NICNAS

Existing Chemicals Information Sheet

SODIUM HYDROXIDE

30 June 2003

Chemical Abstract Service (CAS) Number: 1310-73-2

General

Sodium hydroxide is a strong base that reacts violently with acids and is corrosive.

Background

In 2002 the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) published a list of High Volume Industrial Chemicals (HVIC) that are manufactured in and/or imported into Australia in volumes of 1000 tonnes/year or greater based on information supplied by industry. To address the increasing public demand for concise and easily accessible information on chemicals NICNAS has undertaken a program to provide information, in the most suitable format, on those chemicals on the HVIC List deemed appropriate (e.g. excluding mixtures) for which a full independent hazard assessment has not been conducted by NICNAS. Sodium hydroxide is identified as one such chemical on the HVIC List.

A literature search by NICNAS indicated sodium hydroxide had been reviewed in international review programs. Thus, an information sheet was considered the most suitable format to report data on the human health effects of sodium hydroxide. The data presented here are from secondary sources and though creditable publications, original publications have not been obtained and it has therefore not been possible to determine the robustness of the reported studies.

Data Sources

Data were obtained from the following sources:

1. OECD (Organisation for Economic Cooperation and Development) (2002) Screening Information Data Set (SIDS) Initial Assessment, Draft.
2. IPCS (International Programme of Chemical Safety) (2000) International Chemical Safety Card

Identity and Physico-Chemical Properties

Cited synonyms for sodium hydroxide are provided in Table 1.

Table 1 **Synonyms of Sodium Hydroxide**

	Sodium hydroxide
Synonyms	Synonyms Caustic Soda Sodium hydrate Soda lye Lye
Structural Formula	NaOH

Sodium hydroxide is a white and deliquescent solid. Impurities are sodium chloride (≤2%) and sodium carbonate (≤1.0%), sulphate (≤0.2%), while the concentration of other impurities is less than 0.1%. It has a melting point and boiling point of 318 and 1388ºC respectively, solidifies if the concentration is higher than 52% (by weight) at 20ºC and has a very low vapour pressure. Sodium hydroxide is a strong alkaline substance that dissociates completely in water to sodium and hydroxyl ions. The dissolution/dissociation in water is strongly exothermic (i.e. gives off heat), so a rigorous reaction occurs when it is added to water.

Import, Manufacture and Use

Sodium hydroxide is listed on the NICNAS HVIC List, with industrial use in the range of greater than 1 000 000 tonnes/year. The HVIC List contains information on the use and broad industry categories for sodium hydroxide. The specified use categories identified for sodium hydroxide are: bleaching agents; cleaning/washing agents in additives; cosmetics; laboratory chemicals; oxidising agents; pH-regulating agents; process regulators; solvents; and other uses outside the specified categories. The industry categories identified as using sodium hydroxide are: chemical industry – basic chemicals (manufacture and supply); chemical industry – chemicals used in synthesis; domestic/cleaners; leather processing; mining and metal extraction industry; and the paints and lacquers and varnishes industry.

The draft OECD SIAR reports that sodium hydroxide mainly has industrial uses, and globally these are: organic chemicals (18%); pulp and paper (18%); inorganic chemicals (15%); soaps, detergents and textile (12%); alumina (8%); water treatment (5%); and others (24%). It is also used by the drink and beer industry, to clean non-disposable bottles and for general disinfection and cleaning purposes. Sodium hydroxide (up to 100%) is also used by consumers for drain and pipe cleaning, wood treatment, to make soap, and is present in batteries and oven-cleaner pads.

