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REVIEWER'S REPORT

Manuscript No.: IJAR-51977 Date: 30-05-2025

Title: How Heavy Metals Influence Microplastic Degradation: UV Absorption and Photoreactivity of PS-Fe?O? Composites

Recommendation:
Accept as it is……**YES……**
Accept after minor revision……
Accept after major revision ……
Do not accept (*Reasons below*) ……

Rating	Excel.	Good	Fair	Poor
Originality	√			
Techn. Quality		√		
Clarity		√		
Significance			√	

Reviewer's Name: Tahir Ahmad

Reviewer's Decision about Paper: **Recommended for Publication.**

Comments (*Use additional pages, if required*)
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Reviewer's Comment / Report

Abstract and Purpose Clarity:

The abstract succinctly presents the core aim of the study—to investigate the impact of heavy metals, particularly Fe_3O_4, on the UV absorption and photoreactivity of polystyrene microplastics (PSMPs). The articulation of experimental approaches (UV–visible spectrometry), key findings (UV absorption patterns, enhancement by Fe_3O_4), and broader implications (ecological impact and degradation pathways) is clear and well-balanced. The research question and significance are evident from the abstract.

Scientific Relevance and Originality:

The study addresses a relevant and emerging topic in environmental science and materials degradation—how interactions between heavy metals and microplastics influence

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photochemical behavior. The originality lies in the targeted analysis of PSMPs combined with Fe_3O_4, a naturally occurring iron oxide, under UV exposure. This bridges environmental toxicology with photochemistry, offering a nuanced understanding of pollutant dynamics in natural systems.

Methodological Transparency and Appropriateness:
The manuscript outlines the experimental approach effectively, particularly in terms of UV–visible spectrometry and varying concentrations of both PSMPs and Fe_3O_4. The methods are aligned with the study's goals and provide a robust framework for assessing light absorption and photoreactivity. The use of spectrophotometric analysis is appropriate for this type of investigation and lends credibility to the interpretation of absorption coefficients and photochemical behavior.

Data Interpretation and Results Presentation:
The reported findings—namely, increased UV absorption at higher PSMP concentrations and the enhancement effect due to Fe_3O_4—are logically presented and supported by empirical observation. The identification of a specific peak (295 nm) for maximum UV absorption demonstrates analytical precision. The correlation between metal presence and increased photoreactivity adds depth to the understanding of environmental degradation mechanisms for MPs. These results are scientifically meaningful and provide a foundation for broader ecological interpretations.

Contextualization and Literature Integration:
The introduction effectively situates the problem within the broader context of global plastic pollution. Citations from recent and relevant literature reinforce the study's validity and necessity. The manuscript acknowledges the multifaceted risks posed by MPs—ecological persistence, toxicity, surface reactivity—and further connects them with the behavior of heavy metals in the environment. The scientific narrative benefits from this interdisciplinary linkage.

Ecological and Practical Significance:
The findings have tangible implications for environmental management and pollution mitigation. Understanding how metals like Fe_3O_4 influence microplastic degradation could inform strategies for reducing the persistence of MPs in aquatic and terrestrial ecosystems. This research

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contributes knowledge that can guide future remediation technologies and environmental policy development concerning plastic and metal co-contaminants.

Writing Style and Academic Rigor:

The language is concise, technically accurate, and appropriate for a scholarly audience. Terminology such as "absorption coefficient," "photochemical stability," and "surface characteristics" is used with clarity and precision. The paper maintains logical flow from the abstract through the introduction and effectively communicates both the scientific process and its broader implications.

Recommendation:

This study presents a well-founded and insightful exploration of the interactions between polystyrene microplastics and iron oxide under UV light, with a focus on photochemical behavior and environmental implications. It represents a significant contribution to the growing body of research on microplastic degradation and pollutant interactions, offering both theoretical insights and practical environmental relevance.
