

Making our world more productive



LACTM Linde Ammonia Concept

Putting our engineering and operational expertise to work for you



Direct path to ammonia efficiency with LAC™

Most operators of ammonia plants face similar challenges. On the one hand, they would welcome greater flexibility – over both their feedstock envelope and their choice of possible co-products. And, on the other, they need to optimize plant economics.

Linde Engineering developed the Linde Ammonia Concept (LAC) specifically to meet these challenges. Not only does it increase process flexibility compared with conventional ammonia processes, it also enables a smaller equipment footprint for maximum capital efficiency.

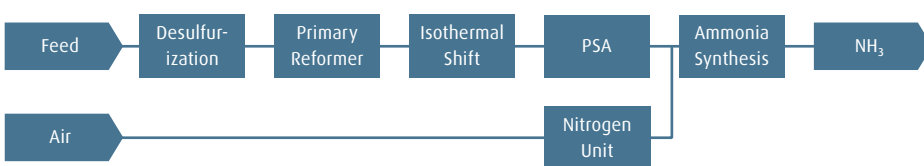
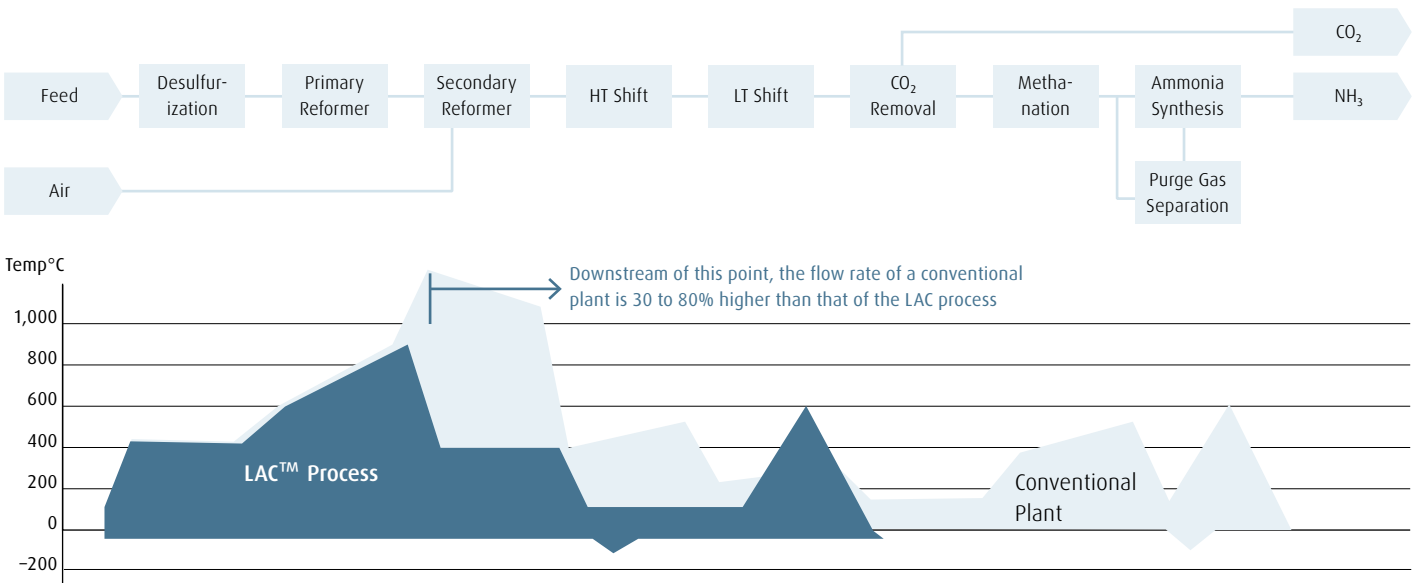
Linde is the only company worldwide that designs, owns and operates hydrogen, synthesis gas and ammonia plants using its own technologies. LAC thus builds on the unique, hands-on insights Linde has gained as both engineer and operator of ammonia (NH₃) plants over the decades. This standout concept eliminates the inert gas “ballast” during syngas generation and further intensifies ammonia synthesis. A streamlined process flow also enhances plant reliability overall.

