File No: NA/563

March 1998

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

Difluoromethane

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Director
Chemicals Notification and Assessment

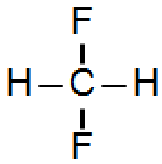
ASSESSMENT REPORT

Difluoromethane

1. APPLICANT

Actrol Parts, a division of GSA Industries (Aust.) Pty. Ltd. of 19 King St BLACKBURN VIC 3130, has submitted a standard notification statement with their application for an assessment certificate for difluoromethane. The applicant has not claimed confidentiality for any part of the assessment and the information herein is available as the full public report in its entirety.

2. IDENTITY OF THE CHEMICAL

Chemical name:	difluoromethane
Chemical Abstracts Service (CAS) Registry No.:	75-10-5
Other name:	methylene fluoride
Trade name:	HFC-32 R-32 R410A: Genetron AZ-20 (blend) R407C: Genetron 407C (blend) Forane 407C Solkane 407C HFA32
Molecular formula:	CF_2H_2
Structural formula:	 $H-\overset{\displaystyle F}{\underset{\displaystyle F}{C}}-H$
Molecular weight:	52
Method of Detection: and Determination	infrared data (IR) were provided for difluoromethane (see below)
Spectral data:	IR; absorption peaks occurred at 3 039, 3 010, 2 946, 1 453 and 1 100 cm^{-1}

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa:	colourless gas with faint ethereal odour.
Boiling Point:	-51.7°C
Vapour Density:	1.8 (air = 1) at 25°C and 101.3 kPa
Vapour Pressure:	1.52×10^3 kPa at 21.1°C 3.48×10^3 kPa at 54.4°C
Water Solubility:	4.4 g/L at 25°C
Hydrolysis:	does not hydrolyse
Partition Co-efficient (n-octanol/water) log P_{ow}:	0.21 at 25°C
Adsorption/Desorption:	not measured, gas
Dissociation Constant:	no dissociable groups
Fat Solubility:	not provided
Flash Point:	not determined
Flammability Limits:	L.E.L. = 13.6% by volume in air U.E.L. = 32.2% by volume in air
Combustion Products	hydrofluoric acid, carbonyl fluoride and carbon oxides
Decomposition Temperature :	not provided
Autoignition Temperature	530°C
Reactivity/Stability:	pure gas release may result in explosive air mixtures, violent reactions occur with alkali or alkaline earth metals including powdered aluminium, zinc, beryllium, sodium, potassium, barium and calcium
Atmospheric Lifetime:	7.7 years
Global Warming Potential:	650 for 100 year time horizon (1)

Comments on Physico-Chemical Properties

Hydrolysis is not expected to be a significant degradation pathway as the chemical is a stable gas containing no groups which are generally considered to be hydrolysable.
Significant sorption to soil of the notified chemical is not expected as it is a gas with a low octanol/water partition coefficient.

Explanation of particular data:

The "atmospheric lifetime" is defined as the time necessary for 63% degradation; it is equal to the "half-life" divided by ln2 (= 0.69) (2). These type of gases are slowly destroyed in the stratosphere by sunlight (photodegradation).

The extent to which a greenhouse gas contributes to global warming depends on the volume emitted, the length of time which elapses before it is purged from the atmosphere and the infrared energy absorption properties of the gas. An index termed the Global Warming Potential (GWP) has been developed which provides a simplified means of describing the relative ability of each greenhouse gas emission to affect global climate change. It is the ratio of the warming caused by a substance to the warming caused by CO_2 (on a molecule per molecule basis) to allow a common basis for comparing impacts (3). Thus, with the GWP of CO_2 defined as one, difluoromethane has 650 times the GWP of CO_2 over a 100 year time horizon.

4. PURITY OF THE CHEMICAL

Degree of Purity: ≥99.8%

Toxic or Hazardous Impurities:

Chemical name: chlorodifluoromethane
CAS No.: 75-45-6
Weight percentage: < 0.2%
Toxic properties: cardiac sensitisation (4)

Chemical name: dichlorodifluoromethane
CAS No.: 75-71-8
Weight percentage: < 0.2%
Toxic properties: cardiac sensitisation (4)

Chemical name: chloromethane or methyl chloride
CAS No.: 74-87-3
Weight percentage: < 0.2%
Toxic properties: kidney, liver damage and central nervous system effects (5)

Chemical name: dichlorofluoromethane
CAS No.: 75-43-4
Weight percentage: < 0.2%
Toxic properties: cardiac sensitisation (6)

Non-hazardous Impurities (> 1% by weight): nil

Additives/Adjuvants: (see below).

