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VUV/US耦合深度处理印染废水尾水研究

Advanced treatment of printing and dyeing wastewater by combination of vacuum ultraviolet and high frequency ultrasound irradiation

关键词: [超声波](#) [真空紫外](#) [耦合](#) [印染废水](#) [深度处理](#)

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摘要: 采用真空紫外(VUV)/高频超声(US)耦合深度处理印染废水尾水,以TOC和UV₂₅₄为污染物指标,比较了不同功率下VUV、US和VUV/US降解印染废水尾水的效果,以确定VUV/US的最佳功率组合;通过批次实验,探讨了反应时间、反应温度、初始pH值对VUV/US降解印染废水尾水效能的影响规律,解释了VUV/US对TOC和UV₂₅₄的降解动力学.通过分析降解产物,揭示了VUV/US对印染废水尾水中残余难降解有机物的去除机理.结果表明,VUV/US的最佳功率组合为VUV16W、US100W,VUV/US处理印染废水尾水的效果明显优于单独UV和US的情况,存在着协同增效作用,反应120 min后VUV/US对TOC及UV₂₅₄的去除率分别达到27.68%和93.03%.反应温度、初值pH值对VUV/US处理效果的影响较小.VUV/US降解TOC和UV₂₅₄的反应动力学分别符合表观二级动力学模型和表观一级动力学模型.VUV/US过程是VUV直接光解、超声空化气泡内的热裂解和羟基自由基的氧化等协同作用,印染废水尾水中以苯系物为代表的难降解物主要通过羟基自由基的氧化作用去除.

Abstract: The vacuum ultraviolet (VUV) and high-frequency ultrasound (US) were combined to treat tail water from printing and dyeing wastewater. In order to determine the best power of the VUV-US combined system, the effects of the power of VUV, US and VUV-US on the degradation of the printing and dyeing wastewater were compared in terms of TOC and UV₂₅₄. The influences of reaction time, reaction temperature and initial pH value on the degradation performance of the VUV-US combined system were investigated through batch experiments, and the degradation kinetics of TOC and UV₂₅₄ were explained. The removal mechanism of residual refractory organics by the VUV-US combined system was revealed by analyzing the degradation products. The results showed that the optimum power was 16 W for VUV and 100 W for US, respectively, and there is synergistic effect between VUV and US. 27.68% of TOC and 93.03% of UV₂₅₄ can be removed within 120 minutes by the VUV-US combined system. The reaction temperature and initial pH value had insignificant effects on the performance of the VUV-US combined system. The degradation kinetics of TOC and UV₂₅₄ by the VUV-US combined system showed a good compliance with the apparent second-order kinetic model and the apparent first-order kinetic model, respectively. VUV-US combined treatment is a synergistic process including VUV direct photolysis, thermal cracking in the ultrasonic cavitation bubbles and hydroxyl radicals oxidation. Hydroxyl radicals oxidation was mainly responsible for the degradation of refractory benzene compounds in the printing and dyeing wastewater.

Key words: [ultrasonic](#) [vacuum ultraviolet](#) [coupling process](#) [printing and dyeing wastewater](#) [advanced treatment](#)

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