

THE LINDE GROUP

Linde

Ethylene Furnaces



State of the Art Technology

Cracking furnaces are the most important piece of equipment within ethylene plants, as they define the product yield of the entire plant. Linde Engineering North America Inc. (LENA) supplies the highest capacity ethylene furnaces available in this industry.

A pioneer in the ethylene industry in the 1950's, LENA is a subsidiary of The Linde Group. Linde Engineering provides ethylene furnaces that are 'top in class' with respect to:

- Cracking selectivity
- Energy efficiency, heat recovery and emissions
- Operability and run length
- Furnace capacity
- Availability and maintainability

Linde's proprietary PyroCrack[®] technology optimally meets our customer requirements for the full spectrum of feedstocks – from light hydrocarbons (ethane, propane and butane) through naphtha up to heavy liquid feedstocks such as gas oils and hydrocracker residues. Linde's exclusive short-residence time coil designs achieve maximum olefin yields and excellent furnace run lengths.

Optimizing our furnace designs to fulfill the specific needs and objectives of our customers, we provide the latest advances in furnace designs to maximize olefin yields. Our radiant coils feature mechanical robustness for long life.

Highest Furnace Capacities

Our twin radiant cell design – a cracking furnace set-up consisting of two radiant cells with a common intermediate convection section – have been designed with ethylene production capacities of up to 250 metric tons per annum. These capacities allow us to supply today's mega-crackers, minimizing the number of furnaces provided for these plants. As a result, our furnace capacities set the benchmark regarding capital and operational expenditure for cracking furnaces.

Technically Advanced Features

Inherent in the twin radiant cell design is the flexibility for independent cracking of different feedstocks in one furnace. We have even designed twin cell furnaces for 'cell decoking', in which one radiant cell is in decoke mode while the other cell is still in cracking mode, providing our customers enormous operational flexibility.

Our patented radiant coil design is another example of technically advanced feature incorporation. Due to its unique layout, stress forces are minimized and guide pins attached to the bottom return bends are not required.



Seven ethane cracking furnaces by Linde Engineering North America for Saudi Ethylene and Polyethylene Company (Tasnee) on an EPC basis. Completed ahead of schedule and contributed over 1 million accident-free man hours to the entire project.

High Performance

Linde's ethylene furnaces are designed for maximum availability and reliability. A PyroCrack[®] radiant coil can be connected to any conventional quench exchanger type as well as to the most modern linear type transfer line exchangers (LQE) ensuring low pressure loss, highest selectivity, and minimum maintenance.

We have experience with all possible firing concepts. Today's furnaces are either equipped with a combination of floor and sidewall burners, or up to 100% floor firing, depending on our customer's preferences and the optimum configuration for each individual project.

Safety is one of our highest priorities; hence firing systems are designed to comply with most recent safety standards. Sophisticated burner management systems ensure safe and easy operation which, if requested, may even encompass complete remote operation of the units.

Low Emission Designs

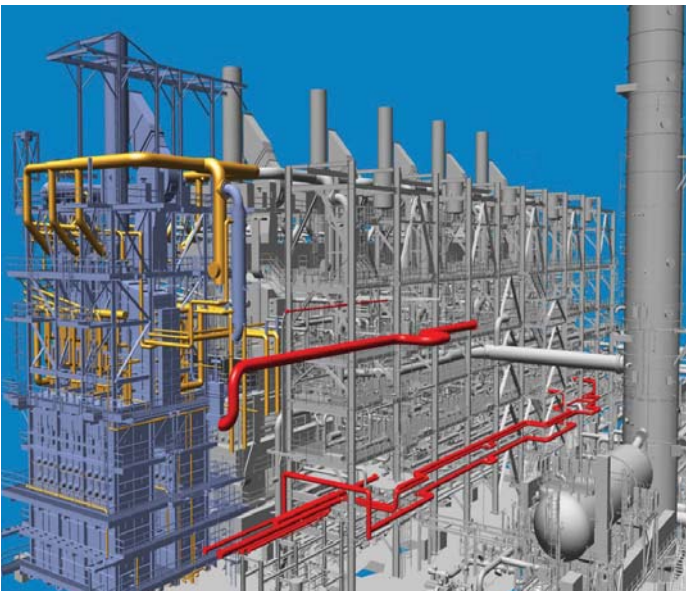
Linde's furnaces have consistently fulfilled their guarantees regarding thermal efficiencies and emissions. Our commitment is to provide ethylene furnaces that comply with all environmental requirements and are therefore low on emissions. Our furnaces are equipped with state-of-the-art low NO_x or ultra-low NO_x burners, or – if necessary - we design them with an SCR system incorporated in the convection section.

