Where energies make tomorrow

Dorr-Oliver FluoSolids® Systems

Technology that makes Technip Energies a leading provider of fluid bed systems

T.EN TECHNIP ENERGIES

Technology history

The Dorr-Oliver FluoSolids® technology makes Technip Energies a leading provider of fluid bed systems, with nearly 1,000 reference projects. The technology has a wide range of applications in the metallurgical, chemical and waste processing industries.

1940s: Technology developed by Dorr-Oliver.

1947: First commercial installation, arseno-pyrite roaster for gold recovery.

1997: Business transferred from Dorr-Oliver to sister company Kinetics Technology International (KTI), a company specializing in furnaces and other high temperature equipment and systems.

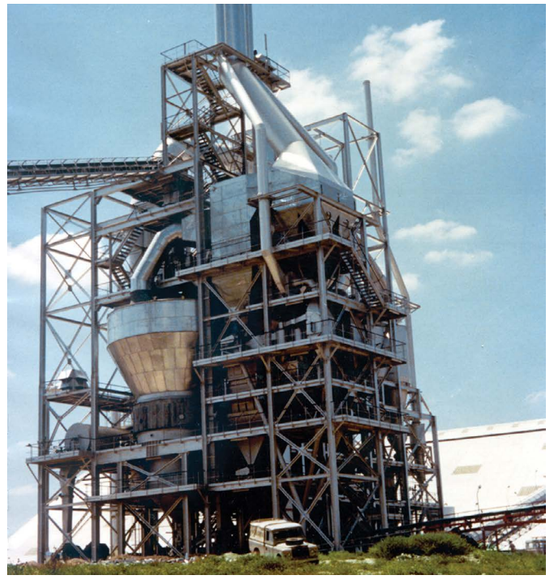
2000: KTI merged with Technip Energies who continues to develop the technology.

2012: Technip Energies Process Technology becomes the exclusive provider of this technology, offering modern fluidized bed systems for roasting, calcining, incineration, and a host of other applications to customers worldwide.

Our references include more than:

- 310 roaster systems for metallurgical applications, as well as sulfur dioxide and sulfuric acid manufacture
- 100 calcining systems
- 270 drying systems
- 90 preheaters and calcine coolers
- 200 waste incineration systems, both municipal and industrial

Arseno-pyrite roaster, Australia



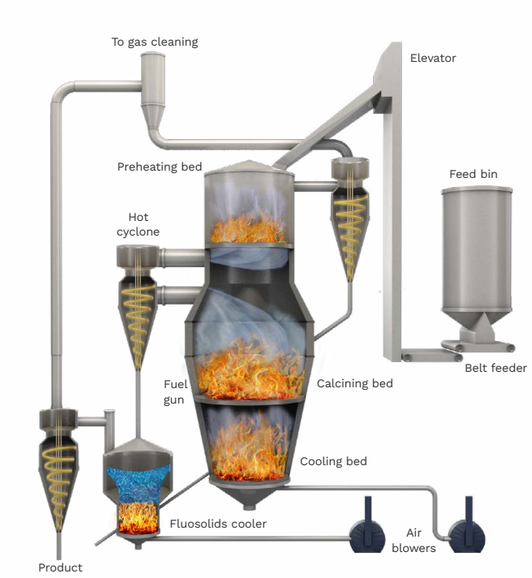
Phosphate rock calciner, Morocco

MAIN FEATURES

- **Chemical and thermal efficiency**
- **Simple start-up and shut-down**
- **Uniform solids temperature in the bed**
- **Variable solids retention time**
- **Vertical, cylindrical design for efficient space utilization**
- **Low operating cost**
- **No internal moving parts**
- **Long refractory life**
- **Low maintenance costs**
- **Simple controls**

Calcining systems

The multi-compartment FluoSolids reactor usually consists of a reaction bed and one or more heat exchange beds for heat recovery.

