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## AMMONIA

### Characteristics

Ammonia (CAS No. 7664-41-7) is a naturally occurring, colourless acrid-smelling gas. It is volatile and highly water-soluble. On a global scale, more than 99% of the ammonia present in the atmosphere is the result of natural processes, mainly biological degradation of organic matter, such as plants and animals, and chemical and microbial degradation of animal wastes, in particular urine. The major sources for atmospheric emissions of ammonia in Alberta are agricultural activities (animal feedlot operations and other activities), followed by biomass burning (including forest fires), fertilizer plants, and to a lesser extent fossil fuel combustion, and accidental releases.

Gaseous ammonia is a very important basic compound in the atmosphere. It reacts readily with acidic substances or sulphur dioxide to form ammonium salts that occur predominantly in the fine particle (size < 2.5 µm) fraction. A small amount of gaseous ammonia is converted to nitric oxide.

### Effects

Human Health - Two types of potential health effects are considered important for ammonia: acute non-cancer effects that may result from short-term exposure and chronic non-cancer effects that may result from long-term exposure. Tables 1 and 2 show a summary of effects in humans following acute and chronic ammonia exposures respectively.

Vegetation - Uptake and detoxification of ammonia can result in changes in tissue nitrogen content, amino acid composition, increased chlorophyll content, leaf gas exchange and nutrient imbalances caused by increased nitrogen content. These changes can result in reduced resistance to drought and frost, increased susceptibility to insect pests and disease, and altered growth and productivity. Nitrogen inputs can also have effects at the ecosystem level. Table 3 shows a summary of effects in vegetation following exposure to ammonia. While all the species in Table 3 are not native to Alberta, species of the same genus are common across the province. Alberta species would be expected to respond in a similar manner as the species outlined in the table.

### Alberta Ambient Air Quality Objectives

Alberta ambient air quality objectives are issued by Alberta Environment, under Section 14 (1), the *Environmental Protection and Enhancement Act, 1992* (EPEA). This document replaces all previous versions of the Ammonia Ambient Air Quality Objective.

- The 1-hour average Alberta Ambient Air Quality Objective for ammonia is 1400 µg m<sup>-3</sup> (2 ppm) based on odour.

### Reference

Alberta Environment. Edmonton, 2002: *Assessment Report on Ammonia for Developing Ambient Air Quality Objectives. Volumes I and II*. Alberta, Canada.

**Table 1 Summary of effects in humans following acute ammonia exposure**

Air Concentration (mg/m <sup>3</sup> ) <sup>a</sup>	Exposure Period	Effects Reported
3480	30 min	Death
350	1 d, 30 min	Nasal and throat irritation, increased minute volume
70	6 hr/d	Transient irritation of eyes, nose and throat
56	1 d, 2 hr/d	Coughing, eyes, nose and throat irritation
35	1 d, 2 hr/d	No adverse effect
35	6 wk, 5 d/wk,	No adverse respiratory effects or eye irritation
10	2 d, 5 hr/d (8 days apart)	Inflammatory response, acute respiratory symptoms and an increase in bronchial responsiveness
0.5 – 37 (3.5 average)		Odour threshold
12 - 14		Odour complaint level

**Table 2 Summary of chronic effects in humans following inhalation exposure to ammonia**

Air Concentration (mg/m <sup>3</sup> ) <sup>a</sup>	Exposure Period	Effects Reported
> 50	> 1 yr	Reduction in pulmonary function of exposed workers (cough, phlegm, wheeze or dyspnea)
8	9.7 yr	3% decline in Forced expiratory volumes (FEV) measured pre- and post-shift
6	12.2 yr	No adverse effects on lung function
5	10.7 yr	2% decline in FEV measured pre- and post-shift
1.7	15.1 yr	No significant association between ammonia exposure and measured bronchial responsiveness
0.12 to 0.16	> 6 mo	Significant increase in the incidence of reported acute respiratory disease in school children
0.12 to 0.16	> 6 mo	No increase in the reported incidence of acute respiratory disease in school children

<sup>a</sup> Conversion factor and assumptions used: mg/m<sup>3</sup> x 24.45/MW = ppm; MW = 17.03, air at 25°C and 101.3 kPa

**Table 3 Summary of effects in vegetation following exposure to ammonia**

Air Concentration (µg/m <sup>3</sup> )	Exposure Period	† Effect
240	3 mo	Scotch pine: Needle/root increased > 25%
180	13 wk	Douglas fir: > 50% increase in N of 7 w needles 25 - 50% increase in N of 1 – 2 yr needles
180	13 wk	Douglas fir: > 50% decrease in mycorrhizal infection
< 150	60 d	Norway spruce: Up to 25% increase in visible needle injury
107	12 mo	Heather: 25-50% increase in larval development feeding on leaves
105	10 mo	Scotch pine: > 50% decrease in bud break and apical shoot growth - two week drought at 9 mo exposure may have affected growth
105	5 mo	Scotch pine: 25 - 50% decrease in frost hardiness
100	38 wk	Heather: > 50% increase in tissue nitrogen content
100	8 wk	Carolina poplar: > 50% increase in max photosynthetic rate
60	53 d	Conifers: Spring, no effects
60	60 d	Wintertime, 25 - 50% increase in visible injury
53	8 mo	Colonial bentgrass: Shoot/root increased > 50%
53	16 mo	Mountain arnica: 25 - 50% decrease in flowering > 100% increase in shoot dry weight

† Effect shown is percentage increase or decrease over the control