FLEXIBLUE®

AMMONIA

N-ELEVA BLUE

Casale's SMR-based Ammonia process for world-scale blue plants

CASALE

We are a global partner in the chemical industry, offering **integrated technologies, engineering, contracting and construction solutions** for over a century.

Our mission

Contribute to shape a new sustainable planet with our plants for the production of fertilizer, methanol, hydrogen, melamine and derivatives, and help our customers creating value respecting the environment.

We are a global company front leader in the energy transition: a key player in the sustainable transformation of the chemical and energy industry, from a social, economic and environmental point of view.

Our values

INNOVATION PEOPLE CARE **PROFESSIONAL EXCELLENCE**
QUALITY **SAFETY** ETHIC **SUSTAINABILITY**

AMMONIA

N-ELEVA BLUE

N-ELEVA BLUE is Casale innovative process to produce low-carbon ammonia through steam-methane reforming of natural gas, coupled with a unique pre-combustion CO_2 capture technology to achieve remarkably reduced carbon emission. Its notable attributes include flexibility to accommodate specific requirements and seamless integration into downstream unit.

Capacity

- Best suited for capacities ranging from **1000 MTD** to **3500 MTD** of ammonia

Performances

- Energy consumption from **7.9 Gcal/MT** LHV basis

Benefits

- Low energy consumption
- Reduced CAPEX
- The steam export can be adjust according to specific needs, from nil export to maximum
- Compact and simple lay-out, minimizing the overall footprint and optimizing the connections across the different sections of the plant

Enviromental Impact

The N-ELEVA BLUE process minimizes its environmental impact effectively.

The only liquid waste effluents are the boiler blow-down and the condensate from compressor air interstage cooler condensate, which are both reused in the cooling water circuit.

The primary reformer's flue gas contains 110 mg/Nm^3 of NOx, well below the allowable limits, at 3% oxygen excess.

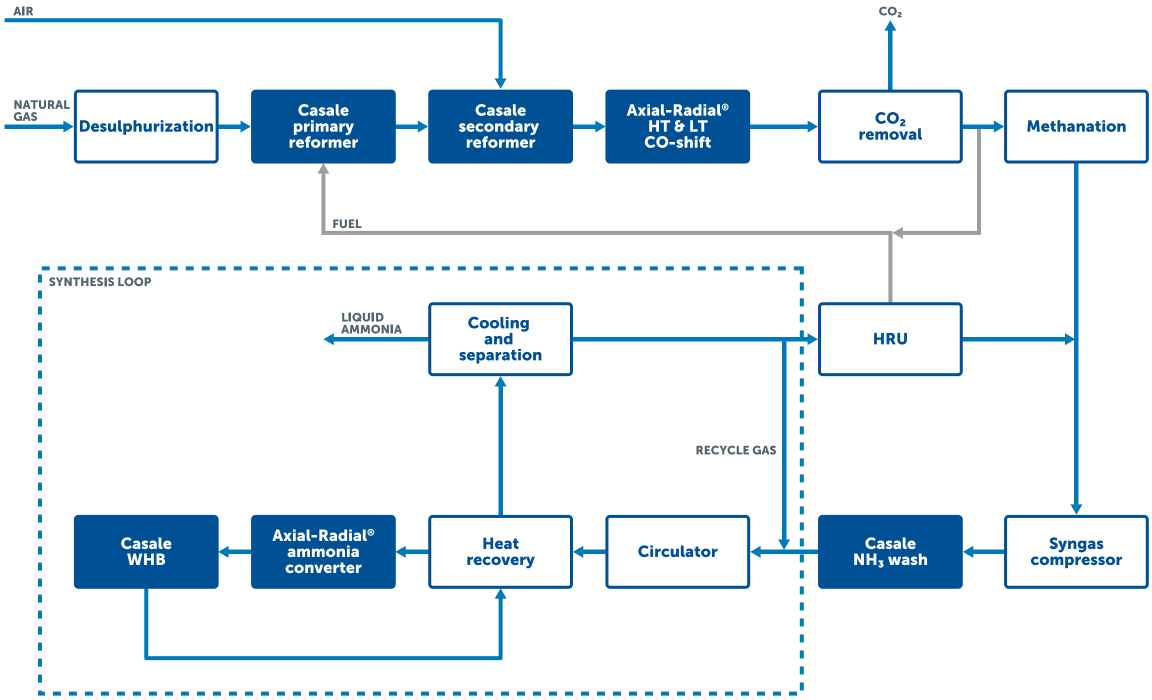
The ammonia content in other gaseous waste is maintained within allowable emission levels.