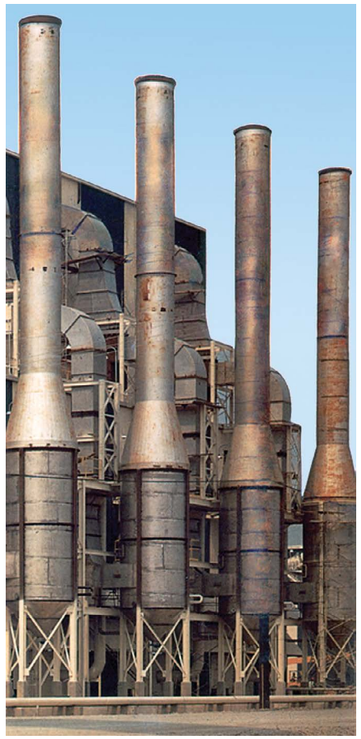


In a typical 3-stage unit as illustrated here, hot gases from the main calcining compartment are used to dry and preheat calciner feed. Fuel is directly injected into the reaction compartment, where temperature and atmosphere are closely controlled. Finally, heat is recovered from hot product solids and used to preheat the fluidizing air. Auxiliary vessels, such as fluid bed spray or indirect coolers, may be used to further cool product solids for ease of handling.

Applications

Multi-compartment FluoSolids reactors have been successfully employed in the following applications:

- Limestone calcining
- Calcium and magnesium sulfite decomposition
- Foundry sand calcining
- Ilmenite roasting
- Phosphate rock calcining
- Fireclay calcining
- Lime mud calcining and pelletization
- Alumina and bauxite calcination
- Iron ore preheating
- Iron ore reduction (hematite to magnetite)
- Manganese oxide reduction



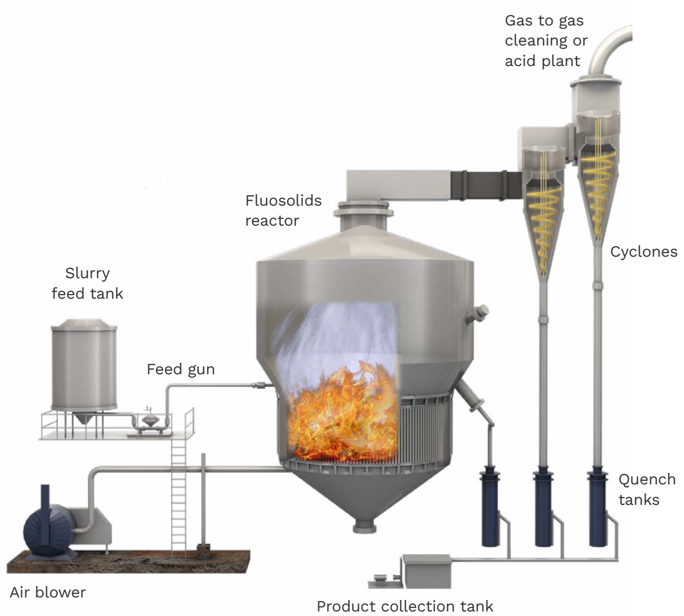
Phosphate rock calciner, USA

Roasting systems and references

The world's first commercial fluidized bed roasting system was a FluoSolids® unit designed to treat gold-bearing sulfide ore. The technology continued to develop under Dorr-Oliver and now Technip Energies to include a vast array of roasting process applications and reactor designs.

Roasting applications

- Two-stage roasting of refractory gold ore using pure oxygen (Freeport process)
- Partial roasting of copper concentrates for arsenic and sulfur removal
- Circulating fluid bed (CFB) roasting of refractory gold ore
- Two-stage roasting of gold-bearing arseno-pyrite concentrates for arsenic and sulfur removal
- Partial roasting of copper and nickel sulfides for sulfur control in smelting
- Dead roasting of pyrite, pyrrhotite, zinc, nickel and other sulfides
- Sulfation roasting of Cu and Cu/Co sulfides (RLE processes)
- Reduction roasting of iron ores and nickel laterite ores
- Chlorination roasting of copper ores (TORCO process)



Features of a FluoSolids roaster system

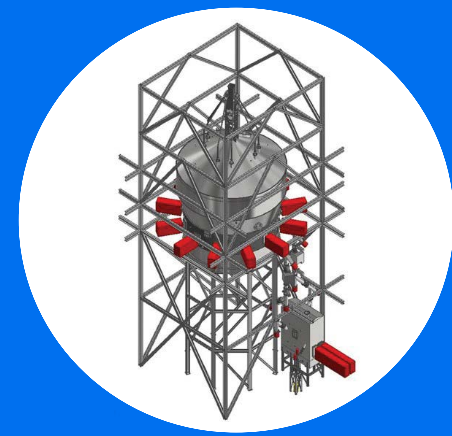
FluoSolids roaster systems incorporate the ideal combination of design features, specific to any application. Each system is tailored to specific process requirements and solids handling characteristics and incorporate the following design features:

