AMMONIA

FLEXIGREEN®

AMMONIA

SMART-N

Casale's solution for small green Ammonia synthesis 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 value

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

AMMONIA

SMART-N

SMART-N is Casale sustainable solution for small green ammonia synthesis plants, whose feedstock is hydrogen produced via water electrolysis using renewable energy and pure nitrogen obtained in an air separation unit. This process scheme can be easily customized to meet specific Client's needs and adapted also for other applications such us in case of small blue or turquoise ammonia plants.
A distinctive feature of this process lies in its wide capacity rangeability and, if required, it can reliably operate with an erratic renewable power supply so to avoid or minimize the negative effects of cyclic operation and fatigue. Main feature of the Smart loop is to minimize the number of equipment required for green ammonia production (the minimal configuration is requiring 5 item).
Minimal Capex and plot plan are thus obtained.
The process scheme is extremely flexible and can be used to produce pressurized or atmospheric (cold) ammonia.

Enviromental Impact

The plant has no CO_2 emissions if all renewable energy is used.

Capacity

- Best suited up to **300 MTD**, typically

Performances

- Loop turndown ratio, from **10%** to **110%**
- Energy consumption: about **300 kWh/MT**
- No demi-water consumption

Benefits

- Simple arrangement
- Compact lay-out
- Reduced CAPEX
- Production of either pressurized ("hot") ammonia or atmospheric ammonia ("cold")

Casale technical assets

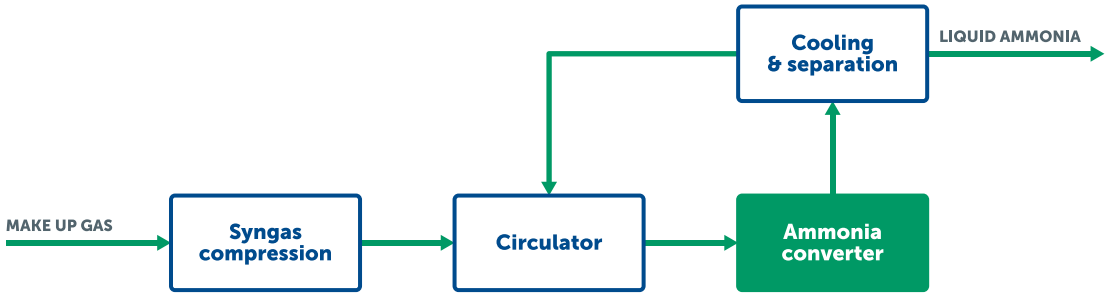
- Casale Axial-Radial® ammonia converter
- Electric Start-up heater of the ammonia converter
- Ammonia washing unit (if required), to remove the water possibly present in the fresh make-up gas
- Casale optimizer
- Casale dynamic analysis system

PROCESS OUTLINE

The make-up hydrogen and nitrogen are supplied at 3 to 1 ratio, compressed up to final loop operating pressure and then mixed with the recycle unreacted gases.
The mixture is fed to the Casale ammonia converter in which the gas is pre-heated to the final reaction temperature before flow through the catalytic beds. The converter incorporates the well-known Casale Axial-Radial® technology for all the catalytic beds. An electrical heater housed inside the converter is used for cold start-up and during catalyst activation.
The hot converter effluent is routed to the 1st downstream cooler, which in a typical arrangement is an air cooler. This is followed by a water cooler where the final ammonia condensation is obtained.

The liquid ammonia is then first separated in high pressure separator then depressurized and sent to Battery Limits, while the unreacted gas is recycled back to the synloop circulating compressor.

The liquid ammonia can also be produced at atmospheric pressure ("cold" ammonia). In this case the ammonia vapors are recovered in a dedicated small refrigerant compressor.



CASALE OPTIMIZER

This tool optimizes the variable renewable energy utilization, minimizing the so-called "curtailed energy", and the pre-sizing of the whole plant components, including the SMART-N, the hydrogen storage and the water electrolyzers.
It also optimizes the overall process control so that the plant operates at the highest possible output and the lowest possible Levelized Cost Of Ammonia (LCOA). Optimization takes account of the yearly profiles for the renewable power unit and exploits the flexible design features of Casale's SMART-N ammonia plant.

