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Brominated Flame-Retardants in Sub-Saharan Africa: Burdens in Inland and Coastal Sediments in the eThekwini Metropolitan Municipality, South Africa

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Abstract

Brominated flame-retardant (BFR) additives are present in many polymeric consumer products at percent levels. High environmental concentrations have been observed near cities and polymer, textile and electronics manufacturing centers. Most studies have focused on European, North American and Asian locales. Releases are likely rising most dramatically in countries with weak environmental and human health regulation and enforcement, demand for electrical and electronic equipment (EEE) is escalating, and importation of waste EEE occurs. Several African countries meet these criteria, but little data are available on burdens or sources. To better understand the extent of BFR environmental dissemination in a southern African urban community, inland and coastal sediments were collected in the eThekwini metropolitan municipality, South Africa, and analyzed for polybrominated diphenyl ethers (PBDEs), hexabromocyclododecane (HBCD), 2-ethylhexyl 2,3,4,5-tetrabromobenzoate (TBB), 2-ethylhexyl 2,3,4,5-tretabromophalate (TBPH), 1,2-bis (2,4,6-tribromophenoxy) ethane (BTBPE) and decabromodiphenyl ethane (DBDPE). BFRs were detected in all samples (n=45). Concentration data are presented on total organic carbon (TOC) normalized basis. ΣBFR ranged from 114 to 47,100 ng g-1. Decabromodiphenyl ether was detected in 93% of samples (mean concentration 3208 ng g-1) followed by TBB at 91% (mean conc. 545 ng g-1). Durban Bay is strongly influenced by urban runoff and tidal hydrology and sediments therein exhibited ΣPBDE concentrations ranging from 1850 to 25,400 ng g-1 (median conc. 3240 ng g-1). These levels rival those in the heavily impacted Pearl River Delta, China. BFRs likely enter the South African environment during manufacture of BFR-containing products, during and following product use (i.e. after disposal and as a result of materials recycling activities), and from nonpoint sources such as atmospheric fallout and urban runoff. These results underline the need to investigate further the environmental burdens and risks associated with BFRs in developing countries.