Basics of Natural Dyeing

Dye adherence

- The knowledge and use of color or dye on cotton, wool and silk began with the dawn of the civilization and was first developed in the East, particularly in India. India has the long rich tradition of colored fabric design. There are many plants and some animal sources in nature that yield color and can dye fabric, leather, hair, and other items. Humans started using dyes as soon as they were discovered; 6000 BC or even earlier. It is not possible to precisely locate the place of antiquity where dyeing was first known as an art. Evidence leads us to believe that different civilizations had each its own methods practiced. It is said that the Egyptians learned this art as early as probably the Indians and Chinese. In the Medieval period there were certain plants that were heavily relied on for most colors till the invent of synthetic colors.

Dye yielding plants

- Color was considered by ancient people as a basic necessity as essential as food and water. The ancient people used exclusively dyestuffs of vegetable, mineral and animal origin, all easily obtained in their own vicinity. Natural vegetable dyes have been used in most of the ancient civilizations in different countries e.g. India, Egypt, Greece, Rome, etc. In India use of vegetable dyes in dyeing, painting and printing goes back to the pre-historic periods.

- In India, according to the information collected so far, there are nearly 300 dye yielding plants available. Based on this, 30 raw materials were taken and some work was done by using these dyes on cotton, silk and wool.

Advantages of natural colors / vegetable dyes

- Natural dyes bearing Eco-mark are ecofriendly and acceptable in today's world
- They are non-toxic & non allergic, hazard free for skin.
- Fastness can be achieved by the use of proper mordants.
- They are safe the life, environment, fuel & time and other investment process.
- For successful introduction of vegetable dyes into technical dyeing processes, some additional demands have to be fulfilled:
- Increase of the number of available vegetable dyes with acceptable fastness properties suited for one – bath dyeing processes;
- Formation of an efficient supplier organization which is able to provide a dye-house with standardized dyes of constant quality and to generate an inventory of suitable vegetable dyes from application point of view;

More Information

- Availability of technical information about the use of the dyes collected from forest or locally grown plantation, emphasis be made on production of plant material in sufficient amounts with modern agricultural methods which would include simple and environmentally clean extraction methods, suiting the requirement of a dye-house;

- Determination of eco-friendliness of the vegetable dyes for suitability for wearing dyed fabrics;

- Determination of biodegradability of the waste generated after dye extraction from the plant sources.

- It is of utmost importance to know the structure of the dye depending on the dyes structure the mordant and dye uptake is expected. Pretreatments are very important part of vegetable dyeing.

Natural Dyeing Principles:

- Application of natural dyes in today's scenario makes use of modern science and technology not only to revive the traditional technique but also to improve its rate of production, cost effectivity and consistency in shades. It therefore, requires some special measures to ensure even-ness in dyeing. Many factors have to be accounted for when one works with natural dyes. They are as follows:
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- **1. Nature of material to be dyed-**Animal proteins, like wool and silk dye best in acidic conditions and are weakened by alkaline. If an animal protein is dyed in alkaline conditions, it is best to end with a diluted vinegar rinse to restore a slightly acidic pH to the fibers before they dry. Plant materials like cotton, flax, dye best in alkaline (basic) conditions and are weakened by acids. If cotton is dyed in acidic conditions, it is best to end with a weak washing soda bath to restore the fibers to slightly alkaline before they dry.

Measurements of Mordants and Dyestuffs:

Most dyeing procedures specify ingredients by weight rather than measure. Recipes will also specify the amount of fiber to be dyed or the other ingredients will be expressed as a ratio to fiber weight. This is because the amount of water in the dye-bath will not affect how strongly the fiber takes color, but the amount of dyestuff in the dye-bath does. So if one gm of fiber has to be dyed with one gm of dyestuff and then one wants to reproduce the same color on 5 more gms of fiber, the amount of dyestuff should be multiplied by 5 times as well. The water should always be enough to let the fibers move around freely; water quantity should be sufficient to dip the fabric/fiber properly.

