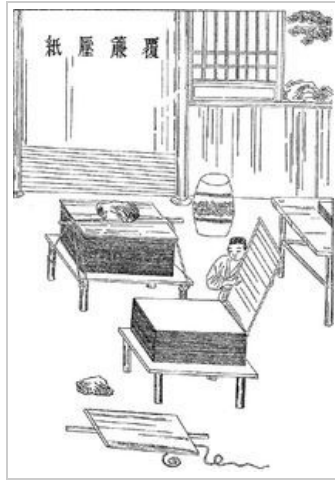


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Health in the Arts

LASER-CUTTING-SAFETY 3D PRINTING

Papermaking



traditional paper making in China (Wikipedia)

By Michael McCann, Ph.D., C.I.H. *

Papermaking involves first preparing the pulp, and then making the paper. A wide variety of woods, plants, vegetables, used paper, rags, etc. can be used in papermaking.

Preparing the pulp involves separating out the cellulose fibers from the plant material. Many plant materials are very tough and require boiling in sodium carbonate (soda ash) or sodium hydroxide (lye) at pH 12-14 to accomplish this.

Rotten or mulched plants require less preparation time. The fibers are then washed and placed in a beater to complete preparation of the pulp. After the pulp is ready, the paper is made by trapping the pulp on a wire or fabric screen frame. The pulp is either allowed to air dry on the screen, and then removed as a sheet of paper, or, after draining, the screen frame is inverted onto damp felt, and water is expelled by applying pressure between layers of felt, a process called couching.

A variety of other chemicals can be used in papermaking, including: bleach for decolorizing the pulp; sizings such as methyl cellulose, kaolin, starch, gelatin, etc.; cationic retention agents; calcium carbonate to adjust the pH; and dyes and pigments.

Hazards

1. Some wood and plant materials can cause allergic reactions and skin irritation.
2. The alkaline soda ash and lye are highly corrosive by skin and eye contact, inhalation, and ingestion. Boiling solutions of these alkaline materials can be very dangerous because of the risk of spilling over, and the fact that the

steam contains trapped alkali.

3. Chlorine bleach is a skin, eye, and respiratory irritant.
4. Beaters can be severe safety hazards due to the chance of trapping hands in the blades when cleaning pulp out of the blades. In addition, beaters can present noise hazards.
5. The presence of large amounts of water presents electrical hazards if it splashes onto electrical outlets or other electrical equipment. In addition, there is the possibility of major water leaks.
6. Some pigments can be hazardous. Titanium dioxide, which is commonly used, has no significant hazards. (See CSA's Art Painting and Drawing data sheet for hazards of other pigments.)

Precautions

1. Learn to identify possible toxic or allergy-causing woods and plants in your area.
2. If possible, do not boil fibers in alkali. In particular, this should not be allowed in secondary schools. Making paper from used paper or cardboard, or from rotten or mulched plant materials, eliminates the need for boiling in alkali.
3. For softer fibers, soda ash can be used instead of lye. Soda ash is somewhat safer than lye, but still requires taking precautions.
4. When using lye or soda ash, wear rubber gloves, a protective apron, and chemical splash goggles. When boiling alkali, I also recommend wearing a face shield over the goggles. An eyewash fountain and emergency shower should be readily accessible.
5. Add alkali slowly to the water while stirring. Adding it too fast can result in boiling and splashing.
6. If possible, do not boil the lye or soda ash solution. It would be safer to heat it to a lower temperature for a longer period of time. Never leave the heated alkaline solution unattended to prevent boiling over.
7. The boiling or heated alkali solution should be equipped with a canopy hood exhausted to the outside.
8. Wear gloves, goggles, and a protective apron when using bleach. There should be ventilation to remove the irritating gases from the bleach.
9. When rinsing the pulp with fresh water to remove the alkali or bleach, remember that the wash water can be alkaline. Use citric acid or white vinegar to adjust the pH of the wash water to between 7 and 8 pouring it down the drain.
10. To minimize the chance of electrical shocks, ground fault circuit interrupters (GFCIs) should be installed on all electrical outlets within six feet of the chance of water splashes. It is also possible to install the GFCI at the circuit breaker for the entire area.
11. Waterproof the floor and area to avoid leaks.
12. The beater must be equipped with machine guards that will prevent anyone from putting their hands near the blades as long as the blades are still rotating. In some old beaters, the blades take a long time to stop, even after the power is cut off.
13. If the beater is excessively noisy, it should be located in a room where only the operator is exposed to the noise. The operator should wear ear plugs or ear muffs. Good maintenance can often decrease noise levels.
14. An alternative to using a beater for small-scale papermaking (e.g in school) would be to use a large blender.
15. Whenever possible, use premixed pigments or dyes to color the paper. To mix the powder, make a concentrated solution or paste inside a glove box.

* This article on papermaking is excerpted from the forthcoming 2nd edition of Dr. McCann's Artist Beware.

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