Waste Water Treatment Of Printing Ink By Adsorption Using Chitosan

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Abstract - In this research, possibility of using chitosan which is biopolymer can be derived from chitin found abundantly in the exoskeleton of crustaceans such as prawns, shrimps, lobsters and crabs to remove color from printing ink containing waste water has been studied. Chitosan offers an interesting set of characteristics including non-toxicity, biodegradability and biocompatibility. Waste water of printing ink contains high color, suspended solids, and dissolved organic pollutants. Adsorption process of printing ink containing waste water onto chitosan was investigated in batch system. The effect of solution P^H, adsorbent dosage, and contact time was studied. In the research, optimum dose of chitosan were the maximum color removal and turbidity removal is obtain is found out. Result shows that adsorption process carried out using chitosan considered as an effective and economical method to remove color, turbidity from printing ink containing waste water.

Keywords - Adsorption ,batch experiment , removal, optimum dosage

1. INTRODUCTION

The printing plants use different types of substances for printing newspapers, magazines, advertisements, books, etc. Over 90 percent of inks are printing inks, in which color is imparted by pigments rather than the dyes used in writing inks. Ink pigments are both inorganic and organic. Ink can be a complex medium, composed of solvents, pigments, dyes, resins, lubricants, solubilizes surfactants, particulate matter, fluorescents, and other materials. There is a misconception that ink is non-toxic even if swallowed. Once ingested, ink can be hazardous to one's health. Certain inks, such as those used in digital printers, and even those found in a common pen can be harmful. Though ink does not easily cause death, repeated skin contact or ingestion can cause effects such as severe headaches, skin irritation or nervous system damage. These effects can be caused by solvent or by pigment ingredients such as p-Anisidine, which helps create some inks color and shine. Three main environmental issues with ink are Heavy metals, Non-renewable oils and Volatile organic compounds.

The technologies for color removal can be divided into three categories: Biological, Chemical, and Physical. All of them have advantages and drawbacks. Biological treatment is often the most economical method as compared with other processes. It requires a large land area and is constraint by sensitivity towards diurnal variation as well as the toxicity of some chemicals and less flexibility in design and operation. Chemical techniques are often expensive. Different physical methods are also widely used such as membrane and adsorption techniques. The disadvantage of membrane process is that it has a limited lifetime. Adsorption is a well-known equilibrium separation process and an effective method for water decontamination applications. Adsorption has been found to be superior to other techniques for water reuse in terms of initial cost, flexibility and simplicity of design, ease of operation and insensitivity to toxic pollutants. It also does not result in the formation of harmful substances. Mostly activated carbon is used for the adsorption process but the disadvantage of the activated carbon is it is expensive so economical adsorbent should be used for the adsorption of printing ink containing waste water. Chitosan which is a biopolymer can be used for this purpose. Chitosan can be used in powder form as well as in solution form. It can be derived from chitin found abundantly in the exoskeleton of crustaceans such as prawns, shrimps, lobsters, and crabs. The adsorption process carried out using chitosan is considered as an effective and economical method to remove color, turbidity from printing ink containing waste water.

2. MATERIAL AND METHODS

2.1 PREPARATION OF CHITOSAN

Chitosan is easily derived from chitin by deacetylation. The high properties of amino functions in chitosan have been found to provide high adsorption properties for many metal ions and organic dyes.

Chitin is highly found bipolar in the world. It is found in exoskeletons of prawns, crabs, shrimps, etc. These prawn shells were separated from their heads to remove unwanted wastes and washed thoroughly to remove meat residue and other contaminants. Then the shells were dried at 105 degree Celsius in oven until constant weight was obtained. After drying process, shells of prawns were ground and sieved to obtain particles of size less than 250 micro meters. Further the steps demineralization, deproteinization, purification and deacetylation involve. Deacetylation is the process of converting chitin to chitosan by removal of acetyl groups. Degree of deacetylation of chitosan was estimated using the Fourier transform infrared (Bruker FTIR Spectrometer) Spectrum in the range of 500-4000 cm-1.

2.2 BATCH ADSORPTION EXPERIMENT

The wastewater containing ink was collected from the printing press which prints magazines, books, cards, etc. The chitosan used for the adsorption having deacetylation degree 90%.
The batch experiment was performed for the study of adsorption. The initial absorbance of the sample was taken in U.V Spectrometer. The same amount of wastewater containing ink sample was taken in a beaker. Then various adsorbent (chitosan) dosages added to it like 5mg, 10mg, 20mg, 25mg. The solutions were mixed for 10 minutes at 100 rpm speed and allowed settling. Then the solutions were filtered through a Whatman filter membrane with a time interval of 30min, 60min, 90min, 120min, and 150min. The final absorbance was measured in U.V. Spectrophotometer and the optimum dose was obtained.

