Adsorption of Eriochrome Black T (EBT) dye using activated carbon prepared from potato peels

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Abstract:
The treatment of colored effluents to eliminate the presence of dyes which have negative effects on the environment and on human health, by means of adsorption was investigated. The choice of this technique is mainly guided by its simplicity and efficiency.
This work is concerned with the adsorptive removal of Eriochrome Black T (EBT) from aqueous solution using two types of potato peels: the first one was calcinated whereas the second was treated with HCl.
Both sets of the obtained results were compared showing that the retention capacity of potato peels treated with HCl was higher.
Keywords: *potato peels, adsorption, Eriochrome black t ,green of malachite.*

1. Introduction

The rise of dyeing wastewater effluents can be considered as a direct result of dyes production as well as a consequence of their use in many industries. Dyes are usually of synthetic origin with complex aromatic molecular structures, which make them very stable, resistant to fading and difficult to biodegrade. Due to the toxic nature of most dyes to plants and micro-organisms, colored wastewater cannot be discharged without adequate treatment.

Even if they are non-toxic, such wastewaters obstruct light penetration, decrease the photo-synthesis in aquatic plants and raises the COD. Dyes can cause allergic dermatitis, skin irritation, cancer, and mutations. To remove dyes and other contaminants from wastewaters, several physical, chemical, and biological methods have been developed, such as, adsorption, nanofiltration, ion exchange, coagulation-flocculation, precipitation, ozonation, and aerobic or anaerobic treatment. Few of these processes are effective when the concentration of dye in the effluent is small. Some of them produce large quantity of sludge causing disposal problems, thus increasing operational costs. However Adsorption techniques for wastewater treatment have become more popular in recent years owing to their efficiency and stability in comparison to biological methods.

The most common adsorbent used for dye removal is activated carbon, which has a good adsorption capacity for organic molecules. In spite of this, it suffers from a numbers of disadvantages such as its high cost which has prevented its application, at least in developing countries. This has led many workers to search for cheaper substitutes. A number of low cost adsorbents are reported in the literature, like fly ash, peat, sawdust, lignite, rice husk, banana pith [2].

So in this work, the adsorption of Eriochrome Black T (EBT) from aqueous solution using two types of potato peels: the first one was calcinated where as the second was treated with HCl, was considered.

2. Material and methods

2.1.Adsorbent

- **Calcination:**

The preparation mode of the adsorbent was quite simple, it consisted of washing to remove the impurities, drying at 100°C and keeping in well-capped silica crucibles at 250°C in a furnace for 2h. The product was then powdered and stored in a desiccator until use [2].

- **Chemical activation:**

-Adsorbent used in this study was washed completely and separated into fine particules (to accelerate drying) and dried at room temperature for 5-7 days.
-Biomass (8g) emulsified into 150mL of acidic solution using 1M at 25°C for 30 min to remove impurities, samples were washed with distilled water until the pH rose above 6
-The biomass was dried at 90°c for 24h, the product was powdered.[3]

Fig. 1. Calcinated adsorbent

Fig. 2. Chemical activation

2.2. Preparation of EBT solution:

The characteristics of EBT dye are summarized in Table 1 and its chemical structure [2] is shown in Fig. 3

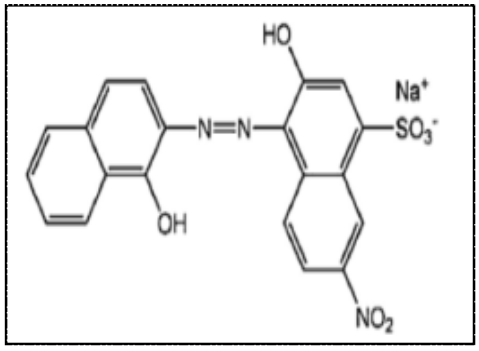

Fig. 3. Molecular structure of EBT dye.

Type of dye	Anionic azo dye
Molecular formula	$C_{20}H_{12}N_3NaO_7S$
Molecular wt.	461.38 g/mol
Max. wavelength (λ_{max})	530 nm
Solubility in water (20 °C)	50 g/L
Solubility in ethanol (20 °C)	2 g/L
Color	Black

Table 1: Properties of EBT dye.

The absorbance characteristics were determined using an UV–vis spectrophotometer and a relationship between the absorbance and the concentration was established, which is given in Eq. (1) .

