NH_3 Ammonia Fact Sheet

Concentration Exposure/Irritation Limits[1]:

- Exposure Limits (TWA) = 50 ppm OSHA; 25 ppm NIOSH — 1 ppm = 0.70 mg/m^3
- IDHL = 300 ppm — IP = 10.18 eV

Threshold Concentrations[2]:

- Odor Threshold = 0.037 ppm (37 ppb)
- Detection Threshold = N/A
- Recognition Threshold = 46.8 ppm

Characteristics: Colorless; pungent odor; repeated exposures lowers sensitivity to gas; lighter than air.

Summary: Ammonia can be present in a number of situations related to: commercial cleaning products, fertilizers, and refrigerants (ice rinks, refrigerated displays, store freezer cases). Typical oxidation of ammonia requires a catalyst; however, as oxygen ions are much more reactive than elemental oxygen, oxidation can occur without a catalyst. The most favorable reaction (in terms of its free energy) converts ammonia into inert nitrogen gas, N_2. The following reactions can occur with oxygen as a co-reactant; side reactions may also occur. Note that while these reactions spontaneously occur, the equilibrium point and the rate of reaction depend on the specific kinetics and conditions of the reaction.

Oxidation of Ammonia with simple oxygen:

$NH_{3(g)} + ¾\ O_{2(g)} \rightarrow ½\ N_{2(g)} + 3/2\ H_2O_{(g)}$	$\Delta G° = -327$ kJ/mol[3]
$NH_{3(g)} + 7/4\ O_{2(g)} \rightarrow NO_{2(g)} + 3/2\ H_2O_{(l)}$	$\Delta G° = -287$ kJ/mol
$NH_{3(g)} + 5/4\ O_{2(g)} \rightarrow NO_{(g)} + 3/2\ H_2O_{(g)}$	$\Delta G° = -241$ kJ/mol

Additional/side reactions:

$NH_{3(g)} + 3/2\ NO_{(g)} \rightarrow 5/4\ N_{2(g)} + 3/2\ H_2O_{(g)}$	$\Delta G° = -456$ kJ/mol
$NO_{(g)} + ½\ O_{2(g)} \rightarrow NO_{2(g)}$	**$\Delta G° = -34$ kJ/mol**
$NO_{2(g)} + ⅓\ H_2O_{(l)} \rightarrow ⅔\ HNO_{3(aq)} + ⅓\ NO_{(g)}$	$\Delta G° = -18$ kJ/mol

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Definitions:

- OSHA – Occupational Safety and Health Administration.
- AIHA – American Industrial Hygiene Association.
- PEL – Permissible Exposure Limit, OSHA standards.
- REL – Recommended Exposure Limit, NIOSH standards.
- TWA – Time Weighted Average, usually based on an 8 (OSHA) or 10 (NIOSH) hour workday.
- ST – Short-term Exposure Limit, usually a 15-minute TWA not to be exceeded during workday.
- C – Ceiling value, not to be exceeded at any time.
- IDLH – Immediately Dangerous to Life and Health.
- Odor threshold - the concentration at which ANIMALS respond to the odor 50% of the time.
- Detection threshold - the concentration at which 50% of a human panel identifies the presence of an odor without being able to characterize it.
- Recognition threshold - the concentration at which 50% of a human panel can identify the odor.
- PPM – parts per million.
- PPB – parts per billion
- IP – Ionization Potential.

Note: Sometimes "Odor" threshold is used when "Detection" threshold is meant.

References

1. NIOSH Pocket Guides at http://www.cdc.gov/niosh/npg/default.html; OSHA Chemical Data at http://www.osha.gov
2. The Science of Smell Part , Iowa State University, May 2004: http://www.extension.iastate.edu/Publications/PM1963A.pdf
3. ΔG° = Free energy of the reaction, calculated at standard conditions (room temperature and pressure). A negative free energy indicates that the reaction is spontaneous (i.e. will occur naturally); however, it does not indicate the rate of reaction (e.g. the reaction may not occur fast enough to be observed). The free energies are calculated per mole of the first listed reactant.