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REMOVAL OF METHYL ORANGE DYE FROM SYNTHETIC SOLUTIONS BY ADSORPTION ON ACTIVE CARBON

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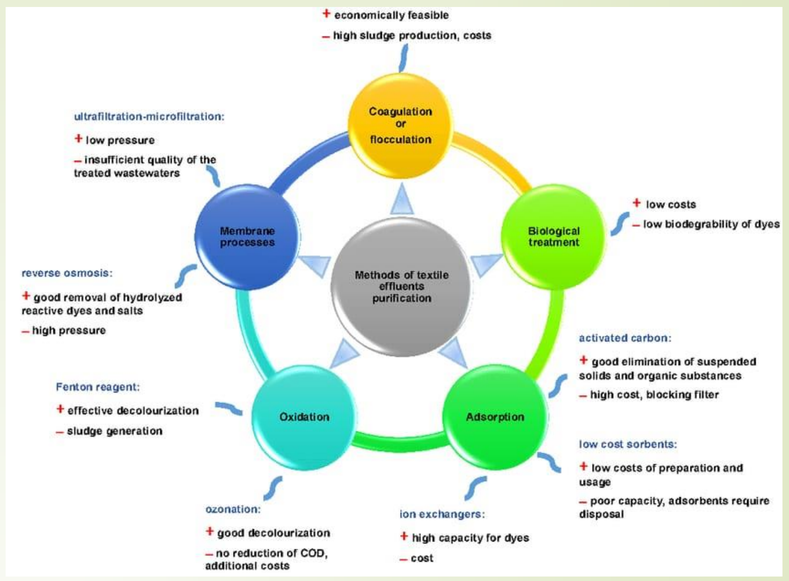
Introduction

- Dyes are the first known contaminants in industrial wastewater streams.
- Various industries such as food processing, paper, cosmetics, leather, textiles, printing, and pharmaceuticals discharge large amounts of wastewater containing dyes polluted with toxic compounds into the environment.
- Adsorption is one of the methods that has received a lot of attention due to its advantages such as: cheap, process flexibility without sludge production, process simplicity, high efficiency and speed.



Materials and methods

- Methyl Orange dye (MO, purity > 95%) was purchased from Sigma-Aldrich (Germany), activated carbon (powder, 10 - 50 µm particle size, 256 m^2/g specific surface area, 14.7 a pore size and 870 m^2/g total pore area) were bought from Trace Elemental Instruments (Delft, Netherland). Acetonitrile (HPLC grade) and ammonium acetate (≥ 98%), used for HPLC mobile phase, were purchased from Merck (Germany).
- The experiments were carried out under optimal conditions with MB solutions of the following concentrations: 100 mg/L; 50 mg/L; 25 mg/L; 10 mg/L; 5 mg/L. The contact time between the two phases was set at 30 minutes, sufficient to reach equilibrium, the amount of active carbon used being 0.005g, the volume of the MO solution 50 mL and the pH range 3-11.

Results

- In this study, the removal of methyl orange dye from aqueous solutions was followed, using active carbon as adsorbent material.
- Samples were collected at well-established time intervals. The supernatant was centrifuged at 5,000 rpm for 5 min and the MO concentration was analysed using HPLC technique (Fig 1).

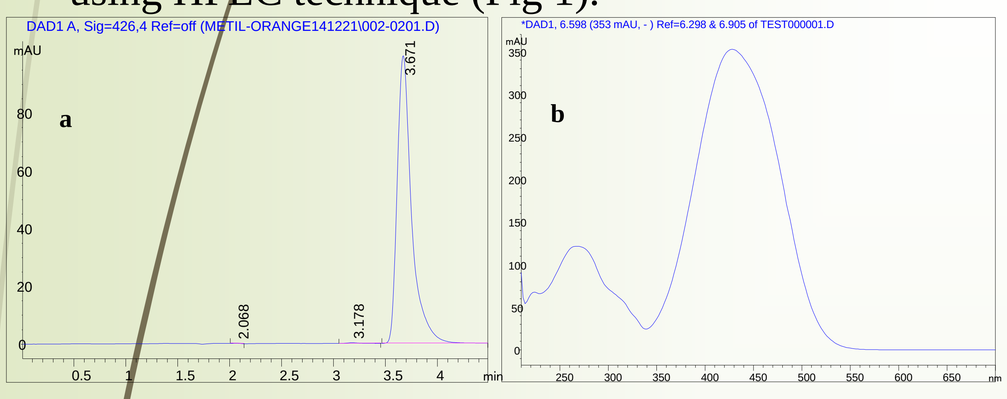


Fig. 1 HPLC chromatogram obtained for 10 mg/L MO (a); The UV-VIS spectrum registered for the MO dye (b).

