

STUDY ON THE APPLICATION OF MELALEUCA CAJUPUT ACTIVATED CARBON IN THE TREATMENT OF WASTE WATER FOR TEXTILE INDUSTRY

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ABSTRACT: *The article describes investigation results in applying the melaleuca cajuput activated carbon in waste water treatment for textile industry. The melaleuca cajuput charcoal activated by steam is of the specific surface area of about 1000m²/g. The received activated carbon is used for further investigations to identify isotherm equilibrium curves, kinetic characteristics of the adsorption of Sulfite Red S3B, Sulzol Blue R-VL and Procion Yellow HE-XL dyestuffs. Langmuir's equations appear to fit well the experiments. For kinetic characteristics, pseudo second order equations are found to fit better the experiments, that is in agreement with other researchers. The investigations point out that the melaleuca cajuput activated carbon could be effectively used for textile waste water treatment.*

Keyword: *Activated carbon; Melaleuca cajuput; Waste water treatment.*

1. INTRODUCTION

It has been found that melaleuca cajuput wood is a good material for activated carbon [1]. Nevertheless, to identify the suitability of the activated carbon to practical uses, it is necessary to study the adsorption characteristics of different species in corresponding media [6,8]. The investigations deal with some types of dyestuffs which are considered harmful to environment: Sulfite Red S3B, Procion yellow HE-XL and Sulzol Blue R. The suitability of the activated carbon to the contaminated components could be evaluated by the adsorption capability, which is judged by isotherm curves, and the adsorption speed, which is judged by kinetics investigations.

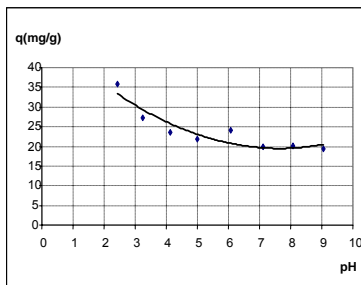
2. MATERIALS AND METHODS

Melaleuca cajuput activated carbon is self produced based on the procedure described in [1]. Its specific surface area is evaluated by BET method. The Sulfite Red S3B, Procion yellow HE-XL and Sulzol Blue R dyestuffs are supplied by the Institute for Textile and Fashion. Compositions of the dyestuffs in liquid media are identified by chromatography (UV-VIS DR Hatch 5000).

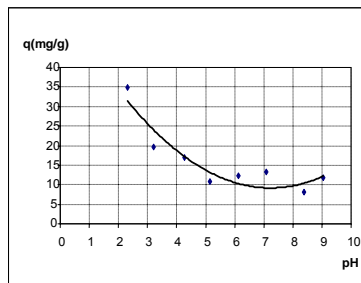
3. RESULTS AND DISCUSSION

3.1. Influence of pH

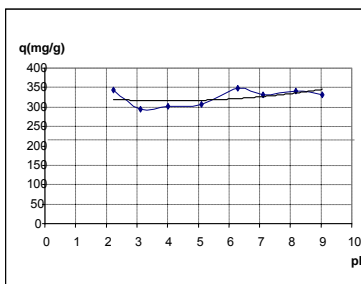
Batch tests have been done to identify the influences of pH on the adsorption capability of the activated carbon. The data are displayed in Figure 1. It is pointed out that at low pH values, the adsorption capability of the Sulfite Red S3B and Procion yellow HE-XL dyestuffs on the activated carbon are higher than at neutral media (pH = 5 -8), while the adsorption capability of the Sulzol Blue R does not change much. Thus, the adsorption to remove those dyestuffs is more effective in light acid media waste water.



a)



b)



c)

Figure 1. Influence of pH on the adsorption capability on the activated carbon
a) Sulfite Red S3B 150%-VL b) Procion Yellow HE-XL-VL c) Sulzol Blue R-VL

3.2. Isotherm equilibriums

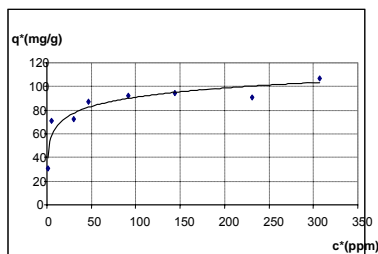
Isotherm equilibriums to the dyestuffs are determined at room temperature as the treatment temperature of most waste water resources. Different volumes with determined initial concentrations of dyestuffs and different determined amounts of activated carbon have been brought to contact in batch tests. The concentration changes of dyestuffs during the contact have been samples, analyzed until pseudo plateaus are observed. The received data are used for the isotherm equilibriums creation. The experimental data are plotted on Figure 2.

