



OUTOTEC TRAVELING GRATE PELLETIZING

Outotec Traveling Grate Pelletizing is the industry's leading induration technology for iron ore pellet processing and is designed for a wide range of plant capacities up to 9.25 million t/a. Based on over 60 years' experience and world-class R&D, our process produces uniform pellets with excellent physical and metallurgical properties. It ensures high performance and quality, low investment and operating costs, and reduced energy consumption and emissions.

BENEFITS

- Produces uniform pellets with excellent metallurgical and physical properties
- Advanced burner design improves fuel efficiency and enables use of changing feed materials
- Efficient heat recovery allows heat to be reused in the pelletizing process
- Highly efficient gas cleaning reduces atmospheric emissions
- Optimal performance and ROI ensured with our lifecycle services



INNOVATIVE PELLETIZING TECHNOLOGIES TAKE IRON ORE PROCESSING TO THE NEXT LEVEL

As the world's reserves of high-grade iron ores continue to shrink, concentration is becoming increasingly important. Thanks to their excellent physical and metallurgical properties, pellets are one of the best options. Furthermore, due to their high strength they are also well suited to storage and can withstand transportation over long distances.

We have extensive experience in developing innovative technologies for the agglomeration of fine-grained iron ores, including 60 years' experience in supplying traveling grate pelletizing plants. Globally, we have delivered more than 65 plants for a wide range of ore types. Our traveling grate indurating process is responsible for two thirds of the world's installed pelletizing capacity.

We have delivered over 65 plants for a wide range of ore types, and our R&D activities have led to several key advances in pellet production design.



WORLD-CLASS R&D THAT OPTIMIZES YOUR INVESTMENT AND OPERATING COSTS

Our innovations focus on improving plant performance and reliability, while reducing capital investment and lifetime operating costs. We have carried out extensive research and testing with a wide range of raw materials and process parameters, and are continuously developing and improving the mechanical design and process automation of our technologies.

At our research facilities in Germany and Finland we have the capability to carry out in-depth testing programs to support the continuous improvement of the pelletizing process. These programs support optimal plant design in terms of both technology and long-term economic performance. Pellet parameters are rigorously tested to ensure compliance with international standards. In order to optimize the entire process from run-of-mine ore through to fired pellets, our laboratories can carry out pellet tests in conjunction with comminution and beneficiation testing.

Our R&D activities have led to several key advances in pellet production design, including:

- Elimination of water cooling in the indurating hood
- Improved refractory lining to further reduce heat losses
- Optimized pallet car identification and exchange station to minimize downtime, reduce maintenance costs, and extend lifetime
- Optimized grate bar design to reduce pressure losses and extend lifetime
- Improved process fan design to increase thermal efficiency and extend lifetime
- Pellet size-monitoring systems to improve green pelletizing operation
- Optimized plant operation supported by advisory tools based on in-house development

In recent years we have completed several large-scale plant deliveries, including the Samarco 4 plant at Ubu Port in Brazil, with an annual capacity of 9.25 million tons per year. In order to meet the requirements of direct-reduced iron production in large-scale shaft furnaces, we have also introduced dedicated plant sizes for 1–1.2 and 2.5–3 million metric tons per year.

THE OUTOTEC TRAVELING GRATE PELLETIZING PROCESS



Process steps



The Outotec Traveling Grate Pelletizing process consists of a green balling section where, after the mixing stage, green pellets are formed either by rolling on discs or in drums. The green pellets are then screened and heat-hardened in the indurating furnace.

