# HNS MARITIME SAFETY DATA SHEET

**FILE NO.:** 010 **DATE:** 05/09/2011

# DIMETHYLAMINE

**CAS No: 124-40-3 UN No: 1032**
**F+- Extremely Flammable, T – Toxic,**
**C - Corrosive,**
**R12, R20, R37/38 R41**
**S3, S16, S26, S36/37/39**

**GAS/DISSOLVER**


## KEY POINTS

- Colourless gas with characteristic pungent and persistent odour of rotten fish.
- Extremely flammable.
- Heavier than air. Dissolves in water forming corrosive alkalis.
- Gas and solutions are toxic and corrosive.
- Reacts violently with mercury, oxidisers and acids. May be corrosive to copper and brass surfaces.
- The vapour is corrosive to the eyes, the skin and the respiratory tract. Inhalation of the substance may cause lung oedema. The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort.
- Exposure to high concentrations may be potentially **fatal.**

## HUMAN HEALTH EXPOSURE ROUTES See Section 3

- Exposure by any route may be dangerous. Secondary contamination may occur.
- Inhalation may lead to irritation and lung damage
- Dermal eposure may cause deep burns.
- Ocular exposure may lead to burns and damage.
- Ingestion may result in burns of mouth and throat

## FIRE See Section 8

- Extremely flammable.
- Leaking containers may explode
- Forms toxic gases on thermal decomposition
- Protective clothing and breathing apparatus

## ENVIRONMENT See section 11

- Does not persist and is rapidly degraded.
- Readily dissolves in water to form alkaline solution and increased pH.
- May harm aquatic organisms
- Has moderate mobility on soils
- Has a low bioaccumulation potential.

## MARITIME TRANSPORT

- Transported as liquefied gas or solutions

## REACTIVITY WITH SEA WATER

- Dissolves to form alkaline solutions.

## INCIDENT MANAGEMENT

- Alert Emergency Services.
- Non-essential personnel should move at least 100 m away from the incident.
- There may be a public safety hazard outside the immediate area of the incident (See Table 1). Consider evacuation/shelter and set up of emergency rest centres for evacuees.
- Initiate real-time ambient monitoring, for use with meteorological and marine forecasts.
- Emergency department staff treating chemically contaminated casualties should be equipped with approved, gas-tight decontamination suits and breathing apparatus. Ventillate enclosed spaces.
- Secondary contamination unlikely from exposure to gas but may occur from solutions.
- Decontamination run-off should be prevented from entering drains and watercourses. Gas may accumulate in sewers and voids.
- Risk Communication strategy to advise members of the public on evacuation/sheltering
- Post-incident epedemiology / follow-up. Medical referrals.
- Effect biomarkers of dimethylamine exposure are limited to possible measurement in urine.

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**GAS/DISSOLVER**

## HUMAN HEALTH CONSIDERATIONS – See Section 3 to 6

### ERG 2008 Table 1: Initial isolation and protective action distances

| Chemical Name | Spill Size | Definition | Isolation Zone in all directions | DownWind Protection Zone | |
|---|---|---|---|---|---|
| | | | | Day | Night |
| Dimethylamine | Raw Gas | Flammable Gas | 100 | 800 | 1600 All directions |
| | Aqueous Solution | Flammable Liquid | 50 | 800 | 800 All directions |

**Isolation Distance:** All personnel to be directed in a cross wind direction this distance from the spill

**Protective Action Zone:** A square area down wind of the spill where protective action should be considered, starting with nearest receptors and working away from spill.

**Such estimates should always be regarded with reservations and never be alternatives for monitoring.**

### Acute Health Hazards (Aliphatic Amines)

| ppm | mg $m^{-3}$ | Signs and symptoms |
|---|---|---|
| 0.01-20 | 0.018 – 36 | Fishlike odor (tolerance develops) >100 ppm Odor becomes ammoniacal |
| 5-25 | 10 - 50 | Slight visual disturbances |
| 10-100 | 18 - 180 | Transient mucous membrane irritation |
| >50-500 | 90 - 900 | Marked irritation of skin, eyes, upper respiratory tract with conjunctivitis, sore throat, coughing |

