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Two Contaminants Effects on Set Environment

An Assignment Submitted by

Student

Autumn 2014

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## Two Contaminants Effects on Set Environment

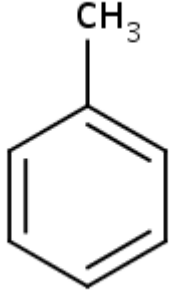
### Basic Properties and Environment Fate

Toluene is a clear, colourless liquid with a distinct smell that occurs naturally in the tolu tree and mainly in crude oil (“ToxFAQs™ for Toluene,” 2001). Although toluene is basically a useful and harmless chemical, when humans are exposed to it and when it enters the environment, it can lead to certain problems. People exposed to toluene at the workplace and through the usage of consumer products, such as paints, fingernail polish, and others, can face problems with their nervous system in the long-run. Toluene enters the environment by mixing with soil, water, and air through spills, leaking, and other ways. In the soil, toluene gets biodegraded maximally. When it mixes in the water, it rapidly volatilizes. In the air, toluene degrades readily, because “it is removed from the atmosphere mainly by reactions with atomic oxygen, peroxy or hydroxyl radicals and ozone” (“Toluene in Drinking-water,” 2004).

Chlorpyrifos is a broad-spectrum insecticide, acaricide and nematicide. (“Chlorpyrifos,” n.d.). It can be effective when it is applied, ingested, and inhaled. For humans, chlorpyrifos is moderately toxic when it is inhaled. However, when there is severe toxicity, it may cause “increased heart rate, unconsciousness, loss of control of the urine or bowels, convulsions, respiratory depression, and paralysis” (“Chlorpyrifos,” n.d.). With its primary use being insecticide, chlorpyrifos has maximal chances of entering the environment. It can enter the environment when it comes in contact with the soil during the application of insecticide for the plants or through various waste streams.

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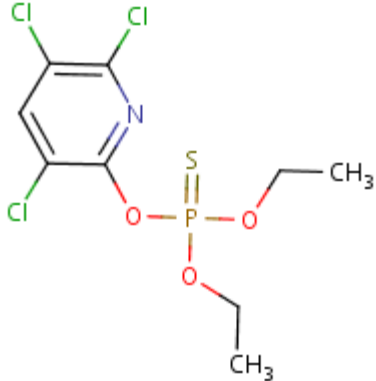
## Physical and Chemical Properties - Toluene

Common sources/uses	For manufacturing benzoic acid, benzaldehyde, explosives, dyes, detergent, and many other organic compounds; as a solvent for paints, lacquers, gums, resins, in the extraction of various principles from plants; as gasoline additive. Also used in cements, solvents, spot removers, cosmetics, antifreezes, and inks Asphalt and naphtha constituent. ("Toluene: Manufacturing/Use Information," n. d.)
Molecular structure and formula	 <p style="text-align: right;">C7-H8</p>
Colour/form	Colourless liquid
Odour	Sweet, pungent, benzene-like odour.
Boiling and melting points	110.6 deg C and -94.9 deg C
Vapour pressure	28.4 mm Hg
Vapour density	3.1 (Air=1)
Solubility in water	526 mg/l @ 25 deg C
Density/specific gravity	0.8636 @ 20 deg C/4 deg C

("Toluene: Chemical/Physical Properties," n. d.).

## Physical and Chemical Properties - Chlorpyrifos

Common sources/uses	Control foliage and soil-borne insect pests like Coleoptera, Diptera, Homoptera, and Lepidoptera on a variety of food, feed crops, food commodities, turf, and ornamental plants. ("Chlorpyrifos: Manufacturing/Use Information," n. d.).
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Molecular structure and formula	 <chem>CCOP(=S)(OCC)c1nc(Cl)c(Cl)c(Cl)n1</chem> C <sub>9</sub> -H <sub>11</sub> -Cl <sub>3</sub> -N-O <sub>3</sub> -P-S
Colour/form	White granular crystals
Odour	Mild mercaptan odour
Boiling and melting points	320 deg F and 41-42 deg C
Vapour pressure	2.02X10 <sup>-5</sup> mm Hg at 25 deg C
Vapour density	Air=1
Solubility in water	1.4 mg/L at 25 deg C
Density/specific gravity	1.398 at 43.5 deg C

(“Chlorpyrifos: Chemical/Physical Properties,” n. d.)

