Coil-Wound Heat Exchangers
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Introduction.

Coil-wound heat exchangers (CWHE) have been used in the industry since the early days, when Carl von Linde liquefied air on an industrial scale for the first time in May 1895. Until today, more than thousand coil-wound heat exchangers have been manufactured in Linde’s fabrication facilities.

Coil-wound heat exchangers are compact and reliable with a broad temperature and pressure range and suitable for single phase as well as two phase streams. Multiple streams can be accommodated in one exchanger.
Each coil-wound heat exchanger is designed to meet the project requirements for the thermal and hydraulic performance as well as for the mechanical design and material selection.

The special features of the geometry and the possibility to use various materials allow a wide range of applications. Coil-wound heat exchangers are manufactured in stainless steel, aluminium alloy, carbon steel and special alloys.

Heating surfaces of up to 40,000 square meters and more can be installed in one unit. Bundle diameters of approx. 5,500 mm and unit weights up to 250 metric tons can be manufactured in Linde’s fabrication facilities. Larger diameters or higher unit weights are feasible and are assembled in Linde’s assembly yards located at the coast.

The coil-wound heat exchanger is known for its robustness in particular during start-up and shut-down or plant trip conditions.

**Thermal and hydraulic design**

For the thermal and hydraulic design Linde’s proprietary computer program GENIUS is used. This software determines the temperature and pressure profiles of the individual streams and calculates the distribution of the tubes to the various layers.

All methods for simulating heat transfer and pressure drop used by the program have been extensively tested. Linde’s own research and development is complemented by the cooperation with professional R & D institutes like HTRI and HTFS.
Linde’s coil-wound heat exchangers are supplied in line with the major codes for the design, fabrication and testing of pressure vessels:
- ASME
- German AD-Merkblatt
- European Pressure Equipment Directive (PED)

Other codes are possible upon request.

Mechanical design.

Linde’s coil-wound heat exchangers are supplied in line with the major codes for the design, fabrication and testing of pressure vessels.

Fabrication and special features
Generally a coil-wound heat exchanger comprises multiple layers of tubes wound around a centre pipe (mandrel).

After assembly with the prefabricated pressure vessel (shell) the coil-wound tube bundle is suspended on top only. This proprietary suspension system allows the Linde coil-wound heat exchanger to cope easily with large temperature differences and changes during operation while effectively avoiding any kind of bundle sagging.

Linde coil-wound heat exchangers are 100% self-draining. This special feature can be important e.g. during shutdown for avoiding possible corrosion defects.

Applications
Coil-wound heat exchangers are used for a wide range of applications as for example:
- Cooler/heater
- Liquefer
- Vaporiser
- Isothermal reactor

They are used in petrochemical plants, air and gas separation plants as well as in gas liquefaction units.

World-class LNG plants are equipped with Linde coil-wound heat exchangers, e.g.:
- Snøhvit LNG
- Brunei LNG
- North West Shelf Venture
- Sakhalin Energy
- Pluto LNG
Benefits.

- Broad temperature and pressure ranges
- Multiple fluids can be treated in one exchanger
- Compact unit with large specific heat transfer area per volume
- Capable for high pressure service
- Robust design suitable to cope with transient off-spec conditions
- Integrated two-phase separator and distributor, if required
- No bundle sagging due to proprietary support system
- 100% self-draining
- Available in various materials
- Possibility for bundle temperature recording

Selected references

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Coil-wound heat exchanger fabrication.
Isothermal reactors.

Characteristics
The Linde isothermal reactor is a fixed-bed reactor suitable for endothermic and exothermic catalytic reactions with indirect heat transfer. Based on the steam raising design, the isothermal mode of operation results in excellent temperature characteristics for all conditions like start-up, partial load and plant upsets.

Applications
Linde’s isothermal reactor can be used for gas/gas, gas/liquid and liquid/liquid reactions. Thus being an excellent solution for various processes in the chemical industry e.g.:
- Methanol synthesis
- Shift conversion
- Hydrogenation
- Methanization
- CLINSULF® sulfur recovery

Benefits
- Easy temperature control by adjusting the steam pressure
- Integrated steam drum
- Smooth behaviour during normal operation and fast start-up and shut-down procedures
- Easy and quick catalyst loading and unloading
Design tools.

Linde’s sophisticated design tools allow the detailed 3-dimensional modelling of coil-wound heat exchangers including tie-in simulations. This contributes significantly to the smooth installation on site.
Quality management and inspection is an indispensable part of our corporate strategy and therefore a managerial responsibility carried out at all levels of the company. We consider the improvement of our product quality and the continued development of our quality management system as a permanent challenge.

The Schalchen plant of the Engineering Division is certified according to:
- EN ISO 9001 / 2000
- German AD-Merkblatt
- ASME (U, U2, R-stamp)
- Manufacture license China
- etc.

Quality standards.
Water-bath vaporisers for liquefied gases.

**Characteristics**
Linde’s water-bath vaporiser are the robust and reliable solution for the gasification of cryogenic fluids. The unit consists of a water vessel in which a coiled tube bundle is installed.

The characteristics of the Linde steam-heated water-bath vaporisers are:
- The water is heated up by direct steam injection through one or more steam lances
- The steam flow is controlled by the water temperature
- During stand-by conditions, the water temperature is kept through a small steam lance at 60°C

**Benefits**
- Excellent solution for stand-by or discontinuous operation
- Availability of full capacity within seconds
- Reliable operation from 0 to 100 percent of nominal capacity
- Two or three streams of different liquefied gases can be treated in one unit
- Load range from approximately 500 Nm³/h up to 150,000 Nm³/h
- Multiple heating sources installed in one apparatus (e.g. steam and warm water)

Please contact the Linde sales team for a separate brochure.
Designing processes – constructing plants.

Linde’s Engineering Division continuously develops extensive process engineering know-how in the planning, project management and construction of turnkey industrial plants.

The range of products comprises:
- Petrochemical plants
- LNG and natural gas processing plants
- Synthesis gas plants
- Hydrogen plants
- Gas processing plants
- Adsorption plants
- Air separation plants
- Cryogenic plants
- Biotechnology plants
- Furnaces for petrochemical plants and refineries

More than 4,000 plants worldwide document the leading position of the Engineering Division in international plant construction.

Production facilities.

At Linde Engineering Schalchen Plant over 700 skilled engineers and workers design and manufacture components and complete modules for numerous applications in process plants such as ethylene plants, hydrogen and synthesis gas plants, LNG plants and air separation plants. Production capacity totals approx. 1.3 million hours per year.

In addition, the plant offers services for field installation and advice on operation. A specialised service crew is available for immediate and professional repair services.

Product range.
- Aluminium plate-fin heat exchangers as single units or as manifolded assemblies
- Cold boxes with aluminium plate-fin heat exchangers, columns and vessels
- Coil-wound heat exchangers and isothermal reactors for chemical and petrochemical plants
- Columns and pressure vessels in aluminium for cryogenic plants
- Spiral-welded pipes in aluminium
- Storage tanks for liquefied gases
- Steam-heated waterbath vaporisers as well as air-heated vaporisers for liquefied gases

For further information please contact:

Linde AG
Engineering Division, Schalchen Plant
Carl-von-Linde-Strasse 15, 83342 Tacherting, Germany
Phone +49.8621.85-6434, Fax +49.8621.85-6622