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REMOVAL OF BASIC DYES FROM WASTEWATER THROUGH BIOADSORBENT

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ABSTRACT
Dyes release as waste water effluent from various industrial outlets, such as paper, food colouring, cosmetics, leather, pharmaceutical, dyeing, printing, carpet industries etc. These dyes are highly toxic and even carcinogenic hence these are needed to remove from the water effluents before they are discharged into water bodies. Dyes are stable to light and not biologically degradable; they are resistant to aerobic digestion and signify one of the difficult groups to be removed from the industrial wastewater. But, the dye-house effluents are very difficult to treat satisfactorily because they are highly variable in composition. Therefore, bioadsorption became one of the most effective methods to remove colour from textile wastewater. Groundnut peels and cow dung mixture were used as a adsorbent and uptake of methylene blue was evaluated with different parameters like contact time, sorbent dose, and temperature. Results shows that sorption process is time, temperature and concentration dependant. Thus sulphonated mixture of biomass of groundnut peels and cow dung is a low cost and easily available good sorbent for the removal of methylene blue from wastewater.

KEY WORDS: bioadsorption, effluents. Dyes. Waste water, methylene blue.

INTRODUCTION
Dyes are colored compounds which are widely used in textiles, printing, rubber, cosmetics, plastics, leather industries to color their products results in generating a large amount of colored wastewater. Mainly dyes are classified into anionic, cationic, and non-ionic dyes[1]. Among all the dyes using in industries, textile industries placed in the first position in using of dyes for coloration of fiber. Dyes are chemical compounds which attach themselves to fabrics or surface shells to impart color[2]. Depolarization of waste water from textile and manufacturing industries is a major challenge for environmental managers as dyes are water soluble and produce very bright colors in water with acidic properties. It has been projected that textile and manufacturing industries are using more than 10,000 commercially available (worldwide) dyes and the consumption of dyes in textile industry is more than 1000 tones/year and about 10-15% of these dyes are discharged into waste streams as effluents during the dyeing processes[3].

The use of synthetic chemical dyes in various industrial processes, including paper and pulp manufacturing, plastics, dyeing of cloth, leather treatment and printing has increased considerably over the last few years, resulting in the release of dye-containing industrial effluents into the soil and aquatic ecosystems. Since most of these dyes are toxic in nature, their presence in industrial effluents is of major environmental concern because they are usually very recalcitrant to microbial degradation. In some cases, the dye solution can also undergo anaerobic degradation to form potentially carcinogenic compounds that can end up in the food chain. Moreover, highly coloured wastewaters can block the penetration of sunlight and oxygen, essential for the survival of various aquatic forms.

Textile industries utilize substantial volumes of water and chemicals for wet-processing of textiles. These chemicals, ranging from inorganic compounds and elements to polymers and organic products are used for desiring, scouring, bleaching, dyeing, printing, and finishing. There are more than 8,000 chemical products associated with the dyeing process listed in the Colour Index[3], including several structural varieties of dyes, such as acidic, reactive, basic, disperse, azo, diazo, anthraquinonebased and metal-complex dyes. The removal of colour from wastewaters is often more important than the removal of the soluble colourless organic substances, which usually contribute to the major fraction of the biochemical oxygen demand (BOD)[4]. Methods for the removal of BOD from most effluents are fairly well established; dyes, however, are more difficult to treat because their synthetic origin are mainly complex aromatic molecular structures, often synthesized to resist fading on exposure to sweat, soap, water, light or oxidizing agents. This renders them more stable and less amenable to biodegradation.

MATERIAL AND METHODOLOGY

Adsorbate preparation

The methylene blue[MB] solutions were prepared by dissolving appropriate amounts of dry powdered dye stuff in bidistilled water. The different concentrations of the solutions 0.799 mg/L., 7.99 mg/L, 39.9 mg/L and 79.99 mg/L. were prepared[5].

Adsorbent preparation

Groundnut peels and cow dung mixture were used as a adsorbent, which are abundantly available in the rural area in chattishgarh. Cow dung cakes were collected and dried at room temperature. The dried material of groundnut peels and cow dung were crushed, powdered and then soaked in AR conc. Sulphuric acid for 2 hours[6]. The biomass was then heated on a water bath till the fumes ceased then washed thoroughly with distilled water till the black mass was acid free. It was then dried at 110 ^{0}C in the oven for 3 hours and passed through 0.63 mm mesh to get particles of uniform size sorbent and stored in vacuum desiccators[7].

Adsorption study

The experiments is carried out in three sets and each set contain 50 mg of sorbent in different conical flasks, to each flasks 25 ml of freshly prepared methylene blue dye solution of initial concentration (Co= 0.799 mg/L) was added[8]. The volume was made up to 100 ml by adding distilled water. The flasks were protected from sunlight and stirred on magnetic stirrer with constant speed 400 rpm for a period of 25,50, 75, 100, 150, 300, seconds respectively and filtered through whatman filter paper. The absorbance of the filtrate was measured using systronic double beam spectrophotometer at wavelength 640nm[9]. The same procedure repeated to study the effect of different variables. The dye uptake capacity for the adsorbate was calculated by simple concentration method[10].

$$q= \ (Co\text{-}Ct)\ V\ /100$$

Where q is the quantity of sorbate (dye) uptake by biomass, Co and Ct are the initial and final concentrations respectively. V is the volume of solution in ml and W is the dry weight of the biomass added. The removal efficieny is calculated by,

Removal efficiency = [(C0 – Ct)/ C0] × 100

Where C0 is the initial concentration of methylene blue, Ct is the solution concentration after adsorption at any time.

