

# **Synthetic Dyestuff vs Natural dyestuff**

## **Advent of Synthetic dyes**

With the advent of synthetic dyes, the limitation of natural dyes became louder, such as Lesser availability of dye producing materials due to difficulty in collection or lack of organized plantation/ farming of the dye- plants, Poor color yield, Complexity of dyeing process, Non-reproducibility of shades, Limited number of dyes, sometimes Inadequate fastness properties, due to these problems encountered with natural dyes, the development of synthetic dyes came into existence. The advent of synthetic dyes led to the collapse of huge natural dye industry. The development of synthetic dyes at the beginning of the twentieth century led to a more complete level of quality and more reproducible techniques of application.

## Blue acid direct dye

In 1740 the first reference occurs, in French, to what became known as 'essence of indigo', indigodisulphonic acid, which is obtained by treating indigo with concentrated sulphuric acid. It is a blue acid direct dye. It can be found in, for example, English samplers, sometimes with late 18th-century dates, and it easily runs on washing. It reached Turkey c. 1850. The first two fully synthetic dyes came on the market in 1856: picric acid in France (a direct acid yellow) and mauvine (a direct basic mauve) in England. Far more important than either was fuchsine, discovered in 1858, a bright magenta and again a direct basic dye. It was much cheaper than mauvine but less fast to light and mild alkalis. A number of relatives of fuchsine were discovered between 1860 and 1870, extending the colour range into blue and green shades, but these very brilliant 'early anilines' (so-called because oxidation of aniline derivatives was the method of preparation) are all fragile; most faded rapidly, giving synthetic dyes a poor reputation.

# Synthetic Dyes

A second important group of dyes, the direct acid azo-dyes, were introduced from 1875 and provided shades of yellow, orange and red.

They did not fade, but many ran easily.

Other major and minor groups of synthetic dyes followed, and before long the whole spectrum was covered. The new dyes, essentially pure chemical compounds, were more consistent and often more brilliant and cheaper than the natural dyes previously used. However, the many other qualities needed by the user were not always available, and the synthesis of improved dyes continued to be a main preoccupation of organic chemists.

# Synthetic dyes

By the end of the 19th century thousands of synthetic dyes were available, covering every possible shade and many (e.g. the chrome dyes, a set of azo-dyes mordanted with chromium salts) had excellent fastness. Around 1920 the last important niche, a green dye of good stability for natural fibres, was filled by Caledon Jade Green, a vat dye.

These synthetic dyes have received faster acceptability due to its ease in dyeing, reproducibility and other factors. The dominance of dye industry by synthetic dyes over natural dyes received a severe blow only a decade ago when toxicological effects of dyes during wearing became more and more known and caused a great concern about the use of synthetic dyes.

One obvious way of obtaining the advantages of the natural dyestuffs was to synthesize the compounds they contain. Thus alizarin, the main colouring matter of madder, was prepared artificially in 1880, giving dyers in Europe all the advantages of that excellent and versatile dye. Similarly, indigo was made commercially in 1897; the synthetic version is exactly equivalent to and indistinguishable from the natural dyestuff.

## Significances where natural dyes surpass the synthetic dyes are;

- Synthetic dyes tend to remain quite stable to common oxidation and reduction processes as per their designing and so are very difficult to remove from textile industry effluents; Natural dyes are biodegradable without the use of any oxidant or reductant.
- Synthetic dyes, if at all degraded, are full of byproducts that are directly or indirectly proven to be health hazards; such hazardous compounds have so far not been detected in the Natural dye degraded byproducts. It is possible that natural dyes completely degrade under natural conditions.

# Intensity and Brilliance

- Natural dye color variation and brilliance is achieved by mixing different mordants with one batch of skeins, manipulating the pH of the dye baths, investing hours of time for one color.
- Colors obtained from natural sources tend to be earthy and subtle. Synthetic dyes often produce garish, stark or muddy colors.
- Wool rugs prepared with natural dyes are colorfast and will last a lifetime.
- Colorfastness can be tested by rubbing the surface of the weaving (if the weaver lets you) with a damp cloth. If the dye does not transfer, there is a good chance that the color is permanent.

