

## Other Gases

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### REVIEW OF AMMONIA INCIDENTS 1992 - 1998

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#### Introduction

This note presents the results of a review of ammonia incidents reported to HSE over the period 1992-1998. It also provides details of the main sources of guidance on the storage, handling and use of ammonia.

Ammonia is used in the manufacture of fertilisers, nitric acid and many other products. It is also widely used as a refrigerant.

Ammonia is flammable in the range 16 -28% (by volume in air). It is toxic and an irritant to the respiratory system. It is very soluble in water.

#### Incidents Involving the Release of Ammonia

The information for the review was extracted from the MARCODE database (1992-1995) and from the FOCUS investigation database (1996-1998). All the incidents on MARCODE have been reported to HSE under RIDDOR (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations) and have been investigated by HSE inspectors.

139 incidents were identified where ammonia gas had been released. Many of them resulted in injury caused by exposure to the gas or being splashed with liquid ammonia or a concentrated aqueous solution. There were no explosions involving ammonia gas or fatalities over the seven year period of the review. The details are summarised in the table. The incidents are categorised in terms of the process involved:

- refrigeration;
- chemical processes including ammonia manufacture;
- transport;
- miscellaneous

#### Summary of Ammonia Incidents 1992 - 1998

	YEAR	1992	1993	1994	1995	1996	1997	1998	Total
<b>ACTIVITY</b>									
Refrigeration		21	6	10	11	8	13	4	73
Process		6	3	7	6	2	5	1	30
Transport		3	3	3	2	0	1	1	13
Miscellaneous		2	6	6	4	3	2	0	23

<b>TOTAL</b>		32	18	26	23	13	21	6	139

### Refrigeration incidents

The majority of the incidents are associated with refrigeration systems. Many of the incidents involved large releases, up to 3 tonnes in one case. This resulted in activation of emergency plans, evacuation of the premises and nearby sites, and the involvement of the emergency services. Most of the reported injuries resulted from exposure to the gas. There were no fatalities.

Many (25) of the refrigeration incidents occurred during maintenance and commissioning activities, the main cause being failure to isolate effectively. Other incidents were caused by plant failure, possibly linked to a lack of preventive maintenance. The main causes were:

- corroded pipework;
- failure of seals;
- failure of valves;
- blockages.

### Chemical process and transport incidents

The causes of the chemical process and transport incidents were typical of process plant in general. They included:

- corrosion;
- failure of valves;
- failure of process monitoring equipment;
- failure to isolate effectively;
- failure to follow procedures;
- operator error;
- blockages in pipes.

Many of these incidents involved comparatively minor releases of ammonia but became serious because RPE was not being worn or was inadequate or defective.

In four of the transport incidents, fork lift trucks were used to move IBC's or drums of ammonia solution. The containers were either dropped or pierced by the forks of the truck, resulting in spillage.

### Miscellaneous incidents

Ammonia solutions or proprietary products containing ammonia are widely used. Most of the miscellaneous incidents involved the use of small quantities of ammonia solutions in laboratories, schools and other workshops. Exposure resulted from leaks or spillage. Four of the incidents involved proprietary cleaning products containing ammonia which caused breathing problems or eye irritation. There were two cases of cylinder rupture.

### Guidance

The hazards of ammonia refrigeration systems have been recognised and there is a range of guidance available.

There is only a limited amount of guidance for the storage, carriage and handling of ammonia. The HSE publication HSG30 'Storage of anhydrous ammonia under pressure in the United Kingdom' was withdrawn as there are very few large scale pressure vessels now in use. The

Chemical Industries Association published 'Guidance for the large scale storage of fully refrigerated anhydrous ammonia in the UK' in 1997.

### **Refrigeration**

Safe management of ammonia refrigeration systems: food and other workplaces

Guidance Note PM81 1995 HSE Books

A safety code for compression refrigerating systems utilising ammonia

Part I Design and construction

Part II Commissioning, inspection and maintenance

Institute of Refrigeration 1990

BS 4434:1989 Specification for safety aspects in the design, construction and installation of refrigerating appliances and systems. British Standards Institute

CEN draft standard: Pr en 378 Specification for refrigerating systems and heat pumps - safety and environmental requirements Part 1 - Basic requirements

Occupational hygiene aspects of the safe use and selection of refrigerant fluids, J McAlinden, SIR 48

Ammonia compressors and refrigeration plant FIC 278/29 1986

Ammonia compressors and refrigeration plant HELA LAC 31/1 1996

### **Plant and Equipment**

Guidance for the large scale storage of fully refrigerated anhydrous ammonia in the United Kingdom Chemical Industries Association 1997

Guidance on transfer connections for the safe handling of anhydrous ammonia in the UK

Chemical Industries Association 1990

Storage of anhydrous ammonia under pressure in the United Kingdom HSG30 1986. HMSO (withdrawn)

### **Other guidance**

Chief Inspector's guidance to inspectors. Environmental Protection Act 1990 Processes for the manufacture of ammonia. Process Guidance Note 1993 IPR 4/18 HMIP

Chief Inspector's guidance to inspectors. Environmental Protection Act 1990 Processes involving the use, release or recovery of ammonia. Process Guidance Note 1993 IPR 4/19 HMIP

Toxicology of substances in relation to major hazards : ammonia