Colorants to Appeal

SITARAM DIXIT
Applications Manager (Fragrances), Bush Boake Allen India Ltd., Mumbai.

All of us like colours. Mother Nature has colourful objects like flowers, leaves, fruits, birds, animals, clouds, the sky, etc. Who in this world is not pleased to see different colours of the rainbow during rains?

What is colour? Colour is a phenomenon of light, a visual perception, that enables one to differentiate otherwise identical objects. Appreciation of colour thus is a function of the light adapted eye and is entirely the property of cones that are present in the retina of our eye. A normal person can easily distinguish the seven colours of the spectrum and an infinite number of intermediate shades. The human eye can distinguish as many as 160 different colour shades in the visible spectrum (400-750 mm), and at a difference of less than 3 mm wavelength can be detected.

White light is composed of seven individual colours of the spectrum — Violet, Indigo, Blue, Green, Yellow, Orange, & Red — present in the same proportion as sunlight. White is thus the brightest achromatic colour and black the darkest. Black is a sensation that is caused by complete withdrawal of light reflectance and white ideally has virtually complete or 100% reflectance.

Most of the colours in the visible spectrum can be obtained by fusion of red, yellow & blue in varying proportions. Red, yellow & blue are therefore termed as primary colours. When two primary colours are mixed in equivalent proportions, we get secondary colours (red and yellow give orange; yellow and blue give green; blue and red give violet).

Thus orange, green, and violet are called secondary colours. Complementary colours are those, which when blended in proper proportions appear neutral or give grey impressions. The same colour may be primary as well as complementary to another colour.

Almost all-available products are coloured by use of certain chemicals, colouring agents or colorants. The term "colorant" means a dye, pigment, or any other substance that is used to impart an intended colour to a product. It naturally also includes substances, like fluorescers and optical brighteners, which may not be themselves coloured, but whose incorporation in the product affects the colour shade. The basic purpose of using a colouring agent in consumer products is to make it more attractive, sometimes to mask the original colour of the product and to enable it be distinct to otherwise similar products.

The elegance and appeal of a coloured product are very important and can often help in distinguishing a genuine product associated with that particular colour. Coloured products become familiar and thus help in increasing sales. In an ideal situation, it requires standardisation of shades to gain customer acceptance. If in case this is not so then it would involve great deal of explanation to convince suspicious customers about the genunity of the product, if the regular product is even slightly different in appearance every time the customer buys one.

If carefully noticed, one would find that in the consumer industry most of the products are coloured in various shades of red, orange, yellow, green, and blue. Psychologically "Avicenna" considered red stimulating and blue relaxing. "Goethe" in his "Theory of Colour" described red and yellow as exciting and blue as cold and restful. Recent studies in the field of advertising, psychology, and physiology have confirmed and even extended these basic impressions.

Red >>>>> Orange >>>>> Yellow >>>>> Green >>>>> Blue >>>>> Violet
Exciting >>>>>>> Cheerful >>>>>>> Tranquillising >>>>>>> Subduing

Basic requirements of colorants in soaps, detergents & cosmetics

* It must be non-toxic and should have no physiological activity.

* It should be a definite chemical compound and its assay predictable. This would ensure that it is available free from harmful impurities with reliable colouring power.

* It is preferable that the colour used are water soluble, although oil soluble or spirit soluble colours are also being used in soaps, detergents and cosmetics.

* It should be light fast, that is, unaffected by light, stable to normal temperature variations, hydrolysis, etc.

* It should be stable to storage and microbial growth. Another important condition governing stability of the colorant is that it should be resistant to unwanted migration from one medium to another. Absence of migration also plays a decisive role in the selection of a colorant for consumer product.

* Colorants should be compatible to different ingredients used in the manufacture of detergents, soaps, and cosmetics.

* It should not be adversely affected by oxidising or reducing substances.

* It should be stable to pH variations or changes and should not bleed. (Stability of colorants is usually determined in 5% solution of sodium carbonate and 5% solution of concentrated hydrochloric acid. It is unstable when there is some degree of change or alteration of shade or bleeding occurs in alkali or acid.)

* It should be free from objectionable odour and when used as a laundry detergent colorant, then it should show no adverse tendency to affect textile fibres.

