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Water Quality Indicators: Hydrocarbons

Hydrocarbons include a large class of hydrogen- and carbon-containing compounds. Natural sources of hydrocarbons include petroleum and natural gas deposits as well as the conversion of organic molecules in the environment through chemical or biological processes (Neff *et al.* 2005). Hydrocarbons are important sources of energy and raw material for the production of numerous other chemicals and consumer products.

The chemical structure of hydrocarbons can vary in terms of size, saturation of chemical bonds, and structure; hydrocarbons can exist as a long, straight chain of atoms or as rings. Polycyclic aromatic hydrocarbons (PAHs) are one type of hydrocarbon that consist of two or more fused benzene rings.

PAHs

PAHs are found naturally throughout the Athabasca oil sands region in association with minerals and sediments, and originate from fossil fuels (i.e., bitumen), the combustion of organic matter, and chemical and biological transformation of organic molecules. PAHs are generally found as complex mixtures of hundreds or thousands of compounds with varying structure and toxicity to aquatic organisms (Neff *et al.* 2005), while some compounds are known to cause cancer. Depending on the solubility of the individual molecule, PAHs naturally found in aquatic sediments can enter sediment pore water or the water column. The toxicity to aquatic organisms is higher in this aqueous form than when PAHs are adsorbed to particles or are found in non-aqueous liquids (Neff *et al.* 2005).

Naphthenic Acids

Naphthenic acids are another type of hydrocarbon that has been identified as a potential toxicity concern in the Athabasca oil sands region (RAMP 2005). Naphthenic acids are complex mixtures of non-aromatic compounds that are also found in bitumen, and can enter the water column through erosion of bitumen-containing sediments and through groundwater. Background concentrations of naphthenic acids in the Athabasca oil sands region are generally less than 1 mg/L. While little is known about the natural degradation pathways of naphthenic acids, it is likely that the compounds persist in the water column and accumulate in sediments (Headley and McMartin 2004).

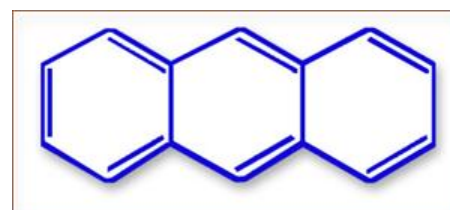
Human Sources

Both PAHs and naphthenic acids are associated with industrial oil sands projects. Large amounts of wastewater containing elevated concentrations of these chemicals are stored in vast tailings ponds, which will eventually become part of a reclaimed landscape. Other industrial sources of PAHs include the pharmaceutical, photographic, and chemical industries, pest treatment, urban runoff, and creosote-contaminated sites.



Coal consists mainly of carbon, hydrogen, and oxygen.

Source: Astec Industries
(click to enlarge)



The molecular structure of anthracene, a polycyclic aromatic hydrocarbon (PAH).
(click to enlarge)

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