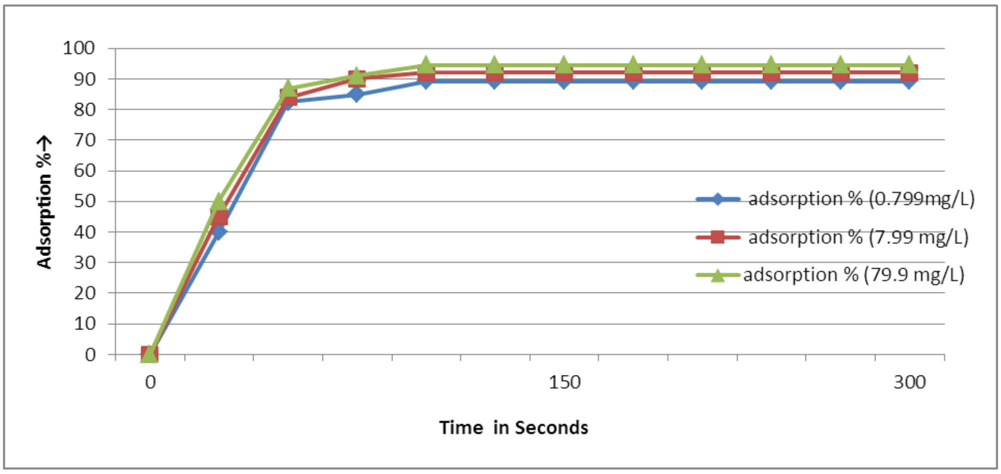

Figure 1 % Adsorption vs. time and concentration

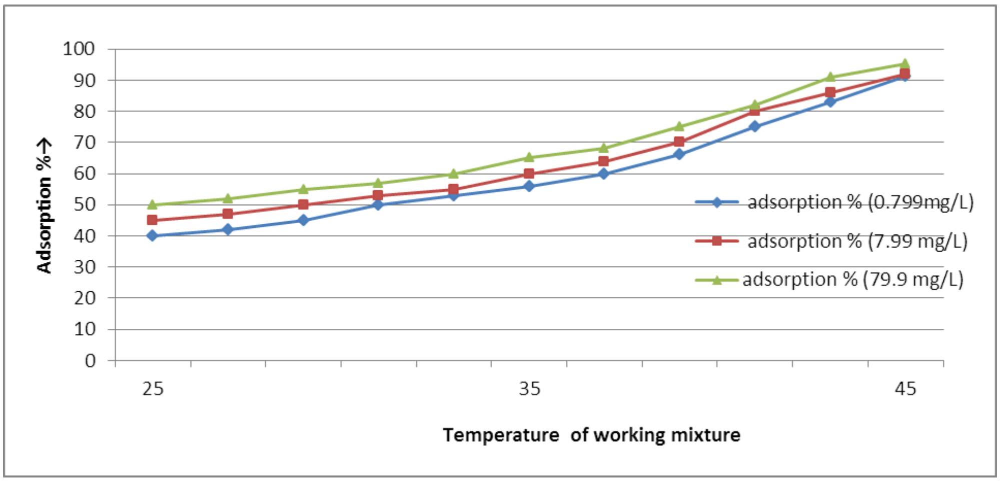

Figure 2 % Adsorption vs. temperature and concentration

RESULT AND DISCUSSION

Initial concentration affects the uptake capacity of the biosorbent to a large extent. figure1shows that adsorbent % increases with concentration of methylene blue, it also shos that at all the concentrations of the dye rate of adsorption is quite high and the process reaches equilibrium within 50 seconds. For an initial concentration of 0.799 mg/L the minimum amount adsorbed is 40% within 25 seconds and the maximum adsorption is 89.2% in 100 seconds. While for an initial concentration of 79.9 mg/L the minimum amount adsorbed is 45 % within 25 seconds and the maximum adsorption 92.1% within 1.5 minute. Out of the total amount adsorbed at equilibrium, more than 60% is seen to be adsorbed within the initial 60 seconds itself (Fig-1). The plots of % adsorbed vs. time shows two distinct regions one clearly indicating rapid adsorption and the other indicating the slowed down rate. This can be due to strong attractive forces between the dye molecules and the sorbent; The plots of % adsorption vs. temperature (fig.2) indicates that maximum amount of methylene blue are adsorbed at 45^0c. Similar shapes were observed for the kinetic curves at all the temperature studied. The curves indicate that as temperature increases the sorption capacities also increases.

CONCLUSION

results shows that sorption process is time, temperature and concentration dependant. The adsorption % can be increased by regulating the different variables so mixture of sulphonated cow dung and groundnut peels is a low cost and easily available good sorbent for the removal of methylene blue from wastewater.

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