PHOTOCATALYTIC DEGRADATION OF LOW-DENSITY POLYETHYLENE IN AQUEOUS SOLUTION USING TiO_2 NANOPARTICLES DEPOSITED ON CLAY KAOLINITE

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Over the years, an increasing number of microplastics with particles diameter ranging from 0.1 μm to 5 mm have been observed in various environmental systems such as water, soil, and air. These small particles are difficult to recycle, easily absorb toxic substances and can enter animal and human bodies through food chain [1]. Hence, there is an urgent need for remediation of the microplastic pollution.

Among different microplastic remediation methods (chemical degradation, biodegradation) photocatalytic degradation has shown the highest degradation efficiency. This microplastic degradation method can be performed under milder conditions than biological or chemical degradation and is suitable for a wide range of plastic polymer [2]. Modified TiO_2 photocatalysts have been used for the degradation of various plastic polymers under different degradation conditions and have shown a degradation efficiency ranging from 6.4% for high-density polyethylene (HDPE) to 81% for polyvinyl chloride (PVC) films [3]. Incorporation of TiO_2 within the clay layers increases the specific surface area of TiO_2 nanoparticles. This results in a mesoporous structure that enhances adsorption properties and decreases the band gap energy which indicates better absorption of light in a wider wavelength range [4].

In this work, TiO_2 nanoparticles and TiO_2/kaolinite nanocomposites were synthesized by sol-gel method. We chose naturally occurring kaolinite which has easy preparation without requiring the use of strong acids or other solvents. These materials were used for a small-sized (300 μm) low-density polyethylene (LDPE) microplastic photodegradation under UV light irradiation in aqueous solution. This study presents TiO_2/kaolinite nanocomposite application for the removal of microplastics.

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