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Editorial: Legacy and emerging flame retardants as environmental pollutants: occurrence, toxicity mechanisms, and control

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Editorial on the Research Topic
Legacy and emerging flame retardants as environmental pollutants: occurrence, toxicity mechanisms, and control

More people are becoming aware of environmental contamination. In addition to well-known environmental toxicants, more and more new pollutants are being found. In contrast to traditional pollutants, their toxicities, environmental effects, and features are still little understood. For a better understanding of their effects on the environment and human health, information and knowledge on their toxicity processes, environmental occurrences, and features need to be thoroughly examined and defined. The use of flame retardants, particularly brominated flame retardants (BFRs), has been increasing for decades. Polybrominated diphenyl ethers (PBDEs) and isomers of hexabromocyclododecane (HBCDDs) are two types of BFRs that have historically been used in large volumes but recently faced legislative restrictions. However, in order to meet fire safety standards, these BFRs have been replaced by a variety of emerging flame retardants (EFRs) about which little is known especially concerning their toxicity, production volumes, and environmental behavior.

Flame retardants (FRs) are chemicals added to combustible materials including electronics, fabrics, and plastics to reduce the risk of fire (Cristale et al., 2013). It has been determined that the usage of FRs plays a crucial role in reducing losses and damages as well as preserving lives. Despite this, certain significant FR group members are toxic and have a negative impact on both people and the environment (Birnbaum and Staskal, 2004; Linares et al., 2015; Bettazzi et al., 2016). According to Yogui and Sericano (2009), there are now about 175 compounds or groups of compounds with flame retardant characteristics. According to their chemical makeup, FRs is grouped into four main categories: inorganic, halogenated organic, nitrogen- and phosphorus-containing compounds, and compounds that are not organic. The brominated flame retardant (BFR) and organophosphate flame retardant (OPFR) are the two most widely utilized category of flame retardants. Since FRs has been in use for so long, they have been found in practically every environmental compartment. The world's freshwater environments include significant

amounts of FRs in the water, sediments, and biota. Numerous investigations have demonstrated that FRs frequently travel great distances and arrive at or deposit in isolated locations.

The primary goal of this Research Topic was to gather recent data on environmental occurrence and characteristics of legacy and emerging contaminants in different environmental media, source and control techniques, and methodological advancement in the measurement of FRs. This Research Topic brings five novel contributions from Asia and Europe that explore different research approaches in understanding the fate of legacy and emerging flame retardants chemicals. This study subject was covered by a total of five publications, including studies from China and Sub-Saharan Africa.

Nippen et al. analyzed sediment core samples from a Tanzanian floodplain system that were dated for this particular study subject. Both historical and newly developing contaminants were examined in the samples. The concentration of each chemical group increased dramatically toward the top sediment layers. A review of probable causes for the observed trend revealed socioeconomic factors connected to population, economic, and waste generation increases have influenced the rise in BFR, chlorinated paraffin, and decrease plus concentrations. To test the effects of phytotoxicity on the germination and seedling of two rice types, Liu et al. conducted a pot experiment. The findings indicated that soil levels of cadmium (Cd), tetrabromobisphenol A (TBBPA), and dechlorane plus (DP) were rising. Two rice varieties' protein and soluble sugar contents were dramatically decreased by halogenated flame retardants and cadmium in the soil while their root activity and proline levels were significantly increased. Two rice types' superoxide dismutase and catalyze activity were enhanced, and a significant amount of malonyldialdehyde was produced. TBBPA and Cd were more readily bio-accumulated in rice, but there was no statistically significant difference in the bioaccumulation of DP in the two rice cultivars.

Skogeng et al. undertook a research to map the regional distribution of air concentrations of DP and DP-related chemicals at background locations across Europe. In 2016, polyurethane foam (PUF) was deployed at 99 locations in 33 European nations for 3 months. The study demonstrated the presence of syn- and anti-DP on all European continents, including a portion of the Arctic. This work provides evidence that these substances may be transported over great distances by the atmosphere to distant locations. In central continental Europe, where anti-DP percentage was near to commercial DP combination, the greatest concentration of DP was found. Only one DP-related chemical, dechlorane-602 was found in 27% of the samples. The measured concentration and spatial pattern of DP and DP-602 in air across Europe indicate the influence of primary sources of these compounds on background concentration in European air.

In two young males from Northwest China, acute 1, 2, 3-trichloropropane (TCP) poisoning was evaluated by Li et al. The findings demonstrated that TCP inhalation without any safeguards can cause serious liver damage in people. The liver enzyme and international normalized ratio climbed quickly to peak and then decreased, and the total bilirubin (TBIL) reached a peak value of 636 μmol/L. Additionally, substantial levels of TCP were found in the blood and liver, indicating severe hepatocyte necrosis, large inflammatory cell infiltration, and cholestasis.

Li and Liu analyzed and investigated the legal cases involving environmental harm that Chinese courts had published between January 2021 and May 2023. They discovered that there is still some harm to the environment and the relief system. A few flaws to mention are the courts' selective interpretation of conflicts of laws, their disregard for public health and environmental damage, and their absence of a rehabilitation strategy.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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