5. USE, VOLUME AND FORMULATION

Difluoromethane is a refrigerant gas which will be imported for use in low temperature refrigeration units such as supermarket freezers, air conditioning units and industrial cooling processes. It has a zero ozone depleting potential and is being introduced to replace ozone depleting chlorofluorocarbons (CFCs), in particular R-22, difluorochloromethane. The notified chemical will be imported, only in blended product forms with other refrigerants, including pentafluoroethane and tetrafluoroethane. It will be sold to equipment manufacturers and service contractors as the blends R410A and R407C (see below).

R410A contains:
50 wt.% Difluoromethane
50 wt.% Pentafluoroethane

R407C contains:
23 wt.% Difluoromethane
77 wt.% Pentafluoroethane and Tetrafluoroethane

The import volume of the notified chemical is estimated to be approximately 30 tonnes per year over the next five years.

It is not anticipated that difluoromethane will be manufactured in Australia, however, reformulation could possibly occur as a result of reblending recovered blends containing difluoromethane.

6. OCCUPATIONAL EXPOSURE

Difluoromethane (as a component of the imported gas blends) will be shipped into Australia in liquefied form in 1 tonne pressurised tanks. These containers will be taken to warehouses from the dockside for storage. For 2 to 3 hours/day on approximately 10 days/year 2 to 5 dockside workers and 5 to 15 transport personnel may be exposed to the notified gas, if it is released accidentally. At the warehouse, the gas is decanted into smaller cylinders from 12 to 65 kg for transport to the sites where the gas will be used. The duration of this work would involve 6 to 10 store workers for up to 12 days/year. The transferral is undertaken using a closed pipe system. However there is the potential for minor losses of gas to occur when connections are made and broken when decanting and during charging and servicing of refrigeration units.

Refrigeration mechanics will drain obsolete refrigerants from existing systems and recharge with the new refrigerant containing difluoromethane or in the case of new systems simply charge the systems with R410A or R407C. Charging is performed using a closed piping system which involves connecting the cylinder to the refrigeration unit via a flexible hose and allowing the gas to flow into the unit until the desired pressure is attained. The hose has an automatic shut-off valve which minimises gas release following charging. The number of service personnel, including refrigeration mechanics Australia wide using difluoromethane blends may be as high as fifteen hundred each year.

Service personnel may be exposed to difluoromethane during routine maintenance of the refrigeration units. Exposure to difluoromethane may occur through accidents when the cylinder is badly damaged, or through minor leaks from seals and gaskets in the system. Most accidental exposure will be to the gaseous form of difluoromethane, but liquid contact will also be possible. Exposure to difluoromethane may occur during the transfer of gas between containers and during the charging and maintenance of refrigeration units. It is estimated that during decanting of bulk cylinders approximately 0.05% (15 kg) of refrigerant will be lost and that during charging and recharging of refrigeration units approximately 0.01% (3 kg) will be lost. The notifier expects direct exposure to difluoromethane will be minimal as refrigeration mechanics and service personnel follow the refrigeration industry's Code of Good Practice which aims to minimise gas release (7).

The blending of difluoromethane with tetrafluoroethane and/or pentafluoroethane suppresses the flammable explosive properties of difluoromethane on its own. Consequently the use of blended difluoromethane with electrical machinery, for example, refrigerators and air conditioners, is much safer. There is however, the potential, through large scale accidental leakage for explosions to occur. This happened in Germany in 1994 at a Hoechst production facility for HFC-134a (8). Before this event HFC-134a had been considered safe and completely inflammable in normal circumstances. Carbon containing gas mixtures should never be considered completely inflammable; the potential for explosive mixtures to be spark ignited should not be overlooked.

7. PUBLIC EXPOSURE

The public will not be exposed to the notified chemical during the handling of the refrigerant. The refrigerant blends will be used in commercial refrigeration units, such as supermarket freezers, air conditioning units and industrial cooling units. Public exposure may occur as a result of slow leaks from refrigerant units; however, such releases are minimised by good work practices according to the Australian Refrigeration and Air Conditioning Code of Good Practice (7).

