



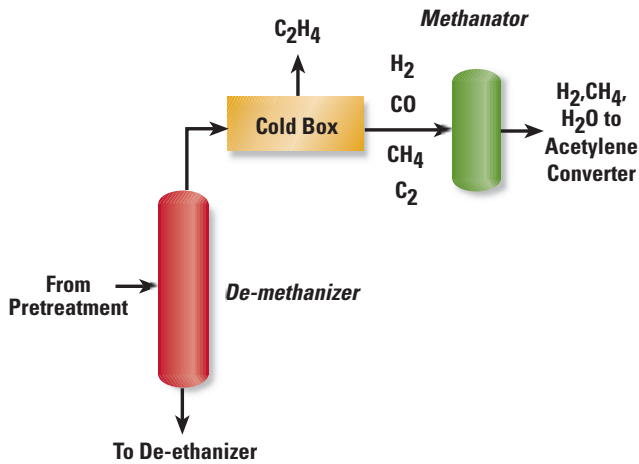
# UOP Polybed™ PSA System for Hydrogen Purification from Ethylene Off-Gas

## Hydrogen

### 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.



*H<sub>2</sub> recovery scheme before the development of PSA technology.*

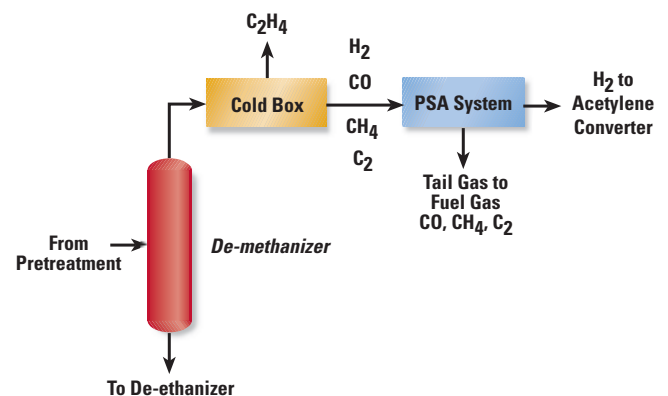
Traditional process schemes provide for a methanator to convert carbon monoxide to methane. Unfortunately, this approach results in a low purity hydrogen stream and low yield.

UOP's Polybed Pressure Swing Adsorption (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



Hydrogen



*H<sub>2</sub> recovery scheme in an ethylene plant with a Polybed PSA system.*

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.

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.

#### **UOP provides:**

- Unparalleled international experience in project development, engineering, fabrication, and technical support
- Flexibility in project execution
- PSA systems optimized within customer requirements
- Worldwide sourcing to meet local requirements
- Shop fabricated skid-mounted systems for fast on-site installation and start-ups.
- Products and services with ISO-9001 certification
- Proven training programs
- Ongoing support after plant start-up

#### **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.

#### **Commercial experience**

UOP has supplied more than 100 systems in this service, with hydrogen production capacities ranging from 1,000 to more than 120,000 Nm<sup>3</sup>/h (1-100 MM SCFD).

Several Polybed 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**

For more information, contact your local UOP representative or our Des Plaines sales office:

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