Current Regulatory Status in Australia

Sodium hydroxide **is** listed in:

- the National Occupational Health and Safety Commission (NOHSC) (1995) *Exposure Standards for Atmospheric Contaminants in the Occupational Environment,* with an 8-hour time weighted average of 2 mg/m^3 that is also the peak limitation concentration (i.e. the 15 minute short term exposure limit is also 2 mg/m^3) .
- the NOHSC (1999) *List of Designated Hazardous Substances* as Corrosive and labelled with risk phrase R35; 'Causes severe burns'
- the National Drugs and Poisons Schedule Committee (May 2003) *Standard for the Uniform Scheduling of Drugs and Poisons,* as requiring child-resistant closures in addition to being in Schedule 5 (Caution) and Schedule 6 (Poison):
  - Sodium hydroxide must have child-resistant closures when it has a nominal capacity of 2.5 L or in oven, hot plate or drain cleaners (except when in pressurised spray packs) at a nominal capacity of 5 L or less
  - Schedule 5 states that sodium hydroxide must carry the signal word "CAUTION" when in preparations containing 5% or less sodium hydroxide being: solid preparation the pH of which in a 10g/L aqueous solution is more than 11.5; or liquid or semi-solid preparations the pH of which is more than 11.5
  - Schedule 6 states that sodium hydroxide must carry the signal word "POISON" *except*

when carrying the signal word “CAUTION” or in preparations containing 5% or less sodium hydroxide being: solid preparations the pH of which in a 10 g/L aqueous solution is 11.5 or less; or a liquid or semi-solid preparation the pH of which is 11.5 or less

- the FORS (1998) *Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code),* 6th edition, with separate entries for sodium hydroxide solid (UN Number 1823) and sodium hydroxide solution (UN Number 1824). Both forms are listed as Corrosive, in Class 8. The ADG Code contains detailed provisions for the packaging and marking of containers in Class 8. In addition, the entries in Appendix 2 note that both the solution and solid in the presence of moisture are corrosive to aluminium, zinc and tin. Both forms also react vigorously with acids; react with ammonium salts evolving ammonia gas; and causes severe burns to skin, eyes and mucous membranes.

It is the responsibility of manufacturers and importers who supply sodium hydroxide for use at work to determine whether it is a hazardous substance in accordance with the National Occupational Health and Safety Commission’s *Approved Criteria for Classifying Hazardous Substances (1999).* If hazardous, the manufacturer or importer has a responsibility to classify and label the substance appropriately.

Data Sources for Human Health Effects

Information on sodium hydroxide was sourced primarily from the draft OECD SIAR (2002). The SIDS program is a voluntary cooperative international testing program that began in 1989, operating under the auspices of the chemicals program within the Environment Health and Safety Division of the OECD. The program focuses on developing base level test information on approximately 600 poorly characterised international High Production Volume (HPV) chemicals. Data are used to "screen" the chemicals and set priorities for further testing or risk assessment/management activities. The OECD List of HPV chemicals serves as the overall priority list from which chemicals are selected for the SIDS program. These HPV chemicals include all chemicals reported to be produced or imported at levels greater than 1 000 tonnes per year in at least one Member country or in the European Union region, and is compiled by the OECD Secretariat on the basis of regular submissions by Member states.

Information was also sourced from the ICSC. The ICSC project is an undertaking of the International Program on Chemical Safety (IPCS). The project has been developed in the context of the cooperation between the IPCS, which in-itself is a joint activity of the United Nations Environment Programme (UNEP), the International Labour Office (ILO) and the World Health Organization (WHO), and the Commission of the European Communities. An ICSC summarizes essential health and safety information on chemicals for their use at the "shop floor" level by workers and employers in factories, agriculture, construction and other work places. An ICSC consists of a series of standard phrases, mainly summarizing health and safety information collected, verified and peer reviewed by internationally recognized experts, taking into account advice from manufacturers and Poison Control Centres.

Health and Safety Information

Sodium hydroxide can be absorbed into the body by inhalation of its aerosol and by ingestion. For dermal exposure of humans to low (non-irritating) concentrations the uptake of sodium hydroxide should be relatively low due to the low absorption of ions.

Animal Data

Acute Toxicity
The acute toxicity of sodium hydroxide depends on the physical form (solid or solution), the concentration and dose, and relates to its corrosive potential. Lethality has been seen in oral studies in animals.

