THE RECYCLER'S GUIDE TO MAKING PAPER

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The aesthetic value of paper is as important to the printmaker as its more practical values such as texture, weight, thickness and hardness. Through the papermaking process, the printmaker can control the aesthetic and functional characteristics according to his or her asethetic needs. This paper documents an experiment in papermaking. It is intended to read as a manual and will provide practical information on making paper and on using recycled materials. While it will not rewrite the papermaking process, since this is well documented in texts listed in the reference section of this manual, it will discuss short-cuts and potential obstacles in a "primitive" papermaking process. Following the text will be samples of the papers made from recycled materials as well as data gathered regarding their worth.

The focus of this manual is the use of recycled materials. All of the paper samples shown here were re-made from scraps and old proofs of rag papers such as Rives BFK, Arches Cover, Lennox, Magnani Corona R, etc. . Some also contain scraps of Japanese papers although the ratio of rag scraps to Japanese scraps is too great to unveil any subtleties.

PREPARATION OF MATERIALS

One of the benefits to using recyclable materials is the reduction of preparation time. Rag paper is made from the cellulose fibers of cotton. Cellulose is an inert substance that constitutes the cell walls of cotton, linen, wood, hemp, etc. and it exists in an almost pure state in cotton. It is a polymer, a union of molecules composed of a number of similar molecules, and in this instance, it is grouped together end to end to form a long chain.

Cotton linters are made from the short fibers that are closest to the seed. Their thick cellulose walls are perfectly suited for thick opaque papers. Cotton rag is 100% staple cotton, made from new garment cuttings and is a longer fiber that makes stronger and harder papers.

The process of preparing these fibers requires that they be literally beaten to a pulp or to their fibrous state. Through the physical pounding of the materials in a bath of water, the cellulose fibers are hydrated or saturated with water to form a wet pulp. The dry materials are beaten for hours before the cellulose is sufficiently hydrated. Consequently, when previously processed rag papers are used as the material for making new sheets, they need only to be re-hydrated. According to Twinrocker Handmade Paper Mill, this process takes only about 45 minutes.

Sizing is used to reduce the absorbency of paper. It was suspected that it may have also acted as an adhesive, thus creating a stronger bond between the fibers. The best example of this suspicion is the difference between a waterleaf paper, a paper with no sizing and a sized paper. When soaked, the waterleaf paper will absorb water almost instantaneously, like a paper towel, and its form dissolves just as quickly. A sized sheet of paper, depending on how heavily sized it is, can be soaked for days without losing its form. It was the writer's concern that the beating process would not be enough to break down the sizing

so that the fibers could bond sufficiently to make new sheets of adequate strength. In order to test this, the following batches of materials were prepared:

Dry sized
Dry unsized
Soaked 4 days sized
Soaked 4 days unsized
Boiled 4 hours sized
Boiled 4 hours unsized

Two types of sizing were used to replace the original sizing, an internal sizing in a concentrated liquid form from Twinrocker, and an external sizing that came in a powdered form from Daniel Smith.

The scraps of used papers were put into two large batches that were broken down into the small batches mentioned above. One was made of clean, white and off-white scraps, and one was made of scraps contaminated with ink and drawing materials like graphite, charcoal and pastels. Each batch was one and one-half pounds of dry materials torn into scraps about one inch square in size and then beaten for 45 minutes. The dry batches were put directly into the beater. Both the soaked and boiled batches were drained and rinsed before they went into the beater. As mentioned before, the soaked and boiled batches were two attempts at releasing the original sizing from the fibers to assure that a sufficient bond would be made in the new sheets.

This provided the most significant data. The papers from each unsized batch came out as waterleaf papers which makes perfect sense because both of the sizings we used were water soluble. If you soak a heavily sized paper for too long, it will eventually fall apart. The dissolution of the sizing is simply accelerated by the pounding action of the beater.

EQUIPMENT

There are four pieces of equipment that the papermaker needs to make good sheets of paper: a beater, a mould and deckle, blankets and a press. Without this equipment, the papers will be nothing more than primitive.