Our furnace designs minimize particulate emissions during decoking. This is accomplished either by re-routing the effluent gas back to the firebox for combustion, or by installation of a separator such as a cyclone to meet applicable regulations.

Continuous Technological Development

Our continued success providing pyrolysis furnaces for the production of olefins has afforded us unrivalled experience. Linde's commitment to continually improve the technology and operating efficiencies of our furnace design is the cornerstone of our success.

Through Linde's Research and Development facilities we have access to pilot plant data for cracking of any feedstock. We gather operating data on a regular basis from our installed units. Sophisticated computer programs such as Computational Fluid Dynamic (CFD) modeling enable our engineers to simulate fluid flow, combustion processes and heat transfer. Together, these resources lead us to improved furnace designs and provide the basis to address increasing needs to lower emissions and improve efficiency and operability of our ethylene furnaces designs.



Add-on furnace for Borouge, started up in 2007
(near duplicate design of five previously installed Linde furnaces)

Location: Ruwais, United Arab Emirates

Technical Data: 120 kTA ethylene production
Ethane feed
Twin radiant cell
PyroCrack[®] 2-2 Coil
Six conventional TLE + one SQE
Floor/Wall burners
Thermal efficiency (LHV basis) > 94%
NO_x guarantee: 104 mg/Nm³

Scope: Engineering, Procurement, Construction
Pipe rack extension, Furnace tie-in, DCS integration

Schedule: 14 months; mechanical completion 4 weeks ahead of schedule

EPC Capabilities and Global Presence

Linde Engineering North America has supplied over 1,000 pyrolysis furnaces throughout the world. We offer engineering, procurement, fabrication and construction engineering services for any furnace project world-wide.

For add-on furnaces and revamp projects, LENA and our parent company, Linde Engineering, offer:

- Concept Studies
- Basic and Detail Engineering
- Procurement and Fabrication
- Field Construction
- Commissioning and Operator Training
- Replacement Parts

For complete EPC projects LENA takes full, single source responsibility. For new furnaces this may include the furnace pipe rack, all civil work, and full integration of the furnaces into the plant.

In recent years we have successfully executed ethylene furnace projects on the Arabian Peninsula, in South East Asia, and in South America. All of these projects have demonstrated our strong qualifications for execution of such projects as we have consistently accomplished mechanical completion on or ahead of schedule.

The Linde Engineering Advantage

For over 60 years, we have served the refining, petrochemical, and chemical industries. Linde Engineering North America Inc. (formerly Selas Fluid Processing Corporation) offers single source responsibility for technology, engineering, procurement and construction - *T-EPC*.

- Technology, engineering, procurement, and project management expertise has been our hallmark since our beginning. Today, we enhance that strength with the latest design, simulation, and project management software packages.
- Worldwide procurement maximizes value to our clients and ensures timely project delivery. Our head office in Blue Bell, PA USA houses one of Linde's strategically located Procurement Centers.
- LENA construction management teams are experienced professionals who demand high standards at each project site, with a goal to provide an incident-free workplace.
- Revamps & rebuilds - we supply, upgrade and service fired equipment - our own Selas Fluid brand or that of other OEMs. Our Revamp Services and Construction groups in Houston, TX, position us to provide prompt support to our clients globally.
- Our Customer Service team is ready to assist with spare parts and equipment supply, working with our engineers and procurement center to provide effective solutions and prompt delivery.
- As a member of The Linde Group, we have a global network of T-EPC resources.

We're local. We're global. And we're proud to be both.

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