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Preliminary Study on Solar-Driven Adsorptive and Photocatalytic Removal of 6PPD-Quinone from Tire Leachates

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The increasing occurrence of emerging contaminants in aquatic environments represents a growing environmental concern. Among these, 6PPD-quinone (6PPDQ), a transformation product of the widely used tire antioxidant 6PPD, has recently been identified as highly toxic to aquatic organisms [1].

6PPDQ originates from the oxidative transformation of tire wear particles and is released into water bodies through runoff and leaching processes [2]. These findings underline the urgent need for sustainable and cost-effective mitigation strategies. This work presents a preliminary study aimed at investigating both the formation and removal of 6PPDQ from aqueous matrices generated through controlled leaching experiments. Rubber samples will be subjected to laboratory-simulated leaching procedures to reproduce the release of 6PPDQ. The resulting leachates will serve as representative contaminated matrices for subsequent treatment tests. Analytical determination of 6PPDQ will be carried out to quantify its concentration and to establish baseline contamination levels prior to remediation.

The core objective of this exploratory investigation is to evaluate the feasibility of low-cost and sustainable adsorbent and catalytic materials for 6PPDQ abatement. Emphasis will be placed on eco-friendly, potentially waste-derived or bio-based materials capable of combining adsorption properties with photocatalytic activity. Degradation experiments will be performed under natural solar irradiation and simulated sunlight using a xenon lamp, allowing comparison between real environmental conditions and controlled laboratory settings. Given the preliminary nature of the study, the research focuses on screening material performance and assessing initial removal efficiencies rather than fully optimizing operational parameters. The potential synergistic effects between adsorption and solar-driven photocatalysis will be explored, along with preliminary observations on degradation kinetics. Although further investigation will be necessary to clarify transformation pathways and by-product formation, this study aims to provide a proof of concept for sustainable 6PPDQ mitigation strategies and to lay the groundwork for future, more comprehensive research toward scalable and environmentally responsible water treatment solutions.

[1] Xiaopeng, et al. (2024), *Environment international,* 191.

[2] Shuang, et al. (2026), *Environmental Science & Technology*.