#### Environmental Properties - Toluene

Octanol-water partition coefficient (Kow)	log Kow= 2.73
Bio concentration factors (BCF)	13 to 90
Half life in water	4 and 56 days in aerobic and anaerobic water
Half life in atmosphere	3 days
Henry's law constant	6.64X10 <sup>-3</sup> atm-cu m/mole @ 25 deg C
Soil adsorption/mobility	Have a moderate mobility based upon Koc values in the range of 37-178
Volatilisation from soil (half life)	Several hours to 71 days
Partition coefficient for adsorption to organic carbon (Koc)	log Kow= 2.73

(“Toluene: Environmental Fate & Exposure,” n. d.)

#### Environmental Properties - Chlorpyrifos

Octanol-water partition coefficient (Kow)	log Kow = 4.96
Bio concentration factors (BCF)	58 to 1,000
Half life in water	24.5 days
Half life in atmosphere	4.2 hours
Henry's law constant	2.93X10 <sup>-6</sup> atm cu-m/mol at 20 deg C
Soil adsorption/mobility	Have low to no mobility based upon measured Koc values of 995 to 31,000
Volatilisation from soil (half life)	45-163 hours
Partition coefficient for adsorption to organic carbon (Koc)	log Kow= 2.73

(“Chlorpyrifos: Environmental Fate & Exposure,” n.d.)

The environmental fate of toluene after it is accidentally released can be tracked starting from the sandy soil. After it reaches the soil, toluene is projected to have high to moderate mobility and that is based upon the Koc values, which could be in the range of 37-178. Toluene may volatilize from both moist as well as dry soil surfaces based on its vapour pressure. Biodegradation of toluene can occur rapidly in the sandy soil, with its half-lives ranging from several hours to 71 days (“Toluene: Environmental Fate & Exposure,” n.d.). As far as chlorpyrifos is concerned, it is projected to have low to no mobility and that is based on the Koc values, which in this case is in the high ranges of 995 to 31,000. Although chlorpyrifos may volatilize from moist soil surfaces based on its vapour pressure, it is not expected to volatilize from the dry soil surfaces. On those lines, the volatilization half-life of chlorpyrifos from moist soils is in the range of 45-163 hours. Overall, the half-lives of chlorpyrifos in non-sterile soils range from 1 week to 2.5 weeks, and in the case of sterile soils, it ranges from 17 to 40 weeks (“Chlorpyrifos: Environmental Fate & Exposure,” n.d.)

Then, when toluene mixes with groundwater and water in the shallow estuarine, it is exposed to air, water, and aquatic species like fish. If toluene comes in contact with the air, because of a vapour pressure of 28.4 mm Hg at 25 deg C, it will exist solely as a vapour. Toluene in the vapour-phase will be degraded, as it will react with photochemically-produced hydroxyl radicals. The half-life for this reaction in air is estimated to be 3 days (“Toluene: Environmental Fate & Exposure,” n.d.). When chlorpyrifos is released to air, because of a vapour pressure of  $2.02 \times 10^{-5}$  mm Hg at 25 deg C, it exists both in the form of vapour-phase as well as particulate phase. Similar to toluene, the vapour-phase chlorpyrifos is degraded in the air, as it will react with photochemically-produced hydroxyl radicals, with the half-life for this process expected to

be 4.2 hours. As far as particulate-phase chlorpyrifos are concerned, it “will be removed from the atmosphere by wet or dry deposition” (“Chlorpyrifos: Environmental Fate & Exposure,” n.d.).

When toluene mixes with the water in the estuarine lake, it is “not expected to adsorb to suspended solids and sediment” (“Toluene: Environmental Fate & Exposure,” n.d.). However, in the water, biodegradation of toluene is expected to happen rapidly, “with reported half-lives of 4 and 56 days in aerobic and anaerobic water, respectively” (“Toluene: Environmental Fate & Exposure,” n. d.). The BCF for toluene are estimated to be in the values of 13 to 90. This figure indicates that bioconcentration is low to moderate, and that implies that fishes in the lake may not be affected. Once released into water, “chlorpyrifos is expected to adsorb to suspended solids and sediment based upon the K<sub>oc</sub>” (“Chlorpyrifos: Environmental Fate & Exposure,” n. d.). Due to this adsorption, the volatilization of chlorpyrifos from water surfaces is expected to be increased. So, the reported half-life of chlorpyrifos in active water would be about 24.5 days. The measured BCF values of chlorpyrifos are 58 to 1,000 and that suggests bioconcentration in aquatic organisms will be moderate to high, and so it will not affect fishes.

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