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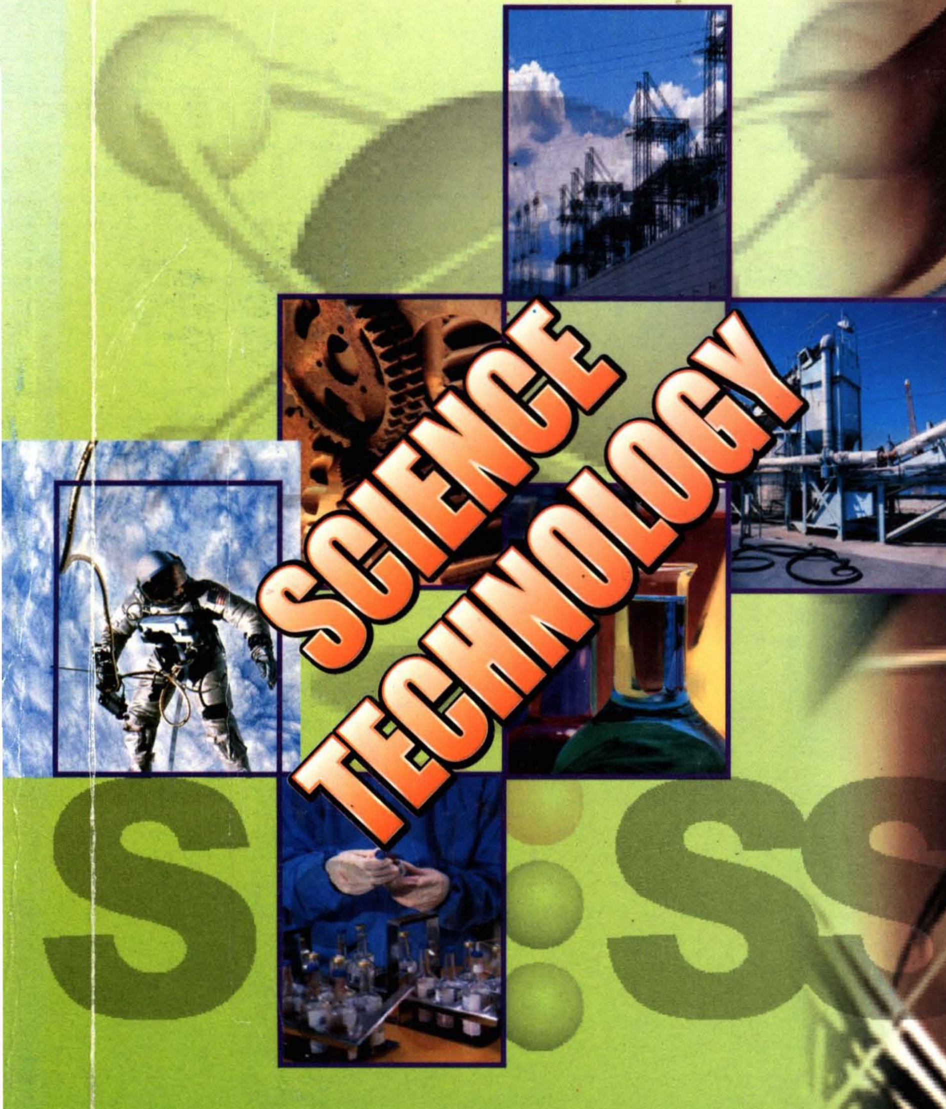

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Treatment of Textile Wastewater with Peat Soil Based System

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ABSTRACT

Peat soil is an organic soil formed from the compilation and degradation of residual plant materials over the years. Malaysian peat soil classified as tropical peat soil was successfully modified to work as a coagulant material. This Peat Coagulant (PC) was found effective for the clarification of turbidity as well as colour from aqueous solutions. It could effectively remove over 95% of the colour from standard dye solutions. It was also found that it could remove colour from textile waste water above 87% without any pH adjustment and at pH 5 it showed 94% colour removal from the textile waste water. The colour removal percentage of PC was higher compared to alum and poly aluminium chloride (PAC) which are 51% and 54% respectively at their optimum pH. PC treated textile waste water was further passed through a peat soil based filter prepared from heat treated peat soil for the removal of chemical oxygen demand (COD). Laboratory scale study showed that this filter was able to remove above 90% of the remaining COD from the textile waste water.

