RESEARCH PAPER

Treatment Wastewater of Oil Refinery by Fe_2O_3 NPs Produce by the Novel *Alishewanella jeotgali* Strain HAQ8

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Abstract

Metal oxide nanoparticles like iron oxide (Fe_2O_3) exhibit strong reactivity and photolytic features in wastewater treatment and serve as an effective adsorbent for water purification due to its substantial surface area and affinity for different functionalized groups. Iron oxide nanoparticles) IONPs) are currently applied to treat oil-contaminated water. Fe_2O_3NPs were produced using an extracellular approach utilizing the *Alishewanella jeotgali* strain HAQ8. IONPs were characterized using UV-vis, FT-IR, XRD, AFM, SEM-EDX, and Zeta potential. λ max for the synthesized nanoparticles observed at (358) nm. The bands at 485 cm^{-1} in the FT-IR spectrum confirmed the formation of IONPs. The XRD showed that the IONPs' average crystallite size was (19) nm. According to AFM and SEM analyses, the surface roughness, maximum height, and mean diameter of Fe_2O_3NPs were (4.86, 18.36, and 48.8) nm, respectively, with spherical shapes. The Zeta potential of Fe_2O_3 NPs was (−43) mV. At 0.2 mg/mL Fe_2O_3 NPs, crude oil degradation reached (69.08) %, increasing to (71.4) % at pH 9. Fe_2O_3 NPs' cytotoxicity results indicated they were biocompatible with red blood cells even at the highest concentration. Fe_2O_3NPs produced by bacteria are harmless and non-toxic. Fe_2O_3NPs are expected to be potential candidates for crude oil degradation.

Keywords: *Alishewanella jeotgali*, Fe_2O_3NPs, Biosynthesis, Treatment wastewater, Crude oil

1. Introduction

Water is essential to humans. With the advancement of humanity and the continuous consumption of water for industrial activities, the scarcity of freshwater resources has emerged as the most pressing issue that humanity must address immediately [1]. Akhter *et al.* [2] stated that the utilization of water resources has escalated with the growth of the global population and advancements in the industrial and agricultural sectors, resulting in increased water pollution with various contaminants. Toxic waste poses a serious threat to the well-being of both aquatic and terrestrial ecosystems [3]. Petroleum refineries are complex systems that involve multiple processes. The characteristics of refinery wastewater vary depending on the types of crude oil processed, the intended products, the composition of condensate, and the treatment methods employed; thus, these elements generate intricate variability patterns. A significant number of processes in petroleum refineries consume substantial quantities of water. Therefore, refineries produce a considerable effluent containing hydrocarbons, heavy metals, and hazardous substances [4]. Organic pollutants such as phenolic compounds, chlorides, antibiotics, and others originate from companies involved in petroleum, dyestuffs, pharmaceuticals, or pesticides. These non-biodegradable pollutants have the potential to accumulate in organisms over time, resulting in cancer development. Even after a significant prohibition period, organisms still contain traces of these prohibited pollutants [5]. The study by Grmasha *et al.* [6] on the Tigris

Received 28 November 2024; revised 2 April 2025; accepted 6 April 2025.
Available online 2 May 2025

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https://doi.org/10.33640/2405-609X.3404