### Monitoring Strategy (Short & Long Term) & Equipment – See Section 6

| | |
|---|---|
| **Health and Safety** | **Air** - Real-time photionisation detection or quantitative colour change tubes (eg. Draeger). Monitors **MUST be intrinsically safe / ATEX compliant**. Monitor Oxygen in confined spaces |
| **Environmental** | Atmospheric fate and transport e.g. Aloha (immediate risk / first response), Calpuff (longer term) |
| **Public Health** | GP referrals, hospital admissions – numbers, symptomology, follow-up studies. (See Biomarkers) |

## OPERATIONAL EMERGENCY RESPONSE – See Sections 8 & 9

| | |
|---|---|
| **Fire fighting measures** | Use fine water spray for gas clouds. Use water to cool tanks, cylinders etc. Use $CO_2$ or foam against small fires. May form toxic gases during combustion - Nitrogen Oxides |
| **Decontamination of responders** | Decontamination should be performed using local protocols in designated areas with adequate ventilation. Water should be contained & disposed of at appropriate waste facility. |
| **Response & Clean up** | Decontamination run-off should be prevented from entering drains and watercourses.Ventilate confined spaces. Absorb liquids and dispose accordingly. |
| **Waste Management** | Dispose as hazardous waste. Gas is non persistent. Solutions will be biodegraded in the environment. Controlled incineration is suitable for contaminated materials. |

## EMERGENCY CONTACTS

| ORGANISATION | TELEPHONE |
|---|---|
| **FIRE, AMBULANCE, POLICE** | **999** |
| **HEALTH PROTECTION AGENCY: Chemical Hazards Unit** | **08448 920555** |
| **ENVIRONMENT AGENCY: 24/7 Pollution** | **0800 807060** |

# Summary Page

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**R12, R20, R37/38 R41**
**S3, S16, S26, S36/37/39**


## SECTION 1: IDENTIFICATION

| | | | | | |
|---|---|---|---|---|---|
| **NAME:** | **Dimethylamine** | | **CHEMICAL FORMULA:** | **$C_2H_7N$** | |
| **SYNONYMS:** | **N-Methyl methanamine** | | | | |
| **CAS No:** | **124-40-3** | **UN No:** | **1032** | **EINECS :** | **204-697-4** |

| | |
|---|---|
| **CLASSIFICATIONS** | **T** – Toxic, **Xn** – Harmful, **F+** – Extremely Flammable, **C -** Corrosive |
| **RISK PHRASES** | **R12** Extremely Flammable<br>**R20** Harmful by inhalation<br>**R37/38** Irritating to respiratory system and skin<br>**R41** Risk of serious damage to eyes |
| **SAFETY PHRASES** | **S3** Keep in a cool place<br>**S16** Keep away from sources of ignition No Smoking<br>**S26** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.<br>**S29** Do not empty into drains.<br>**S36/37/39** Wear suitable protective clothing, gloves and eye/face protection |

**USES:**

Dimethylamine is used as reactive intermediate organic nitrogen in the synthesis of various organics chemicals (pharmaceutical, agriculture, dye, rubber and explosive or propellant compounds).

Trade statistics 2007 for methylamines indicate annual UK import and export in the order of 15,000 tonnes. Typically transported as liquefied gas or aqueous solution.

## SECTION 2: PHYSICAL CHEMICAL PROPERTIES

| | | | |
|---|---|---|---|
| **SEBC CLASSIFICATION** | **G D GAS DISSOLVER** | **BOILING POINT** | $7^oC$ |
| **APPEARANCE** | Colourless gas | **VAPOUR PRESSURE** | 170 kPa at 20 °C |
| **ODOUR** | Rotten Fish | **SPECIFIC GRAVITY**(air = 1): | 1.55 at 21 °C |
| **FLAMMABILITY** | Extremely Flammable | **SOLUBILITY IN WATER** | 23.7 g/l at 20 °C |
| **STABILITY & REACTIVITY** | May react violently with oxidants. May react violently with acids. Reacts with water to form corrosive alkalis. Reacts violently with mercury.<br>Corrosive to aluminium, brass and copper. Attacks plastics and rubber. Reacts with hypochlorites to form chloramines, which may be explosive.<br>Emits toxic fumes of Carbon monoxide and Nitric oxide/nitrogen dioxide when heated to decomposition | | |

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## SECTION 3: HUMAN HEALTH HAZARDS

Following exposure to any chemical, the adverse health effects you may encounter depend on several factors, including the amount to which you are exposed (dose), the way you are exposed, the duration of exposure, the form of the chemical and if you were exposed to any other chemicals.

