



Increase Hydrogen Supply Availability with Cavern Storage

Praxair has built a new way to make hydrogen supply available to refineries no matter when it is needed. Strategically integrated with Praxair's 310-mile Gulf Coast pipeline system, the storage cavern enables refineries to process heavier crudes and meet lower sulfur mandates with confidence. Instantaneous hydrogen availability from Praxair's hydrogen cavern will allow refiners to meet both planned and unplanned hydrogen needs 24/7/365.

Benefits of Hydrogen Cavern Storage

Q. What was the impetus for the development of Praxair's H₂ on-line storage cavern?

A. The impetus was to offer refineries instantaneous, back-up hydrogen supply and to also increase hydrogen availability from Praxair's Gulf Coast hydrogen system. Hydrogen has become more than just a selective additive to the oil refining process. Heavier crudes and mandated ultra-low sulfur transportation fuels make hydrogen absolutely vital to the 24/7/365 operations of a refinery.

Q. How does the cavern increase hydrogen availability?

A. By being integrated directly into the heart of Praxair's 310-mile Gulf Coast hydrogen pipeline system, the cavern can meet a customer's planned or unplanned hydrogen requirements on an instantaneous basis. For example, most refiners supply a significant portion of their hydrogen needs from their own hydrogen sources and, at times, these sources become unavailable. In the past, refiners adjusted their refinery processes when hydrogen wasn't immediately available if their supply was lost. The cavern will now provide that on-line, back-up supply.

Q. Why use a cavern for availability? Couldn't this be done with H₂ production plants?

A. Gas pipeline systems operate with limited storage so Praxair must continually match system supply



The wellhead situated above the cavern, which is drilled to a depth of 4,600 feet.

to meet customer demand. Because hydrogen production plants cannot be instantaneously brought on and off line without large inefficiencies and significant equipment wear and tear, there are times when refinery hydrogen demand goes unmet and the refiner is forced to adjust its production process. The on-line storage cavern will change this availability paradigm.



Integrated cavern support equipment.

Integrating existing and stored hydrogen systems

Q. How does Praxair integrate hydrogen supply with a refinery's existing hydrogen system?

A. Praxair does more than just supply H₂ molecules to the customer gate. Integration of new hydrogen supply with an existing hydrogen system is

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The Praxair hydrogen storage cavern is integrated to the pipeline serving refineries along the U.S. Gulf Coast.





absolutely critical to the most cost effective use of hydrogen. Praxair has developed a refinery hydrogen evaluation program that supplies the people and proprietary software to model and optimize a refinery's existing hydrogen supply. In addition, Praxair's hydrogen evaluation program is an excellent tool for future scenario modeling of potential refinery configurations.

Optimizing Related Energy Needs

Q. What about hydrogen system and energy system integration and impact on availability?

A. The refinery energy system is significantly impacted by hydrogen supply decisions. Through a Praxair-developed proprietary program, Praxair can perform a TEAM (Total Energy Asset Management) energy survey for a refinery by modeling the refiner's energy sources and demands, including fuel gas, natural gas, hydrogen, coke burn, steam and electric power. The system is modeled and benchmarked, and a program for energy improvement is recommended. Future refinery scenarios can then be modeled with a focus on availability and keeping energy supply balanced with demand.

Related Services for Simplified Installation and Management

Q. What other innovations is Praxair bringing to the refinery market?

A. Praxair is investing in technologies to recover existing hydrogen molecules out of a refiner's fuel gas system. These hydrogen molecules have increased value in refinery hydroprocessing, and by removing the low Btu value hydrogen from the fuel system, a refiner may be able to increase the Btu value of its fuel. Praxair has developed different approaches to meet a refiner's specific set of conditions. These technologies will be discussed as part of any hydrogen or TEAM study program that is accomplished with Praxair.

Q. What other services does Praxair offer the refinery market?

A. Praxair Services Inc., formerly known as UCISCO, has developed a suite of proven technologies and services to solve some of the industry's most complex issues such as reactor cooling and integrity assessment and control for tanks and piping. Praxair provides cleaning, purging, drying, displacing, leak detection, hydrotesting, inspecting

and cathodic protection services for such typical piping networks as gathering, transmission and distribution systems as well as above and underground storage tanks.

Q. Does Praxair offer any help on combustion applications?

A. Praxair has a long history of combustion applications. For traditional refinery applications such as FCCU and SRU oxygen enrichment, Praxair brings knowledge and know-how on oxygen compatibility, flow control, mixing and installation. Praxair has also developed oxygen enrichment technologies to address process heater limitations that may be caused by draft/fan limits, tube skin temperatures, NOx or radiant heat transfer.

How to get started.

Call 1-800-PRAXAIR to learn how you can reserve hydrogen supply for your future needs. Visit us on the web at www.praxair.com and look under Industries Served/Refining.



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