It is assumed from the experiments that the Langmuir's isotherms [2,3,4,7] could be used to illustrate the data:

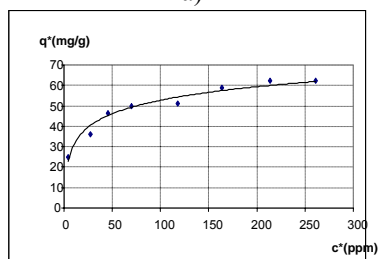
$$q^* = \frac{QK_L c^*}{1 + K_L c^*} \quad (1)$$

in which Q (mg/g) is the maximum concentrations of adsorbate in the activated carbon, K_L is an equilibrium constant, (1/ppm), q^* (mg/g) and c^* (ppm) are the concentrations of the adsorbate in the activated carbon and in the solution, that are in equilibrium with each other.

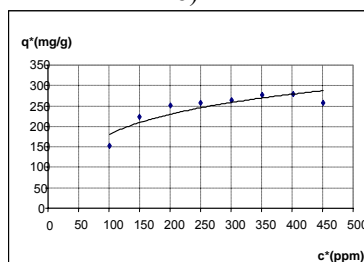
By logarithmizing the equation (1) and plot the calculated values on graphs, it is easy to find out the corresponding values of Q , K_L for the used dyestuffs as shown on the Figure 2.



a)



b)



c)

Figure 2. Isotherm of the dyestuffs adsorption on the activated carbon at room temperature and $\text{pH} \approx 2$.

- a) Sulfite Red S3B, $Q = 93.46$ (mg/g), $K_L = 0.473$ (1/ppm)
 b) Procion Yellow HE-XL, $Q = 54.64$ (mg/g), $K_L = 0.187$ (1/ppm)
 c) Sulzol Blue R, $Q = 277.78$ (mg/g), $K_L = 0.240$ (1/ppm)

3.3. Kinetics investigation

Each volume of 1500 ml with determined initial concentration of dyestuffs is prepared for the kinetics investigations. Two concentrations of the dyestuffs (20ppm and 40ppm of each type) and two different amounts of the activated carbon (ca. 0,3gr and 0.6gr) are used for these investigations. Samples are taken during the adsorption process and analysis has been done to figure out the change of adsorbate concentrations in the solution. The concentrations of the adsorbate in solid phase (activated carbon) are calculated on the base of material balances.

Three types of kinetics models have been used to evaluate the flow of the process: the outer mass transfer [3], the pseudo 1st order and the pseudo 2nd order [4]. By plotting the experimental point and the calculated theoretical lines on the same graphs, it has been found that the pseudo 2nd order kinetic equation fitted rather well the experimental results (Figures 3,4 and 5). This agrees well with the suggestions made by Y.S.Ho and G.McKay [5].

4.CONCLUSION

Based on the study, it is pointed out:

- Melaleuca cajuput steam-activated carbon could be effectively used to treat dyestuffs of the textile wastewater. When the concentration of dyestuffs in waste water is about 250ppm, the activated carbon could adsorb 100, 60, 250 mg/g for the dyestuffs Sulfite Red S3B, Procion Yellow HE-XL and Sulzol Blue R, respectively.

- Equilibrium isotherms of the adsorption processes could be described by Langmuir's equation.

- Kinetics characteristics of the processes could be well described by pseudo-2nd order equations. The theoretical equation with experimentally determined coefficients can be used for process calculation.

- For practical applications, column tests should be done with different types of dyestuffs.

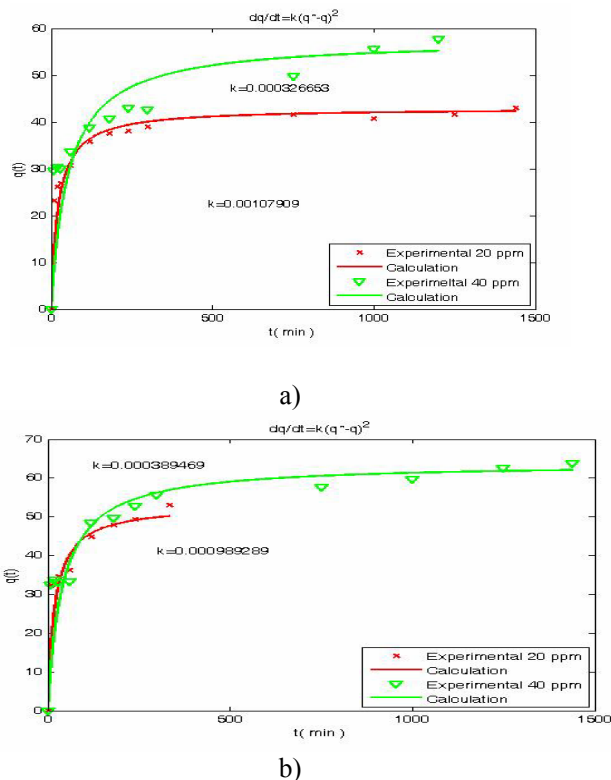


Figure 3. Kinetic behaviours of the Sulfite Red S3B adsorption on activated carbon with initial solution concentrations of 20ppm and 40ppm.