## The Price Difference

- Natural dye materials are scarce and expensive, for example, cochineal is more costly per ounce than the synthetic analogue. Synthetic dyes are readily available at low cost, resulting in a less costly rug to produce. Density of weave also adds to quality and therefore to cost. A low cost rug will likely be woven with synthetic dyes, on brittle, machine (not hand-spun) wool, and have a looser weave.

## Advantages of Natural dyes

Natural dyes cover the area of green chemistry. A great need of research is required for green dyes to replace toxic synthetic petroleum based dyes. It has been a matter of debate that synthetic dyes give a better glow and a range of colors while the natural ones are limited to dull or muddy colors only. It is not at all true, as natural dyes not only give us the feel of superior quality sensory experience but also provide a spectrum of colors. The five classic and popular natural dyestuffs are indigo, madder, cochineal, weld, and cutch. These can give rise to almost any color with the exception of a few colors like fluorescent and electric blues. Natural colors are basically plant dyes, but some of them are of animal origin as Cochineal, which is obtained from insects. These five dyes show the properties of very strong yields, resistance to fading, relatively fast colors along with easy availability.

## Toxicity factor

Considering the toxic effects of the synthetic dyes, there has been a renewed effort to study and implement the various natural dyes in the dyestuff industry. Primarily there are three categories of natural dyes.

Firstly those are derived from plants like *indigo*. Second, the ones that are obtained from animal sources called *Cochineal*, and the remaining are those that are got from minerals (*Ocher*). Natural dyes can provide the much needed alternative to the complex world of chemical dyes.

## The German Ban

In the late 1996, Germany struck a severe blow to dyestuff industries and subsequently other European countries also executed ban on import of textiles and garments, colored with a series of azo-dyes made from aromatic compounds, which are carcinogenic, allergic and poisonous. Azo compounds are reduced by intestinal anaerobic bacteria through scission of azo bonds to form aromatic amines, which are toxic to living organisms . The use of natural dyes, however, has not entirely disappeared. Since the 1960s craftsmen have been interested in those dyes that can be grown and used in a domestic environment; and in the 1980s natural dyes were seen as an ideal alternative to the cheap synthetic ones that had damaged the reputation of traditional weaving.

## Repercussions of German ban

However; due to the German ban on azo dyes (1996) there is currently a move to find renewable sources to supplement the need for safe dye industry. This trend has led to resurgence in research in the production of natural dyes on a commercial-scale. Commercialization of natural dyes which are extracted from vegetative matter and animal residue have become very important in fashion trends. They are not only chemically safe but also add aesthetic value to the dyed fabric.

# Resurgence of Natural dyes

The use of non- allergic, non toxic and ecofriendly natural dyes on textiles has become a matter of significant importance due to the increased environmental aware ness in order to avoid some hazardous synthetic dyes. However, worldwide the use of natural dyes for the coloration of textile has mainly been confined to artisan/ craftsman, small scale/ cottage level dyers and printers as well as to small scale exporters and producers dealing with high- valued ecofriendly textile production and sales

## Health and safety aspects of natural dyes

- Though all natural dyes are not 100% safe they are less toxic than their synthetic counterparts. Many of the natural dyes like turmeric, annatto and saffron are permitted as food additives. Many natural dyes have pharmacological effects and possible health benefits.
- They are obtained from renewable sources.
- Natural dyes cause no disposal problems, as they are biodegradable.
- Practically no or mild reactions are involved in their preparation.
- They are unsophisticated and harmonized with nature.
- Many natural dyes have the advantage that even though they have poor wash fastness ratings, they do not stain the adjacent fabrics in the washing process because of the non-substantive nature of the dye towards the fabric. An exception to this is turmeric, which shows substantivity for cotton.

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- 7) Natural dyes are cost effective
- 8) It is possible to obtain a full range of colours using various mordants
- Natural dyes give earthy shades sometimes called pastels but when combine with mordants they change into beautiful bright colors. Their colors are soothing to eyes, earthy warm, highly appealing, non-carcinogenic and above all they perpetuate an ancient tradition. A vast documentation about these dyes is available in phytochemistry journals.