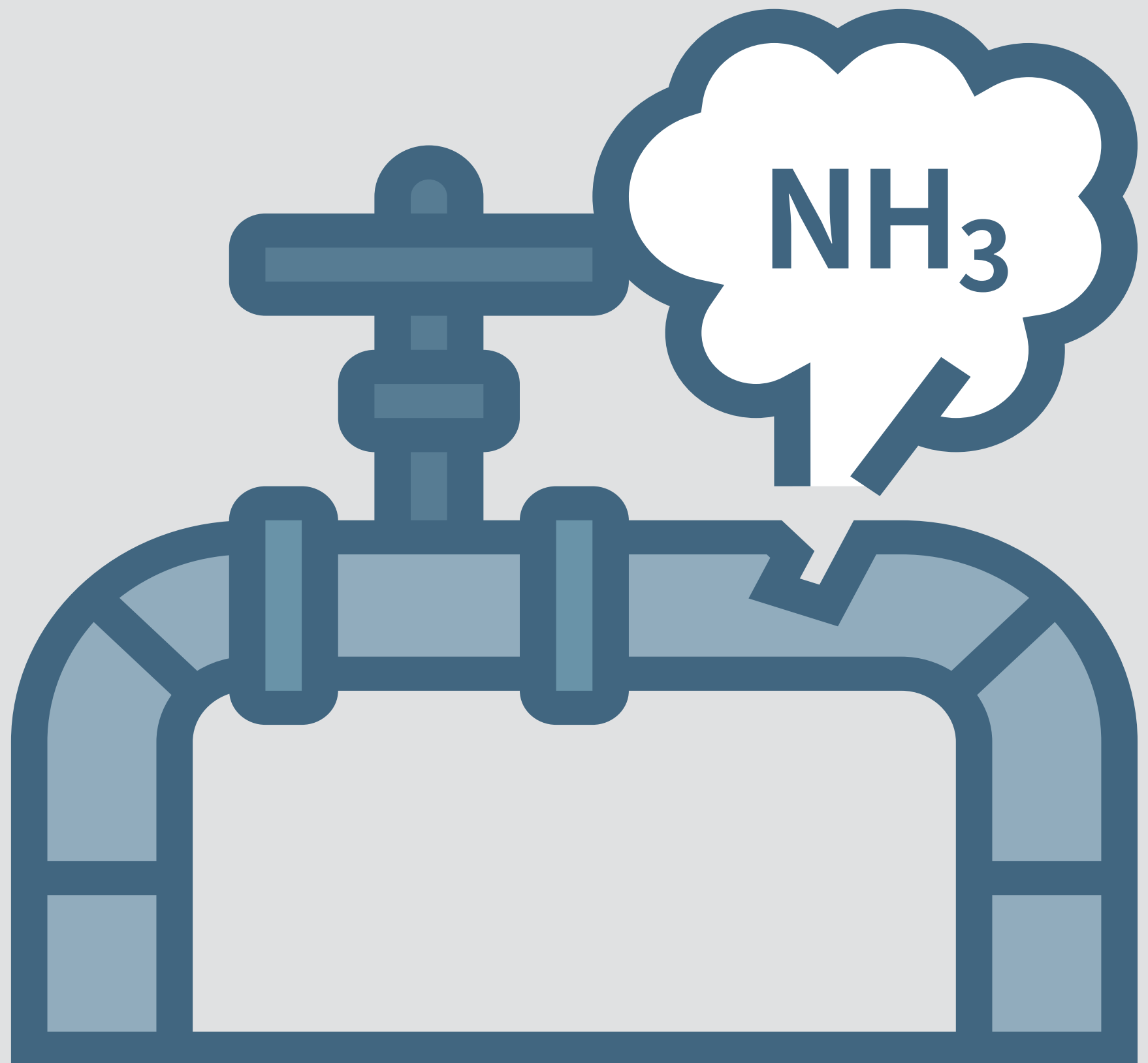


Process safety knowledge

AMMONIA SAFETY

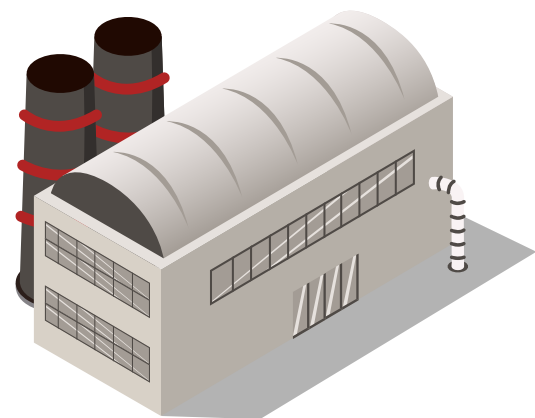
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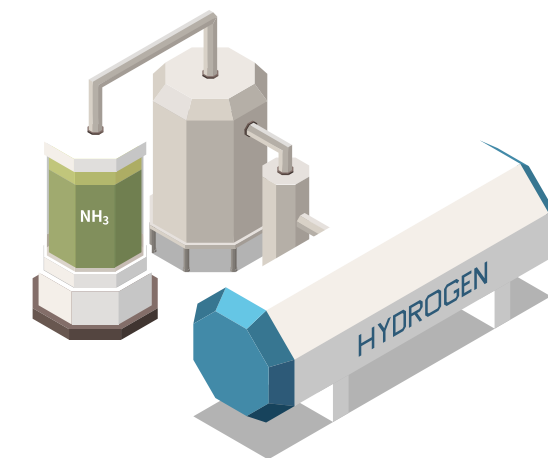
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AMMONIA HAS A WIDE RANGE OF APPLICATIONS ACROSS VARIOUS INDUSTRIES.

