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Petroleum hydrocarbons (PH) in groundwater aquifers: An overview of environmental fate, toxicity, microbial degradation and risk-based remediation approaches

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Abstract

Petroleum hydrocarbon (PH) contamination of soil and aquatic ecosystems is a serious global issue. PH are classified as xenobiotics and emerging priority pollutants. When released into the environment, fate and behaviour of PH varies widely with the particular composition and physicochemical properties. Usually, PH with higher molecular weight are toxic and seldom mobilizes in subsurface plumes when compared to their low molecular weight counterparts. Due to the toxic, mutagenic and carcinogenic nature of PH, various remediation approaches are currently employed for their clean-up from the environment. Degradation of PH by the activity of native microbes is considered as a significant eco-friendly and cost effective approach for the remediation of PH contaminated sites. Changes in the microbial adaptations and dynamics are important indicators for monitoring the effects of PH contamination. Several analytical techniques are available for the identification and quantification of PH present in contaminated sites. Also, toxicity tests are widely employed to monitor the effect of remediated sites where analytical techniques fall short to identify certain PH due to the lack of standardized methods and low concentrations. Consequently, this review provides an overview of environmental fate, toxicity, and remediation of PH with particular emphasis on risk-based remediation which considers the use of both analytical and toxicological studies for effective management and remediation of PH contaminated sites.

Keywords: Petroleum hydrocarbons; Aquifers; Toxicological assays; Microbial degradation; Risk-based remediation