

# HONEYWELL H<sub>2</sub> SOLUTIONS

Meet tighter emissions goals with low-cost CO<sub>2</sub> capture

As the world strives to reduce greenhouse gases, Honeywell H<sub>2</sub> Solutions are a viable way for you to decarbonize your plant today to meet your emissions goals.

Honeywell H<sub>2</sub> Solutions work by efficiently capturing and sequestering carbon dioxide to create hydrogen as a low-carbon energy source. These solutions are based on proven Honeywell UOP technologies widely known for reliability, high purity and low cost. Honeywell experts can tailor a solution to help meet the needs of your operation.

## EXISTING STEAM METHANE REFORMER (SMR) RETROFIT

Retrofitting existing SMR assets with carbon capture technology is a ready-now, commercially proven and significant step on the journey to net zero. Most existing hydrogen production plants for refining, chemical, and agricultural use employ an SMR to convert hydrocarbon feeds such as natural gas or naphtha and steam into synthesis gas which comprises H<sub>2</sub>, CO, CO<sub>2</sub>, unconverted methane, and a small amount of inerts. To maximize H<sub>2</sub>, the synthesis gas is cooled and shifted in a water gas shift reactor to convert CO and water to H<sub>2</sub> and CO<sub>2</sub> and then sent to a pressure swing adsorption (PSA) system for high purity hydrogen production.

To reduce the carbon emissions of an existing hydrogen asset, CO<sub>2</sub> can be captured from the shifted syngas, the PSA tail gas or the flue gas. The most cost-effective location to remove CO<sub>2</sub> is from pre-combustion streams, which are the shifted syngas and PSA tail gas. The CO<sub>2</sub> can be removed by a variety of means including cryogenic fractionation, PSA or solvent-based absorption.

## UOP Ortloff® CO<sub>2</sub> Fractionation System

Cryogenic fractionation provides the lowest overall cost of CO<sub>2</sub> captured, driven by significant additional high purity H<sub>2</sub> yield. In this option, the H<sub>2</sub> PSA tail gas is compressed, dried, condensed, and fractionated, resulting in a high purity liquid CO<sub>2</sub> stream. Combining separation and liquefaction in a single unit operation saves utilities when a liquid product is required. UOP's Ortloff CO<sub>2</sub> Fractionation process was commercialized in liquefied natural gas (LNG) applications in 2011.

This retrofit does not require any revamp to the existing H<sub>2</sub> PSA, can be operated 'on' or 'off' without impacting the SMR operation, is solvent free, has a smaller footprint than an amine unit, requires no steam usage in the CO<sub>2</sub> recovery steps, and is guaranteed to meet high purity CO<sub>2</sub> product specifications with 99+% CO<sub>2</sub> recovery. In addition, 10-20% additional high-purity hydrogen can be directly recovered from within the fractionation system in order to increase SMR production capacity and improve process economics.

## UOP CO<sub>2</sub> Polybed® PSA System

An alternative option for CO<sub>2</sub> capture from the PSA tail gas is a CO<sub>2</sub> PSA unit. A CO<sub>2</sub> PSA unit can be installed on the shifted syngas or the H<sub>2</sub> PSA tail gas, though the latter is preferred primarily due to a simpler revamp and ease of operation in the event the CO<sub>2</sub> capture unit is bypassed. The CO<sub>2</sub> PSA is the lowest CapEx and OpEx carbon capture



## FEATURES AND BENEFITS

- Ready-now, commercially proven technology
- Low-cost options to significantly reduce CO<sub>2</sub> emissions
- 99%+ CO<sub>2</sub> recovery
- Tailored to meet required H<sub>2</sub> and CO<sub>2</sub> purity requirements
- Single unit separation and liquefaction available
- Solvent-free options with a smaller footprint

option and can remove 99% of the CO<sub>2</sub> in the pre-combustion stream. For transport, the low-pressure CO<sub>2</sub> requires drying and liquefaction, or contaminant polishing via catalytic oxidation, followed by drying and multi-stage compression.

### UOP AmineGuard™ FS Process

Amine-based solvent technology can also achieve 99% CO<sub>2</sub> removal from the shifted syngas stream, using steam for solvent regeneration. The low-pressure CO<sub>2</sub> product requires drying and multi-stage compression or liquefaction to be transport-ready. For end-users that want gas-phase CO<sub>2</sub> and are long on steam, an amine unit is a reliable, proven choice for CO<sub>2</sub> recovery, albeit at a higher cost of capture than tail gas recovery.

### UOP Callidus® Burners

CO<sub>2</sub> removal from the fuel gas requires advanced burner technology for stability and to achieve low NO<sub>x</sub> emissions. UOP Callidus burners are widely used in SMR furnaces today. These burners are customized to the furnace licensor's specifications and can be revamped to enable low carbon intensity hydrogen production.

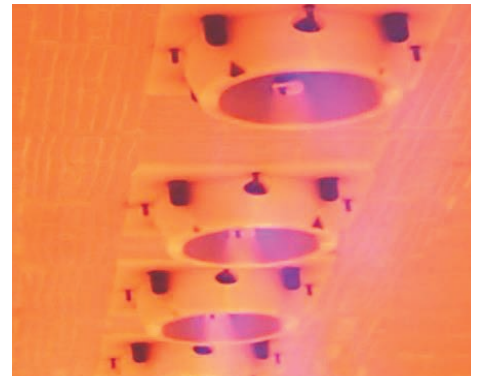
### EXPERIENCE

With 19 engineering and R&D centers and 14 manufacturing facilities in 19 countries, UOP is close to its customers wherever they are. Since 1914, UOP has developed more than 70 licensed processes and 5,000 active patents and applications for the industries served.

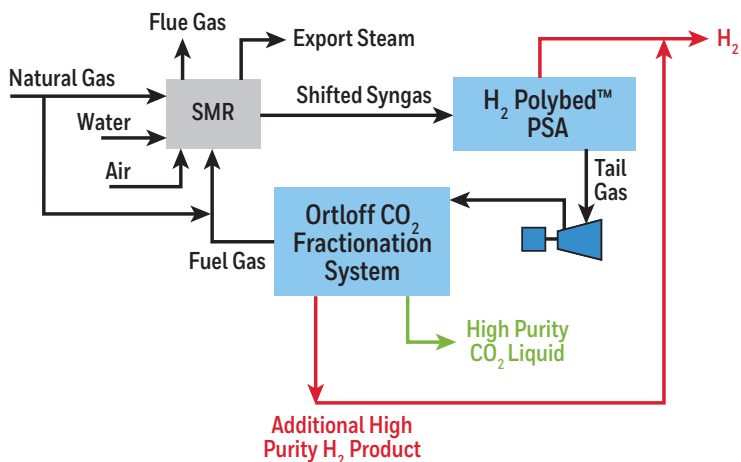
Honeywell UOP invented and developed Polybed PSA technology more than 50 years ago and has delivered more than 1,100 PSA systems worldwide. Field performance tests prove the performance of PSA systems with an on-stream factor of 99.8+% and specified adsorbent life of more than 20 years.

UOP also offers a wide portfolio of process technologies, engineering know-how and patents for the recovery of natural gas liquids and/or liquefied petroleum gas (NGL/LPG), LNG, and CO<sub>2</sub> fractionation. Orloff cryogenic technologies have been applied worldwide in over 200 operating gas processing plants.

Amine Guard FS process technology was introduced more than 20 years ago. To date, UOP has licensed more than 400 Amine Guard units for commercial service.



### Cryogenic Fractionation Flow Scheme



#### For more information

[www.uop.com](http://www.uop.com)

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