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Commentary

# Comment on "Utilization of NaOH Treated Rice Husk for Adsorptive Discharge of Eriochrome Black-T from an Aqueous Solution"

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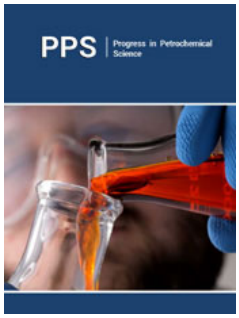


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## Abstract

This work commented on the recently reported work by Khan MI et al. [1] entitled "Utilization of NaOH treated rice husk for adsorptive discharge of Eriochrome Black-T from an aqueous solution" published in Progress in Petrochemical Science in 2024. This is an exciting work dealing with the batch adsorption of Eriochrome Black-T (EBT) dye from aqueous solution to NaOH-Treated Rice Husk (TRH). Experimental data were analyzed by using various adsorption isotherms, including Langmuir, Freundlich, Dubinin-Radushkevich (D-R) and Tempkin. The study found that the experimental results closely matched the Freundlich adsorption isotherm. The thermodynamic analysis of EBT adsorption on Treated Rice Husk (TRH) revealed an endothermic reaction with a positive enthalpy (ΔHo=20.57KJ/mol). Furthermore, the negative values of Gibb's free energy suggested that EBT adsorption onto TRH was a spontaneous event.

## View Point

Khan MI et al. [1] aimed to examine the adsorption of EBT from an aqueous solution onto Treated Rice Husk (TRH) at normal temperature. This study found that using of treated rice husk from agricultural waste could be a cost-effective way to decontaminate EBT. There is currently no research on the adsorption of EBT onto NaOH-Treated Rice Husk (TRH) and this is the first report. Asian countries produce 5.2 million tons of rice annually and the husk, which accounts for 20-23% of the grain, is a waste item that mill owners struggle to dispose of them. Proteins, cellulose, hemicellulose and lignin are the fundamental constituents of rise husk, with hydroxyl and carboxyl functional groups that can interact with cations. This study found that NaOH-treated rice husk would be an effective adsorbent for removing Eriochrome Black-T (EBT) from water. The morphology of untreated and NaOH-treated rice husk was examined by using Scanning Electron Microscopy (SEM). Untreated rice husk had a rough surface, whereas NaOH-treated rice husk had a smooth surface. The modified rice husk's porous structure allowed for effective adsorption of EBT from aqueous solution. Fourier Transform Infrared (FT-IR) spectroscopy was used to demonstrate the adsorption of EBT from an aqueous solution onto TRH.

They modified the rise husk with NaOH and used for the batch adsorption studies. They examined the effects of various parameters such as contact time, mass of TRH, initial concentration of EBT, temperature and pH. Several kinetic models were used to investigate the adsorption kinetics of EBT from aqueous solution to TRH. The study examined how operational parameters affect the removal of EBT from aqueous solutions and adsorption capacity. Thermodynamics of EBT adsorption on treated rice husk were studied by shaking 0.20g of treated rice husk in 20mL of EBT aqueous solution with an initial concentration of 20mg/L at 298, 313, 323 and 333K for 96h at 140rpm. The concentration of EBT was determined by

measuring the absorbance of the supernatant at 530nm by using a UV/VIS spectrophotometer. The plot of wavelength vs absorbance for EBT revealed the maximum wavelength (λmax).

The study examined how contact time, treated rice husk mass, initial EBT concentration in aqueous solution and temperature could affect EBT elimination and adsorption. They also discussed the kinetics, equilibrium and thermodynamics of adsorbing EBT onto treated rice husk. Adsorption of EBT in aqueous solution rose with contact time, TRH mass and temperature, but decreased with starting EBT concentration. Adsorption capacity increased from 0.71 to 1.61mg/g, 1.61 to 17.0mg/g and 1.41 to 1.68mg/g with increasing contact time, initial concentration of EBT aqueous solution and temperature, but reduced from 6.17 to 1.61mg/g with increasing TRH mass. The adsorption of EBT onto TRH followed pseudo-second-order kinetics, with a correlation coefficient (R2=0.996) close to unity. Experimental data were analyzed by using various adsorption isotherms, including Langmuir, Freundlich, Dubinin-Radushkevich (D-R) and Tempkin. They also proposed the mechanism of EBT adsorption onto TRH is represented as shown in Figure 1.


**Figure 1:** Mechanism of EBT adsorption onto TRH from an aqueous solution [1].

The cost effectiveness is a key consideration when creating an adsorbent for adsorption. This can be easily achieved by regenerating the material multiple times. The fundamental challenge is maintaining the adsorbent's efficiency over each cycle. In the current study, the ability of TRH to be recycled was investigated during five consecutive cycles. They found that for the first three consecutive cycles, there was no significant decrease in dye clearance rate. However, a slight decline was noticed in the fourth cycle, which became more significant in the fifth. They justified that the preservation of some dye molecules on the adsorbent surface over time could lead to this usual behavior. These compounds block active sites, causing gradual decrease of adsorbent efficiency over multiple cycles.

The findings of the study by Khan MI et al. [1] revealed that usage of treated rice husk from agricultural waste is a cost-effective way to decontaminate EBT. The proportion of EBT removed rose with contact duration, TRH mass and temperature, but declined with the starting concentration. But, the adsorption capacity of EBT aqueous solution rose with contact time, starting concentration and temperature, but decreased with TRH mass. The kinetics data showed that EBT adsorption on Treated Rice Husk (TRH) followed pseudo-second-order kinetics. The adsorption equilibrium analysis found that the Freundlich isotherm could fit well, with a regression value of 0.962. The thermodynamic analysis found that the adsorption of EBT onto Treated Rice Husk (TRH) was an endothermic process with a negative change in Gibbs free energy, confirming the viability of the procedure. This study thus concludes that affordable rice husk could effectively remove EBT from bulk aqueous solutions, allowing for safe disposal of industrial and textile effluents as an alternative way to mitigate environmental damage caused by these dyes.

## Credit Authorship Contribution Statement

This complete work was done by Munusamy Thirumavalavan.

## References

1. Khan MI, Shanableh A, Manzoor S (2024) Utilization of NaOH treated rice husk for adsorptive discharge of Eriochrome Black-T from an aqueous solution. Prog Petrochem Sci 6(1): 615-627.