The classification of the dyes biology essay

[Science](), [Biology]()

Dyes may be defined as compounds that, when applied to a substrate provide colour by a process that alters, at least temporarily, any crystal structure of the coloured substances. Such substances with considerable colouring capacity are widely employed in the textile, pharmaceutical, food, cosmetics, plastics, photographic and paper industries. The dyes can adhere to compatible surfaces by solution, by forming covalent bond or complexes with salts or metals, by physical adsorption or by mechanical retention.

2. 1. 1 Classification of dyes

Hunger et al mentioned that dyes can be classified in two ways. Dyes are classified according to their application and chemical structure, and are composed of a group of atoms known as chromophores, responsible for the dye color. These chromophore-containing centers are based on diverse functional groups, such as azo, anthraquinone, methine, nitro, arilmethane, carbonyl and others. In addition, electrons withdrawing or donating substituents so as to generate or intensify the color of the chromophores are denominated as auxochromes. Another type of classification is based on their usage or to the type of material they are applied to. The classification of dyes by usage or application is the most important system adopted by the Colour Index International (CI).

2. 2. 2Reactive dyes.

Reactive dyes are mainly used for printing and dyeing of cotton fibres. These are dyes that will chemically bond with the fibrous molecules. Most of reactive dyes have an azo group. Examples of such dyes include metalized-azo, triphendioxazine, phthalocyanine, formazan, and others. These dyes are much simpler molecular structure than direct dyes. Compared to direct dye, reactive dye produces brighter shades. 2. 2. 3Direct dyes. These anionic dyes are soluble in water to form aqueous solution. Direct dyes have high affinity to cellulosic material and fibres. The majority of the dyes of this category are compounds containing polyazo groups and oxazine groups. To improve wash fastness, chelations with metal salts such as chromium and copper salts are commonly applied to the dyestuff

2. 2. 4Vat dyes.

These dyes are water insoluble and can apply mainly to cellulose fibres by converting them to their leuco compounds. The latter was carried out by reduction and solubilization with sodium hydro-sulphite and sodium hydroxide solution, which is called " vatting process". The main chemical structural and functional groups of vat dyes are anthraquinone and indigoid.

2. 2. 5 Basic dyes (cationic dyes)

These dyes are cationic and water soluble. They are applied on paper, polyacrylonitrile, modified nylons, and modified polyesters. In addition, they are used to apply with silk, wool, and tannin–mordant cotton when brightness shade was more necessary than fastness to light and washing.

2. 2. 6Acid dyes.

They are water soluble anionic dyes and are applied on nylon, wool, silk, and modified acrylics. Moreover, they are used to dye paper, leather, printing industry, food products, and in the cosmetic industry.

2. 2. 7 Mordant dyes.

These type dyes have mordant dyeing characteristics with good quality in the presence of certain groups in the dye molecule structure. These groups are capable to hold metal residuals by formation of covalent and coordinate bonds involving a chelate compound. The salts of aluminium, chromium, copper, cobalt, nickel, iron, and tin are used as mordant that their metallic salts.

2. 2. 8Sulfur dyes.

They are water insoluble and are applied to cotton in the form of sodium salts by the reduction process using sodium sulphide as the reducing agent under alkaline conditions. The low cost and good wash fastness properties of dyeing makes these dyes economic attractive.

2. 2 Processes in Textile industries

2. 3 Textile wastewater , Characteristics and Environmental impacts

The textile industry consumes a substantial amount of water in its manufacturing processes used mainly in the dyeing operations of the textile plant. The wastewater from textile plants is classified as the most polluting of all the industrial sectors, considering the volume generated as well as the effluent composition. In addition, the increased demand for textile products and the proportional increase in their production, and the use of synthetic dyes have together contributed to dye wastewater becoming one of the substantial sources of severe pollution problems in current times. Textile waste effluents can be characterized by parameters such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), pH, and colour. The composition of the wastewater will depend on the different organic-based compounds, chemicals and dyes used in the dry and wet-processing steps. Recalcitrant organic, colored, toxic compounds, surfactant and chlorinated compounds and salts can be considered as the main pollutants in textile effluents.

