

Making our world more productive



# HISORP<sup>®</sup> TS

A new performance benchmark Hydrocarbon Recovery Unit – Member of the HISORP<sup>®</sup> family



# Lowering CAPEX and OPEX through process synergies

## One-stop offering for adsorptive pre-treatment for membrane technology and dewpointing

Linde developed the HISORP® TS hydrocarbon recovery unit (HRU) based on the BASF temperature swing adsorption (TSA) process to complement its adsorptive natural gas treatment offering. HISORP TS takes processing efficiency to even greater heights by removing water and heavy hydrocarbons from gas streams. It adds considerable value to our customers through multiple technical innovations such as a novel adsorber vessel design.

## Typical HISORP TS applications

### Pretreatment in membrane plants

→ Membranes for natural gas or process gas separation and purification need to be protected from certain gas components, i.e. water and/or heavy hydrocarbons (HHC). HISORP TS lowers these gas components to acceptable levels. While our specially developed HISELECT® membranes powered by EVONIK provide for outstanding resistance to HHCs, a sound pre-treatment concept based on HISORP TS is key for operational optimization, allowing for even higher membrane performance.

### Dewpointing of gas

→ By removing water and HHCs from gases, HISORP TS acts as a dewpoint control unit to achieve defined pipeline specifications, e.g. for applications in underground gas storage facilities.

## Proven performance

Backed by over forty years of experience in the design and construction of adsorption plants, Linde Engineering continues to push the boundaries of innovation and strengthen its position as a world leader in efficiency-enabling adsorption technologies. Our proven portfolio spans high-performance pressure swing adsorption (PSA) and TSA systems, providing economical and reliable adsorption for a wide range of process gases.

## Main advantages

- Optimized flow distribution inside adsorber vessels based on new and innovative adsorber vessel design
- New and innovative internal insulation design that dispenses with special concrete and rockwool
- Designed for onshore and offshore applications
- No significant pressure loss compared with conventional HRU processes
- Low operational costs combined with highest availability and reliability
- High flexibility over a huge operating range
- Modular design for minimized assembly cost and on-time execution



