

Season Effect of the Operation of IPCC Reactor on Solar Photocatalysis of Phenol Wastewater

*Wen-Shiuh Kuo¹, An-Chi Chen¹

1. National United University, Taiwan

Solar photocatalysis with partial shell-core Ag(0.1%)/P3HT(0.5%)/TiO₂ as catalyst was used to treat phenol wastewater (10 mg/L) in a pilot-scale inclined plate curvature channel (IPCC) reactor. Season effect on the performance of IPCC reactor was investigated. Results showed that the degradation efficiency of phenol in water (180 min) with Ag(0.1%)/P3HT(0.5%)/TiO₂ as photocatalyst were 98.35%, 95.06%, 98.92%, and 99.89% in autumn, winter, spring, and summer (in which UV_{a+b} intensity: 32.85, 27.80, 37.92, 45.86 W/m², respectively; VIS intensity: 743.91, 723.05, 822.72, 869.48 W/m², respectively), respectively. The degradation efficiency of phenol in water were increased 28.79%, 32.78%, 22.29%, and 5.19%, respectively and phenol degradation rate (k_{phenol}) were increased 2.94 times, 2.73 times, 2.66 times, and 1.98 times, respectively in four season as compared to using TiO₂ as photocatalyst. With the assistance of Fresnel lens (39.5 cm L*39.5 cm W*2 mm T, Fresnel circle width: 0.5 mm, Facet depth: 0.2 mm, Fresnel circles: 395), solar light intensity (UV_{a+b}) were increased approximately 1.86 to 2.34 times and the temperature of wastewater could be raised about 5 °C. Hence, the degradation efficiency of phenol wastewater were increased 12.4%, 6.29%, 19.18%, and 2.72% in autumn, winter, spring, and summer season, respectively as compared to that without Fresnel lens. Moreover, the molecules of phenol were more efficiently decomposed into hydroquinone, p-benzoquinone and low-molecular-weight organic acids which were further mineralized into CO₂ and H₂O. The mineralization efficiency of phenol wastewater could reach almost 60% in summer season. Accordingly, it was showed that the Fresnel lens enhanced IPCC reactor would be a promising operation system for solar photocatalysis not only in effectively dealing with a large amount of industrial organic wastewater such as phenols wastewater, but also in the sector of energy conservation in terms of efficient utilization of solar energy for practical application.

Keywords: solar photocatalysis, phenol wastewater, inclined plate curvature channel reactor (IPCC), Fresnel lens