**ROUTES OF ENTRY:** Exposure by any route may be dangerous. Inhalation and ocular exposure are most likely due to its gaseous nature. The substance can be absorbed through the skin.

**POTENTIAL HEALTH EFFECTS**

| | |
|---|---|
| **INHALATION** | Inhalation may result in Abdominal pain. Burning sensation. Cough. Diarrhoea. Laboured breathing. Shortness of breath. Sore throat. |
| **EYES** | Ocular exposure contact may result in redness, pain, blurred vision, severe deep burns |
| **SKIN** | Dermal exposure may result in redness and burns. |
| **INGESTION** | Ingestion of solutions may cause immediate burning of the mouth and throat, drooling, difficulty swallowing with retrosternal and abdominal pain. Strong alkalis may damage the oesophagus more than the stomach with ulceration, perforation and mediastinitis. |

**ACUTE HEALTH HAZARDS:** The vapour is corrosive to the eyes, the skin and the respiratory tract. Inhalation of the substance may cause lung oedema. The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort.

| ppm | mg $m^{-3}$ | Signs and symptoms (aliphatic amines) |
|---|---|---|
| 0.01-20 | 0.018 – 36 | Fishlike odor (tolerance develops) |
| 5-25 | 10 - 50 | Slight visual disturbances |
| 10-100 | 18 - 180 | Transient mucous membrane irritation |
| 100-200 | 180 – 360 | Odor becomes ammoniacal |
| >50-500 | 90 - 900 | Marked irritation of skin, eyes, upper respiratory tract with conjunctivitis, sore throat, coughing |

**CHRONIC HEALTH HAZARDS:** Prolonged exposure of skin may lead to dermatitis and conjunctivitis.

**CARCINOGENICITY:** Non Carcinogen. No reported reproductive or teratogenic effects.

May potentially be metabolised to dimethylnitrosamine, a potential human carcinogen, although evidence for this is limited.

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## SECTION 4: EXPOSURE GUIDELINES AND STANDARDS

**ODOUR THRESHOLD**: 0.012 – 1.6 ppm (0.02 – 2.9 $mgm^{-3}$)

**TASTE THRESHOLD:** -

**EU AIR QUALITY GUIDELINE:** No guideline value specified
(UK EAL – short term 1100 $ugm^{-3}$, long term 38 $ugm^{-3}$)

**DRINKING WATER QUALITY GUIDELINE** - (dimthylnitrosamine WHO guideline 0.1 ug/l)
*(UK DWI 2000)*

**WORKPLACE EXPOSURE LIMITS**
*(UK Health and Safety Executive)*
2 ppm (3.8 mg $m^{-3}$) (8 hour reference period)
6 ppm (11 mg $m^{-3}$) (15 min reference period)

**EMERGENCY RESPONSE PLANNING GUIDELINE (ERPG) VALUES**
(American Industrial Hygiene Association)

| | Listed value (ppm) | Calculated value (mg $m^{-3}$) |
|---|---|---|
| **ERPG-1*** | 0.6 | 1.1 |
| **ERPG-2*** | 100 | 180 |
| **ERPG-3*** | 350 | 630 |

* *Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving objectionable odour.*

** *Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.*

*** *Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.*

**ACUTE EXPOSURE GUIDELINE LEVELS (AEGLs)** (U.S. Environmental Protection Agency)

| | ppm | | | | |
|---|---|---|---|---|---|
| | **10 min** | **30 min** | **60 min** | **4 hr** | **8 hr** |
| **AEGL-1†** | 10 | 10 | 10 | 10 | 10 |
| **AEGL-2††** | 130 | 85 | 66 | 40 | 32 |
| **AEGL-3†††** | 480 | 320 | 250 | 150 | 120 |

*†* *The level of the chemical in air at or above which the general population could experience notable discomfort.*

*††* *The level of the chemical in air at or above which there may be irreversible or other serious longlastingeffects or impaired ability to escape.*

*†††* *The level of the chemical in air at or above which the general population could experience lifethreatening health effects or death.*

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## SECTION 5: EXPOSURE CONTROLS / PERSONAL PROTECTION

**CONTROLS:**

- - Use fine water spray.
- - Spillages and decontamination run-off should be prevented from entering sensitive watercourses.