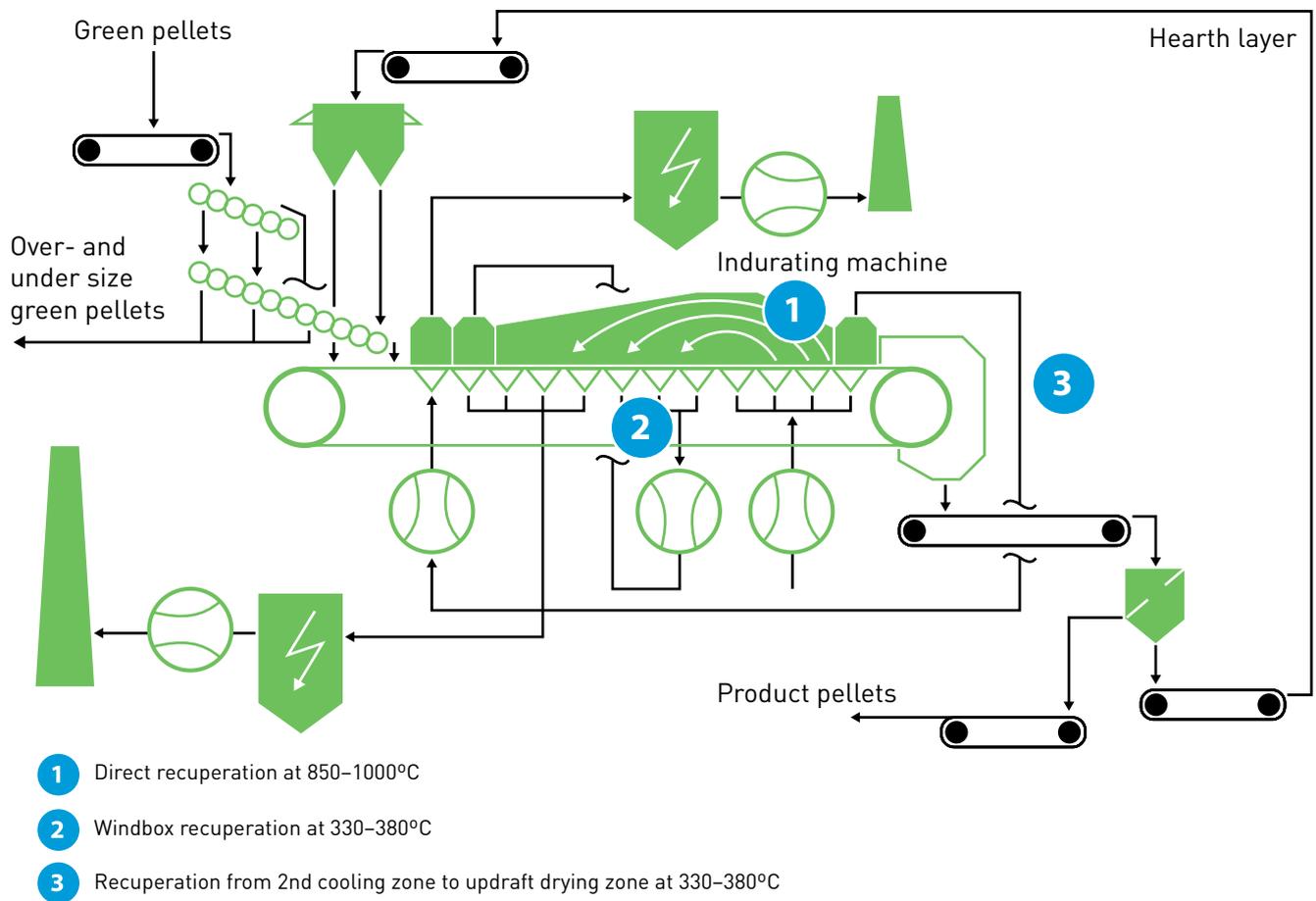
The process comprises four steps:

- Raw material preparation and mixing
- Green pelletizing
- Pellet hardening (indurating)
- Hearth layer and product screening

In order to adjust the moisture content, water is added in the mixing step. The ore is then mixed with small amounts of binding agents, which give the pellets the physical properties required for further processing. Fluxes such as limestone, olivine, and dolomite give the pellets the necessary physical and metallurgical properties for further processing. Mixing is done using drum or pan-type mixers.

The green pelletizing step is where the pellets are formed using pelletizing discs or drums. Drums use a two-stage process where undersize pellets are returned to the drum via a roller screen, whereas discs use a single process step, as they discharge pellets from the disc rim within a very narrow size range. Pellet size can be precisely adjusted by varying the disc inclination, circumferential speed, and feed or water addition rates.