The Hollander beater facilitates the hydration process. It macerates the fibers by literally pounding the materials between the dull steel blades that line a rotating drum and an adjustable steel plate. Each batch of water and one and one-half pounds of dry materials is processed through the beater by gradually closing the gap between the drum and the plate. The process of hydration can occur through the use of other methods, such as using a blender, but the significant benefit to using a Hollander type beater is that the fibers get pounded not cut. As stated earlier, cotton fibers are relatively short and the longer the fiber is the stronger the paper will be. For this reason, the paper should be torn in the initial preparation rather than cut.

The mould and deckle is the tool which the sheets are actually formed on. A properly constructed mould eliminates one inconsistency in sheet thickness by providing adequate support for a newly formed sheet. The simplest design requires a frame, rib supports, a waterproof seal, a mesh surface and a deckle. The deckle is basically a frame that fits over the mould and provides an edge on the mould's surface. In pulling a sheet, a small amount of pulp gathers underneath the deckle and creates the infamous deckled edge. Here are instructions to build an inexpensive mould and deckle.

1. Cut 1 x 2 inch pine stock to desired length.
2. Cut some thin strips of material for ribs to the inside width of the mould frame and bevel one edge.
3. Assemble frame and space ribs evenly on the inside of the frame with the tops of the ribs even with or slightly below the top of the frame. Use waterproof glue and brass screws.
4. Waterproof with varnish.
5. Stretch aluminum screen across the top of the mould in two layers and attach each layer to the frame with brass tacks. Cover the edge with duct tape.
6. Cut corner moulding for the deckle to fit over mould, waterproof and assemble it also with waterproof glue and brass tacks.

See illustration following text and the Heller book for more detailed explanation on the history, use and construction of moulds and deckles.

Blankets are used to couch (pronounced cooch) or transfer the sheets of the mould. Professional papermaking shops use felts like the pusher blankets printmakers use on the etching press. Felts work best for two reasons, their thickness and woven properties make them a strong support for the newly formed wet sheet and they have a smooth, consistent texture. The closest substitute for felt is a heavy wool army blanket. If a substitute is to be used, thickness and texture are imperative. Use of inadequate blankets will be discussed later.

The press is used to squeeze water from the sheets. When a sheet is newly formed it is 90% water. Vertical pressure applies the only appropriate pressure to squeeze out the excess water and facilitate fiber bonding. The amount of water that is removed from the sheet will be a determining factor in the final examination of sheet strength. The squeeze is essentially important to the process.

PROCESS

The following is an abbreviated explanation of the papermaking process, for a more detailed explanation, see the texts listed in the bibliography. The materials first need to be torn to a size adequate for the beater, about one inch square. They are macerated and hydrated in the beater for the desired amount of time to form the pulp. The pulp is transferred from the beater to the vat and water is added to adjust for the thickness of the sheets to be pulled.The beater is cleaned thoroughly. The pulp is stirred so that is does not settle in the vat. The mould with the deckle is dipped into the vat with the edge closest to you submerged first. In a circular motion, the mould picks up some pulp without

being completely submerged. The mould is lifted out of the vat and shaken from side to side and front to back to quickly to distribute the pulp evenly on the surface of the mould. Once this uniformity is achieved, the mould is rested on the edge on the vat to allow the excess water to drain. The vatman next carefully removes the deckle from the mould so as to not drip any water onto the newly formed sheet. If this does occur, it is called a vatman's tear. The deckle is placed upside down in the vat to remove excess pulp.

The sheet is now ready to be couched. In one smooth motion, the mould is rocked onto a waiting blanket that has been placed on top of one or two other blankets for cushioning. When the mould is upside down on the blanket a small amount of pressure may be necessary to successfully transfer the sheet to the blanket. Once couched, a new blanket is placed on top of the sheet and subsequent sheets are couched in the same position on the stack or post.

When the post is complete,it is placed between two boards and put in the press. This initial squeeze is essentially to remove the bulk of the water from the sheets. Depending on the size of the post or the thickness of the sheets, the squeeze time should be determined by the rate at which water stops flowing from the post. Once complete, the post is removed from the press, dismantled, restacked in a different order and returned to the press for an overnight squeeze. If the initial squeeze was adequate, the sheets will hold their shape and can be easily handled.

When the post is dismantled again, the sheets are removed in groups of four to five called spurs. The spurs can be placed on a flat surface, hung over clean plastic tubes or rope or brushed onto a smooth surface to dry. Once dry, the spurs are separated into individual sheets and either pressed again or calandered to achieve the desired finish.

