STUDY ON THE FATE OF PETROLEUM-DERIVED POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) AND THEIR ACCUMULATION IN MUSSELS USING ENCLOSED ECOSYSTEMS, MESOCOSMS

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Oil pollution in the sea arises from multiple sources, oil spill from tankers, leakages from drilling operations, municipal and industrial wastewater and so on. Polycyclic aromatic hydrocarbons (PAHs) are one of the oil components and have carcinogenicity, mutagenicity, and teratogenicity. We studied the fate of PAHs in the marine environment using experimental tanks that mimic ecosystems. Due to their hydrophobic nature, PAHs are accumulated in tissue of aquatic organisms.

Accumulation of PAHs in mussel tissue was studied, because they are widely used for coastal monitoring and have minimal metabolic transformation. Furthermore, the effects of chemical dispersants on degradation behavior of PAHs were studied using the mesocosm.

Seawater was pumped to mesocosm tanks and water-soluble fraction of heavy oil (WSF) or chemically dispersed oil was spiked to the tank of 5000L volume. In some settings, caged mussels were deploied. Water sample, settling particles and mussels were collected periodically and PAHs were analyzed by gas chromatography-mass spectrometry (GC-MS) following extraction and silica gel chromatography. Totally four experiments using mesocosms were carried out with different settings. Individual experiments consisted of three to five tanks with different conditions including a control.

Low molecular weight PAHs (LMW PAHs) with less than 3 benzene rings disappeared rapidly, mostly within 3 days. This may suggest acute toxicity of spilled oil decreases quickly. On the other hand, high molecular weight PAHs (HMW PAHs) with more than 4 benzene rings stayed in the water column for longer time (more than 6 days) and considerable parts (11-94%) were found in the settling particles. Because HMW PAHs include chronically toxic components and anaerobic benthic environments prevent biodegradation of PAHs, long-term effects of PAHs on benthic organisms are concerned.

LMW PAHs were readily accumulated in mussels and reached their maximum concentration at one day after the start of the experiment. Their bioaccumulation factors were in the orders of 10^3-10^5. In concordance with their decrease in water-column concentrations, LMW PAHs concentrations in mussels decreased rapidly. On the other hand, accumulation and release of HMW PAHs by mussels were much slower. HMW PAHs had maximum tissue concentrations between day 2 and 9 and they were still significantly bioaccumulated 60 days after the start.

Chemically dispersed PAHs disappeared from water column faster than that in WSF (i.e., without chemical dispersant), suggesting that PAHs degradation was accelerated by introduction of dispersant. Also larger amount of PAHs were observed in dissolved phase by addition of dispersant. This suggests that the addition of the dispersant may increase the bioavailability of PAHs.