

## Methanex: ammonia frequently asked questions

### What is ammonia?

- Ammonia ( $\text{NH}_3$ ) is a compound of nitrogen and hydrogen.
- It is a colourless gas with a sharp odor. It's water-soluble, naturally occurring in the environment.

### How is ammonia produced?

- Ammonia is primarily manufactured using the Haber-Bosch process, a century-old method that combines nitrogen ( $\text{N}_2$ ) from the air with hydrogen ( $\text{H}_2$ ), typically derived from natural gas, under high pressure (150-250 atmospheres) and temperature (400-500°C) with an iron catalyst.
- This process produces over 180 million tonnes of ammonia annually worldwide, according to industry estimates like those from the International Fertilizer Association (IFA).
- Emerging methods, such as green ammonia production, use renewable energy to electrolyze water for hydrogen, paired with air-derived nitrogen, offer a low-carbon alternative.

### What is ammonia used for?

- Ammonia is primarily used in fertilizers, with over 70 per cent of its global demand tied to agriculture.
- It is also key in refrigeration, plastics and cleaners.
- Emerging uses include marine fuel and hydrogen storage.

### What are the chemical derivatives produced from ammonia?

- **Urea:** fertilizer and feedstock for plastics like urea-formaldehyde resins.
- **Ammonium Nitrate:** used in fertilizers.
- **Nitric Acid:** a precursor to fertilizers like TNT.
- **Hydrazine:** used in rocket fuels and pharmaceuticals.

### What are the risks of ammonia exposure, and how can they be mitigated?

- Ammonia poses risks due to its toxicity and corrosiveness. The Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) warn that inhalation above 300 ppm is immediately dangerous to life and health (IDLH).
- Ammonia is a colourless gas that is an irritant to the upper respiratory tract.
- Skin or eye contact with liquid ammonia may lead to burns or frostbite.
- Ammonia's pungent, suffocating odour, detectable at 5-50 ppm per the Agency for Toxic Substances and Disease Registry (ATSDR), serves as an early warning.
- Mitigation includes wearing personal protective equipment (PPE), such as respirators and goggles, ensuring adequate ventilation, and using leak detectors.
- In emergencies, immediate water flushing for 15 minutes can reduce injury, per the Safety Data Sheet and OSHA guidelines.

### How does ammonia behave when stored or transported?

- Ammonia is typically stored and transported as a liquid under moderate pressure (around 10-15 atmospheres) or refrigerated at -33°C, leveraging its boiling point.
- The Chemical Safety Facts resource notes that it is shipped in steel tanks or pipelines due to its corrosiveness to metals like copper.

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- As a gas, it is lighter than air; therefore, ammonia leaks will tend to rise and disperse outdoors given dry conditions. However, in confined spaces, ammonia vapours can accumulate, posing risks. Its water solubility aids spill cleanup, though careful management is required to prevent environmental harm.

#### **What happens to ammonia in the environment?**

- Ammonia evaporates quickly in air and has a high rate of expansion.
- In water, it dissolves and forms an equilibrium with ammonium hydroxide, a weak base.
- Ammonia doesn't bioaccumulate but can harm aquatic life in high concentrations.

#### **How to manage ammonia safely?**

- Ammonia requires ventilation, protective equipment, and leak detection systems due to its toxicity and corrosiveness. Industry leaders promote best practices for its production, transport, and use.

#### **Can ammonia be used as a fuel, and how does it compare to traditional fuels?**

- Yes, ammonia is emerging as a carbon-free fuel for applications like marine shipping, power generation, and even vehicle engines.
- Unlike gasoline or diesel, which release CO<sub>2</sub> when burned, ammonia (NH<sub>3</sub>) contains no carbon, and produces only nitrogen (N<sub>2</sub>), water (H<sub>2</sub>O) and small amounts of oxides of nitrogen (NO<sub>x</sub>) when combusted.
- Industry trends indicate that it can reduce emissions of sulphur oxides (SO<sub>x</sub>) and particulate matter by over 95% compared to heavy fuel oil. However, its lower energy density and toxicity, compared to heavy fuel oils, require specialized engines and handling, making it a promising but still-developing alternative to traditional fossil fuels.

#### **Why is ammonia important for food production?**

- Ammonia is essential to feeding the world because it is a primary ingredient in nitrogen-based fertilizers like urea and ammonium nitrate.
- The Food and Agriculture Organization (FAO) estimates that over 50% of global food production relies on ammonia-derived fertilizers, which replenish soil nitrogen vital for plant growth.
- Without it, crop yields would plummet, threatening food security for billions. Its scalability and efficiency make it irreplaceable in modern agriculture, supporting everything from wheat fields to rice paddies, with annual fertilizer demand exceeding 100 million tonnes, as noted by the International Fertilizer Association (IFA).

#### **Who We Are**

Methanex is a Vancouver-based, publicly traded company and is the world's largest producer and supplier of methanol to major international markets. Methanex shares are listed for trading on the Toronto Stock Exchange in Canada under the trading symbol "MX" and on the NASDAQ Global Market in the United States under the trading symbol "MEOH". Methanex can be visited online at [www.methanex.com](http://www.methanex.com).

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