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INVESTIGATION OF DIFFERENT TYPE ADSORPTION OF DYES POLLUTION

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ABSTRACT:
Dyes are one of the main pollutants and due to their toxicity, carcinogenesis and irreversible lesions in the environment and humans. Clean, safe and adequate freshwater is crucial to all living organisms and the normal functioning of ecosystems, communities and economies. Adsorption is an economical and commonly method to uptake of dyes and heavy metals also. In recent years, biopolymers such as chitosan have been used for the separation of dyes from industrial wastewaters. An environment, which is hygienically safe and aesthetically acceptable, should provide us sufficient clean water, soil and natural resources necessary for our modern man. Initially man relied on inexhaustible resources as the planet appeared to be without limits and the laws of nature directed our evolution. Later we started to supplement our muscle power with exhaustible energy sources, coal, oil and uranium and to substitute the routine functions of our brains by machines. As a result, in some respects, we have conquered nature but we are directing our own evolution.

Key words: Pollutants, carcinogenesis, functioning

INTROUCTION

Water is one of the vital necessities for the survival of human beings. Earth is a planet with 71% of its surface covered by water. Of the total available water on earth 97% is seawater and unavailable for human consumption, only 3% is available as fresh water. Out of this 3%, only a meager 0.06% can be easily accessed as the rest comprises of the frozen polar ice cap, groundwater and swamp .The water demand doubles globally every 21 years due to the rapid increase in the population and the industrial activities. Compounded with this is the decrease in rainfall in the previous decade. More than 80 countries accounting for 40% of the world's population are facing major water crises. It has been estimated by UN that by 2025, 2.7 billion people will be affected by water deficiency. Many countries re facing the shortage of clean drinking water and it is estimated that 1.2 billion people are already drinking unclean water. Furthermore, 5-10 million people die annually due to various diseases caused by the consumption of contaminated water. Thus, exploitation of safe water sources to overcome the scarcity of water has been a global challenge for many countries like Australia. The increasing demand of clean water has attracted much of the attention of government organizations and water industries to develop cost-effective technologies for water/wastewater treatment and reclamation. Wastewater reclamation, recycling and reuse are vital to meet the water requirements for irrigation, industry and domestic uses due to increasing population and development in many parts of the world. The term reclamation refers to the treatment of wastewater, which produces water with high quality being reused for agricultural and industrial applications. Wastewater recycling implies reuse of the captured effluent from one user by returning it to the system. The reuse of reclaimed wastewater is essential for sustainable development in the 21st century. The water scarcity is not only a problem of developing countries but also has affected many developed countries as well.

Dyes are complex and sensitive chemicals. A dye is a colored substance that has an affinity to the substrate to which it is being applied. The dye is generally applied in an aqueous solution and may require a mordant to improve the fastness of the dye on the fiber. The Dyes are obtained from animals, vegetables, mineral origin, plants, roots berries, bark, leaves and wood. Both dyes and pigments appear to be colored because they absorb some wavelengths of light more than others. In contrast with a dye, a pigment generally is insoluble, and has no affinity for the substrate. Buts Dyes are soluble, some d y e s can be precipitated with an inert salt to produce a lake pigment, and based on the salt used they could be aluminum lake, calcium lake or barium lake pigments.

TYPES OF DYES:

The first human-made (synthetic) organic dye, mauveine, was discovered by William Henry Perkin in 1856. Many thousands of synthetic dyes have since been prepared. Synthetic dyes quickly replaced by traditional natural dyes. Dyes are now classified according to how they are used in the dyeing process.

ACID DYES

Acid dyes are water-soluble anionic dyes that are applied to fibers such as silk, wool, nylon and modified acrylic fibers using neutral to acid dye baths. Acid dyes are not substantive to cellulosic fibers.

BASIC DYES

Basic dyes are water-soluble cationic dyes that are mainly applied to acrylic fibers, for wool and silk. Usually acetic acid is added to the dyebath to help the uptake of the dye onto the fiber. Basic dyes are also used in the coloration of paper.

DIRECT OR SUBSTANTIVE DYE

Direct or substantive dye is normally carried out in a neutral or slightly alkaline dyebath, with the addition of either sodium chloride (NaCl) or sodium sulfate (Na_2SO_4). Direct dyes are used on cotton, paper, leather, wool, silk and nylon. They are also used as pH indicators and as biological stains.

ORDANT DYES

Mordant dyes require a mordant, which improves the fastness of the dye against water, light and perspiration. The choice of mordant is very important as different mordants can change the final color significantly. Most natural dyes are mordant dyes and there is therefore a large literature base describing dyeing techniques. The most important mordant dyes are the synthetic mordant dyes or chrome dyes. They are applied to wool. Many mordant dyes contain heavy metal that can cause hazardous to health and extreme care must be taken in using them.

VAT DYES

Vat dyes are essentially insoluble in water and incapable of dyeing fibres directly. However, reduction in alkaline liquor produces the water soluble alkali metal salt of the dye, Subsequent oxidation reforms the original insoluble dye.

