Pelletizing technologies

Outotec offers unrivalled solutions for processing iron ores. These include two leading pelletizing technologies that guarantee high product quality and low operating costs – the Traveling Grate process for plants with large capacities and the Steel Belt process for those with smaller ones.

Pelletizing processes very fine-grained iron ore into balls of a certain diameter, also known as pellets, which are suitable for blast furnace and direct reduction. Pellet plants can be located at mines, near harbors or be attached to steel mills. Equipped with advanced environmental technology, they are virtually pollution-free, generating no solid or liquid residues.

Outotec

More out of ore

Pelletizing discs.

Traveling grate for large capacities

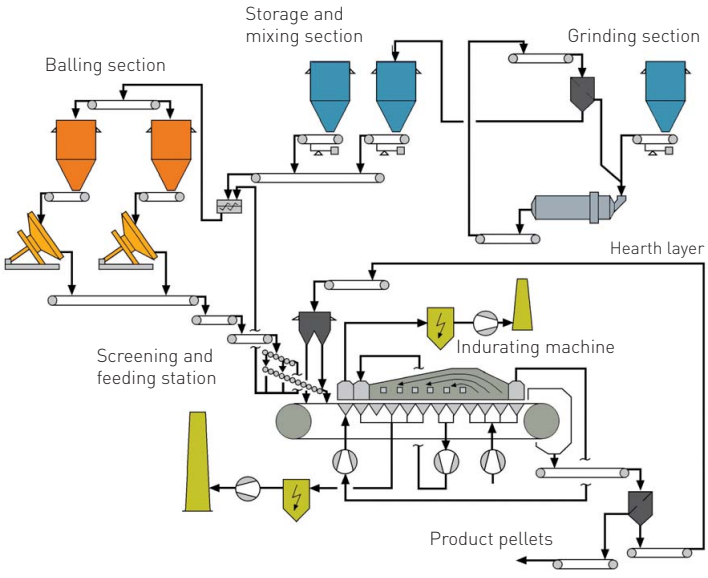
The traveling grate process, developed by former Lurgi Metallurgie, accounts for two thirds of the world's installed pelletizing processes.

It comprises three steps:

- Raw material preparation
- Formation of green pellets
- Pellet hardening

Why pelletize?

In the face of shrinking world reserves of high-grade ores, ores must now be concentrated before further processing. Pellets form one of the best options, thanks to their excellent physical and metallurgical properties. Moreover, due to their high strength and suitability for storage, pellets can be easily transported over long distances, with repeated transshipments, if necessary.



Typical flow diagram of a pelletizing plant.

The benefit of pellets

- Standardization – uniform size range, generally within a range of 9–16 mm
- Purity – 63–68% iron, mainly Fe_2O_3
- Cost-effectiveness – virtually no loss on ignition, while a high and uniform porosity of 25–30% allows fast reduction and high metallization rates
- Strength – high and uniform mechanical strength even under thermal stress in reducing atmospheres
- Transportable – low degradation under abrasive conditions

Innovative raw material preparation ensures for lower energy consumption

Prior to the formation of green pellets, water is added to the fine iron ore, to adjust the moisture content to approximately 9%, and the ore is mixed with small amounts of binding agents such as bentonite (approximately 0.5%) and fluxes such as limestone, olivine and dolomite (1–5%). These agents give the pellets the prerequisite physical and metallurgical properties required for further processing. Mixing takes place in continuously operating drum or pan-type mixers with a capacity up to 1,200 t/h.

Green pelletizing

On an industrial scale, green pellets are formed either in pelletizing discs or drums. Drums are usually being connected to roller screens used for separating undersized pellets (150–250%) which are returned to the drum. This high level of circulation makes pelletizing drums less sensitive to variations in feed material properties. Pelletizing discs need only a single process step to form pellets, their classifying effect discharging the pellets from the disc rim within a very narrow size range. Green pellet size can be precisely adjusted by varying the disc inclination, circumferential speed, feed or water addition rates.

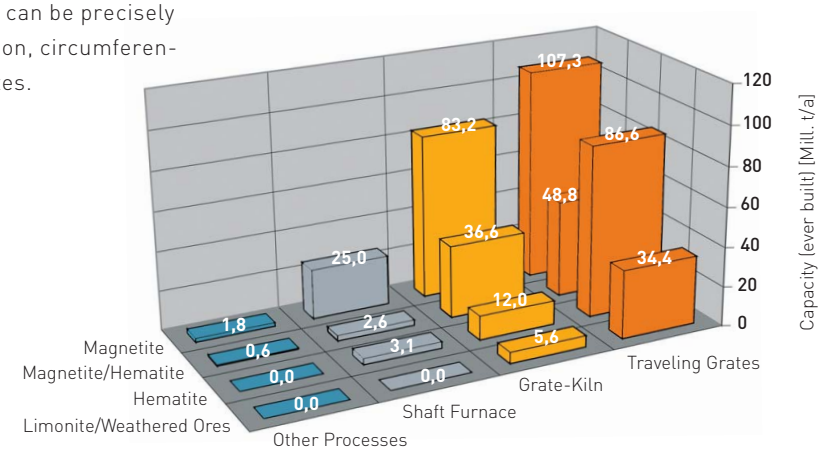
Continuous technology developments to optimise investment and operating costs

