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研究论文

Alternative Use of Light Emitting Diodes in an Activated Charcoal-Supported Photocatalyst Reactor for the Control of Volatile Organic Compounds

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摘要 The applicability of ultraviolet-light emitting diodes (LEDs) as a light source for photocatalysis using granular activated charcoal (GAC) impregnated with transition metal-enhanced photocatalysts for the control of volatile organic compounds (VOCs) was investigated. Two target compounds (toluene and methyl mercaptan) were selected to evaluate the removal activities of the TiO_2/GAC composites. The photocatalysts were prepared by a sol-gel method. Methyl trimethoxy silane was added as a precursor sol solution to bind the photocatalyst with the GAC. Metal (Zn^{2+}, Fe^{3+}, Ag^{+}, and Cu^{2+}) enhanced TiO_2/GAC composites were prepared and tested for their photocatalytic activities under 400 nm LED irradiation. The specific surface area (SSA) and the surface chemical composition of the prepared composites were investigated. The SSAs of all the impregnated composites were similar to those of pure GAC. Both field emission-scanning electron microscopy and energy dispersive spectroscopic analysis confirmed that titanium and the impregnated metals were deposited on the surface of the adsorbent. The breakthrough time for GAC toward toluene or methyl mercaptan gas increased upon photocatalytic impregnation and LED illumination. Using different binders affected the breakthrough time of the TiO_2/GAC composite and the addition of zinc oxide to TiO_2 increased the VOC removal capacity of the GAC composite.

关键词： granular activated charcoal titania sol-gel method light emitting diode surface chemical composition zinc oxide

Abstract： The applicability of ultraviolet-light emitting diodes (LEDs) as a light source for photocatalysis using granular activated charcoal (GAC) impregnated with transition metal-enhanced photocatalysts for the control of volatile organic compounds (VOCs) was investigated. Two target compounds (toluene and methyl mercaptan) were selected to evaluate the removal activities of the TiO_2/GAC composites. The photocatalysts were prepared by a sol-gel method. Methyl trimethoxy silane was added as a precursor sol solution to bind the photocatalyst with the GAC. Metal (Zn^{2+}, Fe^{3+}, Ag^{+}, and Cu^{2+}) enhanced TiO_2/GAC composites were prepared and tested for their photocatalytic activities under 400 nm LED irradiation. The specific surface area (SSA) and the surface chemical composition of the prepared composites were investigated. The SSAs of all the impregnated composites were similar to those of pure GAC. Both field emission-scanning electron microscopy and energy dispersive spectroscopic analysis confirmed that titanium and the impregnated metals were deposited on the surface of the adsorbent. The breakthrough time for GAC toward toluene or methyl mercaptan gas increased upon photocatalytic impregnation and LED illumination. Using different binders affected the breakthrough time of the TiO_2/GAC composite and the addition of zinc oxide to TiO_2 increased the VOC removal capacity of the GAC composite.

Keywords： granular activated charcoal, titania, sol-gel method, light emitting diode, surface chemical composition, zinc oxide

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