HPGR

High Pressure Grinding Rolls (HPGR)

- Ongoing Countries covered: Germany, Denmark

Summary:

Machine for energy-efficient comminution between high pressure grinding rolls (HPGR): The principle of particle bed breakage is known to be more energy-efficient due to particle-particle breakage. It is a good practice example of how an invention arises from academic research and becomes an innovation.

Description:

It is already known from comminution research from the 1970s that inter-particle breakage in a particle bed provides enhanced energy efficiency when fracturing brittle material under high compressive forces (K. Schönert, TU Clausthal). The breakage principle resulted in Schönert's invention of the high pressure grinding rolls (HPGR) and their implementation by different equipment manufacturers, where the patent was first licenced to Polysius and KHD only, but later also Koppers, FLSmidth and Alpine acquired a licence. After solving wear-related operational problems, the HPGR have become widely used in the cement industry. Today, HPGR are more and more adapted to ore grinding:

1982 Patenting of the invention
1985 First implementation in the cement industry
1987 First implementation in the diamond industry
1995 First trials with hard rock comminution
2006 First installation in hard rock ore processing (Cerro Verde copper mine, Peru)
Implementation for other ore types is ongoing.

The benefits of HPGR are:
• Production of more fine material at a given crush size than in conventional crushers
• Formation of micro-cracks in the crushed rock particles - beneficial for subsequent grinding (weakening) and for downstream leaching (increased surface area)
• Generation of less noise and dust compared to conventional cone crushers
• Consumption of approximately 20% less power per tonne compared to conventional crushing plants producing the same product.
• Dry processing
• In some case improved liberation, e.g. diamonds

The innovation has already proven its positive effect with respect to energy efficiency, with improvement of 15-20% less energy demand. Indications for improved mineral liberation are still subject to ongoing research.

Good practice areas:

Resource security

Less need for energy raw materials.

Economic sustainability

Reduced costs for energy.

Environmental sustainability

Less emissions from energy production and HPGR production.

Organisations involved:

TU Clausthal

Polysius

KHD

Innovation category:

Process
Product

Impact on the mining value chain

- mineral and metallurgical PROCESSING (incl. Permitting)

Linked policies

Energy taxation

EU Water Directive

Strategic Implementation Plan for the European Innovation Partnership (EIP) on Raw Materials-1782

Transferability:

Technical solution: Further development was necessary in order to adapt the technology to other application areas. Innovation process: Specific case of an inventor at university that starts from fundamental research and in the end provides a practical industrial method. That the IPR stays with an academic researcher is not common in all MS.

Innovation drivers and barriers

Drivers:
Economic
Energy efficiency and reduction of related GHG emissions in mineral processing Market competition

Barriers:
Other
IPR protection by the inventor and his initial industrial partners restricted the dissemination of the technology.
Economic
In the beginning, the technology was not capable of crushing hard material due to increased wear. This issue was solved by changing from smooth rolls to profiled rolls (the material sticking to the profile acted then as a wear protection)

Impact Area

Area:

Economic, Competitiveness

Impact on listed area:

Leading role of European manufacturers worldwide.

Area:

Environment, Quantity of natural resources

Impact on listed area:

Reduced specific energy for comminution, reduction of related GHG.