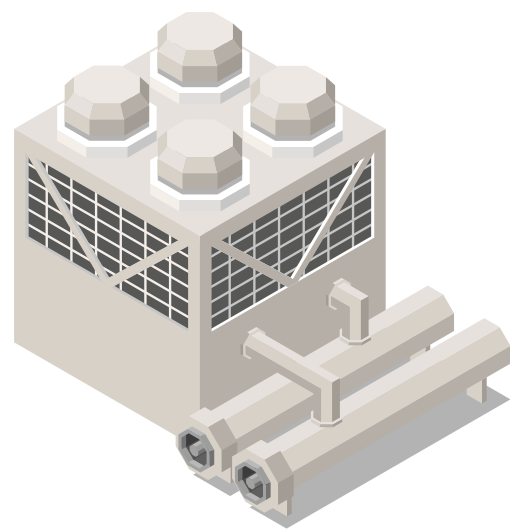
A KEY
COMPONENT
IN CHEMICAL
PRODUCTIONS.



A FUEL IN
ENERGY
PRODUCTIONS.



A REFRIGERANT
FOR COOLING
SYSTEMS.



AN ALTERNATIVE
FUEL FOR
ENGINES.



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AS AN ALTERNATIVE FUEL, AMMONIA HAS MANY BENEFITS.

#1

Can be manufactured using renewable energy sources, making ammonia a carbon-neutral fuel.

#2

Has 9x the energy density of li-ion batteries.

#3

Has 3x the energy of compressed hydrogen.

#4

Will not produce any carbon emissions.

#5

Has already mature production and distribution infrastructure at relevant scale.

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HOWEVER, AMMONIA PRESENTS A SERIES OF HAZARDS.



■ Toxic hazard

Ammonia is very toxic and corrosive. Inhalation of ammonia gas may lead to fatality and direct contact may cause irritation and burns. In addition, direct contact with liquefied refrigerated ammonia may cause frostbite.



■ Flammable hazard

High airborne concentrations can be ignited with a high energy source, leading to possible fire and explosion hazards, especially in a confined space.

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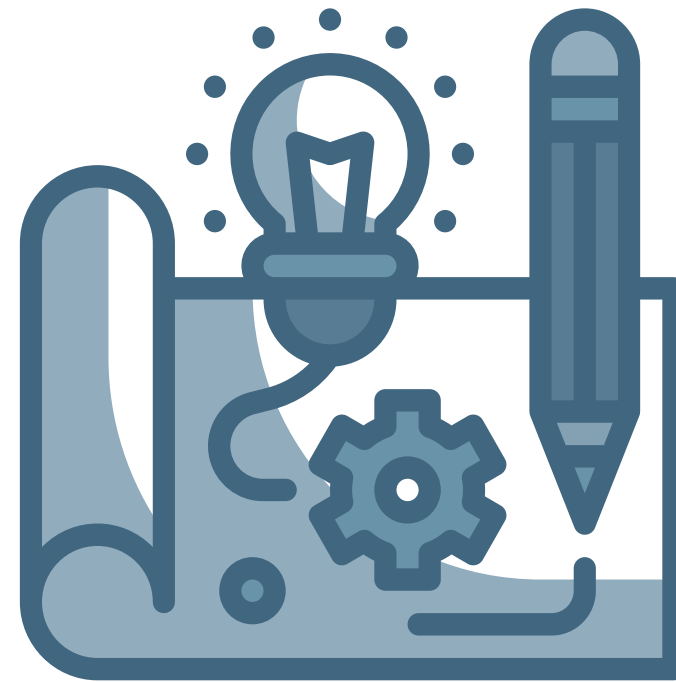


DUE TO THOSE HAZARDS,
**SAFETY NEEDS TO BE TAKEN
SERIOUSLY.**



■ **Ensure protection**

Safety in ammonia processing facilities is essential to ensure people, assets and the surrounding environment are protected.



■ **Consider properties**

This can be done by designing safe facility layouts and processes and considering ammonia's chemical and physical properties.

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WHAT ARE THE PROPERTIES OF AMMONIA?

- Very toxic.
- Corrosive.
- Lighter than air - presents buoyant behaviour when released at ambient conditions.
- Dense gas dispersion behaviour when released as liquefied refrigerated gas (-33°C).
- Has hygroscopic properties, which means it absorbs moisture.
- Has a low flammability range (15–28%) and a very high minimum ignition energy (690 mJ), which is why ammonia's fire risk can usually be neglected.

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CONSIDERATIONS IN DESIGNING A SAFE AMMONIA FACILITY.

- Perform **consequence analysis** to understand the severity of potential ammonia releases.
- Identify **appropriate preventive and mitigative** measures, such as:
 - Use proper personal protective equipment.
 - Optimize gas detector placement.
 - Use corrosion-resistant tools and equipment.
 - Separate storage from incompatible materials.
 - Use a local exhaust ventilation and enclosure.
 - Eliminate ignition sources.
 - Install approved explosion- and fire-proof equipment.
 - Comply with all applicable health and safety regulations, fire and building codes.

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PROCESS SAFETY FROM
INDUSTRY EXPERTS!**



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