Temperature

- Different dyes work better at different temperatures. Most plant dyes benefit from being heated, but some (i.e. madder) change colors if allowed to boil.
- Sappan wood also has a tendency to change color when heated for prolonged hours. Some dyes work best at lower temperatures (safflower and woad/indigo).

Agitation

- For getting even dye uptake, one should move the fibers around as much as possible in the dye-pot. Unfortunately, when wool is heated and agitated it tends to felt, so one must be very careful about how much one should move it around. For most wools, heating and cooling the dye-bath slowly and being gentle while moving the fibers is necessary to avoid felting.

Natural Dyes are unpredictable

- Books on natural dyeing can predict the range of colors that will most likely be given from a dye source, but there are so many factors involved in the process that reproducing a color exactly can be very difficult unless those parameters are followed strictly. Some reasons for disappointing results could be: insufficient heat, or too much heat, accidental iron or other metal contamination in the water, bad growing conditions for the dye-plant, plant harvested at the wrong time of year, dyestuff allowed to dry out, dyestuff kept in humid conditions, dyestuff too old and dye obtained from different plantation in terms of climate and soil conditions. The point here is to list some reasons for failure, which one would face if one does not get the expected color - the most experienced dyers in the world get accidental color sometimes. One can over-dye and get the desired colors.

Wet fibers look darker

- When trying to achieve a certain color, it has to be always remembered that the color when wet will always appear darker and may be disappointing when the fibers dry. Also, some color will rinse out after rinsing the fibers. Always dyeing to a darker shade in the dye-pot than what is required. Lifting the fiber out of the dye-pot to "air" is often good for the dyeing process to check the color.

Rinsing

- Fibers should be rinsed after they have been dyed, and some dyes will still bleed for several washings afterwards.

- As mentioned above, it is advisable to add some washing soda to plant fibers or some vinegar to animal fibers to return them to their optimum pH in the last rinse.

Using Natural Dyes

- **Mordanting:**

- The first step of the actual dyeing process is mordanting. A mordant is a chemical that, when "cooked" with the fiber, attaches itself to the fiber molecules. The dye molecule, then, attaches itself to the mordant. Different mordants give different colors when combined with the same dye. For example: the dye, cochineal when used with alum sulfate gives a fuchsia color; when used with tin, the color is more scarlet, and when used with copper, it is purplish. Mordants except for alum and iron, are considered toxic and therefore, should be avoided in the preparation of eco-textiles otherwise the whole exercise will be self defeating.

Mordanting

As the mordants are toxic to the dyer and the disposal of the bath becomes an environmental problem. Therefore the choice of mordants is limited. Alum and iron are ideal safe mordants. Other chemicals known as assistants may be used in addition to dyes and mordants which help in coloration of the fabric in one way or the other, for example- to change pH and hence the color, sometimes to brighten the color, to help in the absorption of the mordant metal, or to slow down the rate of absorption of pigments or for evenness. These include potassium hydrogen tartrate (cream of tartar), oxalic acid, tannic acid, acetic acid, formic acid, ammonia, sodium sulphate (Glauber's salts), sodium chloride (common salt) and sodium carbonate (washing soda). Treating cotton with tannic acid is useful as it prepares the fabric for effective absorption of the dye.

Mordants

- The word “mordant” comes from the French “Mord” and mordants can be described as metallic salts with affinity for both fiber and dyes stuffs and that improves the color fastness. Even some of the fugitive dyes have been used successfully with the help of mordants. Dyes are categorized as either “mordant”or adjective” or “Indirect” dyes. Most of the natural dyes are mordant dyes except the very few direct dyes and vat dye such as Indigo. The latter dye needs no mordants.

- In addition to adding substances to a bath for mordanting, the vessel that is used may itself serve as mordant. The dyers use copper tin vessels to brighten the color and iron vat to dull the color. To get the effect of alum mordant, now-a-days aluminum dye pot with a little soda is used. To get the basic original color of the coloring materials, earthen or stainless steel materials are advisable.

Mordanting of cotton

- Mordanting is very important for cotton dyeing. Natural dyeing of cotton is more difficult than silk and wool. Cotton is not very porous and will not hold the dye stuff without a more complicated preparation for mordanting, the fiber must be cleaned first.

