Ecologically Sound Disposal Methods in Ammonia Technology

Please note these are German guidelines. You may want to consider them but should be aware of your country's regulations.

This paper covers only the materials used in ammonia-based refrigeration plants – i.e. ammonia as a refrigerant and lubrication oil for various compressors – not the disposal of the plant or its components.

1. Ammonia (NH_3)

1.1 Disposal in Cases of Leakage

Ammonia is a natural and environmentally compatible substance.
The binding limit value (BLV) for ammonia is 14 mg/m^3 = 20 ppm
(0,7 mg/m^3/1 Vppm).
When emitting ammonia into the atmosphere, it is prohibited to cause environmental damage. The ERGP-2 is 150 ppm = 105 mg/m^3 (ERGP = Emergency Response Planning Guidelines).
It may therefore be released to the atmosphere.
Ammonia is not listed in the "TA Luft" (German Technical Guidelines on Air Quality Control).
If the concentration in the exhaust air rises above the value approved by the local authority, the ammonia content must be lowered by water washing the air or by applying water directly to the leakage site.
In such a case, please note the following:

- Collect the water/ammonia mixture (ammonium hydroxide) in suitable receptacles or collecting tanks.
- Ammonia shows only a limited reaction with water, as in $NH_3 + H_2O \rightarrow NH_4OH \rightarrow NH_4^+ + OH^-$. This situation causes the solution to undergo alkaline reaction.
- Most of the ammonia is only physically dissolved in the water. Please note the high vapour pressure of NH_3 vs. the vapour pressure of the water.
- Neutralise using hydrochloric acid or diluted sulphuric acid to a pH-value of between 7 and 8 and dispose of by releasing to the sewer system and its wastewater treatment plant (consult with plant operator, do not release to surface water).

- Automate the waste air surface by connecting a gas scrubber with highly diluted sulphuric acid (< 12 %) as the scrubbing liquid via the installed gas alarm system. This gas scrubber scrubs and chemically binds the ammonia in the ambient air. The resultant bond binds the ammonia for good – the ammonia can no longer escape from the scrubbing fluid. The resultant compound is completely harmless (artificial fertilizer).
  Diluted sulphuric acid = WGK 1 Hazard Category Xi (irritant)
- No installation problems, provided the scrubbing chamber is double walled with automatic monitoring.
- Properly dispose of the solution, making sure to comply with federal and state regulations.

1.2 Disposal procedure for plant shutdowns or when reducing the refrigerant charge

1.2.1 Disposal using Loan Containers

NH_3 suppliers may avail themselves of loan containers for disposing of used ammonia if necessary. These are returned for further commercial utilization.

1.2.2 On-site Combustion of Ammonia

The ammonia awaiting disposal is removed from the refrigeration plant in vapour form and conducted to the disposal plant using a special high-pressure hose.
After a short warm-up period using propane gas, the disposal plant's combustion chamber is brought to a specific operating temperature. A carefully calculated supply of air and NH_3 causes the NH_3 to spontaneously combust – without the addition of propane gas – and then continue to burn in a controlled and calm way. The temperature of the flame is approx. 700 °C.
The main advantage of this type of combustion vs. catalytic combustion is that the NH_3 remains in the flame zone for a very long time and that the NO becomes unstable at 700 °C and breaks down to nitrogen and oxygen.
($2\ NO \rightarrow N_2 + O_2 + 180.62\ kJ$)
The readings showed no nitrosyl compounds.
No C, F, Cl or S compounds are created as no fossil fuels are used to support the flame.
Ammonia is stable at normal temperatures, but when heated the reverse of its synthesis occurs and it breaks down into its individual elements ($92.28\ kJ + 2\ NH_3 \leftrightarrow N_2 + 3\ H_2$).

Combustion causes the NH_3 to dissociate into water vapour and nitrogen. Therefore, the waste air from the disposal plant is invisible and odourless.
The H_2O initially emerges as vapour and becomes detectable below the dew point.

Advantages:

- The disposal procedure is short, and there are no transport problems.
- The elimination of pressure vessels also eliminates potential risks, as well as the costs of cleaning the vessels.
- This method allows for emptying the entire cooling system down to a vacuum, and then refilling it with nitrogen or air.
- **This type of disposal is recommended when 800 kg or more ammonia is being disposed of.**

1.2.3 Further Utilization as Ammonium Hydroxide

The waste ammonia is vaporised at ambient temperature. Because of the partial pressures, the impurities remain in the vaporiser. The pure NH_3 is then absorbed in completely desalted water and processed into ammonium hydroxide (25 % NH_3). The resultant heat is dissipated.

1.2.4 Note:

Federal laws and regulations should be looked into in each case.

2. Ammonia Lubrication Oil

Lubrication oil from NH_3 refrigeration plants (mineral oil) is covered by the Ordinance on Waste Oils (Altölverordnung) § 5a and is thus not a residual material requiring complex and costly disposal (unlike lubrication oils from other types of refrigerant plant that don't use NH_3 as refrigerant).

Because waste oils from NH_3 plants contain neither PCB nor halogens, they fall under waste code 130205 and may be disposed of as mineral lubricant oils.

NH_3-soluble oils (PAG oils) are waste code 130206.

Waste oils from NH_3 plants may contain between 5 and 7 % ammonia, or even higher in the case of PAG oils, so it is advisable to evacuate the warm lubrication oil prior to the oil change and/or observe degasification times before sealing the transport vessels.

Disposal procedure:

- Pickup by authorized carriers (with a permit to collect or convey wastes pursuant to § 12 of the AbfG Waste Management Law).
- Hand over the oil to a carrier in exchange for an acceptance certificate.
- Reprocess in an officially licensed reprocessing plant.

In case of doubt, the German-language original should be consulted as the authoritative text.

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