**PERSONAL PROTECTIVE EQUIPMENT**

| | |
|---|---|
| **EMERGENCY ACTION CODE** | EAC 2PE or l2WE for solution |
| **RESPIRATORY PROTECTION** | to 100 ppm - Full face canister respirator APF = 50 *(BS EN 137)* or self contained breathing apparatus. Otherwise full face self contained or air fed breathing apparatus APF = 10, |
| **EYE PROTECTION** | Full face respirator. |
| **SKIN PROTECTION** | Liquid-tight chemical protective clothing *(BS 8428)* |
| **EMERGENCY RESPONDERS** | Ambulance staff, paramedics and emergency department staff treating chemically contaminated casualties should be equipped with approved, gas-tight decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate with breathing apparatus*(BS EN 137).* |
| **OTHER PROTECTIVE CLOTHING OR EQUIPMENT** | **APP A(fg)** Flammable gas or APP A(fl) Flammable liquid for solutions |

**WORK HYGIENIC PRACTICES:**

Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation.

**DECONTAMINATION OF RESPONDERS**:

Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation. Wash skin with water for at least 20 minutes. Secondary contamination is possible.

**NON ESSENTIAL PERSONNEL / PUBLIC**

There may be a public safety hazard outside the immediate area of the incident. People should stay indoors with windows and doors closed, ignition sources should be eliminated and ventilation stopped. Non-essential personnel should move at least 100 m away from the incident (50 m for dimethylamine solutions).

Risk communication via news media as well as internet / telephone advice lines should be initiated to inform local residents / public based upon forecast data or Table 1 estimates.

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## SECTION 6: MONITORING AND DETECTION

### HEALTH AND SAFETY

- Use real-time gas sensors (Photoionisation detector) and / or quantitative colour change tubes such as Draeger tubes.
  **Monitors MUST be intrinsically safe / ATEX compliant.**
- Note PID is non compound specific so will detect other volatile contaminants in addition to dimethylamine.
- Heavier than air so may accumulate in poorly ventilated areas, voids and other confined spaces. Monitor for asphyxiant (oxygen depletion) and toxic / expolsive atmospheres before entering confined spaces.
- Use colorimetric quantitative kits or electrochemical probes for aqueous liquids.

### ENVIRONMENTAL HEALTH

- Degrades in the atmosphere and is biodegraded in soil and water environments.
- Fire and explosion may lead to particulates and toxic gases, principally nitrogen oxides.
- Use monitoring data, marine and meteorological data to predict gas cloud / smoke plume movement using appropriate modeling software e.g. Aloha (immediate risk / first response), CALPUFF (longer term).

| Chemical Name | Spill Size | Definition | Isolation Zone in all directions | DownWind Protection Zone | |
|---|---|---|---|---|---|
| | | | | Day | Night |
| **Dimethylamine** | **Raw Gas** | Flammable Gas. | 100 | 800 | 1600<br>All directions |
| | **Aqueous Solution** | Flammable Liquid. | 50 | 800 | 800<br>All directions |

**Isolation Distance:** All personnel to be directed in a cross wind direction this distance from the spill

**Protective Action Zone:** A square area down wind of the spill where protective action should be considered, starting with nearest receptors and working away from spill.

**Such estimates should always be regarded with reservations and never be alternatives for monitoring.**

### PUBLIC HEALTH FOLLOW-UP & EPIDEMIOLOGY

- Collate GP referrals, hospital admissions – numbers, symptomology, age, sex, pre-existing conditions
- Effect biomarkers of exposure are limited to possibly increase in dimethylamine in urine.
- Dimethylamine may be metabolised to dimethylnitrosamine although evidence is uncertain.
- Follow-up studies where public health may have been impacted (see chronic effects Section 3)

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## SECTION 7: FIRST AID MEASURES

**Important Notes**
Ambulance staff, paramedics and emergency department staff treating chemicallycontaminated casualties should be equipped with Department of Health approved, gas-tight decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate.

Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation. Water should be contained and disposed of at an appropriate waste facility.

Dimethylamine is a volatile gas and secondary contamination from patients only exposed to the gas is very unlikely. In contrast persons exposed to liquefied gas or solutions of the gas may pose secondary contamination risks from off-gassing, particularly if clothing has been contaminated. In this case patients should be decontaminated at the scene and clothing bagged and washed or disposed of. Clothing will be flammable risk.

**Inhalation**
- Remove patient from exposure.
- Ensure a clear airway and adequate ventilation.
- Give oxygen to patients with respiratory symptoms.
- Where the face is contaminated DO NOT attempt expired air resuscitation unless an airway with rescuer protection is used.
- Apply other supportive measures as indicated by the patient's clinical condition.
- Apply systematic management for serious exposure.

**Dermal exposure**
- Remove patient from exposure.
- The patient should remove all clothing and personal effects.
- Double-bag soiled clothing and place in a sealed container clearly labelled and away from personel.
- Wash with copious amounts of water.
- Decontaminate open wounds first and avoid contamination of unexposed skin.
- Pay special attention to skin folds, axillae, ears, fingernails, genital areas and feet.
- An emollient may be needed to treat burns, which usually heal within 21 days.
- Apply systematic management for serious exposure.

**Ocular exposure**
- Remove patient from exposure.
- Irrigate thoroughly with saline for at least 30 minutes
- Apply systematic management for serious exposure.

**Systemic Management**
- Symptomatic and supportive care
- Apply other measures as indicated by the patient's clinical condition.

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## SECTION 8: FIRE FIGHTING MEASURES

Incompatible with strong oxidising substances and acids, reacts violently with mercury, attacks some plastics, rubbers and coatings. Corrosive to copper brass, aluminium and galvanised surfaces.

**FLAMMABILITY:** Extremely flammable

**LOWER EXPLOSIVE LIMIT:** 2.8%

**UPPER EXPLOSIVE LIMIT:** 14.4%

**EXTINGUISHING MEDIA:** Small fire – any extinguishing media. Large fires - water spray or foam.

**SPECIAL FIRE FIGHTING PROCEDURES:** Prevent spillages and decontamination run-off entering drains.

**HAZARDOUS DECOMPOSITION PRODUCTS:** Reacts with water to form alkaline solutions.

Emits toxic fumes of carbon monoxide and oxides of nitrogen when heated to decomposition

## SECTION 9: RECOVERY RESPONSE AND CLEAN-UP

**Special precautions: Incompatible with strong oxidising substances and acids, reacts violently with mercury, attacks some plastics, rubbers and coatings. Corrosive to aluminium, brass, copper and galvanised surfaces.**

| INCIDENT MANAGEMENT& RESPONSE |
|---|
| • Use fine water spray to control migration of vapors.<br>• Avoid run-off entering sensitive water-courses.<br>• There may be a public safety hazard outside the immediate area of the incident. People should stay indoors with windows and doors closed, ignition sources should be eliminated and ventilation stopped.<br>• Non-essential personnel should move at least 100 m away from the incident. |
| **CLEAN-UP/RECOVERY** |
| • Aqueous solutions may be able to be contained and collected.<br>• Dimethylamine is volatile and highly soluble in water. It will not persist in the environment or bioaccumulate.<br>• Dissolves in water to form alkaline solutions. |

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## SECTION 10: WASTE DISPOSAL

**WASTE CATALOGUE CLASSIFICATION :** Hazardous Waste H3, H6, H7, H8

| | |
|---|---|
| **WASTE DISPOSAL METHOD** | Dimethylamine is volatile and non persistent. Dissolves in water to form basic solutions. |
| **ENVIRONMENTAL** | Dimethylamine is volatile and non persistent. Dissolves in water to form basic solutions. Decontamination run-off and extinguishing materials should be prevented from entering drains and watercourses. |
| **PATIENT CLOTHING** | Double-bag soiled clothing and place in a sealed container clearly labelled and stored in well ventilated area prior to disposal. |

**Handling & Storage:** Store below 50°C in a well ventilated place. Segregate from oxidant gases and other oxidants. Purge air from system before introducing gas. Suck back of water into the container must be prevented. Take precautionary measures against static discharge. Do not allow backfeed into the container. Keep away from ignition sources (including static discharges).