Public exposure may occur from a spill during transport. In the event of a spill the MSDS advises the affected area be cleared of all personnel who should be aware of the danger of frost bite and avoid contact. If the spill is major, the liquid should be contained with sand or soil and allowed to evaporate. Ventilation should be increased to the area to avoid asphyxiation and the formation of explosive mixtures.

8. ENVIRONMENTAL EXPOSURE

Release

The notified chemical will not enter the environment intentionally when used in cooling systems, but any releases during filling or use of cooling systems, or following disposal of obsolete equipment or recovery of refrigerants therefrom, will rapidly volatilise to the atmosphere. It is not possible to estimate how much of the refrigerant might be released in this way, but the notifiers indicate that quantities involved will be small. During decant of bulk cylinders it is estimated that approximately 0.05% (15 kg) of refrigerant will be lost per annum. Charging and discharging of refrigeration units is expected to lead to the release of 0.01% (3 kg) per annum. Fugitive emissions are expected to account for less than 10% of the working charge per annum. Industry sources in the United States, however, have argued that leakage from commercial air conditioning units amounts to 22 to 25% annually despite similar codes of practice (9). The new blends area expensive, providing a financial incentive to minimise losses and install area monitors around large installations.

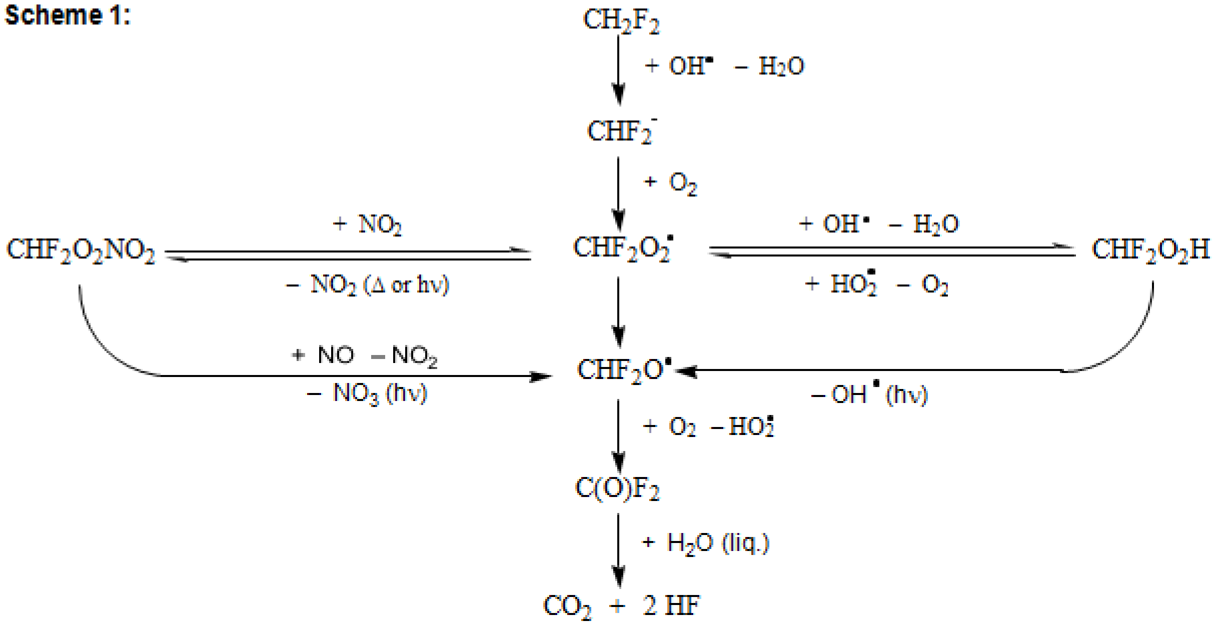
The Australian Refrigeration and Air Conditioning Code of Good Practice (7) requires that releases of ozone depleting refrigerants to the atmosphere during manufacturing, installation or servicing operations be reduced to the minimum level by re-use of refrigerant recovered. Recovery of refrigerant is required from performance testing during development and production. Refrigerant must be recovered in dedicated cylinders, identified by valving, labelling and colour coding. Where contaminated refrigerants are stored, they must be labelled to indicate the contents. The Code is referred to by legislation in all States.