- Cyclone, bag filter and hot ESP dust collection
- Direct quench and fluid bed calcine coolers with heat recovery
- Fluidized feed distributors for bone dry feed
- Slinger-belt feeders for filter cake feed
- Slurry distributors and in-bed slurry injection
- Direct in-bed injection of liquid, gas and solid fuels
- In-bed steam coils for temperature control and heat recovery
- Exhaust gas waste heat boilers

Operating Advantages

- Ease of operation
- High reliability
- Low operating and maintenance costs
- Flexible designs for various roasting applications

" More than 300 roaster references worldwide "



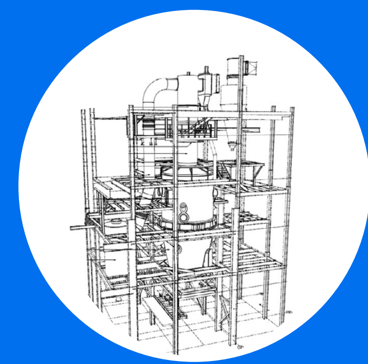
KGHM Glogow - 2017
Client: KGHM Polska Miedz

Country: Poland

Scope: FluoSolids® Roaster System

Facilities: One Fluidized Bed Dead Roaster for reduction of carbon and sulfur of copper concentrate and in-bed steam coils for cogeneration of electricity, 480 dry tpd.

KGHM Glogow is one of the world's largest smelting complexes and the FluoSolids roasting system will reduce carbon and sulfur from copper concentrate to improve copper production, as well as generate electricity from heat recovered from in-bed steam coils. KGHM is one of the world's leading producers of copper, silver and other metals.



Vale Copper Cliff - 2015
Client: Vale Canada, Ltd.

Country: Canada

Scope: Basic and Detailed Engineering for New FluoSolids Roaster No. 3 System

Facilities: Vale Canada, Ltd. has three FluoSolids nickel matte roasters and needed to replace the No. 3 FluoSolids roaster system installed in the 1960s. Technip Energies provided basic and detailed engineering, construction, commissioning and start-up supervision.

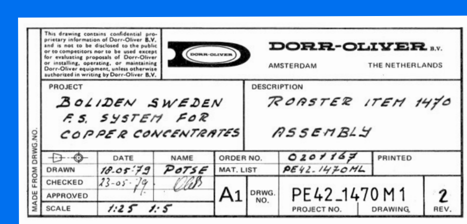
Koniambo - 2012
Client: Glencore Xstrata

Location: New Caledonia

Scope: From bankable feasibility study (BFS) to EPCM (prime contractor)

Facilities: Two Fluidized Bed Reduction Roasters for pre-reduction of nickel laterite feed to DC furnace, 160 t/h, each unit World Nickel 2017 – Process presented by Koniambo Nickel SAS as technical success

Koniambo is one of the world's largest and highest-grade undeveloped nickel deposits. In New Caledonia, we have implemented an opencast mine, ore transportation and storage, a pyrometallurgical plant constructed of modules, and all associated utilities and infrastructure.



Boliden Ronnskar – First copper arsenic reduction roaster
Client: Boliden

Country: Sweden

Scope: FluoSolids Arsenic Reduction Roaster System

Facilities: Located in Ronnskar, Sweden, this 960 tpd FluoSolids copper concentrate partial roaster was designed to reduce arsenic concentration prior to feeding calcine directly into submerged arc electric furnace. This FluoSolids roaster is still in operation after almost 40 years of service.

Combustion systems

Technip Energies is a world leader in FluoSolids® combustion technology with more than 200 installations worldwide, spanning the municipal, refining, petrochemical, food, pharmaceutical and pulp/paper industry sectors.

The fluid bed with its homogeneous temperature, high turbulence and long residence time performs exceptionally well for the combustion of sludges, waste oils, waste chemicals, solid wastes and other hazardous wastes. Total systems are available from feed to stack including ash dewatering and heat recovery.