PROBLEMS

When using recycled materials, it is easiest to use clean scraps, but materials in any condition can be used. To remove ink from intaglio or relief prints, simply soak the papers until the ink separates from the page, three to four days will suffice. The ink should peal off nicely since it is mainly attached to the surface of the paper in these printing techniques. Lithographs are more difficult to work with because of the nature of the printing. The ink is forced into the paper and goes deeper than the surface. It can be removed through soaking and rubbing but there is a lot of waste involved. Ink that remains on the scraps through the beater will be broken into small specks and released from the paper. The results can be seen as a handsome decorative paper , see example number 1.

Pencil and other drawing materials will remain with the paper through the beating process as dirt. They will combine in the water to make a gray tone but can be bleached towards white with some effort. The bleach can be added directly to the beater but must be rinsed thoroughly afterwards. Rinsing is a tedious process, but if it is not done, the bleach will deteriorate the paper. All this can be avoided if clean scraps are used.

Dirt can be a problem even with clean scraps. It shows up during the beating process as a brown foam in the water and as a brown ring around the edges of the paper once the sheet is dry. Again, extensive rinsing will reduce this problem, but there is an easier way. Calcium carbonate can be added to the beater to eat the dirt and provide you with nice white paper. Approximately 2 teaspoons per batch should be sufficient.

The most important step in a primitive papermaking process is the squeeze. The print studio has a small screw press for sheets up to 9 x 12 inches in size, but anything larger than that is difficult to press. For 30 x 40 inch sheets, the litho press can be adapted for this purpose. The post was sandwiched between two boards which in turn were placed between two plate supports. The center was pressed first with as much pressure as possible and then the post was moved back and forth underneath the scraper bar for additional pressings. After it seemed that most of the water had been removed, the post was dismantled to so it could be re-stacked for an overnight press. However, the litho press was far from adequate because the sheets were still too wet to move. It was impossible to get any further significant pressure from this technique, so it was important to concentrated on getting the sheets re-stacked. If the proper type of blanket was used instead of grandma's spare, thin blankets, it might have been possible to couch the wet sheets into a new post. An attempt to lift the blankets, which stretched under the weight of the wet sheets and changed the shape of the sheets, failed. Rolling the sheets off of the blankets and onto the post worked better, but it too damaged the sheets. The stretch marks and the folds as a result of the rolling are visible in example 2.