Keywords: *Peat coagulant, textile waste water, peat filter, colour, COD*

Introduction

Colour removal from textile effluents has been the target of great attention, not only because of its toxicity but mainly due to its visibility. The colour effluent from the dyeing and printing processes has to be decoloured before being fed to the subsequent chemical or biological treatment unit (Morais et al. 1999). These decolorisation methods include adsorption, ozonation, chemical precipitation, biological process etc. Each has its own merits and limitation in application. In some cases one single treatment system is not sufficient to meet the regulatory requirement of the textile effluent discharge (Slokar and Marechal 1998). Therefore multistep treatment system is adopted to achieve the required quality of the effluent.

Peat soil is defined as organic soil formed from partial degradation of plants and mosses. It is normally brown to black in color and is widely distributed through out the whole world (Shotyk 1988). Malaysia has been estimated to have at least 2.5 million hectares of peatland with depths ranging from several centimeters to several metres (Mutalib 1991). Peat soil has been widely used in wastewater treatment throughout the world since last few decades. From laboratory scale to operational scale, peat has shown its ability for the successful removal of suspended solids, odours, organic matter, oil, nutrients and heavy metals from wastewater (Couillard 1994). Since peat soil is a natural organic material, it is expected to produce environmental friendly products that shall enable us to treat wastewater at lower cost and easily managed and safe end products. We have managed to produce two peat products namely peat coagulant (Mohd. Asri et al. 2002) and rubber-coated peat pellets filter bed (Mohd. Asri et al.1997). This work provides the results of the utilization of these two products in the treatment of textile wastewater. Our basic aim was to produce effluents that meet the discharge standards of DOE, to effectively remove the textile dyes colouring of the discharge and to produce safe and easily manage waste sludge.

Materials and Methods

Peat coagulant was prepared from local Malaysian peat soil. Alum [$Al_2(SO_4)_3.16H_2O$] analytical grade was obtained from Fluka, PAC commercial grade was obtained from CCM Chemicals, cibacron red (CR) dye was from Aldrich. USA, reactive blue 19 (RB) was from BASF, India, vat blue 14 (VB) and disperse red 72 (DR) was from Bayer. NaOH and HCl analytical grade were used for this study. HACH disposable COD kit was used for the COD measurement. Textile wastewater was collected from one of the textile manufacturing company situated in West Malaysia. The wastewater sample was collected in a 25 L plastic container from the first waste-collecting pond, which was receiving effluents from all processing units of the factory.

Peat coagulant (PC) was prepared according to the procedure described by Mohd Asri et al. (2002). Peat coagulant solution used in this study was 3.95% solution while for alum and PAC; solutions of 10% were used.

Textile wastewater, l_{max} was determined by scanning the raw sample using a Hitachi Uv-vis spectrophotometer and the percentage removal of the colour was calculated considering the original wastewater absorbance value as 0% removal. HACH DR-2000 spectrophotometer was used for the measurement of absorbance of the supernatant.

Coagulation studies were based on jar test method. For this purpose, a six-paddle flocculator from Stuart Scientific was used for the jar test study. Sample volume used was 250 ml. After settlement of the sludge, the supernatant was collected for the absorbance measurement and calculate the percentage colour removal.

Chemical Oxygen Demand (COD), Turbidity (FTU) and Suspended Solids (SS) were determined using HACH (1992) water analysing handbook method. COD of the sample were measured using HACH disposable COD kit. After the settlement of the sludge the supernatant was used for the analysis. For the blank distilled water was used instead of the sample. Proper dilutions were made using distilled water for higher COD, FTU and SS samples.

Results and Discussion

Peat coagulant was found effective for the removal of colour from standard dye solution. In Figure 1, it could be seen that the removal of four types of dye namely cibacron red (CR), vat blue (VB), reactive blue (RB) and disperse red (DR) has shown more than 95% removal at different coagulant dosage. The mechanism of coagulation of these dyes had been proven to be via adsorption of the coagulant on the dyes surfaces. It was also found that pH played a significant role in this process (Helal Uddin et al. 2003; Helal Uddin 2003).