Combuster, USA

Features

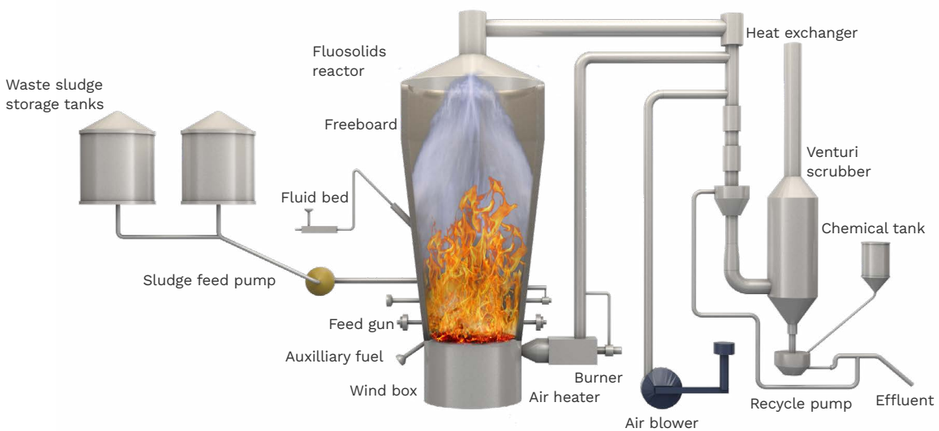
All combustion systems are designed to specific application and process requirements and solids handling characteristics. FluoSolids systems for themunicipal and industrial waste sectors have these integrated features designed into each plant:

- Efficient combustion with low excess air
- Lower temperature operations for equivalent combustion results
- Reduced air emissions
- Flexibility of operation
- Simplicity of control
- Lower staffing requirements
- Lower maintenance and operating costs
- Lower total system capital costs

Applications

Technip Energies is one of the most qualified suppliers of fluidized bed waste combustion systems. Installation capacity ranges from 2 to 200 million BTU per hour feed input.

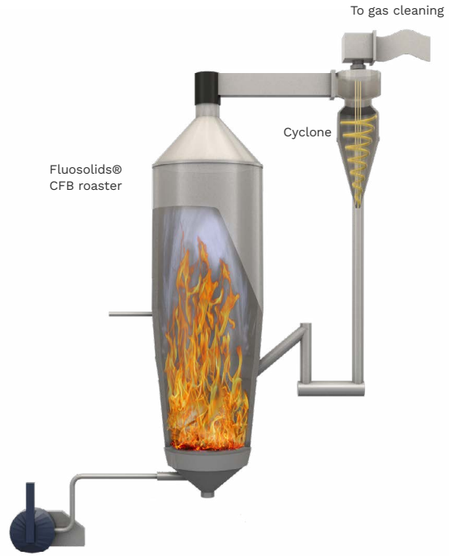
- Municipal sludges - primary, secondary
- Petroleum wastes
- Pharmaceutical sludge
- Pulp and paper deinking sludge
- Automobile manufacturing waste
- Food wastes
- Livestock waste
- Chemical process waste



Circulating fluid bed (CFB) systems

As gas velocities increase, more fluidized solids are carried upward in the reactor and the boundary between the bed and freeboard zones becomes less distinct.

A dense phase of coarse solids is created in the lower zone of the reactor followed by a dilute



phase of upwardly moving particles in the upper zone. A majority of the solids exit the reactor with the exhaust gases and are collected and re-circulated via a cyclone.

Additional capabilities

Fluid bed dryers

Technip Energies can design and supply fluid bed dryers for a multitude of applications. Dryer systems can be configured for direct heating, indirect heating with bed coils, or as a dryer-cooler combination.

ADVANTAGES

- Improved reaction kinetics
- Greater range of gas turndown capability
- Higher throughput per unit area

APPLICATIONS HAVE INCLUDED:

- Limestone and dolomite
- Phosphate rock
- Potash
- Sulfide concentrates
- Sand and flux
- Slag

Heat recovery and gas cleaning

Technip Energies provides heat recovery systems including flue gas to air, water and steam via water tube or fire tube waste heat boiler. Proprietary in-bed coils are used for special exothermic applications for steam generation. Plume-less stack can be achieved by using proprietary heat recovery systems. We also design proprietary cyclones and venturi scrubbers for solids recovery and emissions control and provide custom, multi-component emission systems to meet stringent air regulations.

Pilot scale testing

Technip Energies routinely conducts pilot plant testing of fluid bed processes to support equipment design, scale-up, and process guarantees. This testing offers the following advantages:

- Determine process feasibility
- Optimize product quality
- Define gaseous emissions
- Prove destruction and removal efficiency
- Establish design parameters for commercial design

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