

Industrial Solutions

# High- temperature technology

High-quality and innovative  
solutions for individual application.



thyssenkrupp

# High-temperature technology from ThyssenKrupp Polysius

## In demand worldwide

ThyssenKrupp Polysius AG is one of the world's leading developers and suppliers of high temperature shaft kilns, multiple hearth furnaces and integrated plants based on these systems, with over 35 years' experience on this field after the aquisition of RCE Industrieofenbau Engineering GmbH in 2006.

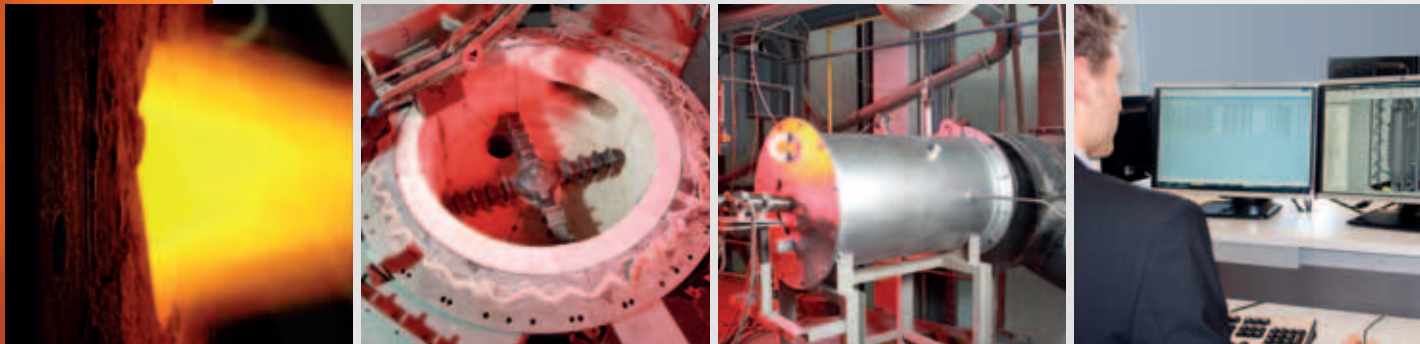
Today, the POLSINT shaft kiln and the MULTIPOL multiple hearth furnace represent the best available pyroprocessing technologies for the refractories industry. These are innovative cutting edge technologies that are trusted by clients all around the world.

The client's requirements lay the foundation for the plant design. With the aid of material analyses, laboratory test processes, computer simulations and calculations, ThyssenKrupp Polysius then creates the optimum plant configuration for the client's needs. Custom-tailored. Innovative. Reliable.

The ThyssenKrupp Polysius Research and Development Centre is among the world's foremost establishments for technological development in the minerals, mining and iron and steel producing industries, as well as the refractories, lime and chemicals industries.

The R+D Centre has laboratories for chemical, physical and mineralogical investigations. There are departments dealing with technical calculations, measurements and process and design development.

And there is the test plant facility, that contains "miniature production lines" in which laboratory-scale tests and pilot trials are performed, components tried out and environmental effects investigated.



Excellent technological competence is the key to winning over and retaining customers, as well as to exploiting growth potential in existing and new markets. With its special test facilities, the ThyssenKrupp Polysius Research and Development Division is able to simulate all relevant process stages and to continuously improve production processes.

### Some examples of possible fields of application for high-temperature systems supplied by ThyssenKrupp Polysius are ...

- ✓ Calcination of minerals such as magnesite, dolomite, bauxite, kaolin and clay, as well as filtercake from synthetic processes
- ✓ Direct sintering of magnesite, dolomite, bauxite and chamotte
- ✓ Two-stage burning (calcination, briquetting and sintering) for producing sintered magnesia and dolomite
- ✓ Pelletising, drying and sintering for the production of tabular alumina and spinel
- ✓ Production of magnesia from seawater and brine

#### Calcining

Depending on quality targets, the calcination of refractory-relevant minerals takes place in a temperature range of 400 to 1,100 °C.

The MULTIPOL multiple hearth furnace is predestined for this application, especially in cases where very low or precisely defined losses on ignition, a particular specific surface, specified residual CO<sub>2</sub> values and high product reactivity are required.

In cases requiring higher calcination temperatures, the POLSINT high-temperature kiln is the preferred system, provided that the decrepitation properties of the feed material permit its use.

#### Direct sintering

Depending on their chemical and physical properties, some dolomitic and magnesite qualities are suitable for direct sintering. This is the domain of the POLSINT high temperature shaft kiln.

This type of kiln guarantees high burning temperatures of 1,500 to 2,300 °C and uniform temperature distribution over the entire cross section of the shaft, which are prerequisites for the manufacturing of a homogeneous, high-quality product.

