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Environmental Behavior of Polybrominated Biphenyl Ethers in Several Typical Environmental Media

Hongjian Fan[1, 2, 3, *], Liangyan Yang[1, 2, 3]

[1]Shaanxi Provincial Land Engineering Construction Group Co. ,Ltd. ,Xi'an, 710075, China

[2]Institute of Shaanxi Land Engineering and Technology Co. , Ltd. , Xi'an, 710075, China

[3]Key Laboratory of Degraded and Unused Land Consolidation Engineering, Ministry of Land and Resources, Xi'an, 710075, China

Abstract

Polybrominated biphenyl ethers (PBDEs) are derived from the production of the product and the production and disassembly of the product as an additive flame retardant. It is a new kind of persistent organic pollutant, which is found in the atmosphere, water, sediments and other environmental media and widely exists in organisms. There are also many systematic studies on the environmental behavior of PBDEs in various environmental media and the pollution control technology in the whole process from source to collection, which are also the directions that need to be paid attention to in the future.

Keywords

Environmental Media; Environmental Behavior Introduction.

1. Introduction

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2. Organization of the Text

2.1. Section Headings

2.1.1. Sub-section Headings

Polybrominated diphenyl ethers (PBDEs) are a class of aromatic organic compounds that replace hydrogen atoms in diphenyl ethers with bromine. They are characterized by low water solubility, low volatility and high lipophile, and are easy to accumulate in the environment and cause carcinogenic effects on human body [1]. Widely used as additives in a variety of industrial products, such as plastics, rubber, textiles, electronic and electrical equipment, to prevent or delay the initial stages of fire development [2].

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However, PBDes have environmental persistence and can exist in living and abiotic environments for a long time [3]. In addition, PBDEs are endocrine disruptors that can affect the level of thyroid hormone, affect the activity of liver enzymes, hinder neural development, induce immune toxicity, and even cause DNA damage [4]. Therefore, this paper will review the pollution hazards and control of POLYbrominated diphenyl ethers, in order to provide reference for future research on pollution control and treatment of polybrominated diphenyl ethers.

3. Chemical Properties and Main Sources of Polybrominated Diphenyl Ethers

The general formula of POLYbrominated diphenyl ethers is C12-H9-O-C12H9, with molecular weight ranging from 249 to 959.According to the number of bromine atoms, polybrominated diphenyl ethers can be divided into 10 homologous groups, with a total of 209 homologues. Bde-209, the most common in the environment, is a decabromodiphenyl ether. China's main production and use of ten bromine diphenyl ether. Polybrominated diphenyl ethers have low solubility in water and high hydrophobicity, and they are easy to evaporate into the air and have the characteristics of long-distance migration. Polybrominated diphenyl ethers are very stable in chemical structure and difficult to be degraded by physical and chemical methods. Therefore, POLYbrominated diphenyl ethers can exist in the environment for a long time, and are easy to be enriched in organisms. Moreover, there are many kinds of polybrominated diphenyl ethers, and the pollution situation is complicated [5].

Factory discharge is one of the sources of POLYbrominated diphenyl ethers in the environment, and the waste water discharge of some plastic products factories makes a large number of POLYbrominated diphenyl ethers enter the water body [6]. Polybrominated diphenyl ethers are less water-soluble and more prevalent in the atmosphere. A large number of POLYbrominated diphenyl ethers (PBDes) are released in the process of dismantling and recycling a large amount of e-waste, which can easily cause pollution. In addition, polybrominated diphenyl ethers are also caused by production sites, automobile interior furniture decoration, circuit board packaging products and textiles [7].

Therefore, identification research on migration and conversion of PBDes in different environments in the process of production and use is of great significance to prevent environmental pollution and ensure ecological safety.

4. Environmental Behavior of Polybrominated Diphenyl Ethers

4.1. Atmospheric

At present, the domestic research on PBDEs in the atmosphere has made some achievements. 11 cities in China (Beijing, Harbin, Dalian, Xi 'an, Nanchang, Shihezi, Lanzhou, Kunming, Lhasa, Guangzhou, Chengdu) the suburbs (Shanghai), and rural and remote areas special industrial zone, PBDEs were detected in the atmosphere. In addition, scholars turned their attention to the study of PBDEs in fine particulate $PM_{2.5}$. In Taiyuan[8], the average concentration of σ PBDEs was 10.9±10.3 $pg \cdot m^{-3}$. In the study of PM2.5 in the atmosphere in eastern China [9], the average concentration of PBDEs was 7.1±6.8 $pg \cdot m^{-3}$. In the assessment of exposure risk [10], it is pointed out that inhalation exposure of children in cities is 2-3 times that of adults. Therefore, PBDEs in fine particles have potential health hazards to human health. PBDEs have been detected in the atmosphere of many countries and regions abroad, such as Sweden and England in Europe, Canada and the United States in North America, Pakistan in Asia, and the Antarctic and Arctic regions.

