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## Vale, BNDES and Logos Tecnom develop unique pig iron production technology in Brazil

Following extensive research that began more than 35 years ago, Tecnored Desenvolvimento Tecnológico S.A., a Vale company, in partnership with Brazil's development bank, BNDES, and Logos Tecnom, have started up the first pig iron demonstration plant that does not use traditional blast furnace methods, in Pindamonhangaba, São Paulo state. Pig iron is a fundamental element in steel production. The innovation enables higher productivity, lower emissions of CO<sub>2</sub> and particulate matter, the flexible use of raw materials, and a reduction of up to 30% in the cost of steel production.

The technology, called Tecnored, may help to extend the lifespan of Vale's mines and reduce their environmental impact, as it enables pig iron to be produced from iron ore of different grades and quality, and even ultrafine iron ore, which is currently deposited in tailings ponds. By using iron ore fines, we can reduce the need to open up new areas for tailings ponds, which require environmental licenses to be created.

Although the results are promising, Tecnored is still at the first stage of development. The next steps are to ensure operational stability and pursue economic feasibility. "This start-up has encouraged us to move ahead in our research, as the tests show that the technology is technically feasible", explains José Borges, Tecnored's CEO.

The new technology's secret lies in the use of cold pellets measuring 50 mm across, made up of lumps of fine particles of iron ore and a reducing product, such as different types of coal. The reducing agent removes oxygen from the iron ore, which is transformed into pig iron when heated in the furnace. Low-cost fuels such as coal or biomass (sustainably grown timber, sugarcane bagasse, etc.) can be used to supply the process with energy.

By using the cold pellets, the new Tecnored technology eliminates the need to use coke and sinterization facilities – indispensable parts of existing steel mills – and thereby significantly reduces construction costs. This is because both coking (the process of preparing coal for use in the blast furnace) and sinterization (the thermal process of agglomerating ore fines) require heavy investment and large areas for their plants.

By eliminating coking and sinterization, it is possible to cut energy use, and consequently emissions of particulate matter and carbon dioxide, as well as raising the productivity of the whole process. Iron oxide reduction using Tecnored takes place in just 30 minutes, while in coke-fueled blast furnaces, for example, reduction may require up to eight hours.

The company's technicians forecast that by using Tecnored, an industrial plant could produce 85% less particulate matter if compared with a traditional steel mill. Nitrogen oxide (NO) emissions may fall even more drastically, by up to 95%. Although it is not a greenhouse gas, NO indirectly contributes to global warming by reducing plants' photosynthesis capabilities, and it is also harmful to people's respiratory system. Tecnored can also cut CO<sub>2</sub> emissions by up to 5%.

Another innovation lies in the furnace's size and versatile design. While in traditional steelmaking, the blast furnace is between 20 and 30 meters in height, the Tecnored plant's furnace reaches no higher than five meters. "Besides being compact, the furnace has the added benefit of being made up of modules, which allows its size and production potential to be raised in line with objectives," explains Borges.

## Brazilian technology

The innovation is a great opportunity to produce pig iron at more competitive prices, and this may attract more international partners to the steel projects that Vale is developing in Brazil. "It's also worth emphasizing that this is a genuinely Brazilian technology, developed with Vale's complete support," Tecnores's CEO says.

Vale owns 43.04% of Tecnores's shares; BNDESPar, BNDES' investment arm, owns 31.79%; and Logos Tecnom, which represents the researchers who developed the technology, has 25.17%. Seven patents related to the new technology have so far been filed, covering 35 countries.

The demonstration plant, whose production capacity is 75,000 metric tons per year, was started up on September 12. Since it joined the venture in 2009, Vale has invested around R\$130 million of the total of approximately R\$250 million spent so far to develop it. The company is committed to building an industrial plant capable of producing 300,000 metric tons per year – 10% of the nominal capacity of a traditional blast furnace.

## Glossary

**Coke plant** – A facility composed of ovens in which a mixture of different types of coal is heated without air at temperatures of between 1,000 oC and 1,100 oC. The process is similar to petroleum distillation, and the solid residue obtained is called coke.

**Sinterization** – The process of agglomerating iron ore fines (with grain sizes of between 6.35 mm and 0.149 mm) and fluxes (limestone, dolomite and serpentine) at a temperature of around 1,300 oC. The result is a granular, porous product, with ideal physical, chemical and metallurgical properties for use in blast furnaces.

**Blast furnace** – A facility where pig iron is produced by removing oxygen from iron ore, using charcoal or coke as a reducing agent. Blast furnaces are fed from above with iron ore, reducing agents and possibly some additives. Inside the furnace, the materials are distributed in alternate layers. While the raw materials descend under their own weight, hot air is injected at the bottom of the furnace, via entrances called vents.

The iron melts and accumulates at the bottom of the blast furnace in the form of pig iron, together with another liquid product made up of impurities, called slag. When it comes out of the blast furnace, the pig iron still contains some impurities, such as phosphorus, which are removed in the steel mill, where the pig iron is transformed into liquid steel.

## More information



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