

THE LINDE GROUP

*Linde*

# Synthesis, Ammonia and Methanol Plants



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# Introduction.

Synthesis, ammonia and methanol plants

## Plants

Linde as a leading supplier of syngas technology designs, supplies and constructs entire synthesis gas plants for the production of carbon monoxide, hydrogen and mixtures of these gases as well as ammonia and methanol plants.

## Processes

Providing the whole range of processes Linde can select the most appropriate solution for each case from the options: steam reforming, tandem reforming (gas heated reforming), autothermal reforming, partial oxidation and CO<sub>2</sub> reforming.

## Feedstocks

Linde has the design know-how and inhouse experience on processing all hydrocarbon feedstocks from natural gas, LPG, naphtha up to residual oil and heavier feeds.

## Economics

Having available the whole range of processes and being experienced in the design of all feedstocks and capacities, Linde can select the technically and economically most favourable configuration.

# Syngas plants.

## Process

Whereas the physical/chemical conditions of the individual process steps may be different, the process sequence in principle is the same for all synthesis gas plants and includes hydrocarbon conversion, heat recovery, sour gas removal and product gas recovery.

## Hydrocarbon conversion

Synthesis gas generation by conversion of hydrocarbon feedstocks typically is the first step of a synthesis gas plant. Depending on the ratio of hydrogen to carbon monoxide desired as products, and the feedstock available, different processes are used. Light feedstocks and

steam reforming are used to produce a crude synthesis gas with a high content of hydrogen, as where heavy feedstocks will yield the lowest hydrogen content in a partial oxidation process. Tandem reforming, a combination of gas heated reforming with oxygen blown secondary reforming is most suitable for large capacity, natural gas based methanol plants.

## Sour gas removal

The RECTISOL® wash process is the typical scrubbing process in hydrogen or ammonia plants based on partial oxidation of heavy hydrocarbon feedstock.

The MDEA wash process is used in steam reformer plants with carbon monoxide as final product due to the absence of  $H_2S/COS$  and a lower  $CO_2$  content.

## Product gas recovery

In most cases cryogenic processes are applied for the separation of  $CO$  from the raw gas. There are two different cryogenic process routes available: the condensation process and the methane scrubbing process. For special conditions of a project membrane separation or pressure swing adsorption are applied.

Syngas plant in Germany





Carbon monoxide plant for the chemical industry in England

Linde has the capability to design and construct the plants for the whole range of industrial syngas, ammonia and methanol capacities.

# Ammonia plants.

Linde offers ammonia plants following the Linde Ammonia Concept LAC™. They are in operation in India, Australia and China with capacities from 230 mtd to 1350 mtd. The Linde Ammonia Concept (LAC™) is a new advance in the design of ammonia plants. LAC™ consists essentially of three proven process steps: a hydrogen unit with a pressure swing adsorption step for the purification of hydrogen, a standard nitrogen unit adding nitrogen to the hydrogen stream and the ammonia synthesis unit.

10 ammonia plants of up to 1350 mtd ammonia based on partial oxidation of heavy hydrocarbon feedstock are on Linde's reference list. For three of these plants Linde acted as main contractor for the complete scope.

## Methanol plants

The main feature of Linde methanol plants is the isothermal reactor, where the catalyst is sub-merged into a coil-wound heat exchanger controlling the reactor temperature by generation of MP steam.

In combination with an upstream autothermal reformer or tandem reformer an energy efficient methanol plant results.

## Outstanding Linde technology

Processes and plant components are planned from new or are developed further in Linde's own research center. Typically such developments are undertaken in cooperation with main customers. Several applications of the pressure swing adsorption process, the novel ammonia process LAC™ and the isothermal reactor are Linde's own developments. In connection with synthesis gas plants, the isothermal reactor is applied for CO shift and methanol synthesis. The RECTISOL® and nitrogen wash process are typical examples of Linde's proprietary process technology in syngas production and are frequently licensed by other contractors, building ammonia/urea plants based on the partial oxidation route.



Linde isothermal reactor

Ammonia plant in India





Gasification complex in Taiwan

## Engineering.

### Licensed technologies

Besides its own technologies, Linde uses licensed technologies for the design of syngas plants: GE/Texaco for the partial oxidation process and BASF for the MDEA wash process as well as Johnson Matthey/Dauy for the methanol synthesis.

The ammonia synthesis units are built with the synthesis process licensed by Ammonia Casale (first two with Topsoe's process).

### Linde's capabilities

Linde has all engineering expertise and contracting capabilities to execute jobs to the full satisfaction of the clients all over the globe. The contracts under which jobs are performed range from engineering services only to turn-key contracts and from cash to financed contracts. As a global contractor for LSTK contracts, Linde has demonstrated successfully its ability to act worldwide and to cooperate with local or international partners.

# Designing Processes – Constructing Plants.

Linde's Engineering Division continuously develops extensive process engineering know-how in the planning, project management and construction of turnkey industrial plants.

## The range of products comprises:

- Petrochemical plants
- LNG and natural gas processing plants
- Synthesis gas plants
- Hydrogen plants
- Gas processing plants
- Adsorption plants
- Air separation plants
- Cryogenic plants
- Biotechnological plants
- Furnaces for petrochemical plants and refineries

## Linde and its subsidiaries manufacture:

- Packaged units, cold boxes
- Coil-wound heat exchangers
- Plate-fin heat exchangers
- Cryogenic standard tanks
- Air heated vaporizers
- Spiral-welded aluminium pipes

More than 3,800 plants worldwide document the leading position of the Engineering Division in international plant construction.

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