Recovery, reclamation and recycling of refrigerants is preferred to disposal. For disposal, the Code requires that unusable or surplus refrigerant not be discharged to the atmosphere, but be returned to the supplier or stored in a cool shaded place pending disposal. Reprocessing will not occur in Australia as such activities require a production facility. Local disposal will also not occur as acceptable disposal facilities do not exist currently in Australia.

Fate

Given its high volatility, any difluoromethane released to the environment will partition almost entirely to the atmosphere. Level 1 Mackay calculations for difluoromethane indicate that at equilibrium approximately 0.01%, 0%, 0% and 99.9% will be partitioned to soil, sediment, water and air, respectively. Any traces entering water would not be expected to undergo biodegradation at significant rates as degradation by activated sludge in a closed bottle test (OECD Test Guideline 301D) was minimal (28-day biological oxygen demand 5% of theoretical). The main degradation pathway in the environment is reaction with tropospheric hydroxyl radicals, which abstract hydrogen (Scheme 1 (2)) which lead through a series of radical reactions to carbonyl fluoride ($C(O)F_2$).

Scheme 1:



Analogous experiments (10) with chlorine radicals, more readily generated in the laboratory than hydroxyl radicals, indicated that both difluoromethane and chlorodifluoromethane (R-22) degrade to carbonyl fluoride. The estimated atmospheric lifetime is 7.7 years (11). It is expected that the generated carbonyl fluoride will be removed from the atmosphere by uptake into clouds, rain and the oceans where it will rapidly hydrolyse to carbon dioxide (CO_2) and hydrofluoric acid (HF).

9. EVALUATION OF TOXICOLOGICAL DATA

9.1 Inhalation Toxicity

Summary of the inhalation toxicity of difluoromethane

Test	*Species*	*Outcome*	*Reference*
acute inhalation toxicity	rat	LD_{50} > 520 000 ppm	(12)
28-day repeat dose inhalation toxicity	rat	LD_{50} > 49 500 ppm	(13)
90-day repeat dose inhalation toxicity	rat	LD_{50} > 49 100 ppm	(14)

Note: because of the gaseous nature of difluoromethane at normal temperature and pressure many standard toxicity tests do not apply

9.1 Inhalation Toxicity

9.1.1 Acute Inhalation Toxicity (12)

Species/strain:	rat/Wistar
Number/sex of animals:	5/sex in 4 groups
Dose	0, 5 000, 50 000 and 520 000 ppm for 4 hours
Observation period:	14 days
Method of administration:	serially diluted atmosphere with oxygen supplement for highest dose
Clinical observations:	no effect at 5 000 ppm reduced response to sound at 50 000 ppm absence of response to sound, increased breathing depth, reduced breathing rate and tail erections at 500 000 ppm
Mortality:	none
Morphological findings:	none related to treatment
Test method:	according to OECD Guidelines (15)
LD_{50}:	> 520 000 ppm
Result:	the notified chemical exhibited low acute inhalation toxicity in rats

9.1.2 28-day repeat dose inhalation toxicity (13)

Species/strain:	rat/Wistar
Number/sex of animals:	5/sex in 4 treatment groups
Dose	0, 2 000, 10 000 and 50 000 ppm
Duration	6 hours/day for 5 out of 7 days over 4 weeks
Detailed clinical observation	1, 2, 3, 8, 15, 22, 29 days
Method of administration:	gaseous in whole body exposure chambers
Clinical observations:	piloerection and nose stains at 10 000 and 50 000 ppm,
Clinical chemistry/Haematology	increase in plasma potassium in males at 50 000 ppm, reduced urine pH at 10 000 ppm in females and 50 000 ppm in males, reduced red blood cell count in females at 50 000 ppm
Mortality:	none
Morphological findings:	3 males at 50 000 ppm exhibited minimal alveolitis (one female in the control group and one female in the 2 000 ppm group also exhibited minimal alveolitis)
Test method:	according to OECD Guidelines (15)
Result:	the notified chemical exhibited low inhalation toxicity in rats in this 28-day sub-acute study

9.1.3 90-day repeat dose inhalation toxicity (14)

