Advanced measurement solutions enhance blue hydrogen production

EMERSON™

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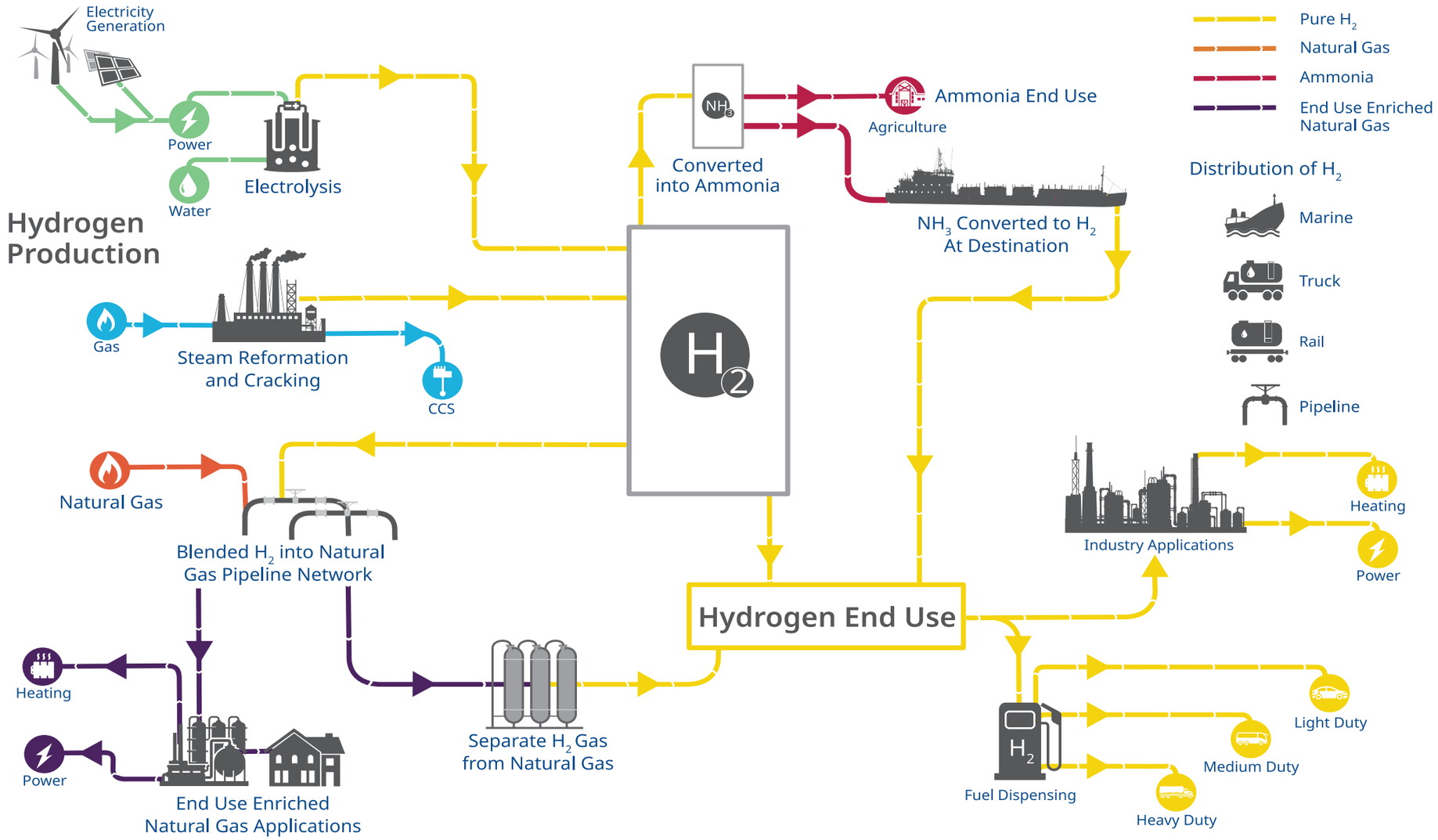
Hydrogen supports decarbonization

Hydrogen has an important role to play in the reduction of greenhouse gas emissions globally, providing a valuable cleaner energy source for hard to decarbonize industrial processes, parts of the transportation sector and long-term energy storage.