The parallel execution of pelletizing projects of various process configurations, plant capacities and in close cooperation with various experienced operators has ensured that our pelletizing technology is:

- The most cost efficient solution from its conceptual layout
- Considers all operators needs for optimized maintenance and low operating costs

This has led to the implementation of detailed technology developments, such as:

- The complete elimination of water cooling of the indurating hood
- Improved refractory lining to further reduce heat losses
- Optimized pellet car identification and exchange stations to minimize downtimes
- Optimized pellet car design to reduce maintenance costs and extend lifetime
- Optimized grate bar design to reduce pressure losses and extend lifetime
- Improved process fan design for higher thermal process efficiency and extended lifetime
- The implementation of pellet size monitoring systems to improve green pelletizing operation
- The use of training simulators and expert systems based on artificial neural networks for efficient plant operation



The share of traveling grate process in the world's pellet production.

Indurating furnance at CVRD's Sao Luis pelletizing plant in Brazil.

Optimized induration improves quality and lowers cost

Since green pellets have low mechanical strength, they need to be hardened for the processes that follow. To do this, we apply the Lurgi traveling grate, best thought of as an endless chain of pallets. A roller conveyor, for example a double-deck roller screen with each deck separating out oversized and undersized pellets, ensures that only pellets of the right size (generally 9–16 mm) are evenly distributed across the width of the traveling grate. The grate carries the green pellets on a bed 30–55 cm thick through a furnance with updraft drying, downdraft drying, preheating, firing, afterfiring and cooling zones.

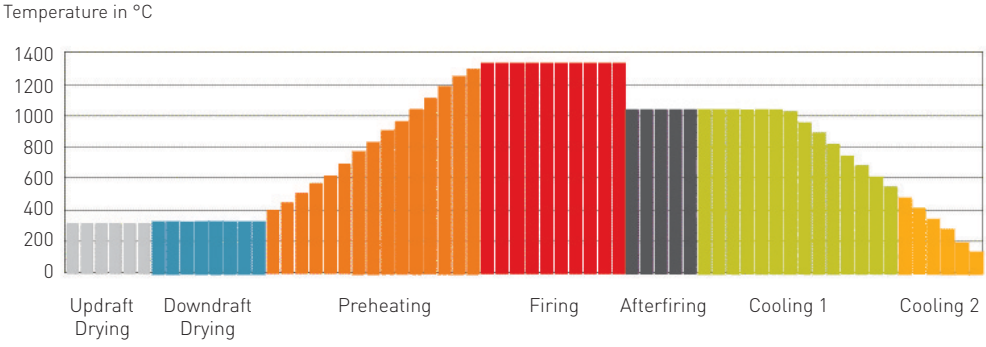
A major advantage of the traveling grate is that the green pellets remain undisturbed throughout the process.

The homogenous pellet charge on the traveling grate reduces the pressure drop within the furnace, minimizing energy consumption. It further enables even heat treatment, which results in high-quality pellets.

High-quality pellets

Numerous burners in the preheating and firing zone allow an exactly controlled firing pattern:

- Superior process flexibility
- Temperature profile easily adjustable
- Ability to vary firing profiles for changing feed materials
- Quality pellets at all feed rates without damage to equipment



Zones of the indurating furnace.

Economical and environmentally friendly gas flow concept

A range of recuperation techniques are applied to the gas flow for the traveling grate, enabling maximum reduction of fuel consumption and gas emissions:

- "Direct recuperation" of heated process gases (850–1,000 °C) from the first cooling zone, transferring the gases onwards to the preheating and firing zones
- "Windbox-recuperation" of exhaust gases (approximately 330 °C) from the windboxes to the downdraft drying and preheating zones
- The use of exhaust gases from the second cooling zone (approx. 350 °C) for updraft drying
- The use of exaust gases from the final cooling zone (approx. 250 °C) for the first cooling zone

Advanced burner design enables lower fuel consumption and reduced corrosion and NO_x formation

Our plants are using compressed air for atomization of the fuel oil. This reduces fuel oil consumption. High-pressure burners also improve combustion efficiency and decrease slag formation and chemical corrosion of the refractory by eliminating oil droplets. NO_x formation can be significantly reduced when the temperature distribution is more equal and hot spots in the flame are reduced.