Concentration =95,112 * absorbance (1)

2.3.Method:

Adsorption experiments were performed in a batch system using initial concentration (25mg/l) at 650 rpm and 20 °C. pH of solution, adsorbent dose (0.8 g). After adsorption, the treated solution was filtered and final dye concentration was analyzed using an UV–vis. The samples were collected at predetermined time intervals from 5 to 120 min. The adsorption capacity was calculated using this relation:

$$q = \frac{(C_0 - C)}{m} \times V \qquad (2)$$

where:

q (mg /g) :the adsorption capacity,

C_o (mg /l) : the initial concentrations of solution of (EBT),

V (l) : the volume of solution ,

m (g): the weight of the adsorbent [3],

3. Results and discussion :

3.1.comparison between calcined potato peels and activated one:

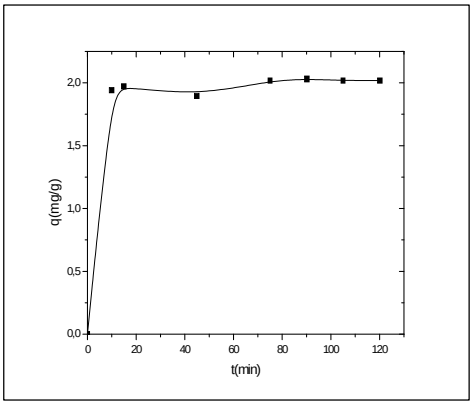

Fig.4.activation, C_0=25mg/l,r=0.8g/80ml,T=20°C pH=6.41(pH of solution) ,v=650tr/min

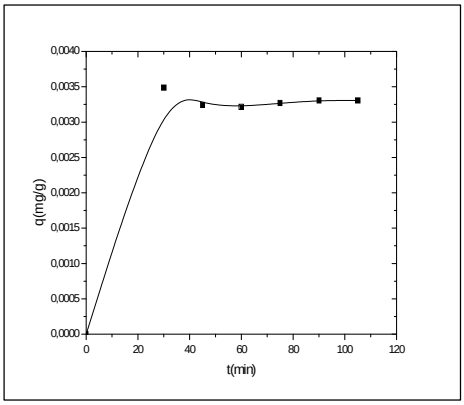

Fig.5.calcination, C_0=25mg/l,r=0.8g/80ml,T=20°C pH=6.41(pH of solution) ,v=650tr/min

The results obtained showed that the adsorption kinetics of calcined potato peels was faster than activated one. However, the amount removed by the activated potato peels may be larger, HCl Eliminated impurities in the pores, increasing their number.

3.2. Comparison between adsorption of Eriochrome black T and green of malachite:

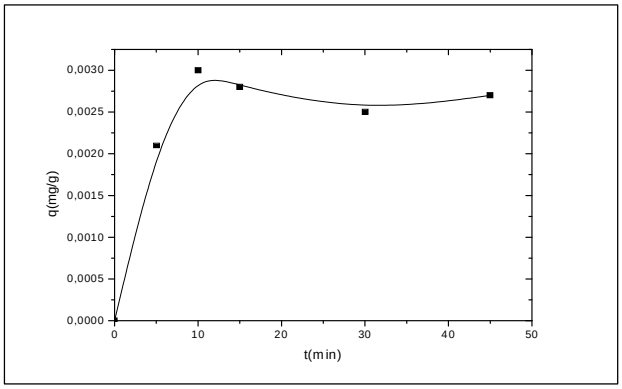

Fig.6. green of malachite,C_0=25 mg/l,r=0.8g/80ml,T=20°C, pH=6.41 (pH of solution) ,v=650tr/min.

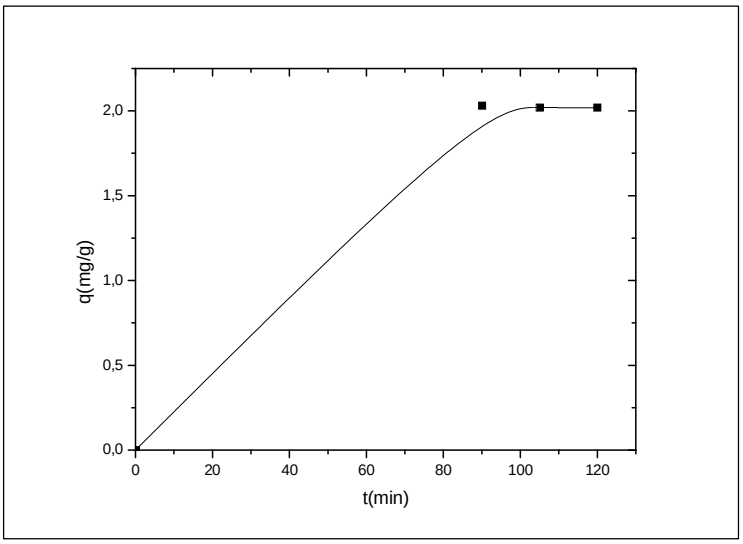

Fig.7. Eriochrome black t ,C_0=25 mg/l,r=0.8g/80ml,T=20°C,
pH=6.41(pH of solution) ,v=650tr/min

The obtained results are compared as shown in Fig 6 and Fig. 7, suggesting that the adsorbed amount of NET was larger than the Green of malachite. This can be explained by the fact that the adsorption is a phenomenon characterized by its selectivity.

4. Conclusion:

This work clearly indicates that the potato peels were excellent adsorbent for the removal of NET from aqueous solutions.

- 0.8 mg of potato peels was found enough to remove 70% of the NET from an aqueous solution of 25 mg /l (80 ml) at pH of solution with a shaking time of 60 min.
- The adsorption of NET on potato peels was better than that of green of malachite [4].

Références :

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