The vast, long-standing experience Linde has gained in this area enables it to customize all LAC builds to individual feedstock, co-product, process efficiency and cost targets.

More flexibility for you:

- Wide feedstock envelope – extending from natural gas and hydrogen-rich gas to naphtha and heavy fuel oil
- Clean syngas generation provides co-product flexibility (e.g. hydrogen, carbon monoxide and methanol, Ar, N₂, O₂, CO₂)
- Higher capital efficiency – fewer units required, lower gas flows and less “ballast” (low CAPEX)
- Process efficiency gains enabled by inert-free syngas generation (low OPEX)
- Cost savings with lower losses
- Less maintenance with smaller footprint and reliable design
- Plant designs customized to individual needs
- Low capacity standardized plants available

Comparison of conventional NH₃ process with Linde Ammonia Concept (LAC™.L1)



Cost-related factors

- Number of temperature changes
- Temperature levels
- Flow rate
- CO₂ removal optional
- Volume of equipment & catalyst requirements

Efficiency-related factors

- Heat exchange losses
- Pressure drops

LAC.L1, the Linde Ammonia Concept for light hydrocarbons, consists essentially of a state-of-the-art hydrogen plant with a:

- single-stage isothermal shift reactor (ISR)
- pressure swing adsorption (PSA) unit
- standard nitrogen unit and
- high-efficiency, purge-free ammonia synthesis loop

Following feed treatment, Linde's high-efficiency top-fired primary reformer converts the hydrocarbons into syngas containing mainly hydrogen (H_2) and carbon monoxide (CO). Because no air is introduced to the process at this stage, inert gases are kept to a minimum – as they are limited to the gases resulting from the respective feedstock composition. This reduces the syngas cooling chain footprint.

Pure nitrogen (N_2) generated by the N_2 unit is fed into the process flow directly before the NH_3 syngas loop. This reduces the load on the syngas generation plant by avoiding air inerts and introducing the N_2 exactly when it is required.

Overall, LAC reduces the number of process steps by avoiding three catalytic steps, eliminating the need for CO_2 removal and overcoming the need for a purge gas recovery unit.

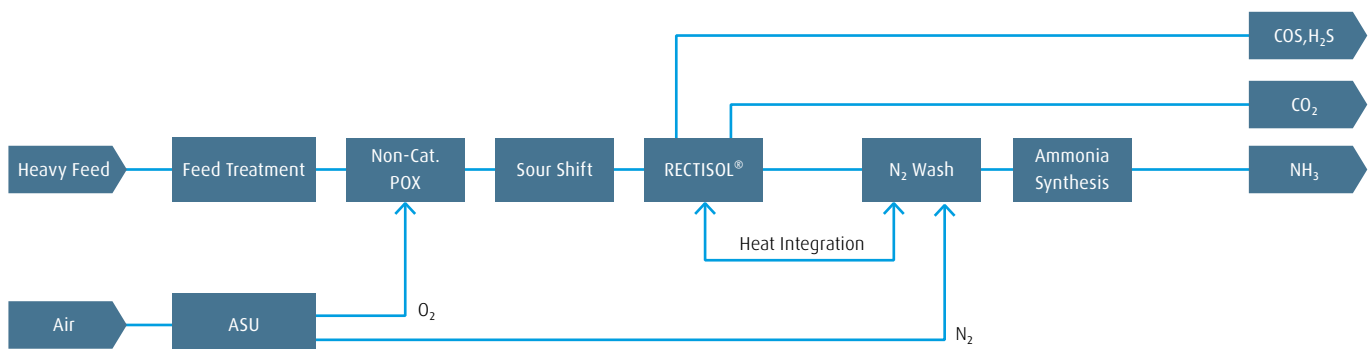


Proof of concept

Built almost 40 years ago and still in operation, the first LAC was based on a liquid feed. This concept is still successfully deployed to this day.