In induration, the green pellets are first distributed evenly across the traveling grate and then hardened in a furnace, where they pass through updraft drying, downdraft drying, preheating, firing, after-firing, and cooling zones. Our unique updraft and downdraft drying sequence significantly reduces fuel consumption. The homogenous pellet charge on the grate reduces the pressure drop within the furnace, which further reduces energy consumption and enables even heat treatment, resulting in high quality pellets.



Our process produces uniform pellets with excellent physical and metallurgical properties, and ensures low investment and operating costs, as well as reduced energy consumption and emissions.



Advanced and fully adjustable burner system for superior flexibility and control

Numerous burners in the furnace's preheating and firing zones provide precise control over the firing pattern. This provides superior process flexibility, full control over the temperature profile, and the possibility to adjust the firing pattern for different feed materials. The result is high quality pellets regardless of feed rate, within the plant's production limits. Because our pelletizing process uses hearth and side-wall layers that consist of indurated pellets recirculated from production, the entire pellet bed can be fired without the risk of grate damage from overheating.

The Outotec Traveling Grate process can be operated with a variety of different fuels:

- Heavy fuel oil (HFO)
- Natural gas
- Mixed off-gases from steel plants with a net calorific value of $>2.500 \text{ kcal/Nm}^3$
- Coal gas admixed with fuel oil
- Coal tar

For operation with HFO, the Outotec process uses compressed air to atomize the fuel oil, reducing consumption. High-pressure burners provide excellent combustion efficiency and decrease slag formation and chemical corrosion of the refractory by eliminating oil droplets. The formation of nitrogen oxides can be significantly reduced with a more equal temperature distribution and reduced hot spots in the flame

Economical and environmentally friendly gas flow and gas cleaning

A range of recuperation techniques are applied to the grate's gas flow in order to reduce both fuel consumption and atmospheric emissions:

- Direct recuperation of heated process gases (850–1,000°C) from the first cooling zone, where the gases are transferred on to the preheating and firing zones
- Windbox recuperation of exhaust gases (330–380°C) from the windboxes to the downdraft drying and preheating zones
- Exhaust gases from the second cooling zone (330–380°C) are used for updraft drying
- Exhaust gases from the final cooling zone (approx. 250°C) are used in the first cooling zone

Because our traveling grate process employs state-of-the-art gas cleaning systems, including electrostatic precipitators and desulphurization units, it complies with strict international environmental regulations.

A LIFETIME OF SUPPORT

Outotec is committed to supporting your operations throughout the plant life cycle, helping you achieve and maintain peak performance levels and guaranteeing the best long-term return on your investment. Our global network of service centers covers more than 25 countries and provides lifecycle services for everything from spare parts, maintenance, and technical services to modernizations, operations and maintenance agreements, training, and consultancy.

1. Spares

Our spare parts solutions are designed to maximize production availability throughout the entire lifecycle of your plant. Our solutions range from high-quality OEM spare parts to complete service agreements, and are tailored to your exact needs.

2. Training

We offer an extensive training portfolio for both new plants and existing operations, with tailored training plans that can be followed up with refresher courses after a few years. Professional training supports knowledge transfer and long-term competence build-up for both operations and maintenance. Training plans combine classroom and hands-on teaching.

3. Operation and maintenance

During the operation phase you want to achieve the highest possible production rates. We support this goal in several ways – from basic inspections and maintenance support to continuous site presence and operational responsibility for the entire plant. The various production challenges you face can be systematically targeted through process and metallurgical expertise, as well as maintenance excellence.

4. Modernization

Operating conditions tend to change over time, so the production process and equipment may need to be fine-tuned or modernized to meet new requirements. We maintain a wide portfolio of modernization solutions for pelletizing technology to ensure you continuously achieve the highest production and quality levels. Whether your challenge concerns burners, gas boosters, optimization of mixing or granulation, raw material classification, firing zones, temperature profiles, gas treatment, or similar issues, we are able to help.



Outotec provides leading technologies and services for the sustainable use of Earth's natural resources. As the global leader in minerals and metals processing technology, we have developed many breakthrough technologies over the decades for our customers in metals and mining industry. We also provide innovative solutions for industrial water treatment, the utilization of alternative energy sources and the chemical industry. Outotec shares are listed on NASDAQ OMX Helsinki. www.outotec.com