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A visible light photocatalytic degradation of endocrine disruptor, methylparaben by green synthesized Reduced Graphene Oxide-Silver Nanoparticle Composite

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PURPOSE OF THE ABSTRACT

Parabens are applied as preservatives and anti-microbial agents in food, cosmetics, and pharmaceuticals and personal care products (PPCPs). The interest in such compounds is due to their good chemical stability, easy production, low cost, but mainly their good working behaviour. These compounds are bio-cumulative which means they can be easily accumulated in the different ecosystems. Methylparaben is a well-known paraben, and widely used as a bactericide and antimicrobial agent in cosmetic products. Due to their widespread use, they have been discharged into the environment increasingly, and is still present at ng/L level, adversely affecting the human health and aquatic ecosystems. These compounds are also classified as endocrine disruptors that affect the hormonal and reproductive system. Therefore, there is an urgent need of effective technologies for the elimination or prevention of methylparaben in the aquatic environment. Nowadays, various technologies have been employed to remove organic pollutants from wastewater, including adsorption, chemical oxidation, and biodegradation. Among them, advanced oxidation processes, has received considerable attention owing to its simplicity and high degradation efficiency [1].

The advanced oxidation processes (AOP) have been tested for pollutants removal from water, since these technologies are efficient in the elimination of these contaminants. The produced hydroxyl radical can react with the pollutants present in the solutions to be treated and oxidize them into simpler organic compounds or into CO2 and H2O. Among AOPs, the photocatalysis has gained much attention among researchers worldwide as the catalysts allow the elimination of such pollutants in aquatic environments. Photocatalysis is considered as one of the most promising techniques in water treatment since it has a great potential utilizing green and sustainable solar energy in removing organic pollutants and harmful bacteria present in polluted water systems. The photocatalyst technology uses light and a photocatalyst in the decomposition of organic pollutant [2].

Graphene-based composite with plasmonic and semiconductor nanoparticles offers unique advantage as a photocatalyst for treatment of organic pollutants. Nanoparticles and graphene can act as antennae for capturing visible light. In addition, the highly conducting graphene surface offers high mobility of photogenerated charge carrier that in turn slows the recombination of photogenerated electron?hole pairs. A hydrophobic graphene surface also offers the adsorption sites of organic molecules. All these factors result in the enhancement of photocatalytic activity [3]. Hence, in this study, reduced graphene oxide (rGO) based composite with silver nanoparticle (rGO-Ag) has been developed using biobased in situ reduction. This heterogenous catalyst can act as efficient visible-light photo catalyst for degradation of methylparaben. The use of green reducing agents makes the overall process cost-effective and eco-friendly. The characterization of the prepared AgNPs was conducted by Fourier transform infrared spectroscopy (FTIR), dynamic light scattering (DLS), zeta potential, scanning electron

microscopy (SEM), energy dispersive x-ray spectroscopy (EDX), and powder x-ray diffraction (PXRD). It is found that photocatalytic efficiency by rGO-Ag under visible light is significantly higher as compared to rGO or silver nanoparticle and depends on the optimum loading of Ag on rGO-Ag. The effect of different parameters, such as pollutant initial concentration, solution pH, catalyst dosage, and contact time can influence the kinetics of degradation performed by heterogeneous photocatalysis. Response surface methodology was used to study the effect of various process parameters on the removal efficiency of methylparaben. The optimal conditions for maximum removal were also identified.

FIGURES

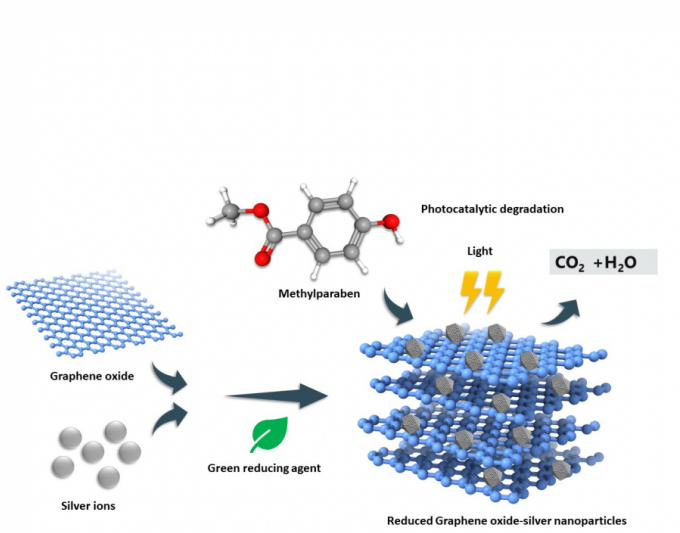

FIGURE 1

Photocatalytic degradation of methyl paraben by rGO-AgNPs

rGO-AgNPs are synthesized by in situ reduction by green extract and utilised for visible light degradation of endocrine disruptor, methylparaben

FIGURE 2

KEYWORDS

photocatalytic | reduced graphene oxide | silver nanoparticles | green synthesis

BIBLIOGRAPHY

[1]J. Lincho, J. Gomes, M. Kobylanski, B. Bajorowicz, A. Zaleska-Medynska, R.C. Martins. Process Saf. Environ. Protect, 152 (2021), pp. 601-613

[2] S. Kotzamanidi, Z. Frontistis, V. Binas, G. Kiriakidis, D. Mantzavinos. Catal. Today, 313 (2018), pp. 148-154

[3] S.K. Bhunia, N.R. Jana. ACS Appl. Mater. Interfaces, 6 (22) (2014), pp. 20085-20092.