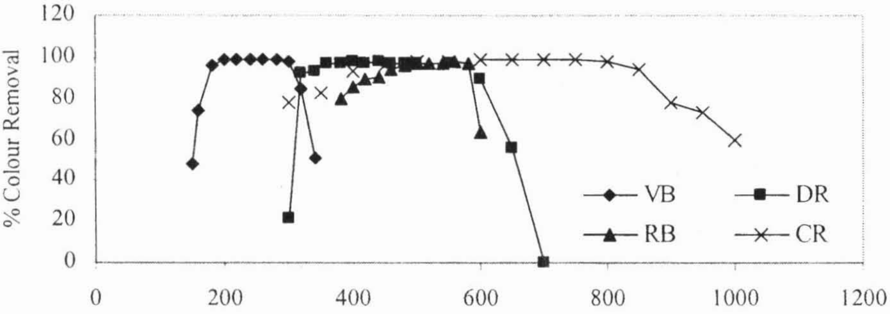

Fig. 1: Dosage study of peat coagulant on 250 ml volume of 50 mg/L dye solution of CR, VB, RB and DR at their optimum pH and coagulation conditions

The removal of textile dyes colouring in the wastewater was deemed possible with peat based coagulant. A jar test involving 250 ml of wastewater was tested and the result of the dosage study is shown in Figure 2. As can be seen, almost 90% removal of the coloring was achieved. No adjustment of pH or dilution was done to the sample. It shows an 87% of colour removal with 3 ml of peat coagulant without prior pH adjustment. 94% removal of colour was obtained with pH adjusted to 5. On the other hand, alum and PAC showed only 51.2% and 54.8% of colour removal respectively. One important feature of this PC coagulation is that the sludge produced is almost 100% organic in nature. Even though a detailed study of the sludge has not been done, it is anticipated that the sludge will be easy to handle or treat.

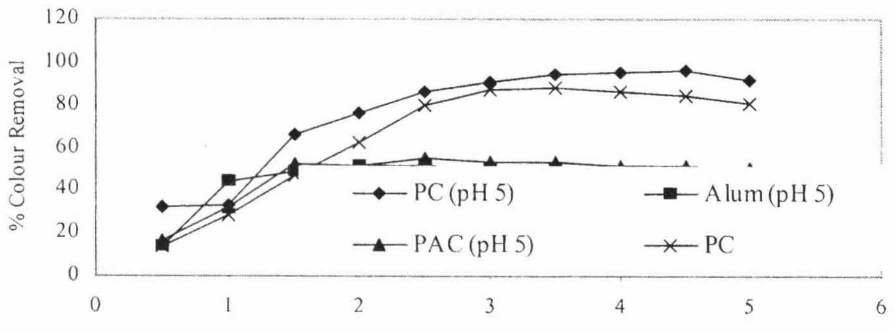

Fig. 2: Dosage study of different coagulant with 250 ml of textile waste water at optimum pH and coagulation conditions

Water quality parameters of the textile waste water treated with different coagulants are summerised in Table 1.

Table 1 : Percentage removal of several parameters of textile waste water after treatment with different coagulant

Parameters	Peat Coagulant (PC)	Alum	PAC
Colour (% Removal)	94	51.2	54.8
Turbidity (% Removal)	70	62.5	59.3
Suspended Solids (% Removal)	98	85	87
COD (% Removal)	15.5	34.1	30.5

Utilization of peat coagulant was effective in removing textile dyes, turbidity and suspended solids but not the COD of the wastewater. Further treatment of the effluent was done by passing the treated wastewater through a latex-coated peat filter bed. The filter bed was prepared from thermally treated peat soil that was further pelletized with rubber latex. The effect of this pelletization process was to significantly improve the hydraulic conductivity of the filter. Earlier study with domestic wastewater indicated that it was effective in removing COD and can be self regenerating (Mohd. Asri et al. 1997).

