

**MATHESON Delivers:
Gases, Equipment, and Services for
the Refining and Chemicals Industry**



MATHESON

ask. . .The Gas Professionals™



Total Solutions for the Refining and Chemicals Industry

For more than 85 years, **MATHESON** has provided gases, equipment, and expertise in a breadth of industries - including refining and chemicals.

MATHESON's forward vision is to be informed and proactive in all of the industries served by the Company.

MATHESON brings value to its partners and customers through responsive provision and support of gas supply, gas application, and larger-scale solutions that contribute to global technology leadership positions for all those who are involved.

MATHESON offers a complete line of industrial gas supply systems, gas products, and gas application equipment to serve the Refining and Chemicals Industry.

Research and Development:

MATHESON gases and gas handling equipment support instrument operation and calibration.

- Specialty gases
- Calibration mixtures
- High purity gas handling equipment
- Analytical equipment
- Regulatory and environmental compliance

Pilot Plant and Full-Scale Production:

Nitrogen • Oxygen • Argon • Hydrogen • Carbon Monoxide • Carbon Dioxide • Helium • Hydrocarbons • Compressed Dry Air (CDA).

MATHESON offers over-the-fence gas supply arrangements (by delivery or by pipeline) for a wide range of gases.

Numerous options exist for delivery, container scale, and pipeline access.

MATHESON also provides system engineering, construction, and maintenance for HYCO (hydrogen, carbon monoxide), atmospheric gases (oxygen, nitrogen, argon), and compressed dry air (CDA).

HYCO (SynGas) Plants for Generation of Hydrogen and Carbon Monoxide:

- Steam methane reformers (SMR)
- Autothermal reformers (ATR)
- Partial oxidation (POX)
- Gasification

Air Separation Units (ASUs) for Generation of Nitrogen, Oxygen, and Argon:

- Cryogenic air separation for larger volume applications
- Non-cryogenic separation, including selective adsorption (PSA and VSA) and membrane separation

With our Total Solution approach, we work with your plant experts to design the customized package that addresses your specific requirements.



MATHESON Hydrogen Plant at Refinery Customer



MATHESON Air Separation Unit, San Antonio, TX

Gases and Applications

MATHESON offers a wide variety of gas supply modes, scales, and application equipment options. We will work with you to design an efficient and cost-effective solution that meets your specific application requirements.

We deliver more than gas and equipment. **MATHESON** can offer you gas handling, application, and engineering expertise, as well as plant or sub-system construction, maintenance, expansion, and upgrades.

Hydrocracking, Hydrotreating and Hydrogenation:

Hydrogen is a key component in a refinery. Hydrogen is required to remove sulfur and contaminants from gasoline and diesel as well as to convert components of crude oil into useful products. Refinery profitability is often directly correlated with the quantity and quality of hydrogen available.

Refineries often produce their own hydrogen, but frequently may not produce the needed volume and purity. On-site hydrogen plants and pipeline hydrogen can supplement the hydrogen produced by the refinery. **MATHESON's** refinery and hydrogen plant experts will work with you toward the ideal solution by assessing your current hydrogen system, examining your needs, and evaluating your options.

Plant Expansion and Gas Clean-up:

MATHESON has the expertise to help meet your expansion and gas clean-up needs. We can provide technology solutions to increase the capacity of your existing hydrogen plants without additional greenhouse gas emissions. We can also provide equipment to help increase the hydrogen content and remove contaminants from refinery and chemical plant gas streams.

FCC Enrichment and NOx Reduction:

Oxygen can be added to the regenerator of a fluid catalytic cracker (FCC) to improve yields, assist with coke burning and heat balance, and to reduce cyclone velocities. This can also reduce NOx and CO emissions. Additionally, oxygen is used to produce ozone, which is required in the LoTOx NOx removal equipment incorporated into many FCC units.

Sulfur Recovery and Acid Gas Plants:

The use of **Oxygen** in a sulfur recovery unit (SRU) can increase plant capacity and help with contaminants and low hydrogen sulfide streams. Oxygen can also be used to boost temperature. Oxygen use can be intermittent or continuous. **Hydrogen** can also be added to the tail gas treating unit (TGTU) of a sulfur plant when the streams to be treated are leaner (i.e., less H₂S).

