

SIDS INITIAL ASSESSMENT PROFILE

CAS No.	822-06-0
Chemical Name	1,6-Hexamethylene diisocyanate
Structural Formula	$\text{O}=\text{C}=\text{N}-(\text{CH}_2)_6-\text{N}=\text{C}=\text{O}$

RECOMMENDATIONS

This chemical is currently a candidate for further work.

SUMMARY CONCLUSIONS OF THE SIAR**Human Health**

1,6-Hexamethylene diisocyanate (HDI) has acute effects: LD50, rat (oral): 746 – 959 mg/kg bw, LC50 rat (inhalation): (0.124 mg/l) 18.2ppm/4h, LD50, rabbit (dermal): 599 mg/kg bw. The observed symptoms are indicative of respiratory tract irritation. 1,6-Hexamethylene diisocyanate is corrosive to the skin and the eye. 1,6-Hexamethylene diisocyanate was found to induce dermal and respiratory sensitization in animals and humans. There is no threshold known for this effect.

Inhalation studies with repeated exposures to 1,6-hexamethylene diisocyanate vapor show that the respiratory tract is the target with 1,6-hexamethylene diisocyanate showing primarily upper respiratory tract lesions (nasal cavity). 1,6-Hexamethylene diisocyanate did not show a neurotoxic effect in a combined reproduction/developmental/neurotoxicity study. Life-time inhalation exposure to rats revealed a progression of non-neoplastic respiratory tract lesions, primarily to the nasal cavity, and represented the sequelae of non-specific irritation. Based on the presence of only reversible tissue responses to irritation at the low concentration of 0.005 ppm, this concentration was a NOAEL. No carcinogenic potential in rats was observed after life-time inhalation.

1,6-Hexamethylene diisocyanate showed no mutagenic activity *in vitro* in bacterial and in mammalian cell test systems. 1,6-Hexamethylene diisocyanate showed no clastogenic activity *in vivo*. 1,6-Hexamethylene diisocyanate has no effect on fertility and post-natal viability through post-natal day 4 in the rat after inhalation up to 0.299 ppm. The overall NOEL was 0.005 ppm. Inhalation of 1,6-hexamethylene diisocyanate during the pregnancy of rats produced maternal effects (nasal turbinate histopathology) at concentrations ≥ 0.052 ppm. No developmental toxicity was observed up to 0.308 ppm.

Environment

HDI has a melting point of -67°C . The substance forms oily droplets in water and hydrolyses rapidly. The vapour pressure of HDI is 0.7 Pa/20 $^\circ\text{C}$. A log K_{ow} is not determinable due to the instability in water.

Hydrolysis of HDI was 90 % after a reaction period of 30 min in water at 20 $^\circ\text{C}$. Hydrolysis products are hexamethylene diamine (HDA) and polyurea. Biodegradation tests on hexamethylene diamine (HAD) show the substance to be inherently biodegradable. Polyurea is more or less inert and because of its molecular size not bioavailable. The favourite compartment for HDA is water as suggested by the high water solubility. Mackay level I distribution for HDA is not applicable as this substance is protonated under environmental pH conditions. Due to the high solubility in water of HDA (800 g/l at 15.6 $^\circ\text{C}$) and its log Kow of 0.02 no bioaccumulation is expected.

In air HDI is indirectly photodegradable with $t_{1/2} = 48.4$ h.

As the inherent property of HDI is to hydrolyse rapidly in an aquatic environment the ecotoxicological tests were conducted with the hydrolysis product(s) under defined conditions. The acute toxicity has been determined for fish (*Brachydanio rerio*) with a 96 h-LC₀ of ≥ 82.8 mg/l, for *Daphnia magna* with a 48h-EC₀ of ≥ 89.1 mg/l, and for algae (*Scenedesmus subspicatus*) a 72 h-EC₅₀ of >77.4 mg/l and a 72h-NOEC of 11.7 mg/l. A PNECaqua of 77.4 µg/l is derived from the EC₅₀-value for algae using an assessment factor of 1000. This factor is chosen because only short-term tests are available.

Exposure

The world production capacity of 1,6-Hexamethylene diisocyanate (HDI) amounts to about 110,000 t/a, thereof about 49,000 t/a are produced in the USA (2 producers), about 11,000 t/a in Japan (3 producers), and about 50,000 t/a in Western Europe (3 producers). HDI is not used as the monomer but is industrially processed to higher molecular weight compounds. These are used in industrial applications (mainly surface coatings) where especially lightfastness and weatherstability are required. Exposure to consumers cannot be excluded because there are a limited number of products that consumers can use which contain low concentrations of HDI. In certain occupational settings exposure may occur from the inappropriate use of products containing small concentrations of HDI.

NATURE OF FURTHER WORK RECOMMENDED

The chemical is an irritant and a respiratory sensitizer without a known threshold. There is a need for further work (exposure assessment) in situations where there are dispersive uses (e.g. car lacquers). SIAM was informed that it is adequately controlled during manufacture (at 8 sites) and in industrial processes.