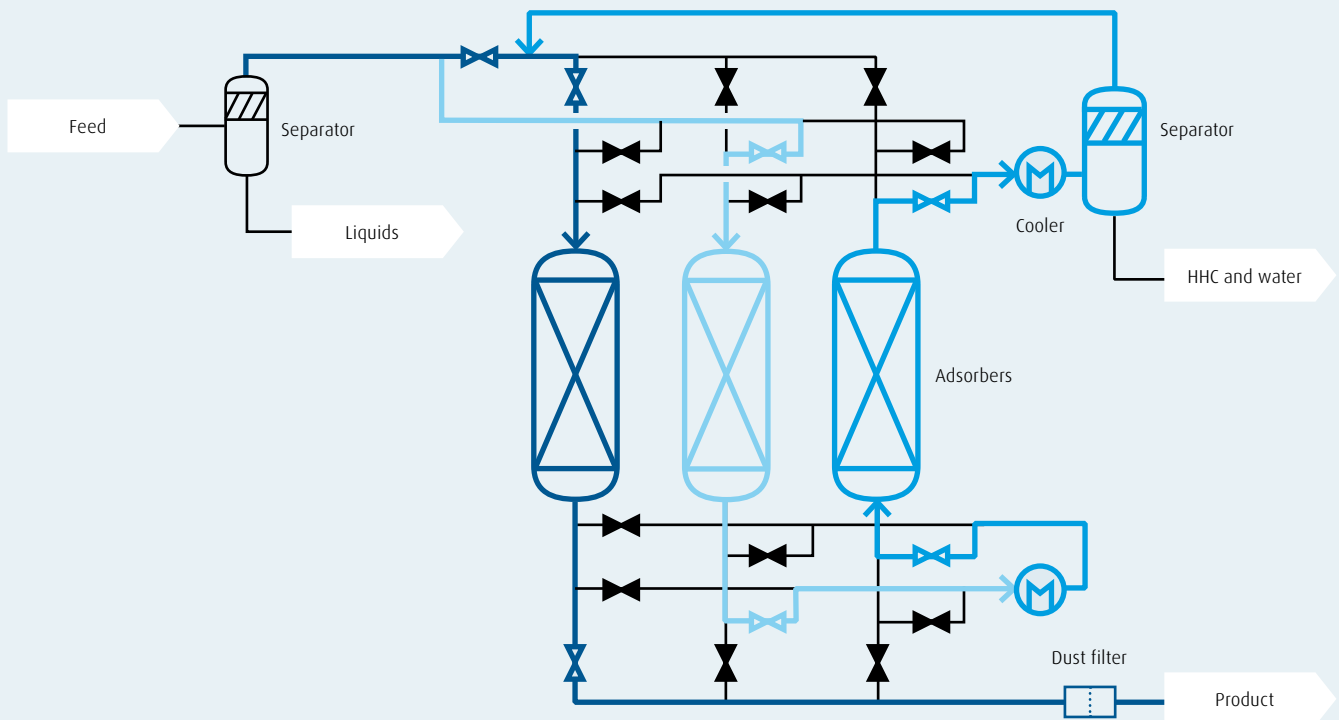
LNG plant, northern Norway

## HISORP® TS Process Flow Diagram

■ Adsorption step

■ Cooling step

■ Heating step



Demand for innovative solvent-free membrane technologies that enable even CO<sub>2</sub>-rich natural gas to be processed in an energy-efficient manner continues to rise. To meet this need, Linde rounded out its gas separation portfolio with a new robust, highly selective membrane technology known as HISELECT®. The HISELECT membrane represents a comprehensive offering for various applications, ranging from standard gas sweetening to achieve pipeline specifications to pre-treatment applications in LNG plants.

Linde's one-stop offering for both the pretreatment and membrane stages creates valuable synergies. Customers benefit not only from lower CAPEX but also from lower OPEX thanks to optimized process integration.

### Closer look at the HISORP® TS process

The HISORP TS HRU removes HHCs and water from gaseous feeds. Each of the three (minimum) adsorber units completes several steps (adsorption, heating and cooling) as illustrated in the process flow diagram above.

During adsorption, the feed gas is routed from the top to the bottom of the respective adsorber in adsorption and the HHCs and water are adsorbed to produce an on-spec product. After a certain time, the adsorbent material is fully loaded and another adsorber switches

to adsorption mode. The fully loaded adsorber switches to the regeneration phase, which consists of the heating and cooling steps.

In the heating step, the regeneration gas is routed through the vessel from bottom to top at an elevated temperature. The previously adsorbed impurities desorb and accumulate in the hot regeneration gas. The gas is subsequently cooled down and sent to a condensate separator to separate the HHCs and water from the gaseous components. Once the heating step has been completed, the adsorber vessel is cooled to adsorption temperature by using regeneration gas. This regeneration gas used for cooling is a split stream from the feed gas and it is routed through the vessel from top to bottom. The gas leaving the adsorber vessel in the cooling step becomes the regeneration gas for the vessel in the heating step. In this way, heat losses are minimized, and heat is recovered efficiently.

After separation of the condensable components, the regeneration gas is recycled from the condensate separator to the feed gas to maximize recovery of valuable components. No compressor or blower is required for this process step. Instead, a throttle valve in the feed line compensates for the pressure loss of the regeneration gas to facilitate recycling. The entire process is designed for maximum efficiency.

# Your partner for the production and processing of gases

## Delivering reliable process plants for maximum capital efficiency

Linde has been optimizing gas processing technologies for 140 years, successfully delivering more than 4,000 plant engineering projects around the globe. Favoring trusted, lasting business relationships, the company collaborates closely with customers to enhance plant lifecycle productivity and innovate process flows. The company's proven gas processing expertise plays an indispensable role in the success of customers across multiple industries – from natural gas and oil refining through petrochemicals and fertilizers to electronics and metal processing.

## Operational excellence along the entire plant lifecycle

We work closely with our customers to gain an in-depth understanding of individual needs. Building on the unique synergies of Linde as an integrated plant operator and engineering company, Linde offers innovative process technologies and services to exceed our customers' reliability and profitability expectations. This commitment to innovation extends along the entire plant lifecycle. The LINDE PLANTSERV® service team supports customers every step of the way – from maintenance and repairs to full revamps. Leveraging the latest digital technologies to offer on-site and remote operational and support services, we consistently take asset performance to the next level.

## Making the impossible possible

From the desert to the Arctic, from small- to world-scale, from standardized to customized designs, Linde's engineering specialists develop solutions that operate under all conditions. The company covers every step in the design, project management and construction of gas processing plants and components. Customers can always rely on Linde to deliver the plants, components and services that fit their needs best – anywhere in the world.

## Discover how we can contribute to your success at [www.linde-engineering.com](http://www.linde-engineering.com)

Get in touch with our adsorption and membrane plants team:

Phone +49 89 7445-4707, inquiry: [www.linde-engineering.com/contact](http://www.linde-engineering.com/contact)

## Core competencies at a glance

### Plant engineering

- Air separation plants
- LNG and natural gas processing plants
- Petrochemical plants
- Hydrogen and synthesis gas plants
- Adsorption plants
- Cryogenic plants
- Carbon capture and utilization plants
- Furnaces, fired heaters, incinerators

### Component manufacturing

- Coldboxes and modules
- Coil-wound heat exchangers
- Plate-fin heat exchangers
- Cryogenic columns
- Cryogenic storage tanks
- Liquefied helium tanks and containers
- Air-heated vaporizers
- Water bath vaporizers
- Spiral-welded aluminum pipes

### Services

- Revamps and plant modifications
- Plant relocations
- Spare parts
- Operational support, troubleshooting and immediate repairs
- Long-term service contracts
- Expert reviews for plants, operations and spare part inventory
- Operator training

