Hydro-Chem Modular Hydrogen Plants
Introduction

Hydro-Chem has been the global leader in providing modular hydrogen plants since 1975. Hydro-Chem has established key clients in the refining, food, steel, glass, electronics, hydrogen peroxide, and petrochemical industries.

We perform total quality control from the design and engineering stage through final testing and installation for each system. Hydro-Chem’s proprietary hydrogen generation technology has been proven throughout the world.

We are committed to delivering the best possible product to meet your gas stream requirements and performance parameters.

Hydro-Chem’s modular design minimizes the customer’s need for construction management and resources. With in-house expertise and demonstrated modular fabrication techniques, we deliver industrial gas plants on time and at low cost.

Our attention to detail not only elevates the standard of our products, but also extends to the personal attention provided to the customer - every step of the way.

+250 hydrogen plants worldwide.

11,000 NCMH (10 MM SCFD) H₂ plant in Alabama, USA
Standardized hydrogen plant design

Many manufacturing processes for the refining, food, mining, metals, and chemical industries require reliable and economical on-site supply of hydrogen or synthesis gas in small quantities. Hydro-Chem specializes in hydrogen and synthesis gas plants in the range of 300 to 28,000 NCMH (0.27 to 25 MM SCFD) capacities. The plants are modular and standardized to meet industry requirements.

Key Features
- Flexible design
- Ease of transport
- Fast delivery and installation
- Reduced construction cost and risk
- High on-stream reliability
- High energy efficiency
- Low life cycle cost
- Conservative design philosophy
- Quick startup and shutdown

Technology
Hydro-Chem’s modular plants are designed to produce high purity hydrogen. Typically a feedstock of natural gas is utilized; other alternatives are methanol, propane, butane, LPG, biogas, naphtha or refinery gases.

If required, a pre-reformer or low temperature shift conversion can also be incorporated. Depending on product needs, the process can then be followed by a purification step using one or more of the following technologies:
- Pressure swing adsorption (PSA)
- Linde cold box technology
- An amine wash unit
- A membrane system

Hydro-Chem serves global industrial hydrogen and syngas demand by meeting high safety and availability requirements combined with fully remote plant control - from easier load controls to complex, fully automatic start-up sequences.

Capabilities
Hydro-Chem’s proprietary catalytic steam hydrocarbon reforming technology is utilized to produce gaseous hydrogen of the highest degree of purity.

Hydro-Chem’s process plant capabilities include:
- Hydrogen production
- Carbon monoxide production
- Syngas (hydrogen/carbon monoxide) production for chemicals such as ammonia and methanol

Co-products can include:
- Steam
- Carbon dioxide
Hydrogen process

The catalytic hydrogen generation process is well-proven and understood. For smaller scale plants, simplification is critical to maintain cost effectiveness without compromising efficiency, operability and safety.

Desulfurization
The feedstock is heated together with a small stream of recycled hydrogen-rich purge gas. It then flows through a desulfurization unit to remove sulfur compounds from the feedstock. This unit consists of a reactor filled with hydrotreating catalyst and zinc oxide which absorbs the hydrogen sulfide from the feed gas.

Reformer feed preparation
The desulfurized feedstock is mixed with steam and then superheated by the reformer flue gas.

Reformer
The gaseous feedstock and steam are reformed in heated high-alloy reformer tubes, which are packed with a nickel-based catalyst. The following reactions take place:

1. $\text{C}_n\text{H}_m + n\text{H}_2\text{O} = n\text{CO} + (n+m/2)\text{H}_2$
2. $\text{CH}_4 + \text{H}_2\text{O} = \text{CO} + 3\text{H}_2$ (Reforming)
3. $\text{CO} + \text{H}_2\text{O} = \text{CO}_2 + \text{H}_2$ (CO shift)

Steam generation
After leaving the reformer, the process gas is cooled from approximately 840°C (1544°F) to 325°C (617°F) through steam generation and superheating.

HT CO-shift conversion
The CO in the process gas is converted to $\text{H}_2$ and $\text{CO}_2$ in order to increase the hydrogen yield. This is accomplished by furthering reaction #3 over a high temperature CO-shift catalyst.

Heat recovery and cool down
After further cooling, whereby more steam is produced and the boiler feed water is preheated (as applicable) and after separation of process condensate, the process gas flows to the purification unit. The process condensate is recycled within the system, which reduces the boiler feed water (BFW) consumption.

H2 purification unit
Purification of the hydrogen stream is accomplished with a pressure swing adsorption (PSA) system. The process gas passes through regenerated adsorbers, which purifies the gas up to 99.9 - 99.9999 vol. % $\text{H}_2$. Meanwhile the other adsorbers are regenerated isothermally using a controlled sequence of depressurization, purging and repressurization steps. Tail gas from the PSA is used as fuel in the reformer.

