

UOP Polybed™ Pressure Swing Adsorption (PSA) Systems

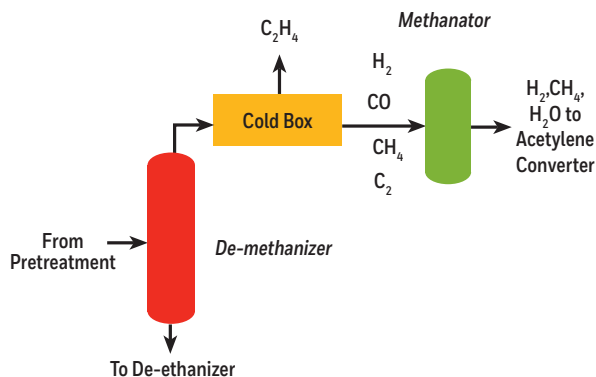
PSA systems for hydrogen purification from ethylene off-gas

Introduction

Purification of hydrogen within the ethylene plant meets two purposes: internal demand (for acetylene conversion and hydrogenation) and export hydrogen.

The de-methanizer overhead provides the best source of hydrogen. After treatment in the cold box, where most of the hydrocarbon components are removed, the stream contains 80-95 vol% hydrogen. The balance is carbon monoxide, methane and traces of other hydrocarbons.

H₂ Recovery Scheme Before the Development of PSA Technology



Traditional process schemes provide for a methanator to convert carbon monoxide to methane. Unfortunately, this approach results in a low-purity hydrogen stream and low yield.

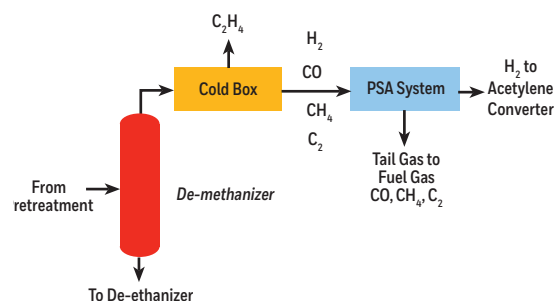
UOP's Polybed PSA system can extract high-purity hydrogen from this stream using a cost-efficient and simpler process scheme. The Polybed PSA system produces dry hydrogen at greater than 99.9 vol% with a carbon monoxide specification of less than 10 ppm, and successfully replaces the methanator for an overall highly efficient operation.

The higher hydrogen purity allows the acetylene converter to operate at a lower temperature, leading to a longer catalyst life and lower green oil formation. Since the PSA system removes all the methane and carbon monoxide, the cryogenics system can be eliminated or designed for lower hydrogen purity in the overhead, resulting in a less complex and less expensive cold box. Since the PSA system operates at the low temperature at which the stream exits the cold box, often as low as 10°C (50°F), no feed conditioning is required.



Reduce capital costs and produce higher purity hydrogen that improves acetylene converter operation by using a PSA to purify hydrogen from ethylene off-gas.

H₂ recovery scheme in an ethylene plant with a Polybed PSA system



Small four-bed PSA systems typically meet the internal hydrogen demand of the ethylene plant, whereas larger systems permit the export of hydrogen after meeting internal needs.

Process Description

The de-methanizer overhead gas exiting the cold box enters the Polybed PSA system. The PSA system adsorbs the carbon monoxide, hydrocarbons, and other impurities in a fixed-bed adsorber at a feed (high) pressure. The impurities desorb from the bed upon “swinging” the adsorber from the feed to the tail gas (low) pressure, and by using a high-purity purge. The adsorbent does not adsorb the hydrogen.

Apart from the pure hydrogen product, the PSA system produces a low-pressure off-gas stream, the tail gas. It contains all of the impurities present in the feed gas and some of the hydrogen used for regeneration of the adsorbent. It is usually sent to the fuel gas header.

UOP Provides:

- Unparalleled international experience in project development, engineering, fabrication and technical support
- Flexibility in project execution
- PSA systems optimized for customer requirements
- Worldwide sourcing to meet local requirements
- Shop fabricated skid-mounted systems for fast on-site installation and start-ups
- Superior quality control resulting in long-term safe, reliable operation
- Greater than 99.8% on-stream factor from the rigorous design and selection of the valves and control system
- Maximum reliability for hydrogen production due to the control system that automatically adjusts to maintain production, even during upset conditions
- The highest hydrogen recovery through the use of proprietary UOP adsorbents

- Long adsorbent life (>30 years)
- Lower capital cost due to adsorbent efficiency, process design and control philosophy
- Products and services with ISO-9001 certification
- Proven training programs
- Full portfolio of UOP services including commissioning, troubleshooting and revamps for future operations

Commercial Experience

UOP invented and developed the Polybed PSA technology more than 45 years ago. UOP has delivered more than 900 PSA systems worldwide, processing more than 40 different types of feedstock.

UOP was the first to commercialize PSA technology for ethylene off gas service. UOP has provided 130 PSA systems for ethylene off gas service with hydrogen production capacities ranging from 1 to more than 112 MMSCFD (1,000 - 123,000 Nm³/hr).

Several Polybed PSA units purify a feed consisting of a mixture of ethylene off-gases and other hydrogen-containing gases, such as refinery off-gases. This provides attractive economics since only a single purification unit is needed.

For more information

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UOP4810-2b April 2016

