环境科学学报
ACTA SCIENTIAE CIRCUMSTANTIAE

研究论文

俞成林,权红恩,康勇.硅藻土基纳米TiO_2降解甲醛的实验研究[J].环境科学学报,2012,32(1):116-122

硅藻土基纳米TiO_2降解甲醛的实验研究

Experimental study on the formaldehyde degradation by nano-TiO_2 immobilized on diatomite

关键词： 硅藻土基纳米TiO_2 甲醛 降解

基金项目：

作　者　单位

俞成林　天津大学化工学院, 天津 300072

权红恩　天津大学化工学院, 天津 300072

康　勇　天津大学化工学院, 天津 300072

摘要： 对比研究了硅藻土和硅藻土基纳米二氧化钛光催化剂对甲醛的吸附降解特点.通过改变反应器内甲醛的初始浓度、反应温度、光照强度和相对湿度,研究了涂覆量为62.5 g·m^{-2}的硅藻土基纳米TiO_2光催化剂对甲醛气体的降解效果.研究结果表明,硅藻土只对甲醛有一定的吸附作用,而硅藻土基纳米TiO_2对甲醛具有持续的吸附和降解作用.反应器内甲醛初始浓度越高,降解时间越长;初始浓度为6.0×10^{-3} mg·L^{-1}的甲醛气体,经过150 h降解率才能达到99%以上,而初始浓度为2.0×10^{-3} mg·L^{-1}和4.0×10^{-3} mg·L^{-1}的甲醛气体分别在14 h和32 h内就可以达到相同的降解率.反应温度越高,硅藻土基纳米TiO_2降解甲醛所需要时间越短;15 ℃时将初始浓度为2.0×10^{-3} mg·L^{-1}的甲醛完全降解需要50 h,而45 ℃时仅需12 h.光照是硅藻土基纳米TiO_2降解甲醛的直接动力,光照强度为0时,甲醛几乎不能被降解,只被硅藻土基纳米TiO_2光催化剂吸附;在8100 lx的照度下,浓度为2.0×10^{-3} mg·L^{-1}的甲醛在14 h内能被完全降解.环境相对湿度越大,该催化剂对甲醛的降解越彻底;相对湿度50%时, 硅藻土基纳米TiO_2光催化剂14 h内能将2.0×10^{-3} mg·L^{-1}的甲醛降解到3.72×10^{-5} mg·L^{-1},在相对湿度80%时,甲醛能被降解到1.0×10^{-5} mg·L^{-1}.

Abstract: The characteristics of the diatomite powder and the nano-TiO_2 immobilized on diatomite for formaldehyde adsorption were compared. The formaldehyde degradation of the nano-TiO_2 immobilized on diatomite by the dosage of 62.5 g·m^{-2} was studied under the condition of varying original formaldehyde concentration, reaction temperature, light intensity and relative atmosphere humidity in the reactor. The results showed that the diatomite powder can only adsorb formaldehyde but the nano-TiO_2 immobilized on diatomite can adsorb and degrade formaldehyde continuously. The degradation time was long for high formaldehyde original concentration. The degradation time of formaldehyde with original concentration of 6.0×10^{-3} mg·L^{-1} were 150 h, whereas only 14 h and 32 h for the original concentration of 2.0×10^{-3} mg·L^{-1} and 4.0×10^{-3} mg·L^{-1} respectively when the degradation ratio above 99%. The higher reaction temperature was, the shorter time of degrading formaldehyde. 50 h was needed for the complete photocatalyst oxidation of formaldehyde with original concentration 2.0×10^{-3} mg·L^{-1} under reaction temperature 15 ℃, but only 12 h under 45 ℃. Light was the key driving power of the nano-TiO_2 immobilized on diatomite degrading formaldehyde. The degradation time of formaldehyde of 2.0×10^{-3} mg·L^{-1} was 14 h when the light intensity was 8100 lx, but formaldehyde could hardly be degraded when the light intensity was 0 lm·m^{-2}. The rate of formaldehyde degradation by the photocatalyst was also enhanced by the relative humidity in the reactor. The formaldehyde degradation time from 2.0×10^{-3} mg·L^{-1} to 3.72×10^{-5} mg·L^{-1} was 14 h under the relative humidity of 50%, but to 1.0×10^{-5} mg·L^{-1} under the relative humidity of 80%.

Key words: nano-TiO_2 immobilized on diatomite formaldehyde degradation

主办单位：中国科学院生态环境研究中心

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

本系统由北京勤云科技发展有限公司设计