



Polycyclic Aromatic Hydrocarbons in South African Water Resources



What are Polycyclic Aromatic Hydrocarbons?

Polycyclic aromatic hydrocarbons (PAHs) are a class of contaminants of emerging concern. They are a group of ubiquitous, persistent and toxic organic compounds with a two or more fused aromatic ring structure. Their persistence in the environment is due to their hydrophobicity, low aqueous solubility and stability of their aromatic ring structure. Most PAHs have no particular use but a few of them are used in pharmaceuticals and as precursors in the synthesis of industrial compounds which include dyes, insecticides, fungicides and plastics. Naphthalene, fluoranthene and pyrene are PAHs that are produced commercially to make other chemicals such as mothballs, fluorescent dyes and perinon pigments.

Where do Polycyclic Aromatic Hydrocarbons originate from?

PAHs are naturally present in fossil fuels (such as coal and crude oil) and produced during burning of gasoline, diesel exhaust, asphalt, coal and coal tar. They are also produced from the burning of organic compounds such as wood and refuse, besides being produced during smoking and barbecuing foods. Furthermore, tobacco smoke contains a significant amount of PAHs. The emergence of crude oil as the major energy source in the 20th century has been associated with PAHs, which pollute environmental matrices in the course of the manufacturing processes of petroleum and petrochemical by-products as well as via leaks and spillage during storage and transportation.

What are the dangers associated with PAHs?

PAHs in freshwaters pose risks such as mutagenicity, teratogenicity, carcinogenicity and disruption to the endocrine system. Their reactive metabolites, such as epoxides and dihydrodiols, are considered to have greater deleterious effects, given their ease of binding to cellular proteins and DNA. As a result of these toxicities, sixteen of the PAHs are prioritised and included in the European Union (EU) and United States Environmental Protection Agency (US EPA) priority list of pollutants. However, recently recommended is a list of 40 PAHs, which include several alkylated homologues, for toxicity consideration.

How to prevent contamination of water resources with PAHs

- Never wash chemicals down the drain, rather take them to the local authorized center
- Do not wash cars into water bodies, rather let the waste water soak into grass or the ground.
- Oil spills or motor oil should not be washed into a gutter or storm drain, rather use a commercial absorbent and then scoop up and take to the local authorized center.
- Educate others on safe disposal of vehicle oils and spillages away from surface water resources.

How to remove PAHs from water resources

- Adsorption and filtration using materials such as silver impregnated activated carbon, granular activated carbon, Zeolite or activated alumina.
- Direct nanofiltration using polyethersulfone and reverse osmosis using copper and zinc alloy.
- Scavenging by nanofibrous polycyclodextrin membrane.