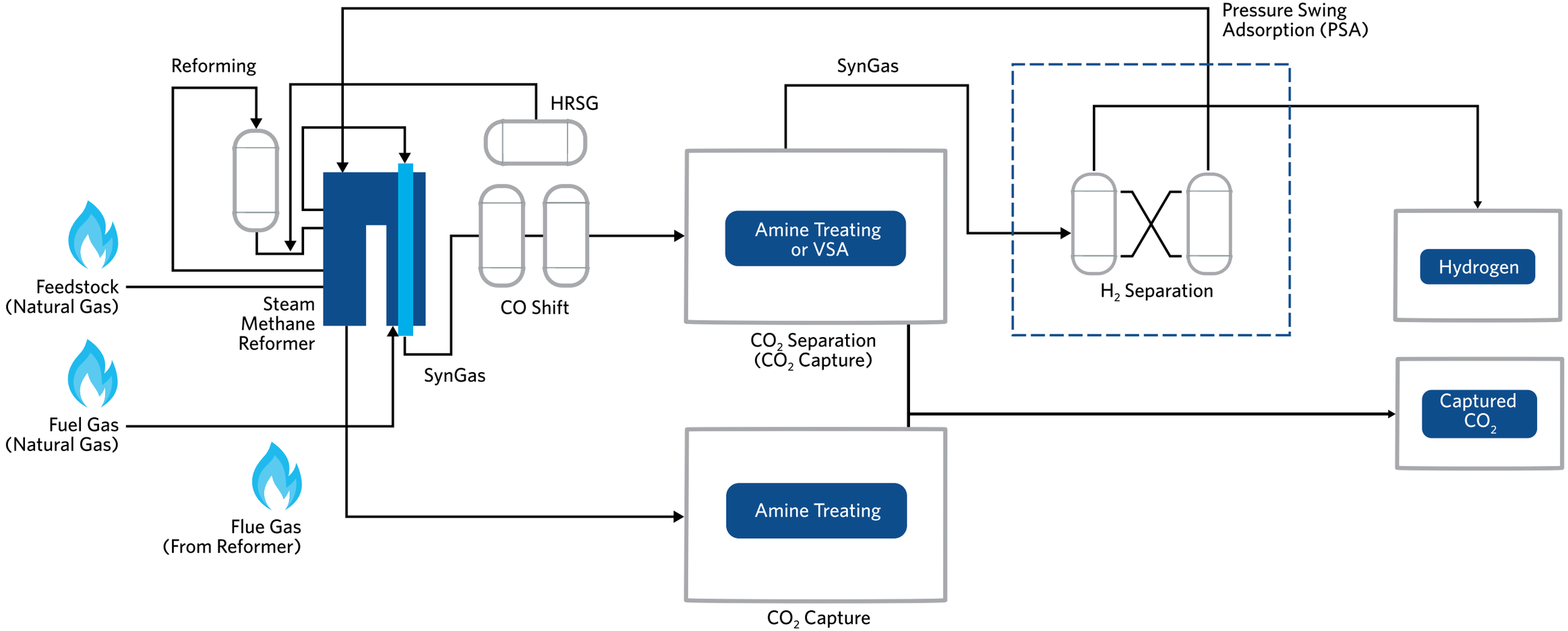
Steam reforming of natural gas and other light hydrocarbons is currently the most common and lowest-cost method of production. By using carbon capture and storage (CCS) solutions to produce ‘blue’ hydrogen, this helps to minimize emissions and supports decarbonization.



Blue hydrogen production

Most of the hydrogen produced today is used in the refining and chemical markets, but as hydrogen is increasingly used as an energy source, production will need to increase significantly. According to the IEA, by 2070, production of hydrogen needs to increase by 700% to reach Paris climate goals and 40% of total production will come from blue hydrogen. Maintaining continued supply and purity requirements for refinery and chemical operations is still essential, but to exploit growing external markets, there is a need to maximize production and energy efficiency, leading to a lower unit cost and greater profitability.