- **Preparation of alum mordant -** To prepare alum mordant, first alum-powder and cream of tartar are mixed with little boiling water and then made up with the remaining required water.

- **Tin mordant** – Dissolving cream of tartar or oxalic acid in a little quantity of hot water. When it is thoroughly dissolved, some more hot water is added. Addition of stannous chloride and mixing well is continued till it dissolves.

- **Copper mordant** – Dissolving sulphate of Copper in lukewarm water and remaining required quantity of water is added.

- **Chrome mordant** - Mordanting with potassium dichromate is best just before dyeing. Dissolving the potassium dichromate in little warm water and making up the solution with the rest of required water.

- **Iron mordant** - Dissolving ferrous sulphate with a little warm and addition of cream of tartar to this and this should be mixed well.

Preparation of fabric for dyeing

Grey yarn or cloth as such is not suitable for dyeing or wet processing as it contains natural impurities such as fats, waxes, coloring matter, broken seeds etc. It needs to be washed with a mild detergent, to remove these impurities, however, in the ancient days the grey fabrics were processed with cowdung, camel-dung, goat-dung solution to make it more absorbent and bright.

Modifier and pH

- **Modifier:** Any bath used after the main dyeing process to change the color. It may contain a mordant or may be very acidic or alkaline.

pH: The pH of a liquid can be taken using litmus paper and is usually expressed on a scale of 0-14 with 7 being "neutral". Numbers less than 7 are acidic and numbers greater than 7 are alkaline (or basic). In chemical terms, the more loose hydrogen atoms in a solution, the more acidic it is. Some dyes and fibers dye differently at different pH levels.

Vat dye

Special treatment of vat dyes:

Plants containing indigotin (Indigo, Woad, Kum etc.) work as "vat dyes" where an anaerobic environment must be achieved in the dye bath before the dye will adhere to fibers. Such vats are usually kept at a steady, warm temperature to promote optimal vat culture.

Safety measures required in Natural dyeing

- Because dyeing substances and mordants can be poisonous, there are some important rules to follow when dyeing:
- 1. Dyeing should never be done in cooking vessels.
- All measuring and stirring spoons, scales, thermometers, jars, etc. should be separately used for dyeing purpose.
- The work area should be covered.
- Wearing gloves to avoid contact with the skin is necessary.
- Dye in a well-ventilated area or outdoors.
- Rinsing fibers thoroughly after dyeing to remove all excess chemicals is essential.
- Do not inhale steam from your dye baths.
- If you experience any itching, burning, rash, or other reaction, get away from the dye bath.

Disposal of Mordants and Dyes:

- Always dilute baths before pouring them out. Mordant baths and extremely acidic or alkaline baths should be diluted heavily before disposal. Natural dyes from plants can usually be poured out onto the ground without ill effects on surrounding vegetation, but mordants and very alkaline or acidic water can damage plants. Never pour baths into ponds or running water, pour them as far away as possible from wells and septic systems, and try to avoid gardens, valued plants and compost heaps. The exception would be if your bath contains something you would have added to the soil anyway; i.e. a bath of lime and madder (no mordants) could be poured out onto acidic soil.

Disposal and safety

- Pouring dyebaths and mordants down the drain can cause problems for septic systems, especially when the bath is extremely acidic or alkaline and when the bath contains a lot of loose fibers or solid dye material. In most cases, dyeing occasionally will not cause a problem for the local sewer, but large-scale or frequent disposal of mordants and dyebaths could damage their systems.

Overdyeing

Overdyeing is the process of taking fiber already dyed in one dyestuff and dyeing it with something else.

It can often produce much better colors than dyeing with one dyestuff alone. For instance, dyeing a fiber yellow and then overdyeing with blue can achieve beautiful greens.

Historically overdyeing was often used commercially to take advantage of two dyestuffs in the same color range with different properties; i.e. brazilwood produces a really bright red that fades, and madder produces a very long-lasting red (but madder red isn't always as bright), so the two were often used together.