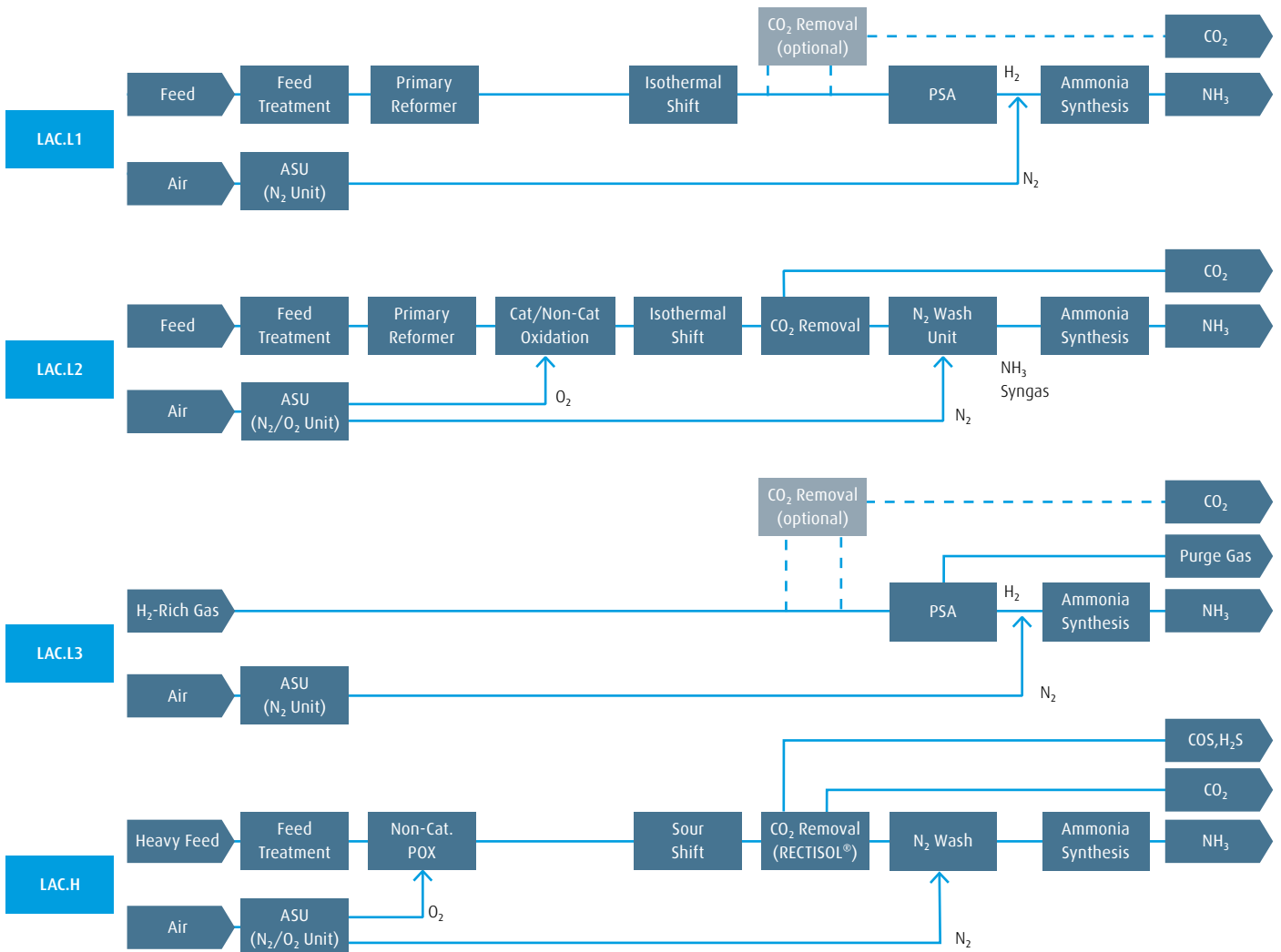
The design includes an air separation unit, which also produces the pure oxygen (O_2) for the gasification process. A downstream sour shift increases the H_2 yield. Linde's RECTISOL[®] wash unit removes sulfur compounds and CO_2 , which can then be used for downstream processes such as urea production. The downstream cryogenic N_2 wash unit reduces the inerts to the lowest achievable levels with H_2 losses of less than 1%. This further increases process efficiencies as the gas stream already has the N_2/H_2 ratio required for the NH_3 synthesis loop.

