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Vale's first research centre turns 50

Responsible for the technological breakthrough that helped the company become the world?s largest iron ore exporter, the Mineral Development Centre in Minas Gerais conducts innovative research in the area of copper and rare earths

In the early 1960s, Vale was at a crossroads: unless it invested in innovation and technology, it ran the risk of having its main business, iron ore production, seriously harmed in an international market that was becoming ever more competitive. At Cauê Mine in Itabira, Minas Gerais, Vale saw its reserves of hematite, a rock containing high-quality iron ore, rapidly shrink. The company had not yet developed its Carajás Mine, and Cauê was its main operation. The solution came in 1965, with the establishment of the Mineral Development Centre (known by Portuguese acronym CDM), known at the time as the Ore Research Centre (CPM) - a small ore laboratory in Santa Luzia, Greater Belo Horizonte.

At CDM, it was possible to create a technology to allow lower-grade itabirite ore to be mined and processed at low cost. This was Vale's first major technological breakthrough, enabling it not only to remain in the market, but to increase its market share. Ten years after the centre was established, in 1975 Vale became the world's largest iron ore exporter,

accounting for 16% of the global seaborne trade. This achievement was due not only to the use of itabirites, but also to the construction of Vale's first pelletizing plants, at the Port of Tubarão in Espírito Santo, which processed fine particles of high-grade iron ore that had built up in piles at Cauê Mine.

Today, CDM is considered Latin America's most sophisticated laboratory complex focused on mining research and development and one of the most advanced mining technology development centres in the world. Its modern laboratories (Processes; Mineralogy and Petrography; and Chemistry) process information about mine profiles, mineral quality and concentration, mining technology, transportation, planning, waste disposal, and mine closure. The research facility employs a team of 100 highly specialized professionals, including 20 people with MAs and 10 people with PhDs. Its annual budget is around US$15 million. Over the course of 50 years, it has obtained 450 patents - nearly 10 per year, on average.

"CDM provides decisive support for Vale's mineral exploration area, as a direct channel making it possible to analyze exploration data throughout the world, including for operations. It also performs work for the company's commercial area, which requests analyses and characterization of ores and products. So, Vale's exploration isn't only about geology, but it also encompasses technology, analysis of financial viability and business engineering. This work starts at the Mineral Development Centre," explains Vale's exploration and mining projects director, Márcio Godoy.

Bio-leaching

Over the course of its existence, CDM has not only been important for the iron ore area. The centre has also provided fundamental support allowing Vale to harness other minerals, such as manganese, gold, bauxite, kaolin, potash, copper and nickel, as well as develop technologies in specific areas such as titanium and rare earths. It now works with fertilizers, ferrous metals, copper, nickel and rare earths. One of its innovative research projects is about the industrial use of bio-leaching, a technique that uses bacteria to stimulate copper extraction from ores until now not processed. These include so-called oxidized ores, which are found close to the surface of copper deposits, but are less rich. These ores are not yet processed because of a lack of financially viable technology.

According to the project's coordinator, engineer Felipe Hilário, bio-leaching is aimed at reducing project costs, as the industrial use of micro-organisms could replace the need to construct a sulphuric acid plant, which represents around 30% of capital investment in copper production. Sulphuric acid is the main input used to produce copper. In contact with oxidized ores, it reacts with copper and makes it soluble, thereby releasing it from its associated ores, such as pseudomalachite or phyllosilicates. "The idea is to mix sulphur with the ore and deploy these micro-organisms to produce sulphuric acid in the industrial process in line with the reaction that solubilizes copper. In other words, what we are doing is repeating a phenomenon that occurs in nature, but now with an industrial application focus," explains Hilário.

At the moment, bacteria are being cultivated and adapted to the process' needs in incubators in CDM's laboratories. Tests have so far been carried out with bacteria in 1-metre-tall bio-leaching columns, which have indicated that copper extraction using bacteria is technically feasible. This year, bio-leaching columns up to 6 meters tall - the same height as an industrial ore pile - will be tested, to obtain engineering parameters. The intention is to evaluate the financial viability of the technology.

Rare earths

CDM has also been conducting research into rare earths as a way of adding value to Vale's fertilizer area. Although they are abundant in nature compared with other elements, rare earths are harder to individually extract due to their similar physical and chemical properties. In all, there are 17 elements in this group of metals, used in high-tech industry and green products, such as catalysts, wind turbines and hybrid cars.

Vale's research is focused on making use of ore that is already exposed within its fertilizer operations. As in the case of oxidized copper ores, the upper layer of mineral deposits, rich in rare earths, is removed and deposited in piles, in order to provide access to phosphate. These rare earths have been building up since the 1980s, when mining operations began.

According to Ruberlan Silva, a project research specialist, researchers are currently studying the best methods for extracting the material, as rare earth elements occur in nature in combination with each other and associated with other impurities.

Paragominas

Over the years, CDM has played a fundamental role in making it feasible to produce bauxite in Paragominas, Pará. This project had the challenge to transport ore from this municipality to Alunorte's refinery in Barcarena, through a 244-km ore slurry pipeline, which opened in April 2007. This bauxite supply has been important to feed new facilities at the Alunorte complex, which is now the largest alumina refinery in the world. Building the pipeline was both a technical and financial challenge.

"When we opted for the pipeline option - the first in the world to transport bauxite - all the tests were carried out at CDM. A mini-pipeline was built to align and define the operational parameters for the bauxite, which helped the project to leave the drawing board," recalls Márcio Godoy. He explains that the centre is highly specialized in the mineral processing area and this enables the development of new processing routes for a wide variety of projects in Vale's portfolio. "We have a set of equipment for bench tests and pilot tests, all integrated, putting Vale in an advantageous position compared with its competitors," he concludes.

More information

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