a) Weight of activated carbon: ca. 0,3gr b) Weight of activated carbon: ca. 0,6gr

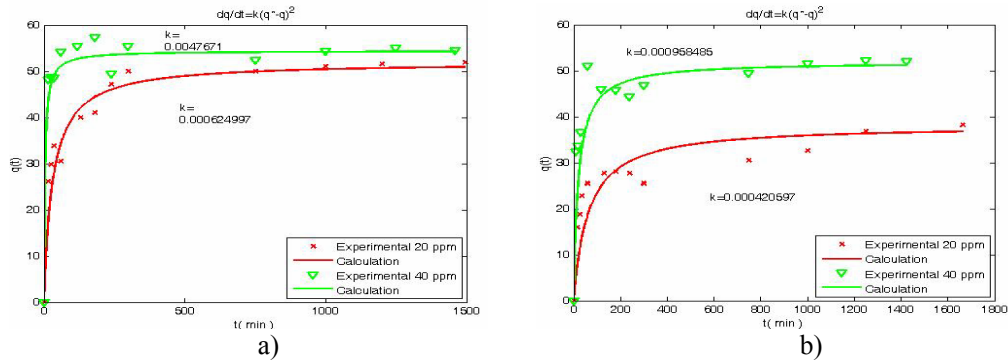


Figure 4. Kinetic behaviours of the Procion Yellow HE-XL adsorption on activated carbon with initial solution concentrations of 20ppm and 40ppm.
 a) Weight of activated carbon: ca. 0,3gr b) Weight of activated carbon: ca. 0,6gr

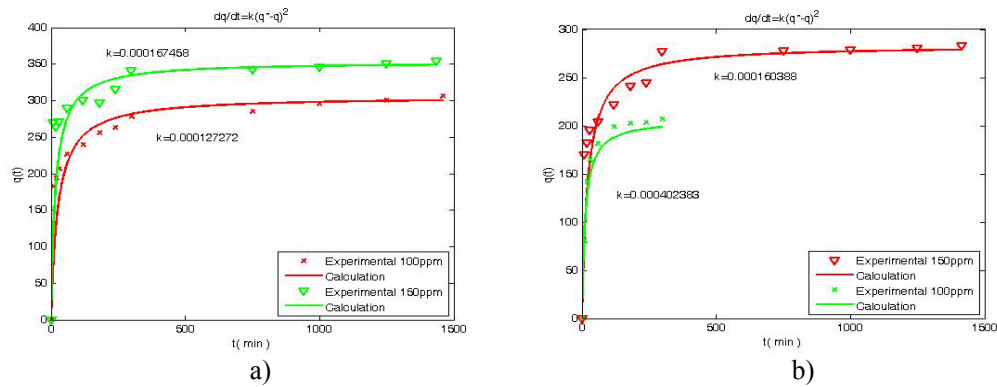


Figure 5. Kinetic behaviours of the Sulzol Blue R adsorption on activated carbon with initial solution concentrations of 20ppm and 40ppm.
 a) Weight of activated carbon: ca. 0,3gr b) Weight of activated carbon: ca. 0,6gr

NGHIÊN CỨU ỨNG DỤNG THAN TRÀM HOẠT TÍNH TRONG XỬ LÝ NƯỚC THẢI DỆT NHUỘM

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TÓM TẮT: Bài báo trình bày các kết quả nghiên cứu về ứng dụng than tràm hoạt tính trong xử lý nước thải ngành công nghiệp dệt nhuộm. Than tràm được hoạt hóa bằng hơi nước có diện tích bề mặt riêng cỡ $1000\text{m}^2/\text{g}$. Than hoạt tính thu được được sử dụng cho các nghiên cứu tiếp tục nhằm xác định đường đẳng nhiệt hấp phụ, đặc trưng động học của quá trình hấp phụ các thuốc nhuộm Sulfite Red S3B, Sulzol Blue R-VL and Procion Yellow HE-XL. Phương trình Langmuir tỏ ra mô tả tốt các số liệu thực nghiệm về cân bằng hấp phụ. Đối với đặc

trung động học, phương trình giả bậc hai mô tả rất tốt các kết quả thực nghiệm, điều này phù hợp với kết luận của nhiều nhà nghiên cứu khác. Các kết quả nghiên cứu chỉ ra rằng than trầm hoạt tính có thể sử dụng hiệu quả để xử lý nước thải dệt nhuộm.

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