Five or six major process fans maintain gas flow efficiently. While the cooling air fan draws in fresh air, the windbox exhaust fan and hood exhaust fan expel around two thirds and one third of off-gases respectively. Gases are recuperated by the windbox recuperation fan.

Reduced environmental impact

Travelling grates comply with the most stringent environmental regulations worldwide by employing state-of-the art gas cleaning systems, for example electrostatic precipitators and desulphurization units.

Maximizing solid fuel means lower operating and installation costs

Using coal as a solid fuel inside green pellets is standard in hematite pelletizing plants around the world. However, our unique indurating machine design maximizes the efficiency of coal combustion, which can generate up to 50% of the total energy input. The resultant need for fewer burners, burning chambers and process gas quantities saves on installation as well as operating costs.

Range of burners gives greater control

An array of burners in the preheating and firing zone enable a precisely controlled firing pattern, yielding the following advantages:

- Superior process flexibility
- Easily adjustable temperature profile
- Ability to vary firing profiles to changing feed materials
- Production of quality pellets at all feed rates without damaging the equipment

Our pelletizing process uses hearth and side wall layers, consisting of indurated pellets recirculated from production and enabling the firing of the entire bed of green pellets and protecting the grate bars from damage due to over-heating.

Optimized drying sequence means lower fuel consumption

In pellet drying, we have reduced fuel consumption significantly through our optimized updraft and downdraft drying sequence.

Facts about traveling grates

Traveling grate dimensions

- 110–768 m² reaction area
- 2.5–4.0 m machine width

Capacity

- 0.35–7.25 million t/a in single unit
- Availability 330–350 days/year
- Specific production rates (grate factor) between 15 t per day m² for weathered ores and >35 t per day m² for high-quality magnetites

Consumption figures

- Between 350 MJ thermal energy/t pellets for natural magnetites and 1,500 MJ thermal energy/t pellets for limonites
- 25–35 kWh/t electric energy for mixing, balling and induration, depending on raw material and plant capacity
- 0.05 m³ fresh water/t pellets for cooling water circuits

Product qualities

- Pellets produced for blast furnaces and direct reduction processes
- Cold compression strength >2,500 N/pellet
- Tumble index +6.35 mm >95%
- Abrasion index -0.5 mm <5%
- Pellets 9–16 mm >85–90%
- Fines -1 mm <1%
- High porosity, reducibility and degree of metallization

Process advantages:

Use of single process plant for pellet drying, preheating, firing and cooling:

- Pellets remain undisturbed throughout the entire process (including cooling)
- Uniform heat treatment
- Minimized dust and fines generation
- No intermediate strength requirement

Several burners in preheating and firing zones:

- Superior process flexibility
- Adjustable temperature profile
- Ability to vary firing profiles to changing raw materials

Stationary refractories, grate maintenance off-line:

- Low maintenance costs and high availability

Several recuperation techniques:

- Low specific heat consumption

Heat transfer by convection instead of radiation:

- Uniform heat treatment, leading to uniform product quality

Steel belt sintering SBS™

Since traveling grate plants are most efficient with 3–7 million t/a production capacities, we have developed steel belt technology for production of 80,000–1,000,000 t/a. This innovation is designed for the cost-effective agglomeration of smaller quantities of chrome ore, iron ore, manganese ore or niobium ore as well as for steel plant residues.

Steel belt plants differ from traveling grate plants in terms of the lighter design of their indurating machines and process gas systems. Green pellets are transported through the indurating machine by a perforated steel belt instead of pellet cars, while heat is generated by the combustion of carbon inside the pellets and by auxiliary burners in the gas duct between the cooling and firing compartments.

Comprehensive test facilities

Over the years, our own research centers in Germany and Finland have played a major role in successful pellet plant design and construction projects. The testwork carried out there yields specific data for optimal plant design in both technical and financial terms. Our R&D centers boast a full range of facilities for testing pellet properties according to international standards such as ISO, ASTM, JIS and DIN.

In order to optimize the entire process from run-of-mine ore through to fired pellets, our laboratories are capable of carrying out pellet tests in conjunction with comminution and benefication testing.

3012EN. Pinta/Libris, Helsinki, Finland. May 2007

Outotec, formerly Outokumpu Technology, is a worldwide technology leader in minerals and metals processing, providing innovative and environmentally sound solutions for a wide variety of customers in minerals processing, iron and steel, aluminum and non-ferrous metals industries. Outotec Oyj is listed on the Helsinki Stock Exchange.

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More out of ore