3. RESULTS AND ANALYSIS

3.1 EFFECT OF CHITOSAN DOSAGE, TIME AND P^H ON ADSORPTION

3.1.1 EFFECT OF CHITOSAN DOSAGE

Waste water sample was collected from printing plant. Same amount of sample put in different beakers and add various amounts of adsorbent in beaker. The adsorbent (chitosan) dosage was (5, 10, 15, 20, 25) mg. Effect of chitosan dosage on adsorption of waste water containing printing ink is illustrated in graph 3.1. The percentage removal of ink from solution increased as the adsorbent dosage increased. Test sample with 15 mg of chitosan showed the highest adsorption. Hence, it could be considered that the optimum chitosan amount to be used for over 93 % ink removal is 15 mg.

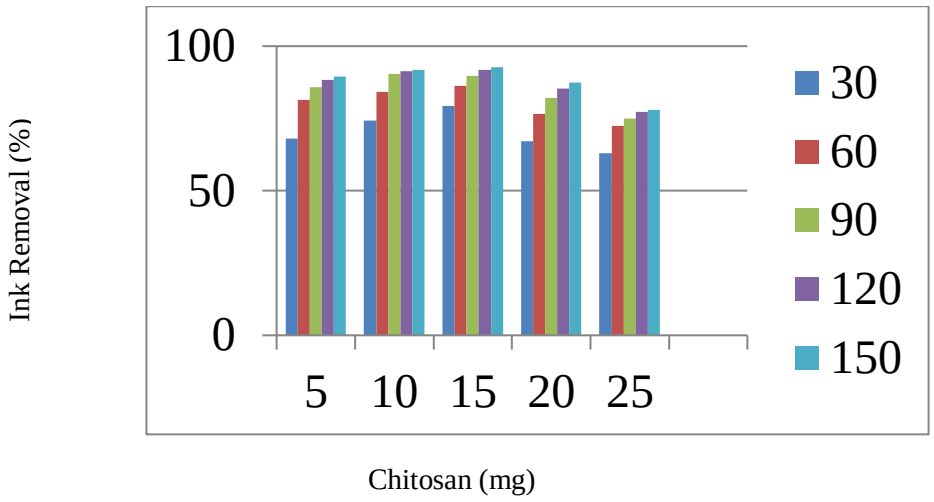

Figure 3.1 Effect of chitosan dosage on adsorption

3.1.2 EFFECT OF TIME

Adsorption was increased as time increases. After 2 hours it shows little improvement. This process proves that the optimum time period that should be provided for the adsorption process is 2 hours. The adsorption was investigated for the time (30, 60, 90, 120, 150) min. the maximum percentage ink removal increased upto 120 min. The effect of time on the absorbance is shown in graph 3.2.

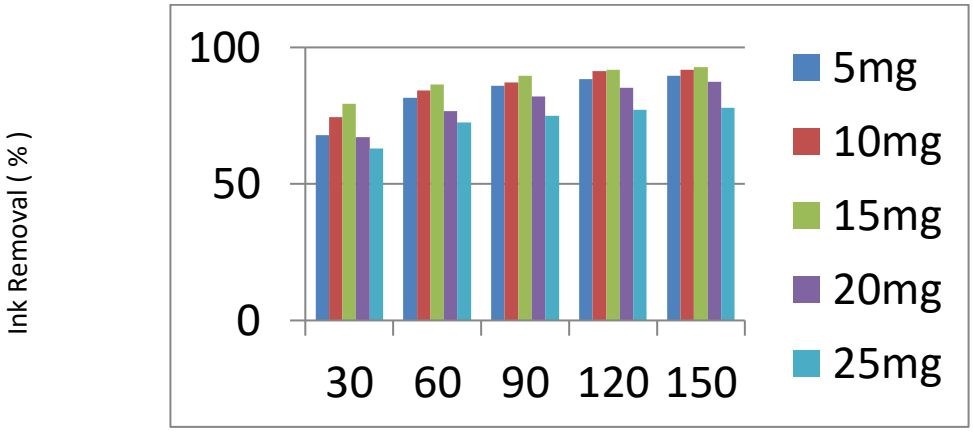

Figure 3.2: Effect of time on absorbance

3.1.3 EFFECT OF ADSORBENT DOSAGE ON TURBIDITY

Turbidity caused by large number of individual particles that are generally invisible to the naked eye. The measurement of turbidity is a key test of water quality. After the addition of adsorbent dose the turbidity remarkably remove. Intial reading of waste water containing ink sample is taken in UV Spectrophotometer. After the adsorbent dosage addition and rpm given to the sample the turbidity had cheked after filtering the sample through whattman filter paper. It shows that turbidity has removed.