Corrosivity/Irritation
Based on animal studies, concentrations of 8.0% were found to be corrosive to the skin. In eye irritation studies in rabbits, the non-irritant level was between 0.2 – 1.0%, while the corrosive concentration was 1.2% or higher.

Effects from Repeated Exposure
No reliable repeat dose toxicity studies are available in animals by the oral, dermal or inhalation routes of exposure, though it is reported that prolonged contact with the skin may cause dermatitis.

Genotoxicity
Sodium hydroxide was negative in bacterial assays (a gene mutation and DNA-repair test) and an in vivo micronucleus assay in mice. The effect seen in a chromosome aberration assay in mammalian cells in the presence of metabolic activation (S9) is considered a "false-positive' and due to S9 breakdown products induced by sodium hydroxide. Therefore, the in vitro and in vivo data suggest that sodium hydroxide does not have mutagenic activity.

Carcinogenicity
No data on carcinogenicity are presented in either of these datasets.

Reproductive Toxicity
No reliable animal studies are available for reproductive or developmental toxicity.

Human Data

Acute Toxicity
Cases of fatal ingestion, and a single case of fatality following dermal exposure, have been reported in humans. It is also reported that 'short-term' inhalation of an aerosol of sodium hydroxide may cause lung oedema.

Corrosivity/Irritation
Solid sodium hydroxide is corrosive. Depending on the concentration, solutions of sodium hydroxide are non-irritating, irritating or corrosive and cause direct local effects on the skin, eyes and gastrointestinal tracts. Based on human data, concentrations of 0.5 – 4% were irritating to skin.

Skin sensitisation
There is no evidence from a human patch test or extensive human exposure that sodium hydroxide has a skin sensitisation potential.

Carcinogenicity
No data on carcinogenicity are presented in either of these datasets.

Reproductive toxicity
The draft OECD SIAR (2002) states that under non-irritating use conditions, sodium hydroxide is not expected to be systemically available in the body and for this reason it can be stated that the substance will not reach the foetus nor the reproductive organs.

Outcome of the Draft SIDS OECD Initial Assessment (2002)
The OECD report (2002) concluded for human health that, *"No further work is recommended if sufficient control measures are in place to avoid significant human exposure, including prevention of accidental exposure."*

Overall, there are no data to indicate sodium hydroxide to be a skin sensitiser, genotoxic, carcinogenic, or a reproductive toxicant. Sodium hydroxide is a potent corrosive and the observed acute toxicity and reported dermatitis following prolonged exposure appear to be a consequence of this corrosive potential. Thus the primary health effect of sodium hydroxide is corrosivity, with local irritation observed at lower concentrations. Consequently, the risk of irritation or corrosion to humans from sodium hydroxide will depend on the amount of exposure to the chemical. Sodium hydroxide use and exposure is well regulated in Australia as the chemical is classified as corrosive, has an exposure standard set for the occupational environment and is included in the Schedule of Drugs and Poisons and the Australian Dangerous Goods Code.

References

1. FORS (Federal Office of Road Safety) (1998) Australian code for the transport of dangerous goods by road and rail (ADG Code), 6th ed. Canberra, Australian Government Publishing Service.
2. IPCS (2000) Sodium Hydroxide: International Chemical Safety Card 0360. Geneva, International Programme on Chemical Safety, World Health Organisation <http://www.inchem/org/ documents/icsc/icsc/eics0502.htm>
3. National Drugs and Poisons Schedule Committee (2003) Standard for the Uniform Scheduling of Drugs and Poisons, Canberra, ACT, Australian Government Publishing Service.
4. NOHSC (1995) Exposure standards for atmospheric contaminants in the occupational environment. Canberra, ACT, Australian Government Publishing Service.
5. NOHSC (1999) List of designated hazardous substances. Sydney, NSW, National Occupational Health and Safety commission.
6. OECD (2002) OECD Screening Information Data Set (SIDS), Initial Assessment Report, Sodium Hydroxide (Draft), Paris, OECD