RISKTECH

Technical Bulletin No.20

Ammonia Plant Hazards

The Hazards associated with Ammonia

The use of Ammonia as a refrigerant is growing in interest as it does not contribute to ozone depletion and global warming when released to the atmosphere. It has a sharp, distinct, penetrating odour detectable at very low concentrations and because it is lighter than air, it can be easily removed from buildings by proper ventilation. On the flip side, ammonia is classified as a hazardous substance as it is explosive when mixed with air in the correct proportions (15-28%) and a respiratory hazard for long term exposure, with the recommended average exposure Threshold Limit Value (TLV) being 25 parts per million (ppm) based on a 8 hour work day and a Short Term Exposure Limit (STEL) of 35 ppm based on a 15 minute period. For this reason, as an employer you have a duty of care to ensure that any ammonia system to be installed or currently operational have a formal risk assessment conducted as this would highlight potential hazards and assist in minimising a catastrophic incident from occurring.

The biggest risk in an ammonia plant room is an accidental ammonia leakage which could potentially harm people and cause property damage if it became explosive. This leakage can be caused from several factors but the most common types include:

- Pipe failure due to vibration or mechanical damage;
- Pipe failure due to electrolytic corrosion between dissimilar metals;
- Valve failure due to impurities lodging in valves;
- Faulty valves allowing higher than normal operating pressures; and
- Defects in the shaft seal, pipe flanges or valve stems.

It is therefore essential that safeguards and risk mitigation measures are implemented within the system, thus limiting or eliminating the probability of an incident occurring.

Risk Mitigation Measures

For best practice, the following guidelines should be considered when designing, altering and installing safeguards for ammonia plant rooms. These include:

Construction

- The plant room should be an isolated room or inside a detached building;
- The construction of the room should be non-combustible;
- No combustible material should be stored inside the plant room;
- Interior Walls should be vapour tight with minimum one-hour fire resistance rating;
- Interior walls should be designed to be pressure resistive so that it does not explosively vent;
- All exhausts (fan, air vent or roof opening) should vent directly to the outdoors;

- The plant room should contain vent relief panels using fasteners designed for explosion venting wall systems;
- Plant rooms with combustible construction and weatherproof equipment can be equipped with automatic sprinklers since the room must be constructed to have at least a one-hour fire resistance rating;
- An emergency isolation button outside or near the plant room door should be installed, which safely isolates the electrical equipment and machinery, at the same time, activates the ventilation system and raises the alarm;

Note: Depending on the situation, you may not want all equipment and machinery to shut down.

Detection System

- Ammonia detectors should be installed in areas where leakage might occur (i.e. over flanges, valves, concealed roof voids where ammonia piping passes) in line with the detectors technical data sheet and standard;
- A two stage ammonia detection system should be installed with detectors sounding a continuous alarm;
- The detection system should activate the emergency ventilation system at 25% lower explosion limit (LEL);
- The system should shut down (isolate) all electrical equipment and close valves at 50% LEL;
- Ammonia detection and alarm systems should be tested and calibrated in accordance with manufacturers recommended testing frequency, otherwise tested annually;
- The ammonia leak detection system should alarm to a remote monitoring centre and to site control offices.

Ventilation System

- A continuous ceiling level exhaust ventilation system for the plant room should be installed;
- The ventilation system could be installed with a scrubber for dilution;
- The emergency ventilation fans should also be able to be activated remotely from the plant room;
- The emergency ventilation system should activate at 25% lower explosion limit (LEL);

Electrical

- Ammonia plant rooms are classified as hazardous and all electrical equipment inside the plant room should be intrinsically rated with explosive proof rated equipment (either Zone 0 or Zone 1)] or alternatively if suitable refrigerant detectors are installed, specially protected electrical equipment shall not be required, except for extraction fans and emergency lighting;
- The power source for the ventilation system should be separate from the plant rooms power.

Valves

- Ammonia leakage can be prevented by stopping the flow of ammonia and diluting or dispersing the ammonia gas. Shutting a valve is the fastest method of controlling a leak. Water and steam are also proven means of diluting and dispersing ammonia leaks;
- Pressure relief valves should be arranged to discharge to a safe outdoor location;
- Accessible sectional valves should be provided outside the cooled areas for emergency shutdown;
- Consider the pipe work layout and equipment selection based on a HAZOP study.

Emergency Planning

- An emergency management plan that incorporates specific considerations for ammonia including the need to consider wind direction and advice to neighbours;
- A detailed operating manual for the ammonia detection system;
- Safe operating procedures for the ammonia refrigeration system; and
- A testing & maintenance manual for the system.

There are a number of risk exposures from the use of ammonia refrigeration. The exposures are generally related to the plant's age, size and operational requirements. To determine the exposures and remediation that may be required it is suggested that an audit be undertaken.

These are only a few risk mitigation measures your company can take to avoid an ammonia disaster from occurring in your facility. For best advice, please contact us on 0416 109 332 or (02) 8745 2000 and ask one of our consultants to help you implement a plan to manage or reduce this risk.

Relevant Standards

- AS/NZS 1677.2:1998
  Refrigeration Systems - Safety requirements for fixed applications
- AS/NZS 2022:2003
  Anhydrous ammonia - Storage and handling
- AS/NZS 3000:2007
  Electrical Installations - Wiring rules
- AS/NZS 2381.1:2005
  Electrical equipment for explosive gas atmospheres – Selection, installation and maintenance - General requirements
- AS2430.1:1987
  Classification of hazardous areas - Explosive gas atmospheres