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4.2. Plants

Soil organic pollutants enter plants mainly through two ways :(1) desorption from soil particles into soil solution or soil gas phase, and then absorbed by plant roots, or into xylem, which is transferred from root to stem and leaf with transpiration flow, and finally accumulated in plant organic components or volatilized into the air; (2) the volatile into the atmosphere, and then through the gas diffusion from the stem leaf stomata, state or by particles sedimentation deposition on the leaf epidermis of wax, then through dissolving in wax through the skin, under the action of van der Waals force, etc, through the cuticular wax into the phloem, which in turn transfer and accumulation in plants in various parts of the organic components. Studies have found that PBDEs can be absorbed by plants, and the accumulation of bDE-209 with strong hydrophobicity in different plants has obvious differences among plant species, and the accumulation in pumpkin is the highest [11]. A variety of PBDEs were detected in roots, stems and leaves of plants through plant cultivation experiments in the actual contaminated soil of the e-waste dismantling site in Guiyu, Guangdong province. Low bromine PBDEs were more easily absorbed by plants than high bromine PBDEs, and the PBDEs in soil would volatilize into the atmosphere and then be absorbed by plant leaves. Therefore, low content of PBDEs was also detected in the stems and leaves of control plants without PBDEs soil. At the same time, the accumulation and distribution of PBDEs were also observed in plants by microbeam X-ray fluorescence analysis based on synchrotron radiation, providing direct evidence for the absorption and accumulation of PBDEs in plants [12]. There are two different views on the migration pathways of hydrophobic organic pollutants such as PAHs and PBDEs in plants. Some scholars think that they are absorbed by plant roots will be part of the transfer to the plant after the part on the ground, but more and more researchers argue that this transmission is hard to happen, because the compound must be through skin to enter the xylem, and through the plant transpiration to realize the radial migration, and some non ionic compounds through the hard skin on selective strong "casparian strip" area. Through soil culture and hydroponic exposure experiments, it was found that the concentration of PBDEs in maize, pumpkin, zucchini and radish showed a trend of decreasing from root to root, and the gradient distribution of decreasing concentration in stem from bottom to top could especially prove the stem transmission of PBDEs in plants. Even BDE-209 with lg Kow value of 10 is detected in the stem and leaf parts of many plants, and mainly comes from stem to stem transmission [13]. At the same time, the distribution law of PBDEs concentration gradually decreased from corn stem core to sheath and epidermis was also observed, providing a basis for the radial transmission of PBDEs [14].

5. Conclusion

Polybrominated diphenyl ethers (PBDes) are widely used as flame retardants. However, the rapid detection of polybrominated diphenyl ethers (PBdes) in pollutants, the wide application of degradation technology, the systematic study of regression behavior and the pollution control technology from source to sink are far from enough, which should be paid attention to in future academic research and pollution control and treatment practice. Most of the studies reviewed above focus on the laboratory stage, especially in the degradation mechanism has been more in-depth analysis, but in the pollution prevention and control practice, there are still deficiencies in the existing technology: for example, reduction debromination reactions are all driven by ultraviolet light. In addition, in the study of microbial degradation technology, first, microbial species that can degrade POLYbrominated diphenyl ethers are rarely found, and the influencing factors and degradation mechanism of microbial degradation process are not clear due to the great difficulty in studying single factor. Second, the research mainly focuses on anaerobic microbial degradation. Compared with aerobic degradation, the anaerobic

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degradation process has a long cycle, which is mostly confined to the reduction and debromination process, and the degradation is not complete. Therefore, the development of aerobic microbial degradation technology has important scientific significance. Pollution based on the above analysis, the innovation body polybrominated diphenyl ether detection methods are introduced, polybrominated diphenyl ether release of pollution source, migration - rule, the whole process and the mechanism of harmful biological control polybrominated diphenyl ether pollution technology, explore to reduce the degradation of intermediate dioxin-like substances produced by the comprehensive degradation method, research new pollution-free flame retardant additives, etc., are the important direction in the future.

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