Blue hydrogen production process



Production challenges

Whereas previously hydrogen production was seen as a cost to refinery operations, sales of clean hydrogen now present an opportunity to increase plant profitability. An expanding external market requires an increase in production capacity, but to accelerate the transition to blue hydrogen, producers must look to reduce unit production costs through greater production efficiency and reduced energy consumption.

Key production challenges:

- Ensure consistent supply and purity
- Increase and maintain peak production efficiency
- Lower energy consumption and costs
- Increase profitability by reducing operational costs
- Enhance safety of plant and workers
- Reduce process downtime and maintenance costs

Carbon capture challenges

Post-combustion amine-based absorption is the most mature carbon capture process, using a chemical solvent to capture CO_2 from the flue gas and syngas, with regeneration of the chemical solvent while CO_2 is extracted. Vacuum swing adsorption (VSA) and pressure swing adsorption (PSA) are also methods for both capturing CO_2 and purifying the hydrogen. The capital investment and the energy required to operate these processes increases the cost of hydrogen production, affecting the competitiveness of blue hydrogen.

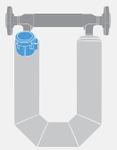
Key challenges:

- Decrease energy costs
- Minimize safety risks
- Meet CO_2 capture targets
- Improve reliability and availability
- Greater monitoring and visibility of the process

Enhanced measurement solutions

The need to maximize plant safety and reliability, increase operational efficiency and reduce energy consumption can be met by implementing advanced measurement solutions. Improved process control supported by greater measurement accuracy and reliability helps to optimize the process, which can provide an immediate impact on the unit cost of production. Implementing measurement solutions helps increase visibility to the process equipment health which ensures greater operational efficiency, process uptime and safety.