#### Two-stage burning process

The two-stage burning process is used for magnesite and dolomite in order to manufacture finished products with very high bulk specific densities that are difficult to achieve when using the direct sintering process.

In the first process stage, raw stone, flotation concentrate or filter cake is calcined. This is the perfect task for the MULTIPOL multiple hearth furnace; but it is also possible to use a single shaft kiln if the raw stone properties are suitable.

Subsequently the calcined material is compacted with briquetting presses. This intermediate process step assures the production of a feed material with uniform grain shape and homogeneous chemical properties to ensure the formation of a perfectly gas-permeable bed of material in the kiln. The second burning process – sintering – in the POLSINT high-temperature kiln achieves high specific bulk specific densities. This achieves high product qualities that cannot

be obtained with the direct sintering process. If a fine-grinding process is added as an intermediate stage, even higher bulk specific densities can be produced.

#### Production of tabular alumina and spinel

The feed material for this process chain (pelletising, drying and sintering) is calcined and ground material. For the production of spinel a mixture of at least two components is needed.

In the POLPELL pelletiser, seed material, water and recycled material are added to the finely ground raw material and uniform pellets of defined diameter are produced.

Next, the pellets are dried in the POLSHAFT dryer in order to prevent them from cracking during the preheating and sintering processes. Finally, the pellets are fed to the POLSINT high-temperature kiln and sintered to the high bulk specific densities that are required for first-class refractory products.

#### Seawater and brine magnesite processes

In this specific field, ThyssenKrupp Polysius/RCE has also played a major role in practically all projects implemented worldwide during the past 35 years and more.

A brine magnesia plant constructed in Jordan is only one example for our top-of-the-line engineering and equipment.

The process begins with seawater or with brine containing magnesium chloride (MgCl<sub>2</sub>). The feed liquid is reacted with slaked lime or dolime in order to convert the MgCl<sub>2</sub> into a high-purity Mg(OH)<sub>2</sub> precipitate required for further process stages or other applications, e.g. in the pharmaceutical industry.

After thickening, filtration and washing, the filter cake enters the two-stage burning process to be converted into top-grade sintered magnesia. For the production of calcined magnesium oxide or dried magnesium hydroxide, the process ends after calcination or drying in a MULTIPOL multiple hearth furnace.



# Special high-temperature systems

## MULTIPOL multiple hearth furnace

With the MULTIPOL, ThyssenKrupp Polysius has taken the lead in the market for the supply of multiple hearth furnaces, particularly in the refractory materials industry. The MULTIPOL is ideal for thermal processing of raw material with very small particle sizes as well as filter cake and enables precise control of the temperature profile. The multiple hearth furnace is the best choice for practically all calcination processes where highest product quality is demanded.

Fields of application	Main characteristics
<ul style="list-style-type: none"><li>✓ Calcination of industrial minerals, e.g. magnesite, dolomite, limestone and clay</li></ul>	<ul style="list-style-type: none"><li>✓ Moisture content levels of over 50% in the feed material (e.g. filter cake) are acceptable</li></ul>
<ul style="list-style-type: none"><li>✓ Calcination of flotation concentrates and filter cakes</li></ul>	<ul style="list-style-type: none"><li>✓ High flexibility and precise control of the temperature profile (± 5 °C) to achieve highest product qualities</li></ul>
<ul style="list-style-type: none"><li>✓ Thermal treatment of ores, minerals, earths, sands and biomass</li></ul>	<ul style="list-style-type: none"><li>✓ Suitable for processing very small particle sizes</li><li>✓ Insensitive to fluctuations in chemical and physical properties and moisture content of the feed</li><li>✓ Application temperatures up to 1,100 °C</li><li>✓ Suitable for oxidation and reduction processes</li><li>✓ Suitable for liquid and gaseous fuels (including low calorific value gas)</li><li>✓ Highest availability</li><li>✓ Low maintenance costs</li><li>✓ No product loss, in contrast to conventional calcining systems</li></ul>

The MULTIPOL multiple hearth furnace consists of a steel shell and refractory lined hearths, a supporting structure, the furnace head platform and the central shaft with drive train. The movement of the material through the furnace is carried out by rabble teeth supported by rabble arms that are attached to the central rotating shaft.

The design of the furnace permits an excellent contact between solids and gases. The furnace hearths are designed alternatively as “out-hearths” and “in-hearths”.

On an “in-hearth” the raw material is charged onto the periphery of the hearth from where the rabble system conveys it to the inside. Here, the material falls onto the next “out-hearth” located underneath.

Here the material is spirally rabbled outwards until it falls through the “out-drop holes” at the periphery onto the following “in-hearth” underneath. This pattern is repeated until the calcined material is discharged from the periphery of the bottom hearth.

The quality of the finished product (i.e. reactivity, specific surface, LOI, residual CO<sub>2</sub>) can be adjusted by controlling and varying the temperature profile hearth by hearth.