Species/strain:	rat/Wistar
Number/sex of animals:	10/sex in 4 treatment groups
Dose	0, 5 000, 15 000 and 50 000 ppm
Duration	6 hours/day for 5 out of 7 days over 13 weeks
Detailed clinical observation	every 7 days
Method of administration:	gaseous in whole body exposure chambers

Clinical observations:	no treatment related changes
Mortality:	none
Morphological findings:	no treatment related changes
Test method:	according to OECD Guidelines (15)
Result:	the notified chemical exhibited low inhalation toxicity in rats in this 90-day chronic exposure study

9.2 Absorption, Metabolism and Toxicokinetics (16)

Species/strain:	rat/Wistar and mice Alpk:APfCD-1
Number/sex of animals:	4 males of each species
Dose	10 000 ppm of ^{14}C-difluoromethane
Duration	6 hours
Method of administration:	gaseous in glass metabolism chambers
Metabolism:	approx 1% ^{14}C-difluoromethane dose recovered in faeces, urine and expired air in both species; CO_2 0.23% rats, 0.27% mice, urine 0.34% mice, 0.13% rats; uniform tissue distribution
Result:	in rats 2.1% difluoromethane absorbed from airways, 63% of absorbed compound metabolised as above,. low absorption and metabolism exhibited in both species

9.3 Developmental toxicity

9.3.1 Developmental toxicity in the rat (17)

Species/strain:	rat/Wistar
Number/sex of animals:	24 females per group
Dose	0, 5 000, 15 000 and 50 000 ppm
Duration	10 days (7-16 days of gestation, 6 hours/day)

Necropsy day 22 of gestation

Method of administration: gaseous in whole body exposure chambers

Clinical observations: low incidence of maternal and foetal toxicity at 50 000 ppm, pre and post-implantation loss of foetuses and minor foetal defects such as parietal ossification and liver changes

Maternal Mortality: none

Test method: according to OECD Guidelines (15)

Result: the notified chemical exhibited low developmental toxicity in rats exposed for 10 gestation days

9.3.2 Development toxicity in the rabbit (18)

Species/strain: rabbits/New Zealand White

Number/sex of animals: 24 female for each dose

Dose: 0, 5 000, 15 000 and 50 000 ppm

Duration: 6 hours/day for 13 days
(6-18 days of gestation)

Necropsy: day 29 of gestation

Method of administration: gaseous in whole body exposure chambers

Clinical observations: maternal weight loss at 50 000 ppm for 45% of animals from days 8 to 10, recovered after day 10, no treatment related effects on foetuses evident at any dose, possibility of pre-implantation loss at all doses but incidence did not increase with dose

Maternal Mortality: none

Test method: according to OECD Guidelines (15)

9.3.3 Chernoff-Kavlock Foetotoxicity and Teratogenicity Assay in the Rat (19)

Species/strain:	rats/Wistar (Alpk:APfSD)
Number/sex of animals:	30 female (10 per group)
Dose	0, 10 000 and 50 000 ppm
Duration	10 days for days 7-16 of gestation (6 hours/day)
Litter observation	5 days post partum
Method of administration:	gaseous in whole body exposure chambers
Clinical observations:	maternal weight gain unaltered by exposure at all doses, 3 rats excluded with more than 50% pup mortality (1 control, 2 at 50 000 ppm difluoromethane), decreased weight gain in pups of 50 000 ppm treated mothers
Maternal Mortality:	none
Test method:	not an OECD Guidelines assessed assay
Result:	although low maternal and foetal toxicity apparently reported, this is a preliminary assay with lack of individual data that precludes accurate assessment

9.4 Genotoxicity

9.4.1 *Salmonella typhimurium* and *E. coli* Reverse Mutation Assay (20)

Strains:	
Salmonella typhimurium	TA 98, TA 100, TA 1535, TA 1537
E. coli	WP2P, WP2P *uvr*A
Concentration range:	5, 10, 25, 50, 75, 100% v/v atmosphere for 3 days
Test method:	according to OECD Guidelines (15)
Result:	higher doses (50% and above) frequently showed toxicity with *S. typhimurium* (particularly TA98), and to lesser extent in *E.*

	coli, causing a significant decline in colony numbers in many strains; no dose of the notified chemical consistently induced back mutation to prototrophy in any of the strains tested; metabolic activation by rat liver S9 fraction had no effect on observed mutation frequency; positive controls showed significant mutation with the expected increased colony numbers

