Adsorptive Potential of *Zea Mays* Cob (ZMC) as Low-Cost Agro-Waste for the Removal of Acidic and Basic Dyes

Gilbab Sami, Uzma Hameed*
Department of Chemistry, Jinnah University for Women, Karachi, Pakistan.
*E-mail: dr.uzmahameed@juw.edu.pk

ABSTRACT

The main objective of the current study is relevant to the adsorption of acidic and basic dyes from aqueous solution with the help of *Zea Mays* Cob (ZMC) commonly known as corn cob as a low cost agricultural waste. Influence of various factors including concentration of dyes, amount of corn cob as an adsorbent, pH of the solution, agitation time of dyes with adsorbent and temperature were analyzed during the experimental work. Concentration of dyes before and after the adsorption process was observed by using double beam spectrophotometer. Morphology of the surface of corn cob before and after the adsorption of both acidic and basic dyes was conduct through FTIR and Scanning Electron Microscope (SEM) techniques. Two adsorption models like Langmuir and Freundlich adsorption isotherms were used to obtain adsorption equilibrium data. The values of percent removal of each dye-adsorbent system will be estimated at different temperature ranges from 308-323±2 K under optimized conditions. Thermodynamic parameters such as Gibbs free energy, enthalpy and entropy of the dye-adsorbent systems were also calculated to determine the feasibility of the system.

Keywords: Adsorption Isotherms, Dyes, Industrial Effluent, *Zea Mays* Cob.

INTRODUCTION

The addition of hazardous substances or contaminants into the environment is known as pollution, leading to adverse effects on human health, natural resources and ecosystem. Human activities are the primary cause of pollution. Environmental pollution is a serious matter of discussion because it increases rate of morbidity as well as mortality. Consecutive deforestation, improper disposal of electronic trash, and improper discharge of industrial waste, particularly dye effluent, are concerning conditions for humanity. It majorly destroying water bodies (Ukaogo *et al.,* 2020). Water pollution is one of the biggest threats to public health in Pakistan. The quality of drinking water is not adequately controlled. Pakistan's drinking water quality is ranked 80th out of 122 countries. Numerous World Health Organization (WHO) drinking water quality standards are not properly followed. The primary causes of the decline in water quality are human activities such as the improper use of agrochemicals in agriculture and the disposal of industrial and municipal effluents in water bodies waste without prior treatment (Azizullah *et al.,* 2011). Pakistan textile industry pursue 3 type of textile according to machine like weaving, spinning and printing. Spinning industry provide yarns of tread. Weaving industry dispatch Grey water from yarn of thread. To make clothes, fabrics colorful these industries generate large amount of effluent (Abbas *et al.,* 2020). There are various techniques for the elimination of wastewater including coagulation, photo degradation, precipitation, ion exchange, flocculation and adsorption (Obaideen *et al.,* 2022). In current study adsorption method is used for the removal of acidic and basic dyes.

OBJECTIVES

In current study the selection of *Corn Cob* as an Agricultural waste was done on behalf of low price or zero cost. In this study it worked effectively as an adsorbent to eliminate acidic and basic dye so it can be used for the removal of various colorants from wastewater. It has an admirable influence due to its low price, productivity, and stability. It is also used to minimize health risk by reducing industrial dye effluent with the help of adsorption process.

METHODOLOGY

Cobs were locally collected from costermonger. Wash and dry under the sunlight for a week then grind with an electrical grinder to make crust powder and sieve to make equal particles and contain in a container for experimental work. Various dilutions of Congo Red (M.W 696.68 g/mol) and Malachite Green (M.W 927.03g/mol) dyes were prepared from the stock solution of both of the dyes. The solution of different concentrations of acidic and basic dyes were prepared and initial absorbance was measured by spectrophotometer. A specific volume of each dye was taken in different volumetric flask with the addition of optimum dosage of adsorbent and placed on orbital incubator shaker at desired temperature and then shaken for an optimum time. After shaking, the dyes solutions were filtered through Whatmann 42 filter paper and then final absorbance were measured from spectrophotometer. The initial and final absorbance data were used for adsorption isotherms calculations. The percent absorbance was calculated by the following expression.

$$\% \text{ Adsorption} = (Co-Ce)/ Co \times 100$$

RESULT

In the present study the removal of two textile dyes such as Malachite Green oxalate (MG) and Congo red (CR) were studied by the utilization of an agricultural waste such as Z*ea Mays* Cob (ZMC). The adsorption isotherm equations such as Langmuir and Freundlich adsorption isotherm were used to find the feasibility of adsorption process either by monolayer or multilayer formation. It is concluded that adsorption of malachite green onto corn cob show physical adsorption while removal of Congo red dye by corn cob exhibit chemisorption. Thermodynamic study told us about the spontaneity of the adsorption of dyes on the surface of Corn Cob.

CONCLUSION

It was concluded that adsorption is favorable at all temperatures ranges. In Pakistan, the temperature is summer is 40-45°C. By applying this method, the wastewater can be purified at significant level therefore the adsorption is a feasible and low-cost method than other techniques. The overall results prove that selected adsorbent used in this study have great potential and high selectivity to remove the acidic and basic nature of textile dyes from aqueous solution.

REFERENCES

1. Ukaogo, Prince O., Ugochukwu Ewuzie, and Chibuzo V. Onwuka. "Environmental pollution: causes, effects, and the remedies." Microorganisms for sustainable environment and health. Elsevier, 2020. 419-429.
2. Azizullah, Azizullah, *et al.*,. "Water pollution in Pakistan and its impact on public health—a review." Environment international 37.2 (2011): 479-497.
3. Abbas, Shahbaz, *et al.*,. "Sustainable production using a resource–energy–water nexus for the Pakistani textile industry." Journal of Cleaner Production 271 (2020): 122633.
4. Obaideen, Khaled, *et al.*,. "The role of wastewater treatment in achieving sustainable development goals (SDGs) and sustainability guideline." Energy Nexus 7 (2022): 100112.