* It should not constitute a safety risk to consumers and there should be sufficient toxicological support for use in soaps, shampoos, cosmetics, and detergents.

* It should be inexpensive, easily affordable, and readily available.

* The colour of the soap, shampoo, cosmetic and detergent products obtained using the preferred colorant should be stable to storage and remain so for the required time, till the product is completely used.

Until the discovery of coal tar dyes, mineral pigments, natural dyes and pigments obtained from animal and vegetable sources were often used. These dyes were naturally replaced when synthetic dyes became available in plenty. The most important application of mineral colouring in present day cosmetic preparation like soap is the usage of titanium dioxide, as an opacifier. The elimination of natural dyes and pigments were due to consequent variation in colouring power and difficulty of standardisation. The tinctorial power being low they were less readily available and expensive than coal tar dyes.

In 1856, William Perkin accidentally discovered "Mauverine" the first coal tar dye, while attempting to synthesise quinine. This discovery led to the synthesis of a large number of beautiful and very stable coal tar dyes of high colouring power. Commercial production of synthetic dyes rapidly found favours for colouring food, drugs,' cosmetics, and detergents. Indiscriminate uses of synthetic dyes for foods and drugs were questioned as they proved a danger to health. The development of bladder tumours among workers manufacturing "fuschin" and "naphthylamine" led many countries to prepare a list of permitted food and cosmetic colours. No colour for which there is an evidence of harmful effect in any animal, and which breakdown into toxic compounds is permitted for use in food and cosmetics.

In 1938, American dye manufacturers were marketing about 300 colours used in drugs and cosmetics under approximately 1500 names. For some colorants, about 30 synonyms were used for marketing. All this led finally to the publication of the Colour Index, in 1971 jointly by "The British Society of Dyers and Colourists" and "The American Association of Textile Chemists & Colourists". This book is very useful because it gives each dye/colour a reference number called as Colour Index Number and tabulates its chemical composition, various synonyms, and its properties. Confusion is avoided if the colour named is followed by the Colour Index Number. The Food and Drug Administration (FDA) in USA and the European Commission (EC) provide lists of colorants that have sufficient toxicological data about the safety of the colorant in question. The US FDA has a listing for Food use, Drugs use, and Cosmetic usage.

In the EC listings, colorants are assigned fields of applications, depending on the amount of safety support data and the toxicological profile available for that specific colorant. It has the following four fields, namely:

1. Colorants allowed in all cosmetic applications.

2. Colorants that can be used in all cosmetics, except products that are intended for cosmetic applications in the vicinity of the eye like eye makeup or removers.

3. Colorants for all cosmetics, but not intended to come in contact with mucous membrane.

4. Colorants for cosmetics intended to come in contact with skin, for a short time.

In India, regulatory control over cosmetics was effected in 1962 through the amendment of the Drugs Act, 1940 that became the Drugs and Cosmetics Act, 1940. Rules were amended to become Drugs and Cosmetics Rules, 1945. This rule lays down standards that are enforced by respective State Drug Control organisations all over the country. The Drugs Technical Advisory Board alongwith specific committee that is set up updates the standards of various products as a continuous exercise. The Bureau of Indian Standards (BIS) is entrusted with the development of standard specifications, which on due notification becomes a statutory requirement. All soap, detergent and cosmetic manufacturers should use colorants in their products that comply with the relevant specifications laid down by BIS, and permitted to be used by, The Drugs and Cosmetics Rules, framed by the Government of India.

The main advantage of coal tar dyes is that it possesses a precise chemical nature, and a dependable method of assay. Moreover it is readily and easily soluble in solvents/water with reliable, high colouring power. It is relatively stable to pH variations, light fast and stable to storage. Although not all coal tar dyes are compatible to detergent and cosmetic

ingredients, the variety of dyes available is so numerous that it is easy to find a suitable dye for use in detergents and cosmetics. The concentration of colouring agent in detergent and cosmetics is approximately about 0.05% w/w of the formulation but one-tenth of this is enough in some cases. It also depends on the depth of the colour required, the colour and brightness of various other ingredients present in detergent and cosmetics and the fineness of the dispersion in the mass.