Most of the CO_2 generated is captured directly from the process gas. The Total CO_2 emission released to atmosphere are up to 0.1÷0.15 ton per ton of ammonia.

Casale technical assets

- Casale primary reformer
- Casale secondary reformer burner
- Casale Axial-Radial® HT and LT shift converters
- Casale ammonia washing unit
- Casale Axial-Radial® ammonia converter, with proprietary nozzle-to-nozzle connection between the pressure vessel and the downstream waste heat boiler
- Advanced waste heat recovery train in the synthesis loop
- AmoMax®-Casale ammonia synthesis catalyst

PROCESS OUTLINE



SYNTHESIS GAS PREPARATION

Desulphurization - The Natural Gas is first desulphurized over a conventional cobalt-molibdenum based catalyst followed by absorption over a ZnO bed.

Steam Reforming - After mixing with steam and being preheated, the desulfurized gas passes through the catalyst tubes of primary reformer furnace, where it reacts to form hydrogen and carbon oxides. The Fuel for the reforming furnace is mainly natural gas; the combustion air is preheated in the reformer flue gas heat recovery train (convection section).

Secondary Reforming - The reforming is completed in a catalytic reactor using the heat generated by the partial combustion of the incompletely reformed gas from the primary reformer, using process air introduced through a special patented Casale burner. The air flow rate is adjusted to achieve a 3:1 H_2/N_2 ratio in the final synthesis gas mixture to the ammonia synthesis section.

CO Shift section - After cooling to an appropriate temperature in a waste heat boiler generating high-pressure steam, the bulk of the carbon monoxide (CO) content of the raw synthesis gas is converted to CO_2 and H_2 by reaction with steam in a two-stage process (Hight Temperature and Low Temperature shift). Casale Axial-Radial® flow internals are used in both shift reactors.
A vPSA can be optionally used to enrich the air going to the secondary reformer.

CO_2 removal - After cooling and condensation of surplus steam, the gas next passes into the absorption column of a high- efficiency regenerative CO_2 removal system (third-party solution technology), leaving with a CO_2 content of <1,000 ppmv. The CO_2 recovered is made available for other uses. For special applications Casale can supply proprietary hardware for this section.

Pre-combustion carbon capture - Downstream the CO_2 removal section, a portion of the H_2-rich and CO_2 -free syngas is sent to the primary reformer fuel gas system thus significantly mitigating the overall carbon emissions of the process

Methanation - The balance syngas is reheated before any remaining carbon oxides are converted back to methane by reaction with hydrogen. The synthesis gas is cooled and fed to the ammonia synthesis section.

AMMONIA SYNTHESIS

Compression - The fresh make up gas (MUG) is compressed up to required pressure for ammonia synthesis. The compressor has a low pressure (LP) casing and a high pressure (HP) casing. Upon leaving the LP casing the gas is dried by washing with liquid ammonia using a Casale proprietary ammonia scrubber. This removes the last few traces of oxygenates compounds (mainly CO_2 and H_2O), which are a poison for the synthesis catalyst.

Part of the hydrogen recovered in the loop purge gas hydrogen recovery unit (HRU) is added to the dry MUG at this stage whilst the remainder is added at the suction of the compressor.
The dry synthesis gas is further compressed in the HP casing up to the synthesis pressure.

Ammonia Synthesis - The combined make-up gas and recycle gas stream is preheated in the hot gas-gas heat exchanger, using the hotter converter effluent.

The preheated gas then enters the ammonia converter, in which it reacts over an iron-based catalyst.
The ammonia converter is based on the well proven Casale Axial-Radial® design with three adiabatic beds with two inter-bed heat exchangers.
The converter outlet gas is cooled, first in a waste heat boiler and then in the hot gas-gas heat exchanger, before condensing the ammonia produced, first in a water cooler, then in the "cold" gas-gas exchanger and lastly in the ammonia chillers.

Ammonia Refrigeration - The ammonia refrigeration section mainly consists of a multi-stage compressor. The ammonia vapors leaving the last stage discharge is condensed by cooling and expansion and is collected in the refrigerant receiver.

