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研究报告

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VUV/Fe^{3+}体系对水中全氟辛酸(PFOA)脱氟影响因素研究

The influencing factors on defluorination of aqueous perfluorooctanoic acid (PFOA) by VUV/Fe^{3+} system

关键词：真空紫外线 全氟辛酸 响应面分析 脱氟率

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摘要：采用VUV/Fe^{3+}光催化体系对全氟辛酸(PFOA)进行脱氟处理,考察了PFOA初始浓度、Fe^{3+}浓度、体系pH值对体系脱氟的影响,并运用响应面正交法(RSM)优化分析了最佳反应条件.结果表明,VUV/Fe^{3+}体系对PFOA具有明显的脱氟作用.PFOA浓度与Fe^{3+}浓度比为1.8: 1~1.2: 1和pH为3~4时,有利于体系的脱氟.基于Box-Behnken响应曲面法,各影响因子显著性排序为pH>Fe^{3+}投加量>PFOA初始浓度,pH值和Fe^{3+}投加量交互作用显著.模型回归性良好,最佳运行条件组合为:pH=3.41,Fe^{3+}投加量为30 μmol·L^{-1}和PFOA初始浓度为38.6 μmol·L^{-1}(16 mg·L^{-1})条件下,反应4 h的脱氟率达到54.13%,与预测值相比偏差为0.36%.在VUV体系引入Fe^{3+}提高了PFOA及中间产物对紫外光利用的效率.

Abstract：A combined process of vacuum ultraviolet and trivalent iron ions was firstly used for defluorination of aqueous perfluorooctanoic acid (PFOA). The effects of pH, Fe^{3+} concentration, and initial PFOA concentration on the defluorination were investigated and the optimum raction conditions were obtained by response surface orthogonal test (RSM). The results show that the defluorination of PFOA was significantly enhanced under the PFOA/Fe^{3+} molar ratio of 1.8: 1~1.2: 1 and pH 3~4. pH was the most important factor for the PFOA defluorination followed by Fe^{3+} concentration and initial PFOA concentration. The synergetic effect of pH and Fe^{3+} dosage on defluorination was significant. The highest defluorination was achieved at pH of 3.41, Fe^{3+} concentration of 30 μmol·L^{-1} and initial PFOA concentration of 38.6 μmol·L^{-1}(16 mg·L^{-1}), repectively, up to 54.13% PFOA were defluorinated after 4 h radiation. The predicted values agreed well with the experimental values with only 0.36% deviation. Addtion of Fe^{3+} enhanced the degradation of PFOA and its intermediates under VUV radiation.

Key words：vacuum ultraviolet(VUV) perfluorooctanoic acid(PFOA) response surface method(RSM) defluorination rate

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