EFFECTIVE REMOVAL OF SYNTHETIC DYE CRYSTAL VIOLET USING ACTIVATED CARBON FROM ORANGE BIOMASS

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INTRODUCTION

Cristal Violet is a dye known for its deep purple colour and long-term stability in water. Its synthetic nature and toxicity pose significant environmental risks, including water contamination and harm to aquatic life. Activated carbon from orange biomass offers a sustainable solution as it repurposes agricultural waste, which is both abundant and inexpensive. Orange peels have a natural porosity and high carbon content, making them an ideal precursor for adsorbent production. This approach not only reduces waste but also provides an eco-friendly, cost-effective method for removing harmful dyes from water.

Preparation of Adsorbent

Fresh oranges were collected from a local market in Karlovac, Croatia. To remove water-soluble pollutants and impurities, they were washed with distilled water. The peel and seeds were separated, dried at 105°C for 24 hours, chopped into small pieces, and then treated with 60% H_3PO_4. The reaction mixture was poured onto cold water and filtered. The resulting material was heated in an oven at 150° C for overnight, followed by washing with distilled water and then soaked in 1% $NaHCO_3$ solution overnight to remove any acid. The obtained carbon was washed with distilled water until pH of activated carbon reached six and dried in oven at 150° C for 24 h.

Preparation of Adsorbate

C.I. Basic Violet 14 (Crystal Violet) was obtained from E. Merck, India and was used without further purification. The solution was prepared by dissolving the required amount of dye in distilled water

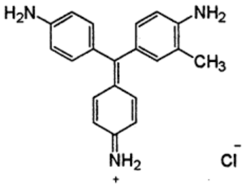

Figure 1. Structure of Crystal Violet (CV)

Experimental protocol

The batch adsorption experiments were conducted in a set of 250 ml of laboratory glass containing adsorbent and 100 ml of MB solution with various initial concentrations. The solute was mixed on a magnetic stirrer at 150 rpm until the equilibrium is reached. After decantation and filtration, the equilibrium concentrations of dye in the solution were measured at λ=695nm using UV-visible spectrophotometer.

The amount of dye adsorbed and percentage removal of CV were calculated using Eqs. (1) and (2), respectively.

$$q_e = (c_0 - c_t)\frac{V}{M}$$

$$\%\ Removal = \frac{c_t - c_0}{c_t}$$

where:
qe - amount of dye in mg per gram of adsorbent.
Ci and Ce - are respectively initial concentration and equilibrium time of MB (mg/l).
V - volume of solution.
M - mass of adsorbent

RESULTS

Adsorption isotherm study

Table 1. Results of Langimiur and Freudlich isotherm plots for the adsorption of MB onto AC.

Activated carbon	Langmuir model q_{max} (mg/g)	Freudlich model K_L (L/mg)
AC orange seed	12,5	0,025
AC orange peel	15,8	0,030
Ac orange mix (80:20)	14,3	0,028

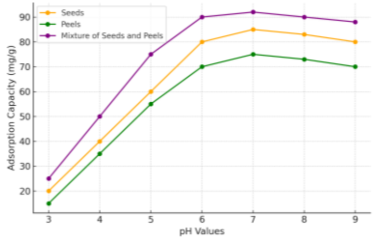

Figure 2. Effect of pH on CV removal

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CONCLUSION

These findings indicate the potential of orange-derived activated carbon as a sustainable solution for treating wastewater containing synthetic dyes, providing insight into the effectiveness of different biomass sources in dye removal.