研究报告

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大气环境变化对污染土壤中PBDEs自然降解过程的影响研究

Natural degradation process of PBDEs in polluted soil under the changes of atmospheric environment

关键词：多溴联苯醚 自然降解 脱溴 臭氧 光照

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摘要：以模拟电子垃圾拆解区污染土壤中的多溴联苯醚(PBDEs)为研究对象,采用室内模拟的方法,考察了臭氧浓度的上升及光照条件、温度和土壤pH值等环境因素对土壤中PBDEs自然降解过程的影响.研究结果表明:臭氧浓度的升高能明显促进PBDEs的自然降解,且臭氧浓度越高BDE-209的降解率越高,随着土壤深度增加,BDE-209去除率则相应降低,10 mg·L^{-1}的臭氧在2 h内对深层土壤中BDE-209的去除率可达99%.光照强度为1.0 mW·cm^{-2}的持续紫外光照条件下,土壤中BDE-209的降解现象较为明显,且光降解速率随光强的增强而增大.40℃的夏季地面高温及pH=9.0的弱碱性土壤均有利于PBDEs的自然降解.此外,PBDEs的降解过程是逐步脱溴的过程.PBDEs的降解过程既包括了BDE-209的降解,也包括了中间产物(BDE-28、BDE-47、BDE-99、BDE-100、BDE-153、BDE-154和BDE-183)的降解.当BDE-209去除率达到一定程度且中间产物逐渐积累达一定量时,中间产物的降解反应逐渐成为主导反应,导致PBDEs总量逐渐降低.

Abstract：The effects of ozone, irradiation, temperature and soil pH on the natural degradation process of PBDEs in polluted soil were investigated under laboratory tests. The results showed that BDE-209 was removed quickly due to the strong oxidizing ability of ozone in the ambient air. The degradation reaction rates of PBDEs increased with increasing ozone concentration but decreased with the depth of soil,and 10 mg·L^{-1} O_3 led to more than 99% of BDE-209 removal on the natural degradation process of PBDEs during 2 h in the deep soils. BDE-209 was quickly transformed into less-brominated BDEs under 1.0 mW·cm^{-2} UV-irradiation, the photodegradation reactions of UV-irradiation were faster than solar irradiation. The conditions of high ground temperature of 40℃ in the summer and alkaline soil of pH=9.0 were both contributors to the degradation of PBDEs. In addition, less-brominated BDEs, ranging from BDE-28 to BDE-183, were formed progressively, and the degradation of intermediate products gradually dominated along with an increase in reaction time, leading to gradually reduced amount of PBDEs.

Key words：PBDEs degradation debromination ozone irradiation

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