WORLD PUMPS

Pumps & Compressors for Ammonia Production

By Sundyne's Peter Roth & Greg Junot

Producing green and blue ammonia involves a wide range of pumps and compressors

Ammonia (NH_3) produced by the catalytic reaction of nitrogen and hydrogen at high temperature and pressure is one of the most commonly produced industrial chemicals in the world. Ammonia can also be found naturally, from the decomposition of plants, animals and animal waste.

About 80% of the ammonia produced by industry is used in agriculture as fertilizer, or as granular urea, urea ammonium nitrate (UAN), or ammonium nitrate (AN). Ammonia plays an important role in the energy transition because it is a flexible, long-term energy carrier and zero-carbon fuel.

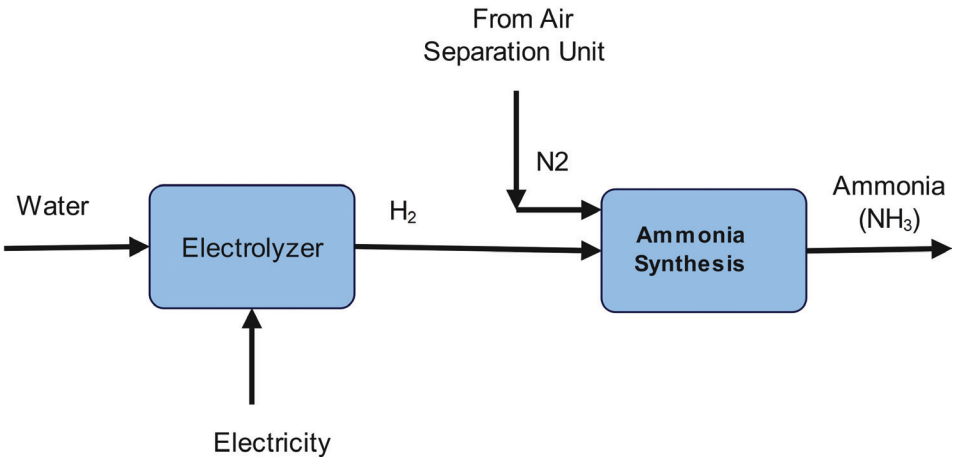
Ammonia is also used as a refrigerant gas for purification of water supplies, and it is used in the manufacture of plastics, explosives, textiles, pesticides, dyes and other chemicals.

Green Ammonia:

Ammonia can be made synthetically by combining nitrogen with hydrogen, in a process called ammonia synthesis. When this process is completed using renewable energy sources with zero carbon emissions (such as wind, solar, hydropower and geothermal energy) the result is green ammonia. Ammonia synthesis is achieved by combining green hydrogen and nitrogen at high temperature and pressures (modified Haber-Bosch Process):

Green Ammonia is often used as a:

- Hydrogen carrier over long distances
- Fuel for engines, such as locomotives and ships, replacing diesel and marine fuel oil
- Fuel for electricity power generation
- Building block to make fertilizers, and a feedstock for industrial applications.



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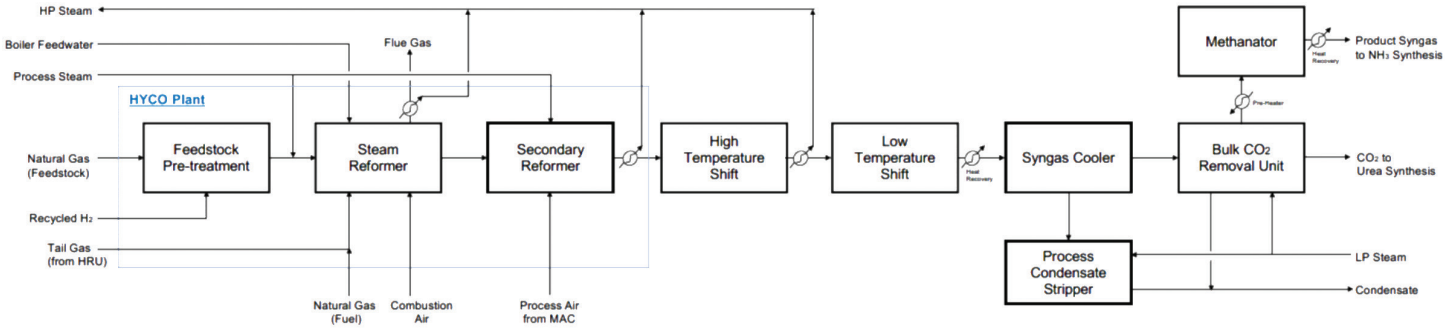
Blue Ammonia:

Blue ammonia is made from nitrogen and hydrogen derived from natural gas feedstocks, with the carbon dioxide by-product from hydrogen production captured, utilized or stored (CCUS). The product characteristics of blue ammonia are identical to conventionally produced ammonia.

Blue Ammonia is manufactured by converting gaseous nitrogen (N_2) and hydrogen (H_2) in synthesis gas (Syngas) in the presence of a catalyst. The Syngas comes from Hydrogen, which is produced by reforming or gasification of fossil feedstocks combined with CO_2 Capture.