Measurement solutions for steam methane reforming

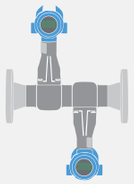


FT Micro Motion ELITE Coriolis Flow Meter

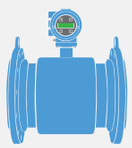
AT Rosemount Continuous Gas Analyzer

AT Rosemount 700XA Gas Chromatograph

TT Rosemount 3144P and 648 Wireless Temperature Transmitter

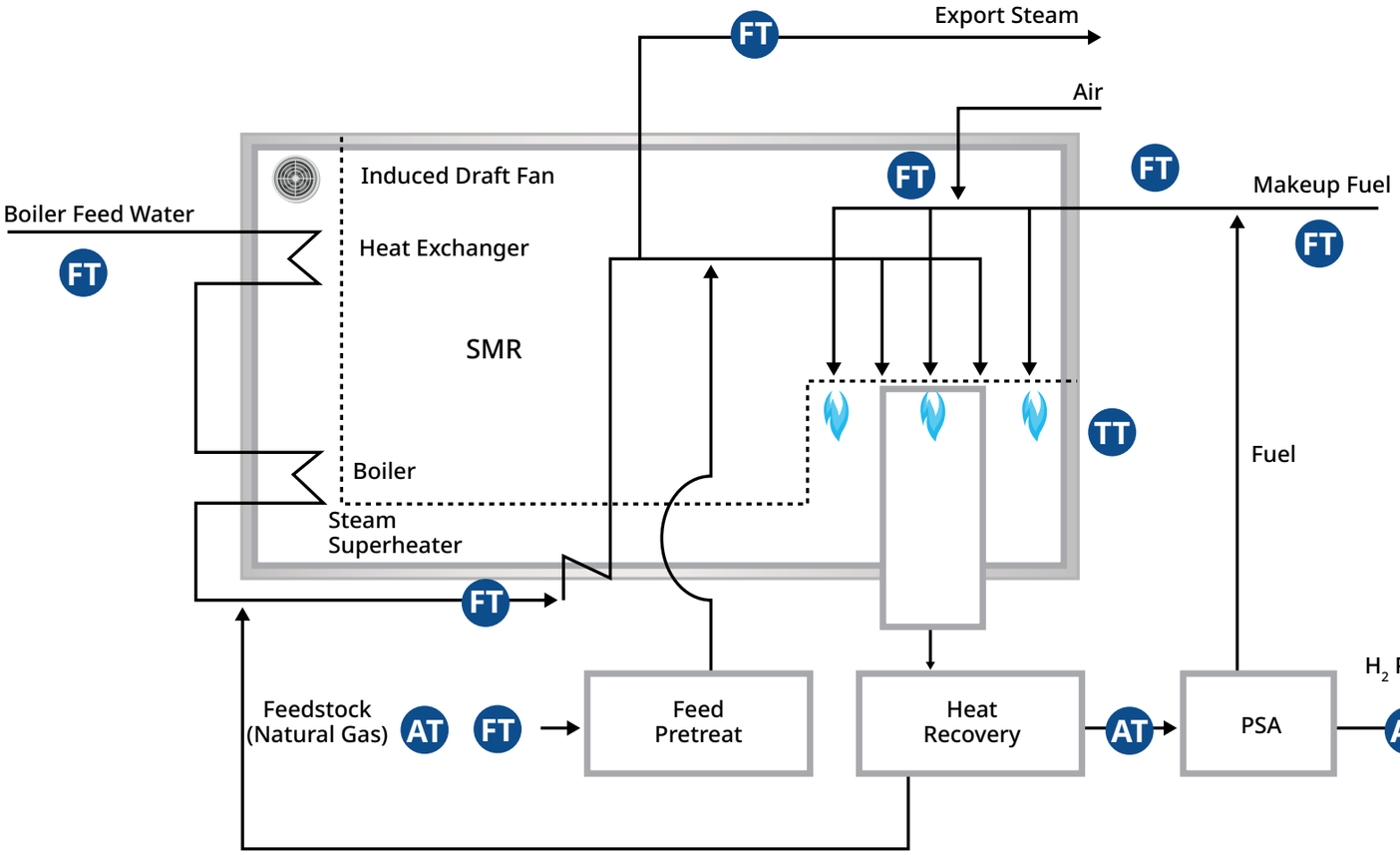


FT Rosemount 8800 Dual Vortex Flow Meter



FT Rosemount 8700 Series Magnetic Transmitter and 8702 Magnetic Sensor

FT Rosemount Annubar Flow Meter



Coriolis flow meters

Changing natural gas and other feed gas quality creates challenges for optimization of the steam-to-carbon ratio in the reformer reactor. By utilizing Micro Motion™ Coriolis mass flow meters, the molar ratio of steam to carbon can be more easily and accurately maintained in real time. This is due to the mass ratio being more closely aligned with the molar ratio than it is with the volumetric ratio. Optimizing the steam-to-carbon ratio helps to extend catalyst life, decrease energy costs, and increase safety.

Measurement solutions for steam methane reforming

Continuous gas analysis

It is important to monitor the feed gas, intermediate streams, and final product to identify process inefficiencies and enable further process optimization. Emerson's Rosemount™ continuous gas analyzers and Rosemount 700XA gas chromatographs provide highly accurate continuous gas composition analysis that enables the monitoring of the reforming and shift converter efficiency.

Measurement solutions for steam methane reforming

Hydrogen flow measurement

Flow meter options for hydrogen service include differential pressure, vortex, Coriolis, and ultrasonic meters. The optimal choice depends upon the process conditions and the application. Differential pressure-based flow measurement has broad industry acceptance, especially for process control or non-custody applications. Vortex meters are also commonly used in hydrogen applications, offer fewer potential leak points, and are especially effective when the flow measurement is part of a safety loop by utilizing the Rosemount Dual or Quad Vortex Meter where multiple measurements are provided in a single meter body.

For custody transfer applications with high accuracy requirements, Coriolis and ultrasonic meters are the best choices. Coriolis meters can currently measure concentrations from zero percent hydrogen to pure hydrogen, covering a large temperature range and conditions down to cryogenic levels, and are independent of the flow profile. Ultrasonic meters currently have a more limited temperature range and can be applied only in services where the concentration of hydrogen is up to 30%, but are available in line sizes up to 36", and have no pressure drop or moving parts. Understanding the application of the flow meters and the process conditions under which they will operate will determine the best fit technology.