9.4.2 Micronucleus Assay in the Bone Marrow Cells of the Mouse (21)

Species/strain:	mouse/CD-1
Number and sex of animals:	10/sex per dose group
Doses:	0, 150 000 ppm (15% v/v) for 6 hours 2 groups, one sacrificed after 24 hours, another after 48 hours
Method of administration:	whole body gas inhalation
Test method:	according to OECD Guidelines (15)
Result:	the notified chemical did not induce a statistically significant increase in micronucleated polychromatic erythrocytes at either the 24 hour or 48 hour sampling time

9.4.3 Chromosomal Aberrations in Chinese Hamster Lung Cells (22)

Species:	Chinese Hamster lung
Doses:	10, 20, 40, 80% v/v for 6 hours with activation and 24 and 48 hours without activation
Method of administration:	gas exposure
Treatment regime:	after 24 and 48 hour treatment with the test substance, colcemid was added for 2 hours to arrest mitosis, cells were trypsin harvested
Test method:	according to OECD Guidelines (15)
Result:	the notified chemical did not induce a statistically significant increase in chromosomal aberrations in either the presence or absence of metabolic activation provided by rat liver S9 fraction

9.4.4 Chromosomal Aberrations in Human lymphocytes (23)

Species:	human lymphocytes, freshly isolated from male and female donors
Doses:	5, 10, 25, 50, 75, 100% v/v for 72 hours and additional female cultures at 96 hours with and without rat liver S9 mix
Method of administration:	gas exposure
Treatment regime:	cells stimulated to enter mitosis by phytohaemaglutin, colcemid was added for 2 hours to arrest mitosis, cells harvested by centrifugation
Test method:	according to OECD Guidelines (15)
Result:	the notified chemical did not induce a statistically significant increase in chromosomal aberrations in either the presence or absence of metabolic activation provided by rat liver S9 fraction *in vitro*

9.5 Cardiac Sensitisation in Beagle Dogs (24)

Species/strain:	dogs/Beagle
Number/sex of animals:	9/male
Doses:	15, 20, 25, 30, 35 % v/v in air for 60 minutes each day for 6 days
Observation Period:	6 days
Clinical Observations:	no changes
Test method:	according to the standard protocol of published cardiac sensitisation literature (4)
Result:	the notified chemical did not induce cardiac sensitisation at any dose level

9.6 Overall Assessment of Toxicological Data

Difluoromethane was found to have a low acute inhalation toxicity in rats (LD_{50} > 520 000 ppm). Difluoromethane is essentially non-toxic when administered daily via inhalation at concentrations up to 50 000 ppm for up to 90 days. In dogs difluoromethane did not cause cardiac sensitisation to adrenaline at any dose level. It was poorly absorbed by the rat or mouse and rapidly excreted through the urine and exhaled CO_2. There was evidence of minor foetal defects in rats treated with doses of 50 000 ppm but no effect was observed on rabbit foetuses at the same dose. No effect was observed at lower doses in either animal. Maternal toxicity was similarly low in both test species.

Difluoromethane was not mutagenic towards *Salmonella typhimurium* or *Escherichia coli*, nor clastogenic towards polychromatic erythrocytes of mouse bone marrow *in vivo*, or human peripheral blood lymphocytes, *in vitro*.

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

No ecotoxicological data were provided which is required for chemicals with import volumes more than 1 tonne per year according to the Act. However, effects on organisms are not expected as hydrofluorocarbons are stable substances that do not exhibit significant biological activity. Furthermore, significant exposure of aquatic organisms to this gaseous substance is not expected.

Halocarbon refrigerants can affect the atmosphere. Difluoromethane contains neither chlorine nor bromine, and thus will not act as a source of ozone depleting halogen radicals in the stratosphere. Scientists from the US National Oceanic and Atmospheric Administration concluded recently that hydrofluorocarbons have negligible potential to destroy ozone (25).

Like other halocarbons, difluoromethane adds to the global warming potential of the atmosphere. However, its atmospheric lifetime of 7.7 years is considered short enough that difluoromethane will not contribute significantly to global warming (11). The atmospheric lifetime is less than that of difluorochloromethane (R-22), 15.3 years (26), which the notified chemical replaces. The global warming potentials (GWP) for difluoromethane and difluorochloromethane over a 100 year time horizon (relative to CO_2 with GWP 1) are 650 and 1 700, respectively (1).

