Ammonia refrigerant

1. Advantages of ammonia
2. Composition of the ammonia molecule
3. Properties of ammonia
1. Advantages of ammonia

- Natural refrigerant
- Tried and tested in refrigeration for more than 130 years
- Good thermodynamic properties
- High availability
- High energy efficiency
- GWP = 0 (global warming potential)
- ODP = 0 (ozone depletion potential)
- Favourable TEWI balance (Total Equivalent Warming Impact) [EN 378-1, Appendix B]
- Leaks are detected quickly
- Lighter than air; other refrigerants displace air
- Low procurement costs
- Low-cost disposal at the end of its service life
- Flooded operation and ...
- ... dry expansion possible
- Excellent performance values in relation to refrigerant fill level / refrigeration capacity (approx. 40 g/kW)
2. Composition of the ammonia molecule

- Chemical formula for ammonia: $\text{NH}_3$
- 1 ammonia molecule consists of 1 nitrogen atom N and 3 hydrogen atoms H

- Molecular geometry of ammonia

\[ \text{N} \quad \text{H} \quad \text{H} \]

\[ \text{H} \quad \text{H} \quad \text{H} \]

- Bond length: 101.7 pm
- Bond angle: 107.8°
3. Properties of ammonia

- **ODP** = 0
- **GWP** = 0
- **Appearance**: colourless
- **Odour**: distinctly pungent
- **Solubility in water (20 °C)**: 0.5 kg/l
- **Boiling point (1.013 bar)**: –33.4 °C
- **Thermal decomposition**: > 450 °C
- **Ignition temperature**: > 651 °C
- **Lower flammability limit**: 15.4 vol.% = 108 g/m³
- **Upper flammability limit**: 33.6 vol.% = 240 g/m³
- **Evaporation enthalpy**: 1262 kJ/kg at 0 °C
- **Vapour pressure**: 8.6 bar at 20 °C
- **Perception threshold**: 5 ppm or 3.5 mg/m³
- **AGW value (formerly MAC value)**: 20 ppm or 14 mg/m³
- **Irritation threshold**: 250 ppm or 175 mg/m³
- **Toleration limit**: 500–1000 ppm (350–700 mg/m³)
- **Symptom of poisoning**: approx. 2500 ppm (1750 mg/m³)
- **Lethal concentration**: > 5000 ppm (3500 mg/m³)
- **ATEL / ODL**: 0.00022 kg/m³
- **Safety class**: B 2 (as per EN 378-1:2012)
- **Substance assessment**: WGK (German water hazard class) 2

* Limit on the time that persons may be subjected to acute toxicity or a lack of oxygen
3. Properties of ammonia

Ammonia gas mixes with the humidity from the air, forms a mist and thus becomes heavier than air.

Ammonia as a substance is »greedy for water«.

1 litre of water can absorb 520 grams of ammonia at 20 °C.

In dry air, ammonia gas is lighter than air and therefore rises.