Measurement solutions for steam methane reforming

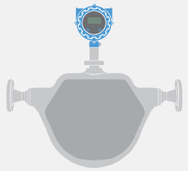
Water flow measurement

Accurate measurement of the boiler feed water flow rate is essential to ensure it does not impact steam flow rate. Emerson's Rosemount 8700 Magnetic Flow Meter is a very cost-effective and reliable measurement solution that provides operators with accurate flow rate information that helps maximize the efficiency of steam production. Advanced diagnostics and continuous meter verification enabling confirmation of meter calibration without interrupting the process increases availability and productivity.

Air flow measurement

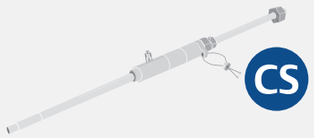
For combustion operations for the reforming furnace, air flow is difficult to accurately and reliably measure because of large line sizes, duct geometry and internals, limited straight runs and variable flow profiles. Emerson's Rosemount Annubar Flow Meter with 485/585 averaging pitot tube and pitot traverse provides very accurate (1–2%) air flow measurement. This supports improved air flow control that optimizes the air-to-fuel ratio, increasing energy efficiency and reducing NOx emissions. A single pipe penetration helps to reduce installation complexity and costs.

Measurement solutions for amine treating process



DT Micro Motion Density Meter

CS Rosemount Wireless Permasense Ultrasonic Sensors

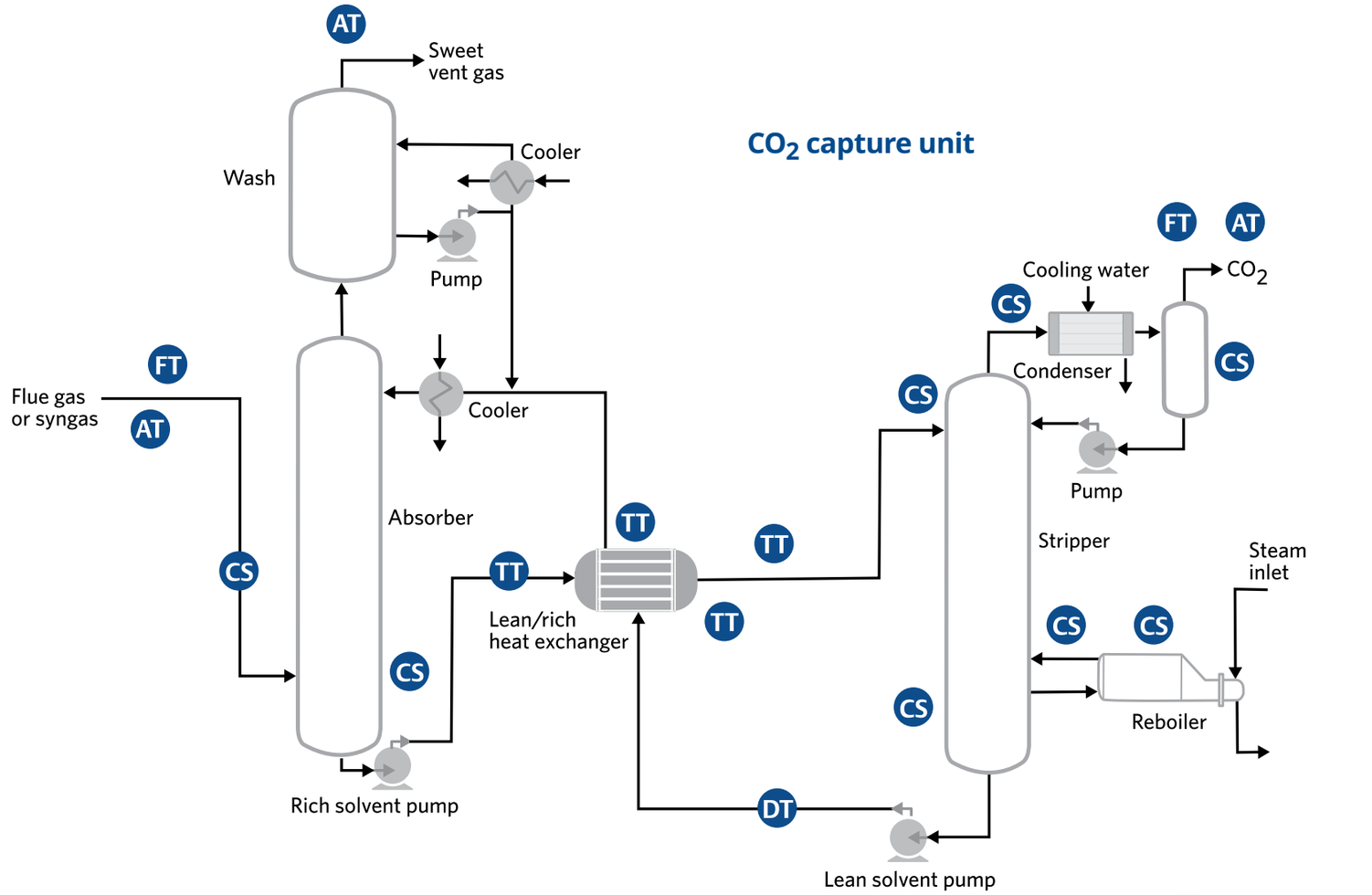


CS Roxar Retrievable Electrical Resistance (ER) Probe

TT Rosemount X-Well Technology with 3144P or 648 Non-Intrusive Temp Assembly

FT Rosemount Annubar Flow Meter

AT Rosemount Continuous Gas Analyzer



Density and flow measurement

To manage the fresh amine make-up rate in order to achieve the desired CO_2 capture efficiency at the lowest cost, it is important to monitor solvent quality. Using Emerson Micro Motion density meters to infer rich or lean amine quality automates the solvent quality sampling process. This improves personnel safety by eliminating manual sampling and also provides real-time monitoring of changes to the solvent quality.

Measurement solutions for amine treating process

Wireless corrosion monitoring

Corrosion is prevalent within amine treating units, due to carbonic acid attack when water vapor condenses. Lack of visibility into corrosion, especially with aging assets, can result in product contamination, health and safety incidents, and reduced capacity and revenue due to asset failure. Emerson's Rosemount Wireless Permasense Corrosion and Erosion Monitoring System removes the need for manual inspections by providing real-time asset integrity data to improve the timing and scope of planned maintenance.

