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COLOUR REMOVAL FROM TEXTILE WASTEWATER USING PULP AND PAPER MILL SLUDGE AS AN ADSORBENT

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ABSTRACT

Dyes have long been used in dyeing, paper and pulp, textiles, plastics, leather, paint, cosmetics and food industries. Nowadays, more than 100,000 commercial dyes are available with a total production of 700,000 tones manufactured all over the world annually. About 10-15% of dyes are being disposed off as a waste into the environment after the completion of dying process (Gupta and Suhas, 2009). Most of the dyes are carcinogenic and toxic in nature and when discharged in to the water they pose serious hazards to the aquatic biota. Wastewater treatment is one of the major problems faced by textile manufacturers. Textile wastewater contains various waste chemical pollutants such as sizing agents; wetting agents; complexing agents; dyes; pigment; softening agents; stiffening agents; fluorocarbon; surfactants; oils; wax and many other additives. These pollutants contributes to high suspended solids (SS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), heat, color, acidity, basicity and other soluble substances. Thus there is a need for continues study and research on the waste water treatment to find new methods of treatment in order to sustain this industry. Hence treating wastewater with dyes is of a prime importance. There are several methods for available the removal of dyes from wastewaters, these include: such as adsorption; oxidation-ozonation; coagulation; coagulation-flocculation and biological methods. There is no single process capable of adequate treatment mainly due to the complex nature of these effluents. Among a number of different techniques of dye removal from the aqueous medium it was reported that the adsorption technique has proved one of the best technology and showed good results in the removal of different colouring materials from the water system. Adsorption process provides an attractive treatment of wastewater containing dyes over other conventional wastewater treatment techniques due to economic consideration, its availability and easy to operate as well as greater efficiency. Presently, commercially available activated carbons are very expensive and thereby non- conventional adsorbents such as fly ash, saw dust, peat, rice husk etc., are the alternate for commercial adsorbents. However, not much work has been carried on the removal of various organic pollutants using pulp and paper mill

sludge as an adsorbent. Hence, in the present study pulp and paper mill sludge has been used as a non conventional low cost adsorbent on the removal of patent blue dye from the textile mill wastewater. This study includes batch as well as column adsorption process on the removal of patent blue dye from textile mill wastewater. Batch study include: the effect of adsorbent dose, pH, contact time and initial dye concentration. Further column adsorption test were conducted using periplex glass column for varied bed depths and flow rates to generate the breakthrough curves.

Textile mill wastewater and pulp and paper mill sludge was characterised for pH, BOD, COD, TSS, TOC, and heavy metals. Proximate analysis for pulp and paper mill sludge was carried out to determine surface area, water content, and specific gravity. The surface area was found to be 260 m^2/g, which is found to be on higher side when compared with other con conventional adsorbents. SEM analysis was also carried out to know the surface morphology of the pulp and paper mill sludge before and after adsorption. From the analysis of textile mill wastewater it is evident that patent blue dye was found to be predominant. From the batch adsorption data it was found that as the adsorbent dosage increased, the colour removal increased and thereafter it reached equilibrium. At the lower pH values (pH 3) the colour removal was maximum (98 %) and further increase in pH decreased the colour removal efficiency. Adsorption equilibrium was attained at 1.5 hours and there onwards it became constant. However, higher patent blue dye removal efficiency was noticed at lower concentration of patent blue dye. The value of correlation coefficient R^2 for pulp and paper mill sludge was almost equal to unity when compared with granular (0.934) and powdered activated carbon (0.839). Freundlich constant 'n' was found to be 2.39 for pulp and paper mill sludge and it was 0.89 for activated carbon, indicated that pulp and paper mill sludge showed a favourable adsorption with pulp and paper mill sludge. The constant related to heat of adsorption 'B' in Temkin adsorption for pulp and paper mill sludge was found to be 0.032 and ,0.098 and 0.041 for granular and powdered activated carbon respectively. Further, the results of column adsorption test with 10 ml/min flow rate indicated 99.99 % removal of patent blue dye. At maximum bed depth (600 mm), the patent blue dye removal was found to be maximum. The critical bed depth (X_o) from the BDST model was found to be 19 to 38 mm