WASHINGTON STATE DEPARTMENT OF
Natural Resources
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Brief Science of Creosote

Not covered in this brief piece are the history of creosote and its use in any of the marine applications.

Environmental Chemistry

Creosote is a general term covering coal tar creosote, coal tar, and coal tar pitch. Coal tar creosote is the most common mixture, and is widely used as a wood preservative in the U.S. As many as 10,000 chemicals may comprise this mixture.

- The primary chemicals of concern within creosote compound —with harmful health effects—are polycyclic aromatic hydrocarbons (PAHs), phenols, and creosols. Of these three, PAHs are the most common ingredient.
- PAHs are organic compounds, and in the context of creosote (and in general) they are divided into two categories: low molecular weight PAH compounds (low PAH) and high molecular weight PAH compounds (high PAH).
- Chemicals in creosote break down in water very slowly. They tend to cling to particles of matter, and as such, sediments are considered the primary location for these contaminants to collect in aquatic environments. Many PAHs do not migrate far from the point of contamination, and accumulate at that primary location.
- The rate of absorption of a particular compound is variable and depends on several factors (e.g., exposure, degradation, and oxidation).
- Microscopic breakdown of some of these toxins can occur at the water/sediment interface; high PAHs can resist degradation more than low PAHs. In sediment with less oxygen, degradation of both high and low PAHs decreases, and may persist in the sediments for an indefinite period.
- Intake by living organisms depends on a particular chemical compound, but organisms that live in or are attached to the sediments can uptake many of the PAHs as they ingest sediment or as they eat other organisms with concentrations of the chemicals.

Toxicity of creosote

The toxic effects of organic contaminants (such as PAHs) depends on several factors, including the route of exposure, duration and concentration, chemical composition, organism sensitivity, life stage affected, organism potential for detoxification/excretion, and the physical condition of a particular organism during exposure.

- In general, these chemical compounds vary widely in toxicity. For some organisms, low PAHs are acutely toxic but may be considered non-cancer causing. High PAHs however, are not as toxic, but to many organisms—such as fish, birds, amphibians, mammals—can cause cancer, mutation or malformation of embryo/fetus.
- These toxins quickly accumulate in an organism, but most organisms can also rapidly metabolize and eliminate them. Most fish tissue contains relatively low concentrations of these toxins, and accumulation is usually short term. Two other processes are more

common: biodegradation (decay and absorbed by environment) and biotransformation (chemical compound alteration by enzymes).

- PAHs generally are not expected in higher order organisms; organisms such as fish have the potential to metabolize and excrete PAHs.
- These toxins can accumulate in tissues of mollusks and other benthic invertebrates that do not metabolize as efficiently. An increase in concentration can result within organisms with higher fat. Reproduction may be inhibited or death may occur.
- For some fish species, this sediments contamination is linked to adverse impacts, such as reproductive impairment, suppressed immune function, liver lesions and fin abnormalities. In addition, embryonic development of the Pacific herring has been shown to be negatively affected by diffusible components of weathered creosote pilings.

References

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