Fuel system
Fluctuations in the composition of the PSA tail gas are leveled out by means of a mixing drum, thus making the gas suitable to be used as fuel in the radiant section of the reformer furnace. Feedstock or other fuel gas is used as supplementary fuel.

Flue gas duct
The flue gas from the radiant section is used for preheating the reformer feed, generating steam, and heating BFW or combustion air before exiting to the atmosphere via a fan and stack.

+40 years engineering and installation experience.
Plant configuration options

Refineries and other industrial complexes have complicated steam systems which can be a challenge for a new hydrogen production unit to integrate into. Hydro-Chem plants have design flexibility to meet any utility requirements and restrictions.

Minimum Feedstock Design

When the value of steam is less than equivalent energy in the feedstock or there is no use for steam.

→ Maximum heat recovery in both process and flue gas for reformer feed heating and combustion air heating
→ Option for steam generation in process
→ Option for higher recovery PSA system

Maximum Steam Export Design

When the value of steam is higher than equivalent energy value in the makeup fuel.

→ Maximum heat recovery in both process and flue gas for steam generation
→ No combustion air preheat

High Efficiency Design

When the value of steam is close to the equivalent energy value in the makeup fuel.

→ Maximum heat recovery in both process and flue gas for reformer feed heating and combustion air heating
→ Option for higher recovery PSA system
→ Low level waste heat utilized to increase steam export
HYDROPRIME® Max

Hydro-Chem has developed a new reforming technology to meet the need for intermediate hydrogen production capacities. With a capacity range from 19,000 NCMH/hr (17 MM SCFD) to 28,000 NCMH/hr (25MM SCFD), HYDROPRIME® Max is fully modularized and standardized.

- Reformer is a single row “box” design
- All components, including waste heat recovery unit and PSA, are fully modularized
- All components can be shipped via truck
- Delivery time is 2-4 months less than a typical stick-built unit

Larger capacity hydrogen plants with the advantage of full modularization.
Fabrication and modularization

Single sourcing
Utilizing Hydro-Chem’s unique capabilities, clients benefit from having all tasks - from conceptual design through commissioning - in one organization. We design and can fabricate most of our plant equipment, including the reformer, PSA system, heat exchangers and steam generation equipment. This single-source responsibility provides unparalleled opportunities for quality control and customer satisfaction.

In house fabrication
Hydro-Chem’s 76,000 sf (7,060 m²) fabrication facility north of Atlanta in Holly Springs, GA, meets the highest quality standards dictated by modular designs. In addition to modular system fabrication and assembly, our capabilities include pressure vessel and heat exchanger fabrication, pipe welding, machining, insulation, painting, full quality assurance, inventory control, and warehousing.

Components such as vessels, heat exchangers, boilers, furnaces and piping assemblies are manufactured into compact, low cost and easy to install modular units. These pre-assembled (equipment pre-piped and instrumentation pre-wired to junction boxes) units offer the most economical solution without sacrificing access for operation or maintenance.

Hydro-Chem plant modules are transported from our facility via truck to North American locations, or containerized for transport to international destinations.

Codes and certifications
Our Holly Springs facility is certified by ASME for Code Stamps “U”, “U2”, “PP”, and “S”. Hydro-Chem’s shops are also certified to supply pressure equipment per PED (European Pressure Equipment Directive), SQL (Chinese Manufacturing License), and A2 (Korean Codes). Hydro-Chem has also designed and built to many other codes around the world together with our numerous quality-audited, long term partners.

Hydro-Chem is qualified to fabricate structural steel, piping, and vessels in compliance with the following codes: ASME Sections I & VIII, ASME/ANSI B31.1, B31.3, B31.5, AWS D1.1, and AISC.

We are authorized by the National Board of Pressure Vessels (USA) with the NB “R” Stamp authorizing repair activities.

Local fabrication
To provide accelerated schedules and reduced cost, we partner with fabrication shops worldwide, supplying key components from the USA.

Process skid ready for delivery.
Quality and service
As a division of Linde Engineering North America, Hydro-Chem’s commitment to quality and service is strong. Linde’s financial resources, management expertise, and proven leadership in the processing industry provide a solid base to provide the right solutions for our customers.

Engineering and procurement
→ Project management
→ Process detail and safety design
→ Quality assurance
→ Fabrication of equipment and modules
→ Fabrication of equipment
→ Procurement
→ Expediting
→ Inspection
→ Shipping

Site services
Hydro-Chem’s skilled, professional technical support team assures clients worldwide a quick response to their operational needs. Our services include:
→ Construction
→ Commissioning
→ Start-up
→ Operator training
→ Supervisory services

With the support of Linde Engineering, clients have additional global resources available.

After sales, consulting, and research and development
Our PLANTSERV™ team offers parts and services as part of our post-sales support commitment. This is part of the total integrated approach to providing quality service to our customers.
→ Spare parts
→ Feasibility and special technical studies
→ Process development
→ Project advisory services
→ Demonstration/pilot plants