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

Difluoromethane is not expected to exert a direct effect on living organisms as hydrofluorocarbons are stable substances that do not exhibit significant biological activity. The high volatility should ensure minimal exposure of aquatic and terrestrial compartments, and therefore minimal hazard to organisms inhabiting them.

The hazard to the atmosphere was reduced when the notified chemical replaced the previously used chlorofluorocarbons, such as R-22, as the replacement refrigerant will not carry chlorine or bromine to the stratosphere (hence, it has no potential for ozone depletion) and has a lower global warming potential.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

Developmental toxicity effects in laboratory animals were of low frequency occurring only at the highest exposure levels. These results suggest no likely hazard from reproductive effects in workers at probable levels of exposure. Very high acute exposures of difluoromethane (100 000 ppm in rats) may lead to an anaesthetic effect suggesting that relatively high concentrations of difluoromethane need to be present before toxic effects become apparent. If a large amount of difluoromethane accumulates as a result of a leak, oxygen may be displaced, leading to an asphyxiation hazard. Direct skin or eye contact with the cold liquid or escaping gas may result in frostbite. Local exhaust ventilation will be used to capture any emissions during transfer operations and personnel are required to wear impervious rubber gloves and goggles to prevent skin and eye contact, respectively.

Difluoromethane is a flammable liquefied gas that may be reactive at high temperatures. However, it will only be used as a mixture with other HFCs and these mixtures are not flammable (all are classified dangerous goods class 2.2, ie non-flammable gases). Its vapour is heavier than air which may result in the gas collecting in low areas and displacing oxygen. Difluoromethane when used in confined spaces will not effectively disperse unless positively ventilated.

The greatest risk for those employed as refrigeration and air conditioning mechanics apart from cold burns would appear to be asphyxiation arising from the unnoticed accumulation of gas from slow leaks. Standard Australia's HB40-1992 *The Australian Refrigeration and Air Conditioning Code of Good Practice* (7) provides guidance for the recommended work practices.

Under normal conditions of use, there will be low potential for public exposure to difluoromethane since its application will be restricted to industry. If public contact to difluoromethane does occur during accidental spillages, health hazards arising from acute exposure are anticipated to be low as difluoromethane has low acute inhalation toxicity. Accidental exposure to difluoromethane can also arise as a result of slow leakages of the refrigerant from faulty equipment. Since the overall toxicity of difluoromethane is low as indicated in the toxicology studies, the potential for adverse health effects under such circumstances is anticipated to be low.

13. RECOMMENDATIONS

To minimise occupational exposure to difluoromethane the following guidelines and precautions should be observed:

- If engineering controls and work practices are insufficient to significantly reduce exposure to a safe level, then personal protective devices which conform to and are used in accordance with Australian Standards (AS) for eye protection (AS 1336; AS 1337) (27, 28), impermeable gloves (AS 2161) (29), protective clothing (AS 2919) (30), and respiratory protection conforming to AS/NZS 1715 (31), and AS/NZS 1716 (32).

- When used in confined spaces positive ventilation is necessary to disperse escaped gases.

- Good work practices should be implemented to avoid spillages.

- Good personal hygiene should be adopted.

- A copy of the MSDS for products containing the notified chemical should be easily accessible to employees working with products containing the chemical.

- Manufacturers, distributors and users must minimise atmospheric emissions of HFC-32 by leak testing of refrigeration equipment on a regular basis and adhering to the Australian Refrigeration and Air Conditioning Code of Good Practice. Storage of cylinders containing difluoromethane should conform to the maximum recommended temperature of 52°C.

14. MATERIAL SAFETY DATA SHEET

The MSDS for a formulation containing difluoromethane was provided in a format similar to Worksafe Australia format (33). This MSDS was provided by Actrol Parts, a division of GSA Industries (Aust.) Pty. Ltd. as part of their notification statement. The accuracy of this information remains the responsibility of Actrol Parts.

15. REQUIREMENTS FOR SECONDARY NOTIFICATION

Under the Act, secondary notification of difluoromethane shall be required if any of the circumstances stipulated under subsection 64(2) of the Act arise. No other specific conditions are prescribed.

16. REFERENCES

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