HYDRAZINE

Chemical and Physical Properties of Hydrazine

Hydrazine is a colorless, oily liquid or sometimes white crystalline compound (Hydrazine 2000; Environmental Protection Agency (EPA) 2008; Material Safety Data Sheet (MSDS) 2005). This compound is a very highly reactive base and reducing agent, having many industrial as well as military uses. The chemical structure of hydrazine is simple as illustrated below:

Some chemical and physical characteristics of Hydrazine (Hydrazine 2000; EPA 2008; MSDS 2005; Safety Data for Hydrazine 2008):

- Molecular Formula N_2H_4
- Hydrazine Synonyms: diamine, nitrogen hydride, levoxine, oxytreat 35
- Physical State and Appearance: Liquid
- Molecular weight: 32.05 g mol^-1^
- Boiling point: 113.5^{o}C (236.3^{o}F)
- Melting point: 1.4^{o}C (34.5^{o}F)
- Specific gravity: 1 (Water = 1)
- Vapor pressure: 10 mm of Hg (20^{o}C)
- Solubility: Easily soluble in cold water, hot water.
- Odor threshold: 3.7 ppm

Hydrazine is also flammable in the presence of open flames, sparks, heat, and oxidizing materials (MSDS 2005). Hydrazine is highly explosive in the presence of oxidizing materials and metals and incompatible with moisture and acids (MSDS 2005).

Uses

Hydrazine can be used in nickel plating, the removal of halogens from wastewaters, as an inhibitor to corrosion, and in photograph development (Hydrazine, 2000; Choudhary et. al 1997; EPA 2008). It has also been used in boiler water treatment, in blowing agent manufacturing for producing plastics used in vinyl flooring and auto foam cushions, in the production of agricultural chemicals such as maleic hydrazide, as a reducing agent in nuclear fuel reprocessing, and even used for medicinal purposes as a medication for sickle cell and cancer (Choudhary et. al 1997; Lunn et. al 1983; EPA, 2008). Some nitrogen fixing bacteria may create hydrazine as a by-product while some derivatives (N-methyl-N-formylhydrazine and agaritine) have been obtained from edible mushrooms (Lunn et. al 1983). Despite these few natural occurrences, hydrazine is primarily manufactured. Hydrazine is also contained in

tobacco and cigarette smoke (Liu et. al 1974; EPA 2008). According to Liu et. al, Hydrazine is contained in tobacco smoke in the form of pentafluorobenzaldehyde (1974).

Current Events

Recently, hydrazine has gained attention after the Navy announced it may attempt to shoot down a government spy-satellite containing the chemical as a fuel source and rocket propellant.

Routes of Exposure

- Eye and skin contact
- Inhalation
- Ingestion

Derivatives of Hydrazine

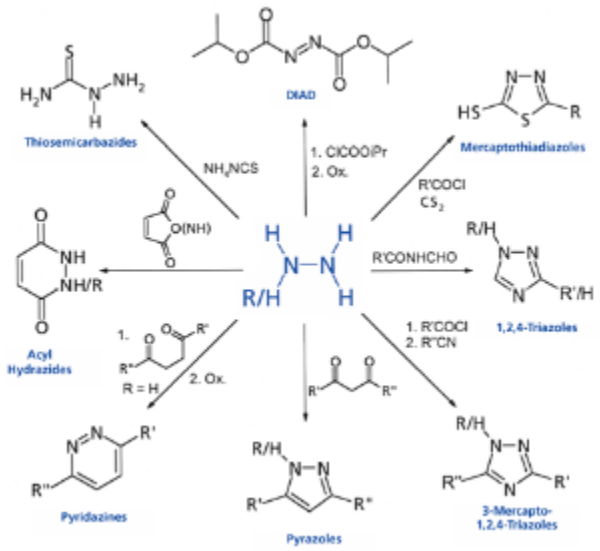

Figure: The many derivative of Hydrazine. Image taken from Novasep.com Hazardous Chemistry: Hydrazine Chemistry.

The class of hydrazines refers to three chemically similar compounds including: hydrazine (N_2H_4), 1,1-dimethylhydrazine (CH_8N), and 1,2-dimethylhydrazine ($C_2H_8N_2$) (Choudhary et. al 1997). Hydrazines are thought to be a human carcinogen with immediately dangerous levels of exposure being 50ppb (Occupational Safety & Health Administration (OSHA) 2008; EPA 2008). Hydrazines are very volatile liquids, so the risk of exposure through inhalation is of great concern. Studies show that while these compounds are similar, the toxicity of 1,1-dimethylhydrazine vapors is the greatest; 1,2-dimethylhydrazine vapors the least toxic (Choudhary et. al 1997).

Metabolism

There are several pathways involved with the metabolism of Hydrazines including both enzymatic and nonenzymatic. People with slow acetylation may accumulate more of the compound due to the decreased ability to metabolize the hydrazine. The route of exposure, while it does play an small role in the metabolism, ultimately is inconsequential with the formation of metabolites.

Using animal studies, it has been shown that hydrazine is metabolized in the liver. This metabolism is increased with an introduction of cytochrome P-450 inducers and was decreased by P-450 inhibitors. Free radicals were produced when hydrazine was metabolized including acetyl, hydroxyl, and hydrogen radicals. The occurrence of an acetyl radical indicates that acetylation of hydrazine occurs before radical formation. Data taken from this animal study indicates that hydrazine is metabolized by P-450 but may be transformed through other pathways as well. The formation of the free radicals during metabolism potentially play a part in the toxicity of hydrazine.

Source : http://www.toxipedia.org/display/toxipedia/Hydrazine