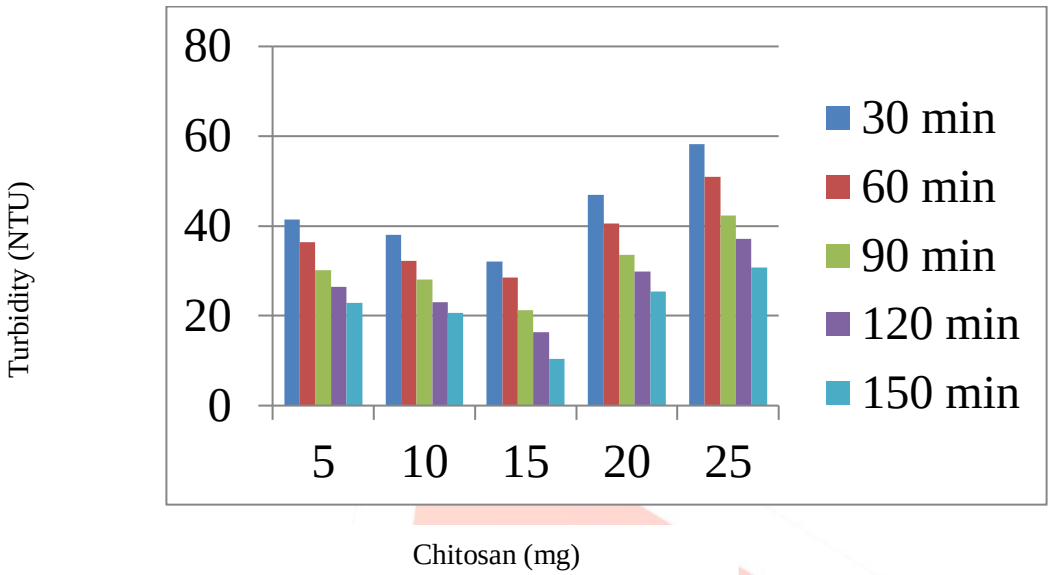

Figure 3.3: Effect of adsorbent dosage on turbidity

3.1.4 EFFECT OF PH ON ADSORBANCE

The pH of the sample solution affects the adsorption process. The removal of ink at different pH values is plotted in graph 3.4. The experiment was conducted at various pH values from 4 to 9 in acidic and alkaline conditions respectively. The value of pH is controlled by addition of NaOH and HCL. In the study, the most suitable pH for adsorption process was 8.

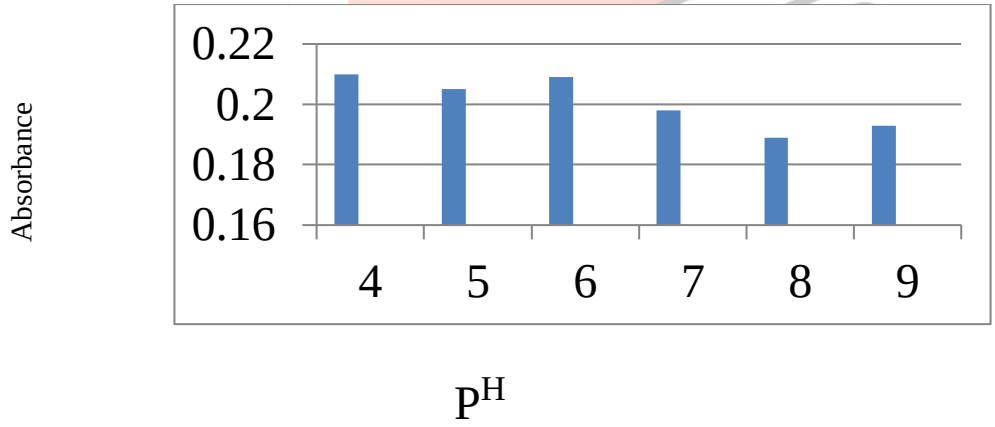

Figure 3.4: Effect of pH on adsorbance

4. CONCLUSION

The use of chitosan as an adsorbent allowed a significant reduction in the absorbance of water containing ink of the printing press. The batch experiment shows that ink adsorption into the chitosan depended highly on adsorbent dosage, solution pH and time. The result also shows that maximum turbidity is removed with time after filtration. An optimum amount of chitosan required for proper adsorption was estimated as 15mg for 100ml of waste water containing ink. The optimum time period to be provided for adsorption was 120min and the optimum pH was 8. The initial and final absorbance of the sample was measured using U.V. Spectrophotometer (chemito UV 2100).

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