Linde Ammonia Concept (LACTM.H) with liquid feed





Overview of LAC™ options:





References

Project	Country	Capacity mtpd	Year of Start-up	Feedstock	Co-products	Remarks on Concept
Bharuch	India	1350 (Revamped: 2000)	1981	Oil	CO, Methanol	LAC.H for heavy feedstock
Dalian	China	1000	1996	Oil	-	LAC.H for heavy feedstock
Vadodara	India	1350	1998	NG + Naphtha	Ar, H ₂ + N ₂	LAC.L1
Moura	Australia	230	1999	NG	-	LAC.L1
Phosphate Hill	Australia	600	1999	NG	-	LAC.L1
Jilin	China	1000	2003	Oil	-	LAC.H for heavy feedstock
Daqing	China	250	2005	NG	-	LAC.L1
Jubail	Saudi Arabia	615	2016	NG	CO, H ₂	No isothermal shift due to CO product
Togliatti	Russia	1340	2017	NG	H ₂	LAC.L1, H ₂ extraction
Rock Springs	USA	Confidential	2017	NG	-	LAC.L1
Salalah	Oman	1000	2020	MeOH-Purge gas	-	LAC.L3, no syngas generation due to H ₂ -rich feedstock

Your partner for the production and processing of gases

Delivering reliable process plants for maximum capital efficiency

Linde has been optimizing gas processing technologies for 140 years, successfully delivering more than 4,000 plant engineering projects around the globe. Favoring trusted, lasting business relationships, the company collaborates closely with customers to enhance plant lifecycle productivity and innovate process flows. The company's proven gas processing expertise plays an indispensable role in the success of customers across multiple industries – from natural gas and oil refining through petrochemicals and fertilizers to electronics and metal processing.

Operational excellence along the entire plant lifecycle

We work closely with our customers to gain an in-depth understanding of individual needs. Building on the unique synergies of Linde as an integrated plant operator and engineering company, Linde offers innovative process technologies and services to exceed our customers' reliability and profitability expectations. This commitment to innovation extends along the entire plant lifecycle. The LINDE PLANTSERV® service team supports customers every step of the way – from maintenance and repairs to full revamps. Leveraging the latest digital technologies to offer on-site and remote operational and support services, we consistently take asset performance to the next level.

Making the impossible possible

From the desert to the Arctic, from small- to world-scale, from standardized to customized designs, Linde's engineering specialists develop solutions that operate under all conditions. The company covers every step in the design, project management and construction of gas processing plants and components. Customers can always rely on Linde to deliver the plants, components and services that fit their needs best – anywhere in the world.

Discover how we can contribute to your success at www.linde-engineering.com

Get in touch with our hydrogen and synthesis gas plants team:

Phone: +49 89 7445 4203, inquiry: www.linde-engineering.com/contact

Core competencies at a glance

Plant engineering

- Air separation plants
- LNG and natural gas processing plants
- Petrochemical plants
- Hydrogen and synthesis gas plants
- Adsorption plants
- Cryogenic plants
- Carbon capture and utilization plants
- Furnaces, fired heaters, incinerators

Component manufacturing

- Coldboxes and modules
- Coil-wound heat exchangers
- Plate-fin heat exchangers
- Cryogenic columns
- Cryogenic storage tanks
- Liquefied helium tanks and containers
- Air-heated vaporizers
- Water bath vaporizers
- Spiral-welded aluminum pipes

Services

- Revamps and plant modifications
- Plant relocations
- Spare parts
- Operational support, troubleshooting and immediate repairs
- Long-term service contracts
- Expert reviews for plants, operations and spare part inventory
- Operator training