REACTIVE DYES

Reactive dyes utilize a chromophore attached to a substituent that is capable of directly reacting with the fibre substrate. The covalent bonds that attach reactive dye to natural fibers make them among the most permanent of dyes. Cold reactive dyes, such as Procion MX, Cibacron F, and Drimarene K, are very easy to use because the dye can be applied at room temperature. Reactive dyes are the best choice for dyeing cotton, cellulose fibers and art studio.

DISPERSE DYES

Disperse dyes are water insoluble. They were originally developed for the dyeing of cellulose acetate. Their main use is in dye polyester but they can also be used to dye nylon, cellulose triacetate, and acrylic fibres. They have fine particle size which gives a large surface area that aids dissolution to allow uptake by the fiber. The dyeing rate can be significantly influenced by the choice of dispersing agent used during the grinding.

AZOIC DYES

Azoic dye is an insoluble azo dye is produced directly onto or within the fiber. This is achieved by treating a fibre with both diazoic and coupling components. This dye is applied on cotton.

SULFUR DYES

Sulfur dyes a r e two part developed dyes used to dye cotton with dark colors. The initial bath imparts a yellow or pale chartreuse color. This is after treated with a sulfur compound in place to produce the dark black Sulfur Black 1 is the largest selling dye .

FOOD DYES

Food dyes are food additives; they are manufactured to a higher standard than some industrial dyes. Food dyes can be direct, mordant and vat dyes, and their use is strictly controlled by legislation. Many are azo dyes, although anthraquinone and triphenylmethane compounds are used for colors such as green and blue. Some naturally-occurring dyes are also used.

OTHER IMPORTANT DYES

A number of other classes have also been established including Oxidation bases, Laser dyes, Leather dyes, Fluorescent brighteners, Solvent dyes, Carbene dyes, Contrast dyes.

REVIEW OF LITERATURE:

Kurniawan et al (2011) studied technical applicability of a various physico- chemical treatments for the removal of heavy metals such as Cd(II), Cr(III), Cr(IV), Cu(II), Ni(II) and Zn(II) form contaminated wastewater. A particular focus is given to chemical precipitation, coagulation-flocculation, floatation, ion exchange and membrane filtration. Their advantage and limitations in application are evaluated. Their operating conditions such as pH dose required, initial metal concentration and treatment performance are presented. It is evident from the survey that ion exchange and membrane filtration are the most frequently studied and widely applied for treatment of metal-contaminated wastewater.

Isabel Villaescusa et al. (2009) revealed the sorption of Pb (II), Ni(II), Cu(II) and Cd(II). The kinetic studies show that the initial uptake was rapid and equilibrium was established in one hour for all the studied metals and that the data followed the pseudo-second order reaction. The Langmuir and Freundlich isotherm models described the equilibrium sorption data for single metal system at initial pH 5.5. However the non-competitive Freundlich model has been found to provide the best correlation.

Sona and D'souza (2005) reported the possibility of low grade phosphate for the removal of lead, copper, zinc and cobalt ions from aqueous solutions. Effects of contact time, amount of adsorbent and initial concentration of metal ions were studied. Adsorption of heavy metal ions was found to follow the order of Pb (II)>Cu (II)>Zn(II)>Co(II). Similarly Chockalingam and Subramanian reported the utility of rice husk as an adsorbent for metal ions such as iron, zinc and copper from acid mine water. The adsorption isotherms exhibited Langmuir behavior and were endothermic in nature. The free energy values for adsorption of the chosen metal ions onto rice husk were found to be highly negative attesting to favorable interaction. Over 99% Fe(III), 98% of Fe(II) and Zn (II) and 95% Cu(II) uptake was achieved from acid mine water, with a concomitant increase in the pH value by two units using rice husk indicated successful growth of *Desulfotomaculum nigrificans(D.nigrificans*). The possible mechanism of metal ion adsorption onto rice husk is discussed.

Biosorption is a promising potential alternative to conventional processes for dye removal (Robinson et al 2001). A wide variety of microorganism such as algae, yeasts, bacteria and fungi are capable of decolorizing a wide range of dyes with high efficiency (Nigam et al 1996). Fungi can be classified into two kinds ; living cells and dead cells. Fu and Viraraghavan (2002) demonstrated that dead fungal biomass Aspergillus niger is a promising biosorbent for dye removal. The performance of yeasts as a low cost adsorbent has been demonstrated by Aksu et al (2003).

CONCLUSIONS:

The foregoing pages have described the salient points related to the results of kinetic and thermodynamic studies on the adsorption of dyes onto various adsorbents reported in literature during recent past. However, such studies with an aim to identify easily available and economically viable materials for the removal of dyes from aqueous solutions are on. Apart from the adsorbents mentioned above lots of other materials have also been tried for the past several years to abate dyes from aqueous solutions which include acid activated bentonite Diatomite agricultural waste residues corncob and barely husk, anionic resins, fungus aspergillus niger and Thelephora sp, yeast kluyveromyces marxianus, chitin and ctivated carbons prepared from various materials by chemical or thermal activation process, natural wastes and fly ash.

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