- The optimal conditions of the studied remediation process were determined through experiments in which four essential parameters, the activated carbon dosage, the initial concentration of MO, the pH and the contact time in the solutions subjected to the remediation process were varied.
- As it can be seen in Fig 2a, the removal percentage of methyl orange increased from 35% to 94% when the amount of the activated carbon was increased from 0.001 g to 0.01 g. Between 0.007–0.01g of activated carbon, the graph become flat, indicating that the amount of AC is more than sufficient to adsorb all the MO molecules.

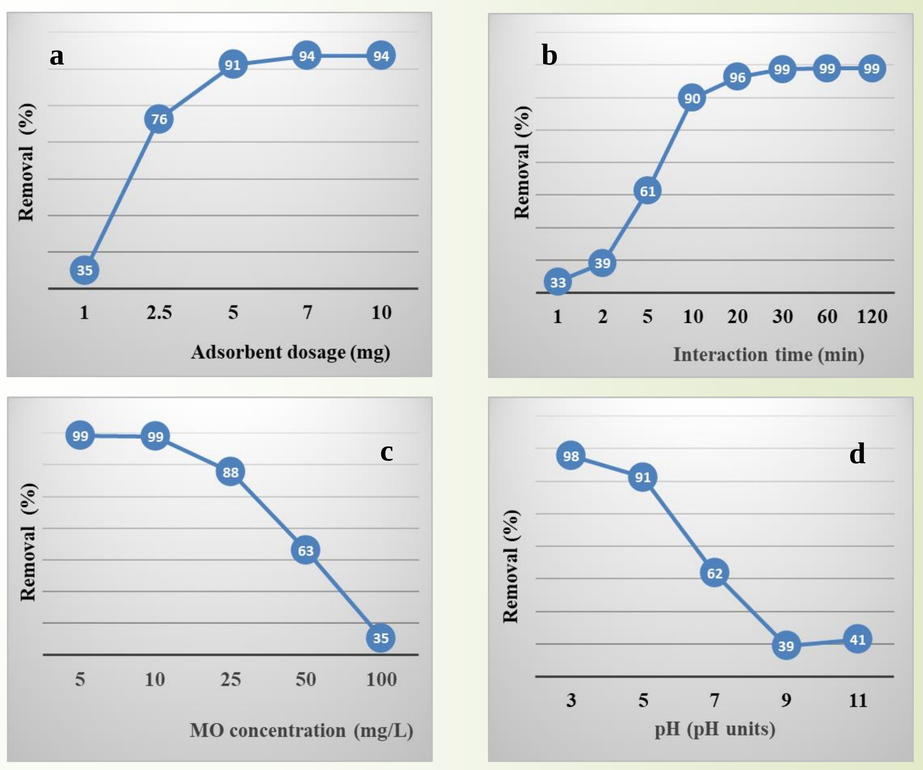


Fig. 2. The effect of adsorbent amount (a), time contact (b), initial dye concentration (c), and pH (d), on the MO adsorption by the activated carbon

- Data presented in Fig 2b, revealed a fast adsorption process of MO, on the adsorbent material, the time necessary to reach the equilibrium was only 30 min. The highest removal efficiency was observed at 5 mg/L and 10 mg/L MO (Fig 2c).
- pH prove to be a very important parameter for MO adsorption, influencing the interactions between the activated carbon and the MO molecules. The maximum removal efficiency of MO was obtained at pH 3, namely 98%, and drastically decreased to 42% with the increasing of pH at 11 (Fig 2d).

Conclusions

- The results obtained in this study revealed that activated carbon is an efficient adsorbent material for the removal of the methyl orange dye from aqueous solutions.
- In conclusion, the use of activated carbon as an adsorbent material for the removal of the methyl orange dye from aqueous solutions is an effective process, and it can be used on an industrial scale to remove this dye from wastewater at the level of their treatment plants.