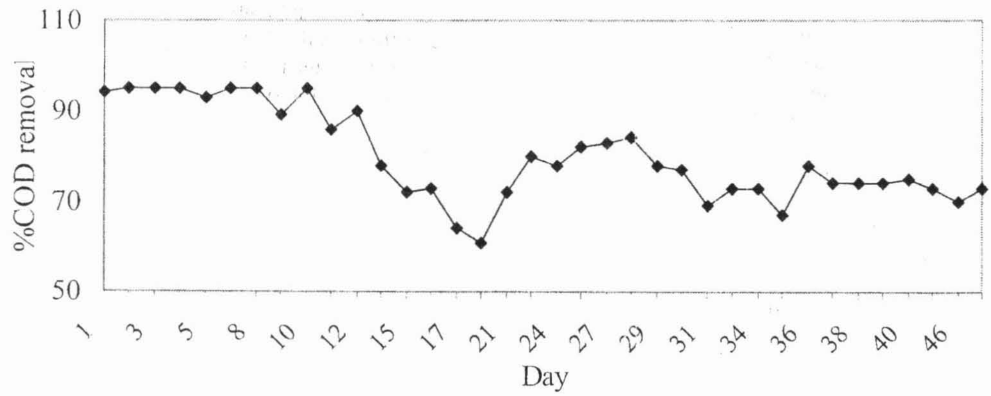

Fig. 3: COD monitoring results of the filtered textile waste water which was pre-coagulated with PC. 500 ml waste water sample was filtered everyday for monitoring

Figure 3 shows a month long filtration activity involving the pre-coagulated textile wastewater. Initially for the first 11 days, COD removal was about 90%. The COD removal reduced with time beyond that to almost 60% but eventually stabilized to between 75%-80%. Of course, the effectiveness of the filter bed depends on its depth. The deeper the filter bed, the more effective will be the COD removal. The depth of the filter used here was 15 cm.

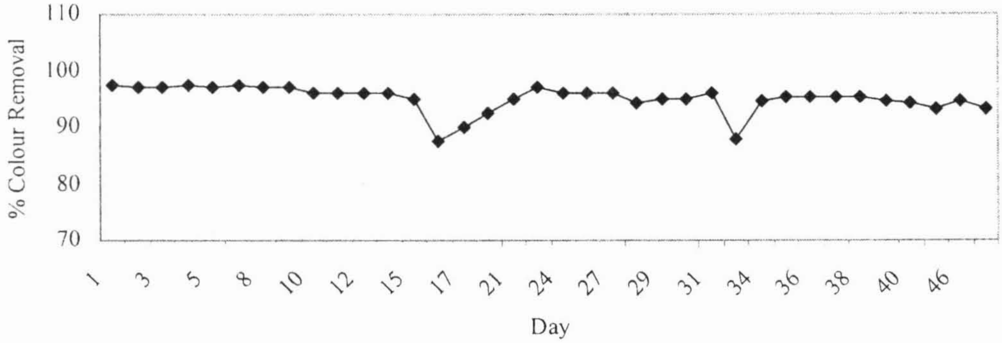

Fig. 4. Colour removal monitoring of the textile waste water using peat filter. The PC coagulated 500ml textile waste water was used daily for month long study

Figure 4 shows the final color removal of the discharged effluent calculated from the absorbance at l_{max} for the original waste water. l_{max} was previously determined by scanning the sample in visible region using UV-Vis Spectrophotometer. Overall, the color removal was more than 86% with most cases occurring beyond 95% removal. To the bare eyes, the final effluent was definitely colorless.

Conclusion

The overall results from the various experiments and studies on the textile waste water show that the peat based system could be an encouraging treatment system for treating textile waste water. Combination of peat coagulant and peat rubber filter made the system totally organic and more environmentally friendly. Textile dyeing industry is one of the largest water consuming sectors among other industries. So the waste water produced by this sector is also huge. Treatment of this huge amount waste water is a big concern in this sector. Moreover most of the existing treatment systems are less environmentally friendly and involve higher cost. If we can establish our peat system for the treatment of textile waste water, we hope it will be of much interest among the textile industries.

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