

Hydrogen



Air Liquide Hydrogen Unit,
Trinidad

Customized Solutions

The vast part of hydrogen produced world-wide is subsequently used in refineries and petrochemical industry for various purposes. Besides, hydrogen is also required for the production of metals, electronics, edible fats and oils as well as float glass, to name only some of the applications.

More than 95 % of this demand is covered by steam reforming of hydrocarbon feedstocks. Lurgi and Air Liquide have a long experience with this technology. Many efforts were put into its further development to be able to offer tailor-made solutions for each and every application in industry. With the acquisition of Lurgi by Air Liquide, two strong companies have partnered up who know best the clients' needs and market conditions in all regions of the world.

Steam Reforming by Lurgi

- proven technology
- easy and smooth operation
- fully automatic load change
- low emission, typically below 50 mg NO_x/ Nm³ flue gas

Refiners and chemical companies have several options for the supply of hydrogen. These include:

- recovering hydrogen from refinery fuel gas or chemical unit offgases
- building and operating a new steam reformer
- producing hydrogen via gasification
- outsourcing by importing hydrogen over the fence from a third party like/such as Air Liquide

The client's unit concept will be optimized to meet any requirements for efficient and reliable hydrogen production

at the specified purity. Lurgi commands the full range of experience in engineering hydrogen and steam reforming units based on various feedstocks. Natural gas, refinery gases, associated gases, naphtha, LPG or any mixture are used as process feedstock.

Export steam flow is adapted to the individual optimum for low cost, on the one hand, and high overall unit efficiency, on the other.

Special care is taken to identify the optimum solution for integrating a new unit into existing site concepts in close interaction with the client's personnel. Co-generation of reformed gas for other products besides hydrogen (carbon monoxide, methanol, etc.) may be a worthwhile consideration during project evaluation.

- multiple feedstock range
- optimized integration in overall plant concepts
- unit optimization for specific application

Lurgi Hydrogen Units Especially Excel due to their

- high efficiency
- availability higher than 99 % (outside planned shut downs)
- high reliability ensured through 2 out of 3 voting system and special design features
- time between turn arounds particularly optimized to suit refinery turn around cycles (3 to 5 years)
- low utility consumption
- low maintenance cost



Syngas Complex,
Kuantan, Malaysia



Experience in Engineering and Project Execution

State-of-the-art plant engineering methods and software tools like 3D modeling are applied in the design. The benefit of long years of engineering experience for steam reforming plants is available and applied in order to achieve optimum results. More than 100 steam reforming plants for the production of hydrogen, carbon monoxide or syngas have been engineered and built by Lurgi worldwide.

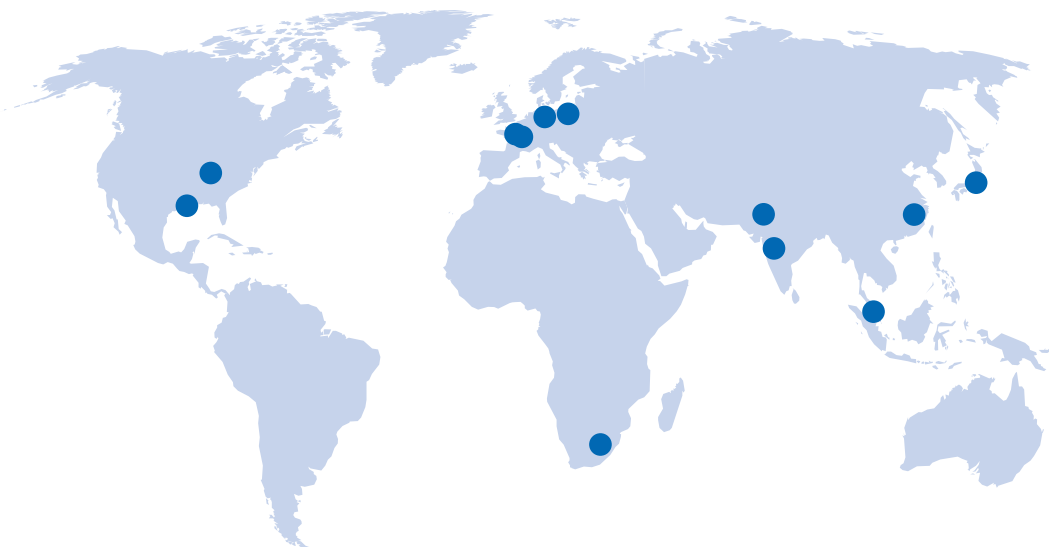
- plant sizes ranging from 1000 m³n /hr to 250,000 m³n/hr hydrogen production
- more than 30 hydrogen plants worldwide
- more than 100 steam reforming plants
- over 110 years of worldwide engineering experience

