Degradation of Crude Oil Polluted Water via Photocatalysis

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Abstract:

Significant concerns have been raised regarding the contamination of water sources by crude oil pollutants due to their proximity to oil fields. Depending on various biological, physical, and atmospheric factors, oil pollutants can disperse in different ways and end up in the air, soil, or water sources. Oil spills into water sources can alter their physical and chemical properties, including taste, odor, color, salinity, alkalinity, and acidity, due to the presence of numerous organic compounds and heavy metals, some of which may be highly toxic and difficult to remove. This study aimed to utilize modern and efficient techniques for removing these pollutants using photocatalysts and to determine the optimal laboratory conditions for achieving the highest removal efficiency.

An experimental strategy was developed to synthesize a magnetic photocatalyst composite from silicon oxide, and metal oxides. The resulting catalysts underwent a series of characterization techniques to evaluate their structural, morphological, and surface properties. These techniques included X-ray diffraction (XRD) for phase identification, field-emission scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (FESEM-EDS) for morphological and elemental analysis, and Fourier transform infrared spectroscopy (FTIR), surface area, and porosity. A UV reactor was used to evaluate the photocatalytic performance in the degradation of crude oil polluted water. The performance of the synthesized nanocomposite was systematically tested in terms of degradation and removal efficiency, chemical oxygen demand (COD), and total organic carbon (TOC). The highest processing efficiency was achieved using the nanophotocatalytic process under optimal conditions.

The study demonstrated the potential of a multifunctional nanosystem of metal oxides, silicon oxides, and TiO_2 in treating crude oil-contaminated water through highly efficient synergistic catalytic activity.

Keywords:

Photocatalysis, Nanocomposite, oily waste pollutants, drinking water , magnetic nanoparticles.