Today, there are three primary methods for producing Blue-H_2:

- **Steam Methane Reforming (SMR):** is the most widely deployed technology. SMR involves reacting natural gas with steam in the presence of a catalyst at high temperature to produce hydrogen. Approximately two-thirds of the CO_2 is in concentrated form during hydrogen production. The remaining third is generated in dilute form in the flue gas from burning natural gas for heating purposes. Post-combustion carbon capture can be retrofitted to convert grey hydrogen production to blue.
- **Autothermal Reforming (ATR):** improves the cost-effectiveness of SMR by adding Oxygen to the process and a higher overall energy efficiency. In ATR, pure oxygen is supplied for combustion which results in a concentrated and high-pressure stream of CO_2 making carbon capture integration easier. This requires a substantial feed gas pretreatment investment and the fired heater produces CO_2 emissions.
- **Partial Oxydation (POX):** reactions between oxygen and hydrocarbons in the reformer produce H_2 rich syngas. It is a noncatalytic process that does not consume steam and has no direct CO_2 emissions. With no need for feed gas pretreatment, POX technology is simpler than ATR.

Blue syngas is further processed to adjust the gas mixture composition. It is then purified in a CO_2 removal section to produce blue hydrogen-rich syngas, and it also goes through a methanator unit which removes the remaining CO and CO_2. Finally, Blue ammonia synthesis is achieved by combining and reacting blue H_2 rich syngas and nitrogen at high temperature and pressure (modified Haber-Bosch Process).

Blue ammonia is a high-volume carrier of hydrogen energy. It helps hard-to-abate industries (such as transportation and power generation) decrease their carbon intensity.

Pumps & Compressor Applications for Ammonia Production:

Some ammonia solutions (at concentrations of 25% or higher) are corrosive, so the hydraulic equipment used to produce ammonia must be durable and reliable. A wide range of pumps & compressors are used in Green and Blue Ammonia Production, including:

Pump Applications:

1. Boiler Feed Water Circulation Pump
2. Hydrogen Condensate Pump
3. Sea Water Pump
4. Cooling Water Pump
5. Corrosion Inhibitor Pump
6. Water Feed & circulation Pump
7. KO Drum Pump
8. Amine Circulation & Booster Pump
9. Wash Water Pump.

Compressor Applications:

1. Refrigerant Gas Compressors
2. Hydrogen Recycle Compressor
3. Fuel Gas Compressors
4. Natural Gas Feed Compressor
5. CO_2 Compressor
6. Molecular Sieve Regeneration Gas Compressor
7. PSA Regeneration Compressor
8. Gas Treatment Compressor
9. Flare Gas Recovery Compressor.

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Hall 8,
Stand A95

Pumps for chlorine, ammonia and caustic soda

Sundyne

At ACHEMA, Sundyne will showcase its Ansimag and HMD sealless magnetic drive pumps, which are a preferred choice for chemical processing applications. The company will also show Sundyne pumps and compressors, which are used in a wide range of chemical, energy and environmental applications.

Sundyne pumps and compressors are widely used to produce the three most commonly manufactured chemicals – chlorine, ammonia and caustic soda. Sundyne engineers are well versed in the production processes for chlor alkali and ammonia.

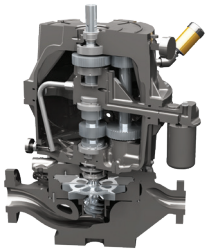
Sundyne rotating equipment is specifically designed to withstand the rigors of these production processes, and the company's aftermarket service and support teams are intimately familiar with the issues that chlor alkali and ammonia processing pose for rotating equipment.

To learn more about pumps and compressors for these as well as other chemical, energy and environmental applications, visit Sundyne in Hall 8 at ACHEMA.

Sundyne pumps are used in a wide range of chemical, energy and environmental applications

Criteria for Selecting Pumps and Compressors Used for Ammonia Production:

Operators should consider the following criteria when selecting pumps or compressors for ammonia applications:



- **Reliability:** ammonia plants are built to run for 20-50 years. Sundyne equipment has a service life of 30 years and some units have operated for more than 50 years.
- **Efficiency:** the footprint of Sundyne equipment allows users to install additional equipment in less space, like the addition of CO_2 capture on existing plants. Sundyne's 70-plus year track record makes it easy for operators to run equipment at Best Efficiency Point (B.E.P.)
- **Worker Safety:** Ammonia compressors and pumps are subject to strict safety regulations. Sundyne liquid mechanical seals and dry-gas seals are proven for use in the petroleum, chemical and gas industry services. Ansimag and HMD sealless pumps are leak-proof by design, with fully enclosed wet-ends that eliminate leakage.
- **Superior Chemical Resistance:** Ammonia processing can wreak havoc on rotating equipment's internals. A wide range of metallic and ETFE materials are available to address any process requirement.
- **Simplified Maintenance:** The global volume of ammonia production illustrates the need for reliable equipment that minimizes plant downtime. Sealless pumps have fewer parts and no seal support systems, which increases Mean Time Between Maintenance (MTBM), and minimizes costs.

For decades, Sundyne has worked with the world's largest ammonia producers, pioneering many of the technologies that are commonplace today. To learn more about pumps & compressors for Ammonia production, visit www.sundyne.com or visit Sundyne at ACHEMA in Hall 8, Stand A95.