Question and Answer

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Question:

Would you please explain the process of pigmenting pulp in terms a layperson can understand?

Answer:

The coloring of pulp has been a source of confusion, mystery, and even despair for most hand papermakers on at least one occasion during their exploration of the process. The explanation of how and why it works is scientific. However, because the questioner specifically requests an answer for a "layperson," I will stay on the simplistic side of science.

Pigmenting is only one way of coloring pulp; it can also be colored with dyes, which require a different process. Dyes dissolve in water and permeate the fiber; they are held in place by chemical links. Although the bonds which form are extremely strong, it is important to note that dyes in general are less permanent and light fast than pigments. Pigments, on the other hand, are insoluble and must be attached to the fiber through the use of a cationic agent (commonly known as "retention agent"). Paper pulp normally has a negative electrical charge. With the addition of retention agent, it adopts a positive charge. Pigments, which have a negative charge, are then attracted to the pulp and form a bond with the fiber. This is not as strong, however, as the bond formed with dyes.

The problem for many beginning papermakers lies both in not understanding this chemical process and in not knowing about the variables which can affect it. Some pigments bond more easily than others and the quantity of pigment and retention agent needed will vary. The use of different fibers also yields a wide range of results.

One important principle is that there are a finite number of bonding sites on the fiber for the pigment. These can be thought of as parking spaces for the pigments. Instructions from papermaking suppliers give a recommended formula for the amount of pigment and retention agent based on the dry weight of the fiber. A frequent error is to use pigment and retention agent meant for a certain amount of fiber with a smaller amount of pulp. The pigment particles fill up the available bonding sites, while the extra pigment sits in the water. Like cars circling city blocks for parking spaces, the extra pigment in the water has no place to go.

You can let the pulp sit overnight, allowing additional time for the pigment to find a bonding site. These spaces are limited, though, and if the water is still filled with color the next day, you will have to rinse the pulp. Because pigment can be knocked off of the pulp with a hard stream of water, it is best to rinse by straining the pulp and then placing it in a pail of fresh, clean water. A simple way to avoid this problem is to reduce the quantity of additives while maintaining the correct ratios of pigment and retention agent in proportion to the dry weight of the fiber.

Another critical factor is how the pulp has been prepared. Pulp beaten in a blender for a few minutes will not hold as much pigment as pulp which has been beaten in a Hollander beater. Beating pulp in a Hollander can develop additional bonding sites—like building a parking garage with many more spaces for the same city block—resulting in pulp which can have a greater saturation of pigment. Many of the vivid colors being achieved by contemporary papermakers are the result of pulp which has been beaten in a Hollander for an extended period of time, making it receptive to additional pigment.

There are a few other considerations which might help diagnose unexpected results. Some papermakers report that mixing supplies from different sources results in minor incompatibility. Products have been developed by suppliers to work together for optimum results. Mixing them can throw the system off balance. Others report variations based on the water used. Additives to water and how it is filtered can change your results. Careful observation and recording of formulas, with accompanying samples of pigmented paper, should help to document the range of colors and papers which can be achieved. One way to get started is through a controlled experiment, changing one variable (such as water, amount of pigment, amount of retention agent, length of beating, etc.) as a time. This should lead to some sense of control and understanding of the process.

For those who would like to learn more about this subject, Elaine Koretsky's *Color for the Hand Papermaker* is a thorough guide to coloring pulp, discussing dyes as well as pigments. Koretsky examines the coloring of paper pulp with regard to aesthetic considerations, permanence, and safety. This text is useful not only for its technical information, but also for the historical perspective it gives on the development of pulp pigmentation for hand papermaking. Supplies such as aqueous dispersed pigments, which are now readily available and even taken for granted, are presented in this 1983 publication from the perspective of newly acquired tools.