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### 焦化废水尾水 $O_3$ 氧化消除消毒副产物生成潜能的影响分析

#### Treatment of coking wastewater effluent by ozonation to minimize the disinfection byproducts formation potential

关键词:  [\$O\_3\$](#)  [焦化废水](#) [分子质量](#) [三维荧光光谱](#) [消毒副产物](#) [潜能](#)

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作者 单位

袁孟阳 华南理工大学环境与能源学院,工业聚集区污染控制与生态修复教育部重点实验室,广州 510006

林冲 华南理工大学环境与能源学院,工业聚集区污染控制与生态修复教育部重点实验室,广州 510006

欧桦瑟 华南理工大学环境与能源学院,工业聚集区污染控制与生态修复教育部重点实验室,广州 510006

廖建波 华南理工大学环境与能源学院,工业聚集区污染控制与生态修复教育部重点实验室,广州 510006

韦朝海 华南理工大学环境与能源学院,工业聚集区污染控制与生态修复教育部重点实验室,广州 510006

摘要: 焦化废水经生化处理后的尾水中含有多溶解性有机物(DOM),可能成为消毒副产物前体物,进而影响受纳水体下游给水厂的水质安全.因此,对焦化废水外排水(尾水)的消毒副产物生成潜能进行了分析,以实际焦化废水厂尾水为基质,采用气相色谱(GC)考察了 $O_3$ 氧化深度处理前后卤乙腈和三卤甲烷的生成潜能,并结合分子质量分布法和三维荧光光谱法分析了 $O_3$ 氧化处理尾水过程中前体物的转化规律.GC结果表明,焦化废水尾水各个分子质量范围的卤乙腈和三卤甲烷生成潜能分别达到 $1950.5\sim 3965.1\ \mu\text{g}\cdot\text{L}^{-1}$ 和 $1498.2\sim 2571.2\ \mu\text{g}\cdot\text{L}^{-1}$ ,表明工业废水排放之前需要考虑其对水体消毒副产物生成潜能的贡献. $O_3$ 氧化作用可以实现尾水中消毒副产物前体物的削减,相同反应时间的条件下 $O_3$ 浓度越高其削减越有效.溶解性有机碳(DOC)及在254 nm波长下的吸光度值( $UV_{254}$ )分析结果表明, $O_3$ 氧化能部分矿化尾水中的有机物,并优先分解不饱和和芳香性有机组分.分子质量和荧光光谱分析结果表明, $O_3$ 氧化优先矿化小分子组分( $<1\ \text{kDa}$ ),并将尾水中大分子有机物分解为小分子( $<1\ \text{kDa}$ ),对活泼基团进行预氧化,从而实现氯消毒副产物生成潜能的削减.

**Abstract.** Various kinds of dissolved organic matter (DOM) that existed in the effluent of coking wastewater treatment plants could become the precursors of disinfection byproducts (DBPs) during chlorination in the downstream drinking water treatment plants, posing a significant threat to water supply. Here, the potential of DBPs formation from coking wastewater effluent was investigated. The concentrations of haloacetonitriles (HANs) and trihalomethanes (THMs), two representative disinfection byproducts formed either from untreated or ozonation-treated effluents of a real coking wastewater treatment plant were analyzed using gas chromatography (GC). The analyses of molecular weight (MW) distribution and 3D-excitation-emission-matrix (3DEEM) spectrum were conducted to understand the transfer mechanism of the precursors during ozonation. The results of GC showed that THMs and HANs formed from untreated effluent had concentrations in the ranges of  $1950.5\sim 3965.1\ \mu\text{g}\cdot\text{L}^{-1}$  and  $1498.2\sim 2571.2\ \mu\text{g}\cdot\text{L}^{-1}$ , respectively, indicating that the effluent of industrial wastewater treatment plant could be the precursors of DBPs. In contrast, ozonation significantly reduced the amount of precursors of DBPs in coking wastewater effluent. Furthermore, it was found that higher concentration of  $O_3$  resulted in lower amounts of precursors. The results of DOC,  $UV_{254}$  and SUVA showed that  $O_3$  preferentially decomposed DOM that had unsaturated and aromatic components. The results of MW and 3DEEM showed that small MW ( $<1\ \text{kDa}$ ) DOM was more easily degraded by  $O_3$  as compared to large MW ( $>1\ \text{kDa}$ ) DOM. All the results provided evidence that treatment of coking wastewater effluent by ozonation was effective in minimizing the disinfection byproducts formation potential (DBFPF).

**Key words:** [ozonation](#) [coking wastewater](#) [molecular weight \(MW\)](#) [3DEEM](#) [disinfection byproducts](#) [formation potential](#)

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单位地址：北京市海淀区双清路18号 邮编：100085

服务热线：010-62941073 传真：010-62941073 Email: [hjkxxb@rcees.ac.cn](mailto:hjkxxb@rcees.ac.cn)

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