Study on Distribution, Sources and Historical Trend of Organic Micropollutants in Thailand

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Thailand is a developing country in tropical Asian countries, where inputs of organic pollutants from urban sources have been increasing. Especially, Bangkok is a mega-city with ~7 million inhabitants and various pollutants are derived from both point and non-point sources and are transported to aquatic environment. They have potential adverse effects on aquatic organisms. However, inputs, distributions, and behaviors of organic micropollutants in Thailand have been poorly revealed. The present study focused on two major classes of organic micropollutants: organochlorine compounds and polycyclic aromatic hydrocarbons (PAHs).

The objectives of study were 1) to assess the status of pollution by organochlorine compounds and PAHs and to identify the main sources of the anthropogenic compounds in the aquatic environment; 2) to study the process of offshore transport of the organic pollutants; 3) to reconstruct of pollution history of the organic contaminants in the upper Gulf of Thailand by using sediment cores and understanding of pollution mechanisms for estimating effective countermeasures against pollution.

Chapter 2 reported the first reconstruction of history of organic pollution by using sediment cores collected in the upper Gulf of Thailand. The cores were analyzed for PAHs, hopanes, linear alkylbenzene (LABs), tetrapropylene-alkylbenzene (TABs), polychlorinated biphenyls (PCBs). ^{137}Cs and chronological molecular markers (i.e., LABs and TABs) were utilized for the dating the sediment cores. Vertical profiles of PCBs showed subsurface maximum and their concentrations decreased toward surface, indicating the effectiveness of regulation of PCBs in Thailand which was implemented in 1980s. On the other hand, concentrations of PAHs increased toward the surfaces in most of the cores, indicating their increasing inputs. Thus, the later two chapters focused on PAHs.

Chapter 3 described the

distribution of PAHs and molecular marker (hopanes) in sediments from urban canals (n = 8), the Chao Phraya River (n = 11), estuarine (n = 9) and coastal area (n = 14). The research finding indicated that PAH contaminations in Thai sediments are categorized as low to moderate on global comparison. In the urban canals high concentration of PAHs ranging from 512 to 8399 ng/g (2290 ± 2556 ng/g; n = 8) were observed. On the other hand, the coastal areas showed extremely low concentrations of PAHs ranging from 6 to 228 ng/g (50 ± 56 ng/g; n = 14). A ratio of the sum of methylphenanthrene to phenanthrene (MP/P ratio) indicated that sources of PAHs in the urban aquatic environments are mixtures of pyrogenic (MP/P <0.5) and petrogenic (MP/P >2) sources.

More detailed source identification of PAHs in Bangkok was conducted in Chapter 4 Potential source materials (asphalt, tire, crankcase oil, vehicle exhaust soot) and transport media (street dust, and street runoff and ambient air) were collected from Bangkok and analyzed for PAHs and hopanes. On the cluster analysis, street dust, street runoff, and canal sediment were categorized into a single group, indicting that street dust and street runoff are the major source and major carrier, respectively, of PAHs to urban canals. Multiple regression analysis of PAH profiles identified tire debries as major contributors of PAHs to street dust and the urban canal sediment, followed by diesel vehicle exhaust.

The distribution and transport of PAHs and related anthropogenic contaminants in surface sediments in the upper Gulf of Thailand were described in chapter 5. The surface sediments were collected from 30 locations along offshore transects from the mouths of 4 major rivers flowing into the gulf. Concentrations of PAHs, triterpanes, LABs, 4,4'-bis[(4-anilino-6-morpholino-1,3,5-triazin-2-yl) amino]stilbene-2,2'-disulfonate (DAS1), and 4,4'-bis (2-sulfostyryl) biphenyl (DSBP) ranged from 4 to 724 ng/g, 31 to 577 ng/g, 2 to 258 ng/g, 2 to 572 ng/g and 1 to 570 ng/g, respectively. The highest contaminant concentrations were observed near the river mouth of the Chao Phraya River. All compounds showed offshore decreasing trend from river mouths to offshore area. The results showed active deposition of laterally transported riverborne particles in nearshore area with a half distance of ~10 km.

To understand the status of pollution of organochlorine pesticides and PCBs residue in Thailand, Green mussels (*Perna viridis*) and surface sediment samples were monitored. The results indicated that organochlorine pesticides residues detected lower than the Maximum Residues Limit (MRL) for aquatic animal as recommended by The Ministry of Public Health of Thailand. PCBs in sediments indicated low-level concentration, especially at upper stream of the Chao Phraya River PCBs was undetectable.

The present study is useful to update the environmental quality standard and improve monitoring parameter to integrate the status of anthropogenic compounds.