Gas analysis

Understanding the effectiveness and efficiency of the carbon capture process is critical. Continuous, real-time data provided by the Rosemount continuous gas analyzers helps plant operators to evaluate performance and adjust the process to achieve maximum carbon capture effectiveness.

Measurement solutions for hydrogen putiry

Hydrogen purity of the final product is another important element and is required to ensure it meets the appropriate specification. The Rosemount CT5800 Continuous Gas Analyzer provides extremely fast and accurate measurement and analysis within a single instrument, with the ability to identify gas impurities down to ppm levels. Best-in-class accuracy is complemented by simplified installation, operation and maintenance, and lower operational costs.

Plantwide measurement

Demands to push processes to do more, with greater process variability, makes optimizing your operation more difficult than ever. Emerson's measurement instrumentation products reduce operational complexity and deliver actionable insights that can allow you to meet and exceed production goals.

Wireless temperature measurement

High accuracy temperature measurement is needed to support enhanced process control, but performance is hampered because the ideal resistance vs. temperature relationship curve of sensors does not match the one programmed into the transmitter. Rosemount 3144P and 648 Temperature Transmitters improve measurement accuracy by 75%, while reducing risk of loss of measurement. This ensures critical temperature control and safety loops are optimized.

Non-intrusive temperature measurement

Install accurate process temperature measurement without adding additional potential leak points and without process shutdown. Rosemount X-Well™ technology provides non-intrusive temperature measurement that is simple and quick to install. One particularly good application of this technology is in helping to identify fouling and degradation of heat exchangers, with additional temperature measurements that may have not been previously installed.

Pressure measurement

Accurate pressure monitoring across the production process is important, but a wide application range that requires multiple device types increases complexity. Rosemount 3051S Pressure Transmitters not only help reduce installation time and costs, but are suitable for a wide measurement range, enabling standardization on a single device type. Rosemount's sensor shield® technology prevents hydrogen permeation ensuring a long sensor life.

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