

孙玲芳,喻泽斌,彭振波,项国梁,李明洁,陈颖,王莉·可见光助三维电极/电Fenton处理罗丹明B废水的研究[J].环境科学学报,2014,34(7):1705-1715

可见光助三维电极/电Fenton处理罗丹明B废水的研究

Degradation of Rhodamine B by visible irradiation-assisted three-dimensional electro-Fenton system

关键词: [可见光](#) [三维电极/电Fenton](#) [光电催化](#) [协同作用](#) [反应动力学](#) [能耗](#)

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摘要: 提出了以多孔TiO₂薄膜(Porous-TiO₂)板为阳极, 活性炭负载Fe-Ni共掺P25颗粒(Fe-Ni-P25/AC)为粒子电极的可见光助三维电极/电Fenton(Vis-3D/EF)降解有机废水的新方法.同时, 考察了该体系对罗丹明B溶液的去除效果和影响因素, 探讨了降解过程的反应动力学, 并与常规阳极和粒子电极组成的体系处理能耗进行了对比, 探讨了Vis-3D/EF体系各个作用对去除率的贡献及对罗丹明B的降解机理.实验结果表明, 在电源电压20 V、溶液pH=3、Fe²⁺离子投加量0.5 mmol·L⁻¹、曝气量1.5 L·min⁻¹、反应时间60 min时, 20 mg·L⁻¹罗丹明B的降解率为96.84%, 处理过程更符合二级反应动力学.在此条件下, Porous-TiO₂阳极板和Fe-Ni-P25/AC粒子电极组成的体系, 降解过程具有明显的协同催化特点, 协同因子达1.22, 且处理能耗仅为常规石墨(Gr)阳极、活性炭(AC)粒子电极组成体系的1/85.5.Vis-3D/EF降解过程中电催化氧化作用、Fenton氧化作用、可见光催化作用及可见光下的协同作用对去除率的贡献分别为43.88%、20.21%、15.26%和17.49%.同时, 通过叔丁醇捕获实验发现, ·OH对去除率的贡献为75.58%, 表明·OH是该体系中产生的主要活性物质.

Abstract: A novel wastewater treatment method was developed by using visible irradiation-assisted three-dimensional electro-Fenton (Vis-3D/EF) system with porous TiO₂ thin film (Porous-TiO₂) electrode as the anode and Fe-Ni co-doping P25 particles loaded by activated carbon (Fe-Ni-P25/AC) as particle electrode. The removal rate, effect factors and degradation kinetics in treatment Rhodamine B solution through the novel system was investigated. Energy consumption in the novel system was compared with traditional system consisted of conventional anode and particle electrode. Afterwards, the contribution of degradation rate in different processes and the reaction mechanisms was investigated. The experimental result demonstrated that under the conditions of electrolytic voltage 20 V, initial solution pH=3, Fe²⁺ dosage 0.5 mmol·L⁻¹, aeration rate 1.5 L·min⁻¹ and reaction time 60 min, the highest discoloring rate of the 20 mg·L⁻¹ Rhodamine B was 96.84%, and the degradation process fit with the pseudo-second order kinetic equation. In such conditions, the novel system had a significant synergistic effect with the Synergy index of 1.22, while energy consumption was only 1/85.5 compared to the traditional system. The contribution of degradation rate in electric catalysis oxidation, Fenton oxidation, visible light photocatalysis oxidation and synergic effect processes were 43.88%, 20.21%, 15.26% and 17.49%, respectively. At the same time, the effect of ·OH radicals on contribution rate by tertiary-butyl alcohol capture experiment was 75.58%, which showed that the ·OH radical was the main active material in the novel system.

Key words: [visible irradiation](#) [three-dimensional electro-Fenton](#) [photoelectrocatalytic](#) [synergic degradation](#) [reaction kinetics](#) [energy consumption](#)

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