MULTIPOL design parameters:

- ✓ 4.5 to 7.8 m outer diameter
- ✓ 6 to 19 hearths
- ✓ 25 to 300 tonnes daily output
- ✓ 0 to 30 mm feed particle size
- ✓ gaseous or liquid fuels

## POLSINT high temperature shaft kiln

The POLSINT High Temperature Kiln was developed in close co-operation with the refractory materials industry. Today, ThyssenKrupp Polysius is the market leader for this sintering technology.

Fields of application	Main characteristics
<ul style="list-style-type: none"><li>✓ Calcination of natural magnesite, chamotte and bauxite</li></ul>	<ul style="list-style-type: none"><li>✓ Uniquely high thermal efficiency</li></ul>
<ul style="list-style-type: none"><li>✓ Direct sintering of magnesite, chamotte and dolomite</li></ul>	<ul style="list-style-type: none"><li>✓ High flexibility in adjusting the temperature level and profile to achieve highest product quality</li></ul>
<ul style="list-style-type: none"><li>✓ Sintering of calcined materials in a two-stage process, e.g. magnesite, dolomite lime, alumina and spinel</li></ul>	<ul style="list-style-type: none"><li>✓ Application temperatures up to 2,200 °C</li><li>✓ Suitable for liquid and gaseous fuels (including low calorific value gas)</li><li>✓ Highest availability</li><li>✓ Low maintenance costs</li></ul>

Like any shaft kiln, the POLSINT Kiln requires larger-sized raw materials as feed. The raw material (either in lump, briquette or pellet form) is supplied via the feed hopper.

The material is then preheated in counterflow by the combustion gases before reaching the burning zone. In the burning zone the material is sintered at high temperatures.

In order to reach the required very high temperatures, the heated-up cooling air is used as secondary air. The cooling air is introduced at the discharge end of the kiln to cool the material in coun-

terflow. The required fuel is introduced through burner lances arranged radially at the kiln shell.

This system ensures sufficient flexibility to suit the temperature profile requirements of the specific feed material and the required product quality.



Specific heat consumption:

- ✓ Magnesite/dolomite: 1,200 to 1,300 (kcal/kg)
- ✓ Bauxite: 400 to 800 (kcal/kg)
- ✓ Chamotte: 400 to 800 (kcal/kg)
- ✓ Briquetted magnesia/dolomite: 250 to 400 (kcal/kg)
- ✓ Alumina/spinel: 250 to 300 (kcal/kg)

POLSINT design parameters:

- ✓ 2.6 to 3.6 m outer diameter
- ✓ 25 to 150 tonnes daily output



# POLPELL pelletiser and POLSHAFT shaft drier

These two machines were also developed on the basis of the know-how gained in close cooperation between ThyssenKrupp Polysius and the refractory materials industry.

The POLPELL pelletizer requires a lower capital expenditure than briquetting machines.

## Main characteristics

- ✓ High pellet density and strength
- ✓ Uniform and adjustable pellet diameter
- ✓ Low power consumption of the pelletizer
- ✓ High thermal efficiency of the dryer
- ✓ Dryer suitable for liquid and gaseous fuels (including low calorific value gas)
- ✓ Low formation of fines (low recycle rate from screening)
- ✓ Highest availability
- ✓ Low maintenance costs

## Fields of application

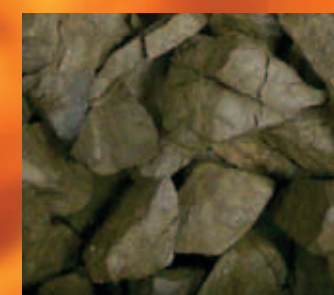
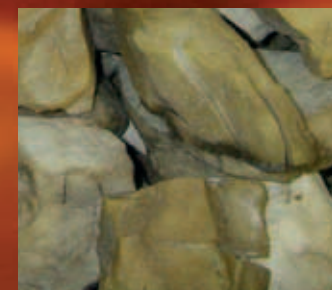
- ✓ Pelletizing and drying of calcined materials, e.g. alumina and spinel
- ✓ Pelletizing of dusts (e.g. dolomite lime flue dust)

Ground powder or dust is fed to the front end of the POLPELL pelletizer, seed grains and recycled material are added and pellets of uniform size are formed. The drum is divided into two sections: the front section is used for pellet formation while the rear section removes undersized pellets via a wire screen basket and returns them to the pelletising section.

The POLSHAFT shaft drier operates in counterflow. It is specifically designed to reduce the moisture content of pellets or briquettes to a level acceptable for the kiln feed. Its unique design enables efficient heat exchange and generates only a small amount of fines, thus improving the overall plant efficiency.

POLPELL produces up to 60 tonnes of pellets per day with 10 to 30 mm diameter (adjustable).

POLSHAFT systems dry up to 100 tonnes of pellets per day.





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