Chemicals Production:

Oxygen is a feedstock in the production of many chemicals, including ethylene oxide, propylene oxide, titanium dioxide, vinyl chloride monomer and vinyl acetate monomer. It can also be used for air enrichment to increase the rate of chemical and combustion reactions.

Hydrogen is used in the production of ammonia, methanol and a number of hydrogenation reactions.

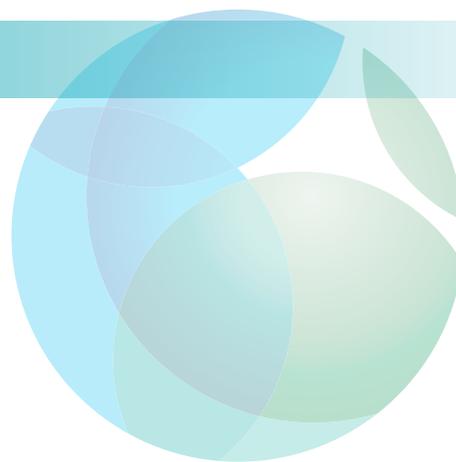
Carbon Monoxide is used in the production of acetic acid, methanol, and polycarbonates.

Syngas (H₂/CO blends) is used in oxo-alcohols, methanol, and other chemicals production.

Nitrogen is used primarily for its inert properties (typically to maintain a non-reactive atmospheric blanket), and it is used in the manufacture of ammonia.

Turnaround Services:

MATHESON can arrange to provide **Nitrogen** and turnaround services to help your refinery or chemical plant get back up and running as quickly as possible. Using state-of-the-art equipment and **MATHESON** gases, we can provide cooling, heating and purging services on a short-term or intermittent basis.



Pressure and Leak Testing:

An inert gas such as **Nitrogen** can be used to pressurize new, repaired, or modified tanks, pipelines, vessels, and process equipment in order to check their integrity and leak tightness. Dry, high purity nitrogen will not contaminate the system with moisture, lubricants or oxygen (whereas pressure testing with compressed air or water can easily lead to system contamination).

Cryogenic Condensation for VOC Recovery:

Liquid Nitrogen can be used along with cryogenic recovery equipment to remove and recover volatile organic contaminants from process streams.

Wastewater Treatment:

The treatment of municipal and industrial wastewater can be made more efficient with the addition of **Oxygen**. **Carbon Dioxide** can also be used for pH control.

Purging and Blanketing:

Inert gas, typically **Nitrogen**, can be used to displace air, flammable vapors, and contaminants from storage tanks, pipelines, process equipment, railcars, ocean-bound containers, or other vessels. Gas can be used to maintain an inert atmosphere above a liquid or powdered product inside a storage tank, silo, reactor, process equipment, or other container. The gas will help prevent product degradation from moisture and oxygen, control volatile emissions, and safeguard against fires and explosions.

Process Control, Laboratory Analysis and Emissions Monitoring:

Specialty Gas Mixtures and **Calibration Gases** are used in laboratories and for process and emissions control. **MATHESON** has the capabilities to produce the specific gas mixture that is required, including complex mixtures and trace component mixtures.

Pipe Freezing:

Liquid Carbon Dioxide or **Nitrogen** can be used to freeze a section of a pipeline's contents. The frozen section, or plug, permits work such as valve repairs, the addition of tees or tap-offs, or the extension of existing pipelines without draining of the entire system. Only liquids which freeze at the liquid gas temperature, such as water, glycol, and some oils can be handled by the process.

Pressure Transfer:

Nitrogen can be used to transfer liquid or powder products to and from railcars, tanker trucks, or storage vessels without requiring pumps, mechanical compressors or external power sources. Dry, inert nitrogen is ideal for transferring toxic fluids, highly viscous fluids, ethical pharmaceuticals, flammable products, and materials which become corrosive when contacted with moisture.

Process Chilling and Process Equipment Cooling:

Liquid Nitrogen or **Carbon Dioxide** can be used as a refrigerant for temperature control in a variety of processes, including solvent recovery and chemical processes. Liquid gases can achieve a lower temperature and provide a faster cooldown rate than mechanical refrigeration systems.

Streamlining:

Oxygen can be used to enrich the air in oxidation processes to increase throughput and improve productivity.



3D Isometric of MATHESON Hydrogen Plant at Refinery Customer

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