



New Technological Concept for Nitric Acid: The Compact Nitric Acid Plant

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The nitric acid market demands plants with low investment costs but with uncompromising adherence to high product quality and ever more demanding environmental standards. Krupp Uhde has been a leader in the design and construction of nitric acid plants for some eighty years. Now Krupp Uhde has developed a new concept particularly suited to medium capacities which meets the requirements outlined above: the Compact Nitric Acid Plant.

The concept involves the optimum utilisation of the space available by paying careful attention to equipment layout and by minimising the size of buildings and structures. With this philosophy a reliable plant which incorporates proven Krupp Uhde standards and know-how has been developed with the aid of modern computer technology. It also goes without saying that an ISO 9001 quality management system is in place at Krupp Uhde and its project-specific effectiveness has been verified in practice.

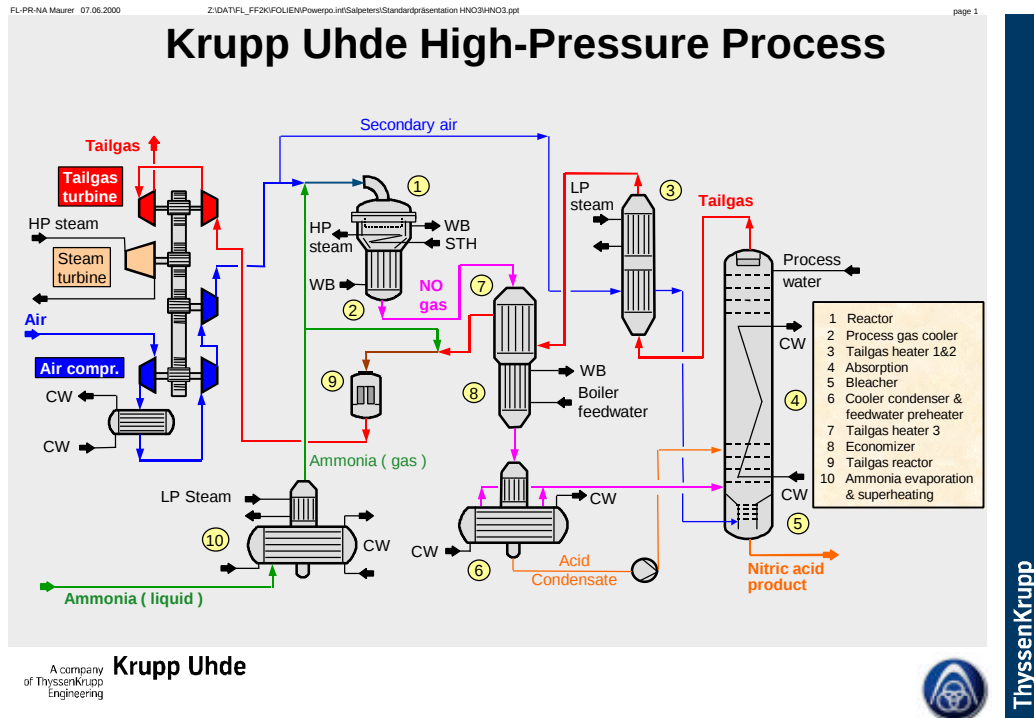
The process used is the proven Krupp Uhde high-pressure process. The catalytic ammonia combustion unit and the acid absorption unit operate at the same pressure of approximately 10 bar. Such a plant naturally requires smaller equipment and piping than, for example, a medium- or dual-pressure plant. As regards emissions, this compact design meets international requirements for nitric acid plants, which generally limit the NO_x concentration in the offgas to 50 ppm (vol.) so as to ensure an invisible plume. To achieve this emission limit a selective catalytic reduction (SCR) unit utilising ammonia as the reducing agent is integrated into the process. The acid absorption unit can be tailored for the production of standard 60 percent acid or any higher concentration up to around 68 percent strength, as required. Bleaching of the acid is performed in a stripping column that is incorporated into the bottom of the absorption tower in the interests of a reduced plant footprint.

Another characteristic feature of the Compact Nitric Acid Plant is the machinery concept. For the first time, a two stage axial tail gas turbine has been integrated as a module and coupled with a three stage bull gear compressor. This modular construction permits the use of just two planetary shafts and the central pinion to drive all the machinery required. The compressor and tail gas turbine are mounted on a common base frame which also accommodates both the drive and the intercoolers. This results in a compact machine set which can be easily covered by an acoustic hood, if necessary. Either an electric motor or a condensing steam turbine can be used as the drive. With a steam turbine, the process is designed for energy self-sufficiency, i.e., for normal continuous operation exporting a significant amount of steam rather than importing it.

This machinery concept simplifies plant maintenance and reduces erection times, since a completely pre-assembled unit is installed. Time consuming on-site alignment and test runs of each individual machine are not required, because these tasks can be performed in advance in the manufacturer's workshop.

The heat exchangers of the process heat recovery train and the tail gas preheating section are combined to the maximum extent possible and arranged vertically. This generates significant savings in space requirements and erection time.

Summarising, it can be clearly stated that due to the very compact arrangement of all the equipment the size of the building needed to house the machine set and the boiler unit can be minimised without compromising maintenance access, thus conferring an additional advantage with regard to investment costs. A 210 mtpd Compact Nitric Acid Plant built for the Thai Nitrate Co. Ltd., Thailand and a 405 mtpd unit for Queensland Nitrates Pty. Ltd., Australia are currently in operation.



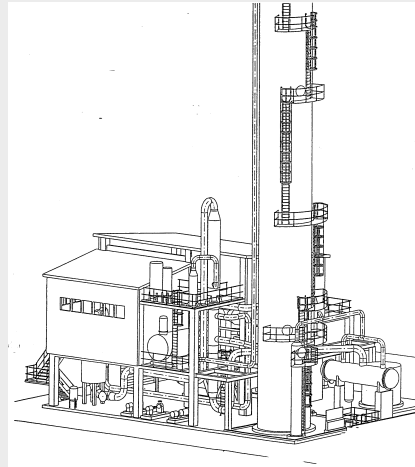
Compact Nitric Acid Plant specific production and consumption figures per metric ton of nitric acid (100 percent) produced - steam turbine driven compressor train assumed:

Primary loss of catalyst	0.260 g
Net loss of catalyst with recovery system installed	0.080 g
Consumption of ammonia	290 kg
Cooling water circulation, $\Delta T = 10\text{ K}$	125 t
Electric power (LT)	13 kWh
Catalyst charge (per t HNO_3 production/day)	85 g
Export steam (net, with condensing steam turbine drive, 40 bar, 450°C)	0.30 t
NO _x in tail gas	< 50 ppm

With the above catalyst charge the running period between catalyst changes exceeds 3 months.

The Krupp Uhde Compact Plant

- ◆ Market
 - low investment costs
 - high product quality
 - environmental aspects
- ◆ Design
 - Mono-high-pressure process
 - Advanced absorption system
 - Advanced machinery concept
 - Vertical heat exchanger arrangement



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Compact nitric acid plant, Thailand (left) and Australia (right).