2. 4 Treatment of Textile effluents

Generally, treatment of textile effluent is rather difficult as those textile plants generate complex type of wastewater which can contain multiple components. The concentration of colorants present in that type effluent undergoes constant variations daily or even hourly. The strongly coloured textile effluent contains enormous amount of suspended solids and is characterized with a high COD content and irregular variation in pH which can make it even more difficult to treat. As treatment of textile effluents as it is not usually the most economical, some small scale dyeing industries are facing closure since they cannot do so (Rao and Rao, 2006). Various methods for treatment of the textile effluent exist, but the best combination of treatment methods and system will differ from plant to plant which will based upon the size of the plant, the nature of the pollutants and extent of treatment needed for compliance to norms. Generally the treatment options can be divided into three main categories namely biological, chemical and physical methods.

2. 4. 1 Biological method

Various types of biological treatment methods exist for the remediation of textile effluents. These include trickling filters, activated sludge process, anaerobic process, oxidation pond etc. Up to now, the most common options for used for the remediation of dye effluent are aerobic biological processes, consisting primarily of conventional and extended activated sludge system. The principle of biological methods for removing pollutants from wastewater involves the action of bacteria and other microorganism on the degradation of the organic waste. Biological methods are normally cheap and simple to apply and are presently used to eliminate organic matter and colour from textile factory effluents (Kim et al., 2004). Both the combination of anaerobic and aerobic type of treatments have been utilized for the treatment of textile effluents but additional physical or chemical treatment are usually required to achieve compliance. Colour removal from textile wastewater containing azo dyes by aerobic treatment system was found to be quite ineffective in(O'Neill et al., 2000). Because many commercial dyestuff are toxic to organism present in biological treatment system problems such as sludge bulking, rising sludge and pin flock may arise which makes biological process not quite an effective way for treatment of dyestuff wastewater (Ahn et al., 1999). Also due to their low biodegradability, many textiles chemicals and dyes may not be removed hence making biological treatment is not really an effective way for treating textile industry wastewater (Pala and Tokat, 2002).

2. 4. 2Chemical method

Chemical method includes coagulation/flocculation and Oxidation. Conventional coagulation and flocculation system is removes dye molecules from the dye effluent rather than partially decomposing them into simpler aromatic molecules which evenly more be harmful and hazardous (Golob et al., 2005). Chemical treatment techniques are more effective than biological processes in terms colour removal, but those processes are however more energy intensive and may involve the use of large quantity of chemicals. The major drawback of coagulation/flocculation is that sludge is produced (Golob et al., 2005). Large quantity of sludge is generated during the process and may ultimately become another pollutant itself and increase the treatment cost (Ahn et al., 1999). In contrast chemical oxidation makes use strong oxidizing agents to force the degradation of resistant organic pollutant. Chemical operations can oxidize the pigment in the printing and dyeing wastewater as well as bleaching the effluent. Currently, Fenton oxidation and ozone oxidation are often used in the wastewater treatment. Fenton reaction is mainly used as a pre-treatment for wastewater resistant to biological treatment or/and toxic to biomass. The In large scale plants, reaction are commonly carried out at ambient temperature using a large excess of ions as well as hydrogen peroxide. In such conditions ions do not act as catalyst and the great amount of total COD removed has to be mainly ascribed to the Fe(OH)3 co-precipitation. The main drawbacks of the method are the significant addition of acid and alkali to reach the required pH, the necessity to abate the residual iron concentration, too high for discharge in final effluent, and the related high sludge production (Sheng. H et al., 1997) . Ozonation is also a very effective and fast way of decolorizing effluents as double bonds present in most of the dyes are easily broken. Ozonation also inhibit or destroy the foaming properties of residual surfactants and it can oxidize a significant portion of COD. Moreover, it can improve the biodegradability of those effluents which contain a high fraction of non-biodegradable and toxic components through the conversion (by a limited oxidation) of recalcitrant pollutants into more easily biodegradable intermediates. As a further advantage, the treatment does increase neither the volume of wastewater nor the sludge mass. Full scale applications are growing in number, mainly as final polishing treatment, generally requiring up-stream treatments such as at least filtration to reduce the suspended solids contents and improve the efficiency of decolourisation.. The negative effect is the release of carcinogenic aromatic amines and otherwise toxic molecules and, therefore, it should not be used (Sheng. H et al., 1997).

2. 4. 3 Physical method

2. 5 Adsorption

2. 5. 1 Mechanism