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Gasoline and its Organic Constituents

Guideline

Because of the complexity of gasoline, a maximum acceptable concentration (MAC) for gasoline in drinking water has not been established.

Identity, Use and Sources in the Environment

Gasolines are complex mixtures that contain many substances, such as antiknock agents, antioxidants, metal deactivators, antirust additives, anti-icing agents, preignition additives, upper cylinder lubricants and dyes. Commercial gasolines contain mainly C_5 to C_8 paraffins (60 to 80%), with much smaller quantities of aromatic compounds (14 to 33%) and olefins (6.4 to 13%).

Gasoline is usually considered as a mixture of those hydrocarbons that boil between -1 and 202°C.[1–4] The density of gasoline is reported to be about 0.730 g/cm^3, and its vapour pressure is estimated to be 93.3 kPa at 25°C.[5,6] Gasoline is highly flammable with a flash point of -45°C and minimum and maximum explosion limits in air of 1.3 and 6% by volume.[7] It is not possible to define gasoline and its composition exactly because the properties of gasoline are somewhat variable.

The most important use of gasoline is as a fuel in internal combustion engines, principally automobile, aviation and marine engines. It has also been used as a solvent for rubber adhesives and as a finishing agent for artificial leathers.

During 1982, 41 Canadian establishments were engaged in the refining of crude petroleum, producing 34 503.8 million litres of gasoline. A slight decrease was observed in 1983, when 34 003.8 million litres were produced.[8] In 1982 and 1983, Canadian exports of gasoline amounted to 500 and 12.4 million litres, respectively.[9] In the same years, imports were 22.6 and 43.7 million litres, respectively.[10]

Regular leaded gasoline represented 59.6 and 58.3% of all gasoline sales in 1982 and 1983, respectively, and regular unleaded gasoline accounted for 31.8 and 33.8% during the same periods. Premium unleaded gasoline sales represented only 8.6 and 7.8% of the total sales for 1982 and 1983, respectively.

Exposure

Gasoline is not likely to be found in drinking water except as the result of a spill or a leaking storage tank. When gasoline comes into contact with water, there is selective partitioning. The aromatic compounds tend to dissolve in the water, and the aliphatic compounds remain on the surface or evaporate into the air. Thus, those substances that remain dissolved in the water are not gasoline, as such.

When gasoline enters groundwater, such as from a leaking storage tank, it tends to remain more like the original mixture. In such a situation, the liquid migrates down to the water table and then laterally along it. Because it is confined underground, there will be only limited evaporation of the more volatile components; however, the more water-soluble compounds (aromatics) will, as with surface water, dissolve in the groundwater and may become widely distributed in the subsurface water[11] unless they are adsorbed on surfaces or on suspended matter.

Between 1974 and 1981, 13 566 petroleum fuel and oil spills in Canada were reported to the Environmental Protection Service of Environment Canada.[12] From the National Analysis of Trends in Emergencies System (NATES), there were only 1524 reported “events” (leaks) from surface and subsurface storage tanks between 1974 and 1983, and it has been estimated that during this time 29 760 tonnes or about 45 million litres of gasoline were spilled or leaked into the subsurface.[12]

Some organic constituents of gasoline have been detected in water in Canada. Only limited data are available on the levels of benzene found in Canadian drinking water supplies. Benzene was detected in 50 to 60% of potable water samples taken at 30 treatment facilities across Canada.[13] Mean concentrations ranged from 1 to 3 µg/L, and a maximum value of 48 µg/L was recorded in one instance.

In a study of 30 potable water treatment plants in Canada, analysis of the raw water showed toluene, ethylbenzene and para-xylene, and meta- and ortho-xylene to be present in 27, 14 and 7 of the 60 samples, respectively.[13,14] In both the raw and treated

water, ethylbenzene and m-xylene were found at concentrations below 0.001 mg/L, whereas the concentration of toluene was 0.002 mg/L in the treated water. In a study of Ontario drinking water, toluene and xylene were found at concentrations ranging from the detection limit of 15 ng/L to 500 ng/L.[15] When drinking water from 12 Great Lakes municipalities was analysed, toluene was detected in five areas (1.0 to 2.8 ng/L) and o- and p-xylene in seven areas (1.1 to 12.0 ng/L total). No values were given for ethylbenzene.[16]

Analytical Methods and Treatment Technology

Studies involving the determination of gasoline in water samples commonly use benzene and its alkyl derivatives (up to propylbenzene) for identification and quantitation.[3,17–19]

Because of the varying compositions of gasoline, it is necessary, for testing purposes, to have standard reference fuels. Both the American Society for Testing and Materials (ASTM) and the American Petroleum Institute (API) have such standard fuels.

Aeration has been used successfully in the treatment of potable well water contaminated by a gasoline spill.[20]

Classification and Assessment

Exposure to gasoline *per se* is unlikely to occur. Because of the complexity of gasoline and its variable composition, it is not appropriate to review any data on the health effects of exposure to gasoline in drinking water. Therefore, gasoline has not been classified on the basis of potential health effects.

Some of the constituents of interest from a health point of view (i.e., benzene, toluene, ethylbenzene, the xylenes, lead and 1,2-dichloroethane) are dealt with separately.

Rationale

People would probably not drink water if it had the taste and smell of gasoline. Such rejection of the water would take place at concentrations well below those at which there might be harmful effects. For this reason and because of the complexity of gasoline, a maximum acceptable concentration (MAC) for gasoline in drinking water has not been established.

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