**Transport Information:** IMDG Class 2.1. Packing Instruction P200, EmS FD,SU.
ADR / RID Regulations Class 2 Classification Code 2F. P200 B/D Tank carriage: Passage forbidden through tunnels of category B, C, D and E; Other carriage: Passage forbidden through tunnels of category D and E. IATA Class 2.1. P200

## SECTION 11: ECOLOGICAL INFORMATION

**Toxicity Data:** Dimethylamine does not persist in the environment. It will degrade in the atmosphere, with a half-life of about 6 hours. In water dimethylamine is very soluble and will raise pH forming basic solutions. It will adsorb to particles in water and will degrade over several days. In soil dimethylamine has moderate mobility and will adsorb to solid particles. Dimethylamine has low bioaccumulation potential. Dimethylamine will biodegrade in soils with a half-life of days.

| **ACUTE TOXICITY** | | | | | | |
|---|---|---|---|---|---|---|
| **Species** | **Age/Size** | **Bioassay conditions/analysed parameters** | | | | **Reference** |
| | | **Temperature (°C)** | **Salinity ‰** | **LC50 -48h** | **LC50 96h** | |
| Daphnia magna (Water flea) | - | - | 0 | - | 46 mg/L | Toxnet HSDB |
| Poecilia reticulata (Guppy) | - | - | 0 | - | 210 mg/L | |
| Oncorhynchus mykiss (Rainbow trout) | - | - | 0 | - | 20 mg/L | |

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## SECTION 12: CASE STUDY – MARITIME INCIDENT

No specific incidents recorded for dimethylamine, but several minor spills and leaks of amines reported in UK waters by MCGA. Details of impacts unknown. One larger incident involving amines is reported for the *Sam Houston* in the Gulf of Mexico in 1982. Again details of impact are not known.

## SECTION 13: CASE STUDY – REPORTED PUBLIC HEALTH EFFECTS

No reported studies for maritime incidents.

Again no specific incidents for dimethylamine but several land based incidents for amines in general.

Train Derailment near Dunsmuir, California, July 14 involving 19,000 gallons of metam sodium spilled into the Sacramento River. Reacted with water forming methylamine, methylisothiocyanate and hydrogen sulfide, all released as a gas cloud with reported odor and burning eyes over several miles. A review of emergency room records between July 15 and July 31 found a total of 252 visits, compared to 8 visits the first three weeks of August. The most common symptoms that occurred were nausea (51%), headache (44%), eye irritation (40%), throat irritation (26%), dizziness (23%), vomiting (22%), and shortness of breath (21%).In addition, workers who were brought in to clean up the spill in and near the river on July 21 and 22 developed unusual skin rashes on the feet and ankles. Later studies indicated residents affected by the spill showing a range of psychosocial impacts (Committee on Government Operations of the House of Representatives, One Hundred and Second Congress, First Session, October 3, 1991, Washington, DC: U.S. Government Printing Office, 1992.)

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## SECTION 14: SOURCES OF FURTHER INFORMATION

| | |
|---|---|
| **Emergency Response Guidebook** | http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/ergmenu.aspx |
| **TOXNET Hazardous Substances Database** | http://toxnet.nlm.nih.gov/ |
| **NIOSH** | http://www.cdc.gov/niosh/npg/npgd0219.html |
| **CAMEO** | http://cameochemicals.noaa.gov/ |
| **ALOHA** | http://www.epa.gov/osweroe1/content/cameo/aloha.htm |
| **CEDRE** | http://www.cedre.fr/index-en.php |
| **ARCOPOL** | http://www.arcopol.eu/home.aspx |
| **EMSA** | http://www.emsa.europa.eu/ |
| **Storage** | http://encyclopedia.airliquide.com/Encyclopedia.asp?GasID=2#MSDS |