CASALE DYNAMIC ANALYSIS MODEL

This tool is a dynamic process model of the plant which can simulate the process using scenarios from real fluctuations in the renewable power profile. It allows fine tuning of the system, troubleshooting and scheduling.

The tool can dynamically analyze and determine the following:
- renewable power profile
- grid power, if available, although 'off grid' island mode generation can also be an option
- electrolysers: specifies their optimal size
- hydrogen storage: including sizing, control philosophy and plant integration
- ammonia plant: its unique and independent controls
- nitrogen generation: suggests the optimal N_2 profile.

PLANTS FOR
A NEW PLANET.
SINCE 1921.

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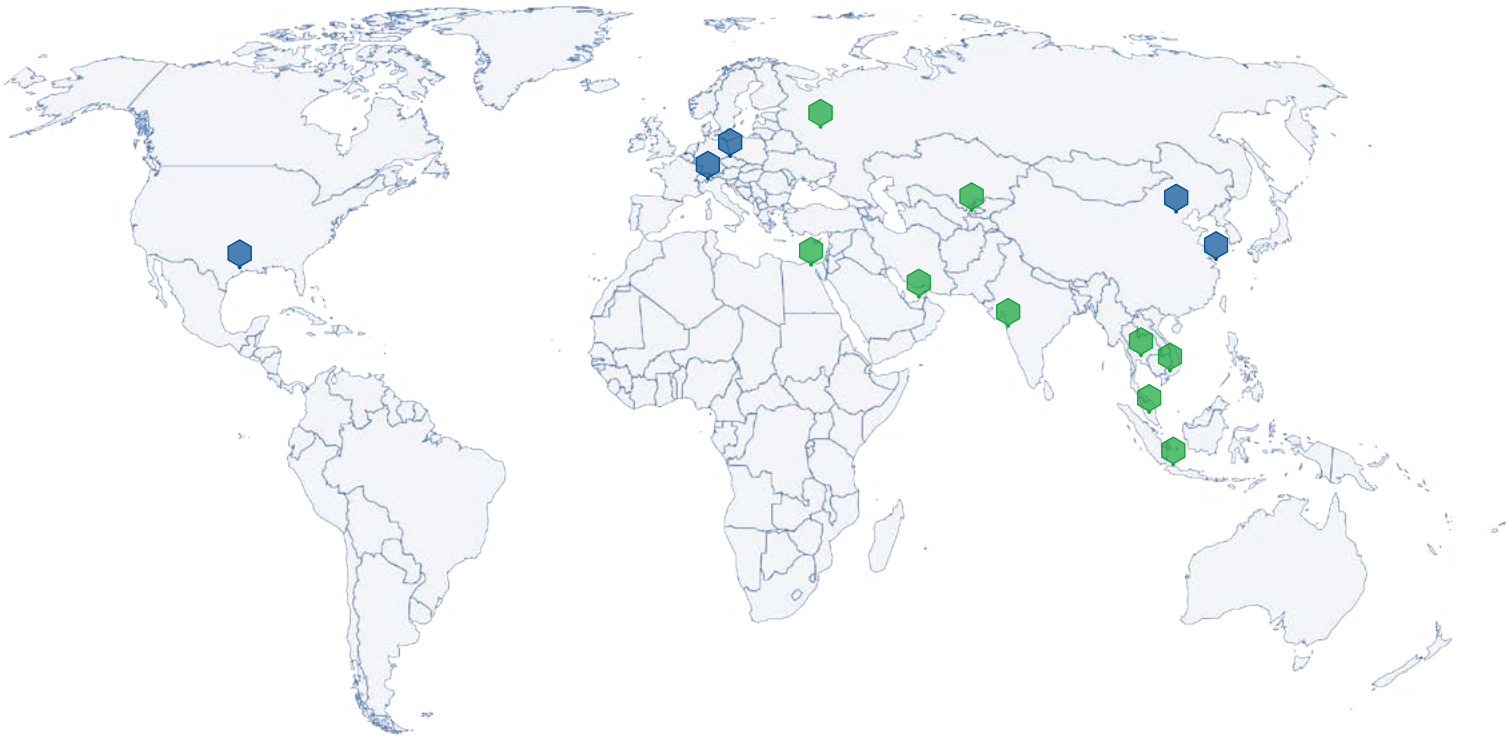
Casale in the world



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