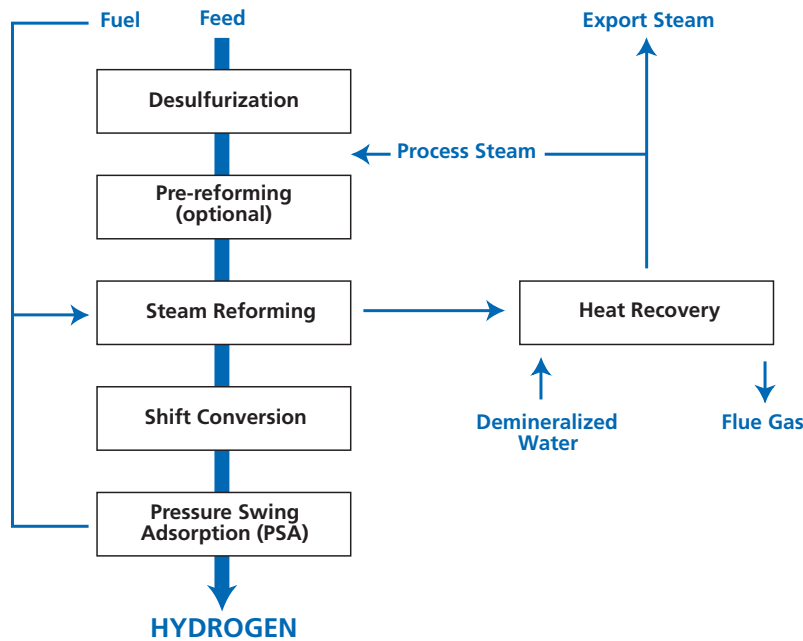
Competence in Project Execution

- basic and detail engineering
- turn-key contracts
- plant upgrade and uprate
- over-the-fence concepts
- powerful design software
- 3-D modelling
- adaption to client's standard

Plant Safety

- proven safety concepts for design and operation
- HAZOP analysis (hazard and operability)





Process Description

The standard process route comprises feed desulfurization, steam reforming, shift conversion and hydrogen purification by means of pressure swing adsorption (PSA).

The hydrocarbon feedstock is mixed with recycled hydrogen. The desulfurization may comprise two process steps. In the first step, organic sulfur compounds are converted to H_2S at about 360 °C on a cobalt-molybdenum or nickel-molybdenum hydrogenation catalyst. In the second step, H_2S is adsorbed on zinc oxide.

The desulfurized feed is mixed with process steam at an optimized steam/carbon ratio and superheated to 500–650 °C upstream of the primary reformer. On a nickel catalyst, the feed is converted at 800–900 °C to a reformed gas containing H_2 , CO_2 , CO , CH_4 , N_2 and undecomposed steam.

As a process option, a prereformer for conversion of all higher hydrocarbons may be inserted upstream of the feed superheater.

The CO in the reformed gas is shift-converted to increase the hydrogen yield. During this exothermic reaction, the gas temperature rises. The CO content is typically reduced to below 3 vol %.

In the PSA unit, pure hydrogen is separated from the shift gas stream. The process uses multiple adsorbent beds to provide continuous and constant product flow. The adsorbents operate on an alternating cycle of adsorption and regeneration. The off-gas is used as a fuel covering the main fuel demand of the steam reformer.

Steam generated by using the waste heat of reformed gas and flue gas is utilized as process steam while the excess is routed to the battery limits as export steam.



KHARG - Burner Row



Success through Technology

Steam Reformer

The heart of the hydrogen unit is the steam reformer.

Lurgi offers an advanced design:

The Lurgi Reformer® combines all advantages of outstanding operation characteristics and excellent maintenance features. This finally leads to easy and stable operation at low investment and operating cost.

Reduced Investment Cost due to

- top-fired design
- multiple tube rows allowing for a reduced number of burners
- large single train capacities with up to 1000 catalyst tubes

Reduced Operating Cost due to

- up to 40 bar reformed gas pressure at Reformer outlet
- feed preheating temperature up to 650 °C

Reduced Maintenance Cost due to

- completely maintenance-free catalyst tube suspension system

Pre-Reformer

The installation of an adiabatic pre-reformer (BASF-Lurgi RECATRO process) provides flexibility in feedstock ranging from natural gas to naphtha and may improve unit performance and unit economics.

Advanced Hydrogen Management

Advanced hydrogen management systems are the key to high unit efficiency and availability. Lurgi steam reforming units feature the most sophisticated control systems that can be found in this sector. They therefore reach exceptionally high on-stream factors.

Load Control

- fully automatic adjustment within 30–100 % capacity
- load change at 3 % of nominal capacity per minute
- minimum steam / carbon ratio ensured

Firing Control

- peaks in PSA tail gas flow and composition compensated by fuel gas
- stable reformed gas temperature ensured
- minimum oxygen content in flue gas ensured

Lurgi is a leading technology company operating worldwide in the fields of process engineering and plant contracting. Based on syngas, hydrogen production and clean conversion technologies for fuels or chemicals Lurgi offers innovative solutions that allow the operation of environmentally compatible plants with clean and energy-efficient production processes.

Its technological leadership is based on proprietary and exclusively licensed technologies which aim to convert all carbon energy resources (oil, coal, natural gas, biomass, etc.) in clean products.

Lurgi is a member of the Air Liquide Group.

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