The permitted colorants sometimes do not always give satisfactory shades when used alone but by suitable combination or blends of approved colorants the popular tints and shades can be easily achieved. Although different types of colorants are used in soaps, cosmetics and detergent products, the most popular ones are the pigments, oil/solvent soluble dyes, water soluble colorants and food dyes.

In case of detergents and soaps, colouring with pigment is very popular. Colouring with pigments is simple. It is incorporated through a medium in which the pigment is dispersible. The physical condition of pigments that is incorporated in detergent and soap is very important as it determines the colouring strength, hue, tint, of the resulting mass. Commercially pigments are available in a variety of different shades and forms suitable for incorporation in soaps and detergents. Water dispersible pigment emulsion pastes are easily dispersible in detergents and soaps. They are so made by modification of the physical attribute of the pigment by use of a carrier or dispersing agent that helps dispersion of the colorant in the medium. Pigment pastes are preferred in soaps and detergents as compared to powder form, as they are easy to incorporate, convenient to handle, and the colour delivery is uniform throughout the mass.

Solvent dyes, as the name suggests, are soluble in organic solvents and is the next most important class of dyes largely used in soaps, cosmetics and detergents. Solvent dyes commercially available belongs to various classes of chemical groups. Most of the yellow, orange, brown and red colorants are azo dyes. Bright red shades belong to xanthene group of dyes. Majority of the blue and green shades in solvent dyes are anthraquinone and triarylmethane types. Some belong to the azine, thiazine and phthalocyanine groups. Solvent dyes are dissolved in mineral oil, oils, fats & waxes, in perfumes that is a mixer of various solvents for higher solvation and to obtain the required properties for successful incorporation in soaps and detergents. Solubility of solvent dyes is influenced by the quantity and qualities of the dye used, for example, technical grade/chemically pure grade or by the presence of homologues or isomeric components present in it. Nowadays solvent dyes are losing its charm for soaps, detergents and cosmetics formulators and are being gradually replaced either by safer pigments or by use of food colorants.

Food colorants are the third group of dyes that are used to colour soap, detergent and cosmetic products. Majority of the food colorants belong to the azo group of dyes. Although food colorants are to be preferred, sometimes stability of some colorants of this group, in the alkaline medium do cause some problems.

Florescent whitening agent, which fluoresces under ultraviolet radiation is used in toilet soaps and shampoos to help reduce product yellowness. The use of, a super brightener of the distyryl-biphenyl type, namely Tinopal CBS-X, provide relative quality improvements in toilet soaps and shampoos. Fluorescers when used in laundry detergents also deliver whiteness effect on washed fabric alongwith its contribution to improve product whiteness.

Toxicology & environmental aspects of colorants

Although colorants are used in a very small proportion in soaps, detergents and cosmetics, it should be non-toxic and give no indications of adverse effects like irritation, skin sensitisation or subacute toxicity, allergy, carcinogenic, mutagenic or tetratogenic effects and be environmentally acceptable. In this age of changing consumer attitudes, result of continuous media coverage, and large-scale commercial production of consumer products, the quality of the various ingredients used in the manufacture of soaps, detergents and cosmetics become very important. Use of inferior quality colorants do more harm than good. Toxic metal impurities of arsenic, heavy metals, cobalt, chromium, nickel that may be present in inferior quality colorants in substantial proportion could cause responses in humans in form of allergic contact dermatitis. This condition of allergic dermatitis is chronic in nature and its symptoms remain even after the obvious source of contamination is removed.

Good manufacturing practice is to be followed with utmost importance during manufacture of soaps, cosmetic and detergent to limit these impurities within acceptable limits as it is suspected that even low level of these toxic impurities in consumer products is sufficient to maintain allergic dermatitis. This naturally infers that colorants used should be of a good quality, free from toxic metal impurities to reduce hazard to the user.

Colorants frequently carry bacteria and moulds. Colorants in paste forms should contain preservatives like 1,2, benzisothiazolin-3-one at 100 to 200 ppm active or 0.2% of 40% formaldehyde solution as to prevent spoilage. The water used for the manufacture of pigment emulsion pastes should be of the highest quality, free from contamination. The use of chlorinated water (2 ppm of available chlorine) is preferred. The vessel where the colorants are stored also requires regular cleaning and sanitation so that the colorants continue to appeal.