proceedings

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Abstract

Adsorption of Methyl Orange onto Calcium Ferrite for Environmental Sustainability †

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† Presented at the 3rd International Electronic Conference on Processes—Green and Sustainable Process Engineering and Process Systems Engineering (ECP 2024), 29–31 May 2024; Available online: https://sciforum.net/event/ECP2024.

Keywords: water pollution; environmental; calcium ferrite; adsorption; kinetic models

Wastewater poses public and environmental problems when discharged into aquatic systems due to industrial, agricultural, or domestic activities. Water pollutants commonly found in effluents include dyes, surfactants, phenolics, chlorides, heavy metals, etc., which are detrimental to plants, animals, and human lives. These effects are noticeable in the slow photosynthetic activity of aquatic plants, which also serve as a breeding ground for bacteria, viruses, and vectors, leading to waterborne diseases. Herein, the potential of calcium ferrite ($CaFe_2O_4$) as an adsorbent for the removal of methyl orange (MO) dye from wastewater was evaluated by studying the adsorption kinetics. Batch adsorption experiments were carried out after reacting calcium chloride ($CaCl_2$) with ferric nitrate ($Fe(NO_3)_2$), and the mixture was heated continuously at 90 °C for two hours to form the $CaFe_2O_4$ precipitate, which was then calcined for four hours at 600 °C in a furnace. The synthesized $CaFe_2O_4$ was found to have high adsorption capacity for MO, as evidenced by its ability to remove 80.02% of MO dye from wastewater within one hour. Furthermore, the adsorption capacity at equilibrium (q_e) and at variable time (q_t) for the kinetic model with a linear regression coefficient (R^2) value of 0.9979 signifies that the adsorption process is best described by pseudo-second-order kinetic models. Thus, $CaFe_2O_4$ can be effectively used for the removal of dyes such as MO from wastewater to ensure sustainability.

Author Contributions: Conceptualization, S.A.A.; methodology, S.A.A.; formal analysis, S.A.A. and H.A.; investigation, S.A.A.; writing-original draft preparation, S.A.A.; writing—review & editing, H.A. and S.A.A.; visualization, S.A.A.; supervision, H.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data are contained within the abstract.

Conflicts of Interest: The authors declare no conflicts of interest.

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Citation: Abubakar, S.A.; Abdulhamid, H. Adsorption of Methyl Orange onto Calcium Ferrite for Environmental Sustainability. *Proceedings* **2024**, *105*, 26. https://doi.org/10.3390/proceedings2024105026

Published: 28 May 2024