressure cooker  
 Divide pulp into two batches  
 Add 500 ml of water to each batch  
 Blend each for 5 minutes on medium in a standard blender  
 Store pulp by refrigeration (with fungicide), canning, freezing, or drying  
 Tone pulp using dilute acrylic emulsion applied on dry pulp  
 Before using the pulp stir in 40 ml of 2% solution of methyl cellulose (by volume) for 500 ml of stock pulp

If a particularly heavy paper or a grass paper is chosen as the pulp source, a second 20-minute pressure-cooking session may be necessary with a blending session in between. I find that I do this as a matter of course as I like the "lilt" of the pulp. (This is my own term, which denotes buoyancy. This pulp does not easily settle to the bottom of the jar. It floats in the water for a long time, thus the term "lilt.")

If a wood pulp paper is chosen as the pulp source, a brown stained water will accumulate after pressure-cooking with the pulp, and the pulp should be thoroughly rinsed to remove the brown stain. I do use wood pulp to pulp losses on wood pulp artwork. I apply a small amount of calcium hydroxide to the diluting water when working with this pulp.

Pulp cooked in a pressure cooker still has long fibers after being cooked under pressure, but the fibers are more pliable. The knots, when present, are easier to disperse.

#### DISPERSAL

Dispersal is a key part of the making of good pulp, and it has not been really appreciated. The most important dispersal step is adding the proper ratio of water to pulp: 5:1. If this is done, the pulp has a much better chance of being smooth and knot free. The time in a blender can be 2 to 5

minutes on medium in a standard blender. (I prefer the longer time.) The resulting pulp has less pulp per volume of water, and you may need to allow it to settle and pour off excess water. The excess water is necessary for the movement of the pulp in the blender.

#### APPLICATION AND WHAT TO DO ABOUT BUBBLES

My favorite application method is by pipette. I use a range of pipette sizes depending upon how much pulp I need for the size of loss. If bubbles are a problem, I charge several pipettes with pulp and leave them for a few minutes standing vertically in a container so that the pulp will settle toward the tip and the bubbles will rise toward the bulb. I jiggle the charged pipettes to encourage the bubbles to dislodge and move to the top. I apply the pulp in layers as usual over a light box, comparing the opaqueness of the original with the opaqueness of the pulp. As is known in the technique, I cover the pulped areas with non-woven polyester sheets and tamp out excess moisture with small blotters. I use a small fan to reduce excess moisture in the area, and I also use blotters around the losses to reduce moisture levels. When I am working rapidly, I use a magnetic stirrer hotplate to keep the pulp continuously agitated, and this technique tends to reduce the bubbles, I believe. It is a very good idea to gently add the methyl cellulose right before use and try not to incorporate any bubbles. Blending methyl cellulose is a bad idea if you are trying to avoid bubbles.

#### STORAGE

The Keiko Keyes recipe recommends refrigeration with a fungicide. She recommended thymol in methanol or freezing. I have found that simple refrigeration will slow the growth of mold, but a fungicide will be required if storage over two weeks is planned. I find canning to be better than refrigeration as the pulp improves upon further soaking, and the fungicide is not required. I use half-pint glass jars with standard canning lids and rings submerged in a boiling water bath for 10 minutes. There are several canning techniques that use the microwave and the oven. They take very little time given the great benefit of having available pulp ready to use at a moment's notice. Freezing requires thawing time, but otherwise appears to have no bad affect on the pulp. I have noticed that freeze-drying does occur with frost-free freezers over time, thus double-bagging is recommended. Drying the pulp (see below under "Toning") enables you to tone the pulp, and it lasts indefinitely stored in a glass jar or plastic bag. Label the pulp according to date, source, and processing. A sample placed in a plastic slide sleeve with a source sample can be attached to the pulp container or kept in a notebook.