PURGE GAS TREATMENT

Ammonia Recovery - To prevent an excessive built-up of inerts in the synloop, a portion of the recycle gas is continuously withdrawn as "purge gas". Along with other inert gas from the refrigerant ammonia receiver, this gas is scrubbed with water to absorb the ammonia residues.

Hydrogen recovery - A hydrogen recovery unit (HRU) recovers the H_2 in the scrubbed gas and returns it to the synthesis loop.

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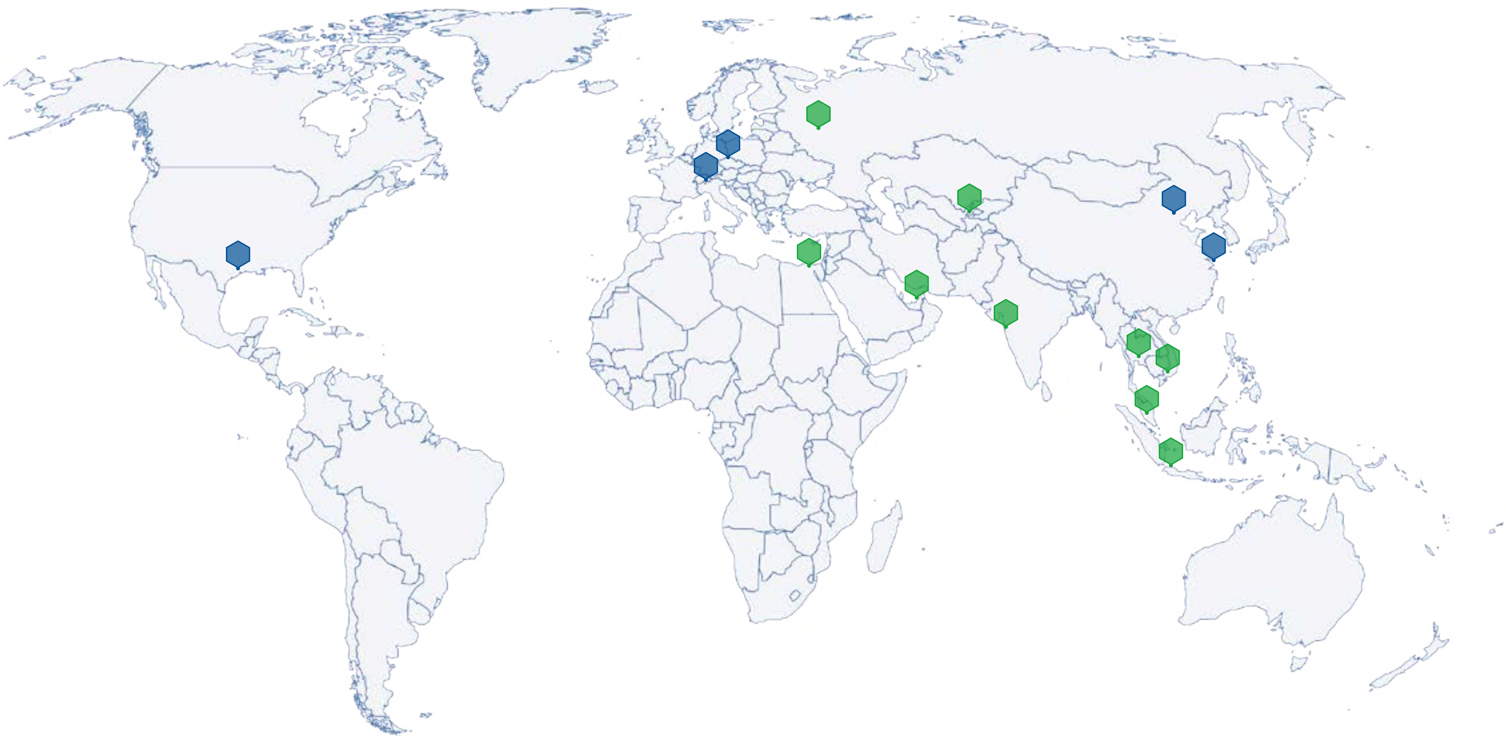
PLANTS FOR
A NEW PLANET.
SINCE 1921.

Casale in the world



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