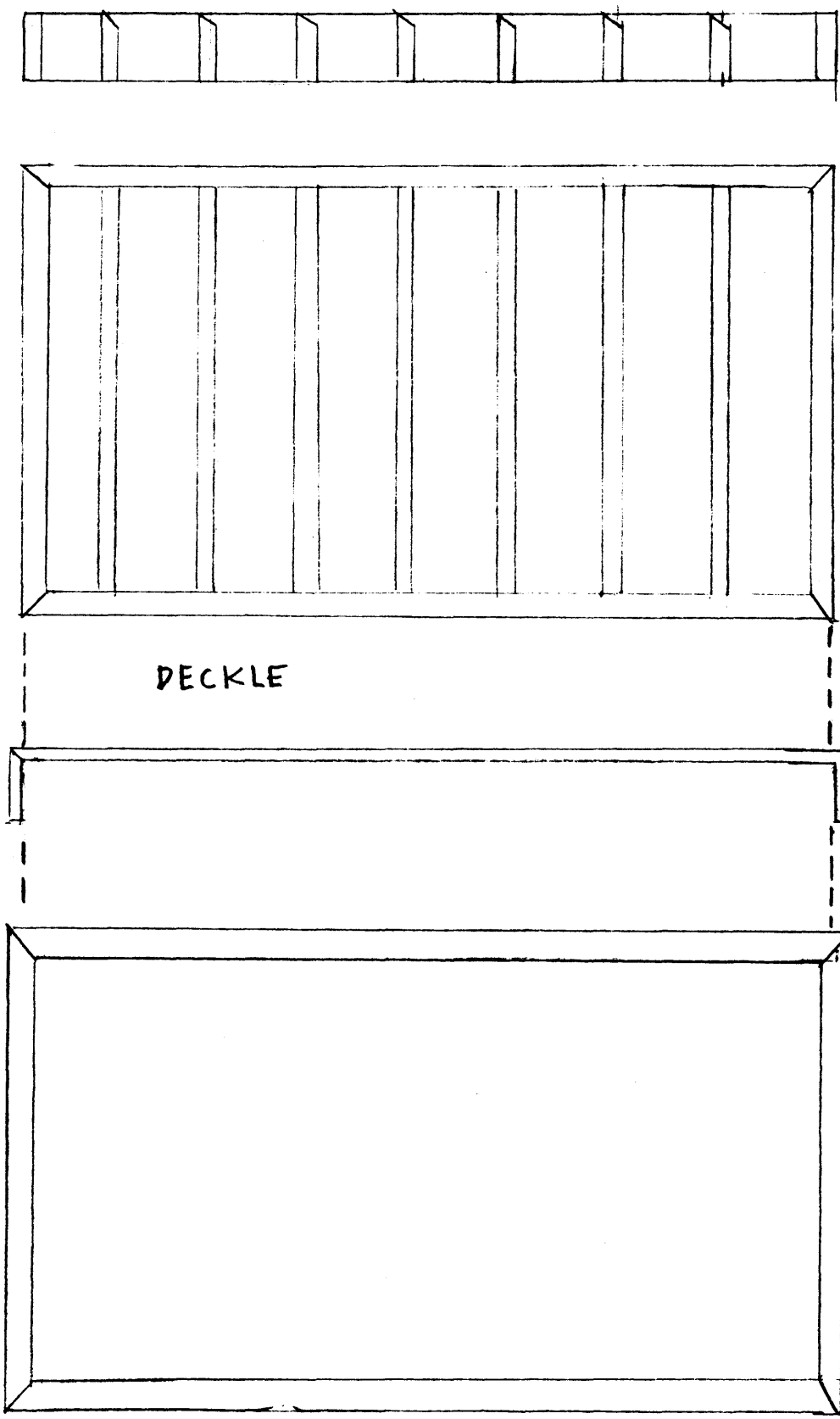
One more problem that resulted from an inadequate pressing was the affect it had on the surface tension of the sheets. The texture of the large sheets changed after they had been soaked and dried. The people at Twinrocker said that this was a reduction of the surface tension and that it was a result of an inadequate fiber bond. This however was a minor problem because it seemed to have no affect on the quality of the print and seemed to remain only as an aesthetic problem.

When drying the sheets, make sure they are on an even, desirable surface. This was especially appropriate to the wet sheets because they conformed to every surface they came into contact with. Place the spurs on a smooth surface to dry, see example 2. Slow drying is best. If you place the spurs in the sun to dry, they will dry quickly and from the outside edge inward and more than likely separate as they dry. This will result in severe buckling. For flat, dry sheets, brush the damp spurs onto a smooth surface and dry slowly. The remaining examples 3-7 show sheets from the different batches, and examples 8&9 display the printability of the sheets.

In conclusion the samples can speak for themselves. The heavier papers worked best for intaglio printing and the thinner papers worked best for lithography and relief printing. In some cases, the difference that the sizing made was inconsistent. Where one unsized batch would make waterleaf papers, there would be the occasional sheet that could withstand soaking. The

sized sheets also made good drawing papers. Their hardness versus the softness of the waterleaf papers withstood the abrasive action of erasing. Some of the papers aren't completely beaten. When held up to the light, bits of unbeaten paper scraps are noticable. This was due to the quality of the beater used in this experiment, it made a coarse pulp at best. It is difficult to make fine art papers in a primitive studio. What you can get are some average quality, functional papers that in the end will provide you with a great appreciation for the best papers. So proof on rag papers, save your old rag scraps and *recycle!*

MOULD + RIBS



EXAMPLES

INKED SCRAPS SOAKED 4 DAYS SIZED BEATEN 1 HOUR

BOILED 4 HOURS UNSIZED BEATEN 1 HOUR

BOILED SIZED 1 HOUR

SOAKED 4 DAYS UNSIZED BEATEN 1 HOUR

DRY BEATEN 1 HOUR UNSIZED

DRY BEATEN 1 HOUR SIZED

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