When storing large quantities of pulp for a large project, I will drain off the excess water temporarily, simply to save on large jar space. Thus, the paper pulp becomes “pulp stock” and is a concentrated wet pulp for a few days. It is rewetted at the 5:1 dilution as needed during the pulping sequence or canned if not needed.

#### TONING

To my knowledge, toning wet pulp hasn't proven successful as the toning (in the form of water color or dyes) bleeds out on the artwork when it is applied and doesn't appear to stay attached to the pulp during the other treatment processes, such as patching and lining. I believe that Keiko Keyes's recommendation that you mix different pulps is a good one, but it is also not always possible. Thus, I offer the following suggestion, which I have used successfully.

Applying color to manufactured dry pulp is a simple process based on the fact that acrylic emulsions dry and hold onto the paper when it is dry. If a dilute acrylic emulsion is applied in layers to dry pulp, it appears to stay attached when the pulp is rewetted. I simply apply a dipper of approximately 50 ml of dilute pulp (this should be 1 part completed pulp stock to 5 parts water) to a form—in my case I use new canning rings on a fiberglass window screen. This gives a thin 2-inch wafer or disk. I make ten to fifteen at a time. These dry to thin paper disks. I peel these disks of pulp from the screen when they are completely dry and store them in jars. As needed, I place them on blotters and apply a dilute acrylic emulsion wash on the dried pulp disks, usually using mixtures of raw umber, burnt umber, black, and yellow ochre for most paper matches. The paint *must* bleed through to the backs of the disks for all the fibers to be toned, and this should easily occur, as there is no sizing in the disks. Allow paint layers to dry before adding other layers of paint. I usually stop at three layers of acrylic wash. When matching your disk to your original artwork, choose a disk color which is slightly darker than the original, as some fibers will be left untoned. Those untoned fibers will tend to lighten the toned pulp. This toning technique is not recommended for strongly colored papers. First soaking for 1 to 2 hours and blending for 2 to 5 minutes on medium in a standard blender will reform the toned disks. Less time will not thoroughly mix pulp, which is less toned underneath than on the surface. Remember the 5:1 ration of water to pulp. *There is an extra step here: I always drain the water from the toned pulp using a large sieve and add more water before using the pulp, as I find that a small amount of the dried paint may be dispersed in the water and may reveal itself as a tide line or stain on the artwork. Add methyl cellulose before working with the pulp, especially if you must add more color or inpaint on the pulp fills when they are dry.*

#### CONCLUSION

Paper pulp prepared in a pressure cooker was designed to be used for treatments requiring a very smooth, free-flowing pulp which could be delivered through a pipette rather quickly. I found, however, that it satisfied more than that. In fact, it can be used as a sort of thin paper wash or film to reinforce weakened paper. It flows that well. Keiko Keyes mentioned that pulp could be used as a lining, but I do not believe she had a wash of fibers in mind. I simply had never found a pulp which could be dispersed well enough to do so. I also find that the canned pulp increases in this flow quality the longer it is immersed in the canning liquid. This technique does not answer all of the common complaints of my colleagues whom I initially contacted regarding pulping problems. Indeed, it simply provides a working technique for making a variation of paper pulp for special needs and offers some interesting alternatives to the usual materials with which we are used to working. I look forward to hearing your comments.

#### ACKNOWLEDGEMENTS

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#### MATERIALS

The methyl cellulose used in the above testing was: Methyl Cellulose for Museum Mounting, Grade A-4-CP, Product # 2368, sold through Light Impressions, P.O. Box 787, Brea, California 92822-0787; phone 1-800-282-6216; [www.lightimpressionsdirect.com](http://www.lightimpressionsdirect.com).

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- Mirro instructions manual & recipe book: Pressure cooker & canners*. [s.d.]. Booklet is available when purchasing a pressure cooker either through a local distributor or from Cooks Corner Factory Outlet, P. O. Box 220,

Manitowoc, Wisconsin 54221-0220; phone: 1-800-236-2433; [www.cookscorner.com](http://www.cookscorner.com).

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