CORNCOB ACTIVATED CARBON (CCAC) AS TEXTILE EFFLUENT ADSORBENT

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ABSTRACT:

This paper investigates the potential of activated carbon prepared from corncob through chemical activation as an adsorbent to remove textile effluent containing artificial dyes. Agro waste from corn plantation in Terengganu has been chemically treated with H_3PO_4 at three different impregnation ratio (by weight) before carbonized at high temperature (700 °C) to develop microspores onto the corncob surfaces. Batch adsorption process of *Remazol red 3BS* dyes from aqueous solution was conducted after corncob activated carbon (CCAC) was prepared through chemical activation. Adsorption studies were carried out at four different initial dye concentration, different contact time and different adsorbent dosage. Batch equilibrium condition was attained within less than 2 hours and highest removal efficiency 47%, was recorded for highest impregnation ratio activated carbon for initial dye concentration of 10 ppm. Higher adsorption efficiency can be achieved as adsorbent dosage is gradually increased. The equilibrium adsorption studies show that activated carbon impregnated at 2.5:1 impregnation ratio was very effective in adsorbing reactive dye from artificial textile effluent.

***Keywords*:** Acticated carbon, Corncob

INTRODUCTION

The main aim of the study is to prepare the activated carbon from corncob through chemical activation using phosphoric acid (H_3PO_4) as an alternative adsorbent to the waste water problem from textile industry. Textile industry is among the most important industry for developing country like Malaysia and its effluent waste water is however characterized with high pH values, high in dissolved solid materials and surfactant due to the presence of strong artificial dyes coming from dyeing and finishing process during the manufacturing (Solmaz *et al.*, 2006). Discharge of colored effluent into water streams may cause problems to consumers such as allergies, skin irritation, or different tissue changes (Chequer *et al.*, 2011). The presence of colored materials and dissolved solids make the waste water from textile industry are highly in chemical oxygen demand and biological oxygen demand (Khan *et al.*, 2010). Corncob is chosen as the precursor for activated carbon prepard due to its high in carbon content (lignin, cellulose and semi-cellulose) (Zheng, 1993). The corncob activated carbon (CCAC) was prepared at three different impregnation ratios (by weight) – 0.5:1, 1.5:1 and 2.5:1. After impregnation for 24 hours, the wettish corncob later was carbonized at 500°C. The prepared activated carbon was later used in adsorption of artificial textile solution to test its potential in adsorbing color from solution, at different initial dye concentration, contact time and adsorbent dosage using batch process. Equilibrium adsorption was achieved within 120 minutes for all the study parameters. A significant removal efficiency was shown by CCAC that is prepared at highest impregnation ratio.

METHODS

Corncob was cleansed, drenched in distilled water and cut to approximately 1 cm^3 cubic, and later dried in oven at temperature of 105°C overnight to remove excess moisture. Dried corncob was impregnated with 50% phosphoric acid, H_3PO_4 (as an activating agent) at 3 different impregnation ratios; 0.5:1, 1.5:1.0 and 2.5:1. Impregnation ratio (by weight) is ratio of activating agent to the weight of corncob. Phosphoric acid is preferable among many dehydrating agents due to its environment concerns (Qada et al., 2008).

After impregnation for 5 hours, wettish corncob was carbonized stream for 2 hours at 500°C and later washed with hot distilled water to remove remaining acid until the effluent reaches pH equal or greater than 6. Batch experiments on adsorption of artificial dyes were conducted using all three impregnation ratio CCAC prepared. CCAC was added into a 100 ml of dye aqueous solution of known initial concentration (10ppm, 20ppm, 30ppm & 40ppm) in a 200 ml conical flask. The mixture was agitated at a constant speed of 120 rpm and adsorption was allowed to take place for 2 hours at pH 7. Samples were withdrawn at different time intervals (0-120 min), filtered and analysed for remaining dye concentration. The removal efficiency of dye was later calculated.

RESULTS AND DISCUSSIONS

Effect of initial concentration: The equilibrium for batch adsorption process was attained within 2 hours for all three CCAC, thus, makes 120 minutes shaking time to be appropriate for maximum adsorption. As initial concentration of dye solution increases, the amount of dyes adsorpt deacreases (for all CCAC). CCAC with impregnation ratio of 2.5:1 and 1.5:1 shows 47% and 28% of removal efficiency at 10 mg/l of initial concentration. This efficiency reduces for initial concentration 40 mg/l, to only 31% and 19.8 % respectively. High adsorption efficiency at lower concentration is due to available surface area on the active site (activated carbon) is still abundant to be able to adsorp dyes particles.

Effect of contact time: The study on contact time, initial concentration of reactive dye solution prepared was set at 20 mg/l which is equivalent to 4 mg of reactive dye was added per gram of adsorbent. All three types of CCAC showed significant trends of adsoption for the first 20 minutes, and gradually decrease afterwards until they reach equilibrium. At the beginning, the surface area of activated carbon has not yet occupied thus the rate of adsorption of dye ions by the exterior surface was significant. Once the exterior surface fully occupied by the dye ions and saturated, the dye ions entered into the pores were adsorbed by the interior surface of the particle, until interior surface was also saturated and caused equilibrium.

Effect of adsorbent dosage: The study on adsorbent dosage parameters, CCAC with highest impregnation ratio (2.5:1.0) was selected but with 4 different dosages (0.1, 0.5, 1.0 and 1.5 g). These CCAC were added into 100 ml of dye solution of 20 mg/l concentration while agitated at constant speed and the amount of removal was calculated after 2 hours. It was found that by increasing the adsorbent dose the percentage of dye removal increases. This is due to the number

of available adsorption sites increases by increasing the adsorbent dosage which allows more dye particles to be adsorped onto the surfaces.

CONCLUSION

From this study, the activated carbon prepared from corncob has the potential in removing reactive dye, Remazol red 3BS which represents artificial dyes in textile industries. To have higher efficiency in removing dyes, the activated carbon prepared from concorb should be prepared at high impregnation ratio through chemical activation. However, this study was only conducted at laboratory scale with very small amount of activated carbon. To have a better view on the potential of CCAC onto dye removal, pilot scale study is more comparative. Overall results from this study indicated that corncob which has been chemically treated with phosphoric acid has the potential and very effective to be used in removing dyes from textile effluent. Methods of preparing the corncob activated carbon can be improved and the study onto its thermal characteristic and morphology of the activated carbon prepared can be done in future.

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