Advances in superfine crushing – A study on IMPTEC superfine crusher's operating parameters

E Baawuah[1], C Kelsey[2], J Addai-Mensah[3], W Skinner[4]

1.
PhD student, Future Industries Institute, University of South Australia, Mawson Lakes, SA 5095. Email: emmanuel.baawuah@mymail.unisa.edu.au

2.
FAusIMM, Technical Director, IMP Technologies P/L, 83A Proctor Rd, Hope Forest, SA 5172. Email: christophergkelsey@gmail.com

3.
Adjunct Professor, Minerals and Resource Engineering, Future Industries Institute, University of South Australia, Mawson Lakes, SA 5095; Department of Mining and Process Engineering, Namibia University of Science and Technology, Windhoek, Namibia. Email: jonas.addai-mensah@unisa.edu.au

4.
Research Professor, Minerals and Resource Engineering, Future Industries Institute, University of South Australia, Mawson Lakes, SA 5095. Email: william.skinner@unisa.edu.au

Steel has been a major contributor to the recent global industrialisation due to its unique combination of strength, formability, versatility, recyclability and low cost. The primary raw material for steel making is metallic iron extracted from iron ore. The main sources of iron which are mined for the production iron concentrate are magnetite, hematite and goethite. Low grade magnetite mineralisation is fine-grained and require fine to ultrafine grinding (P_{80} 30 - 40 µm) to liberate them from the predominantly silica/silicate gangue matrix, for effective beneficiation processes, to make saleable Fe grades. With deteriorating ore grades coupled with ore complexities and competence, mineral processing requires enormous comminution to achieve the required liberation size. Historically, achieving the required particle size is carried out by multi stage crushing and grinding technologies requiring huge capital and operational costs, with low energy efficiencies. Comminution accounts for 35 to 70% of the total energy requirement for mineral processing. The high energy requirements and cost involve in fine and ultrafine grinding are a major bottleneck on the economic potential for developing and operating a low grade magnetite deposits. This motivated the development of a novel super-fine crusher (SFC) that reduces coarse feed to fine and ultra-fine product with minimal recycle loads and energy input. The SFC (brainchild of Christopher Kelsey known for Kelsey Jig) consists of a vertically mounted compression chamber with an internal gyrating mandrel. It provides potential for step changes in mineral comminution flowsheets with associated reduction in energy consumption and environmental footprint. In this study, the effects of operating parameters of the super-fine crusher on product particle size distribution, energy consumption and work indices have been investigated and discussed.

Keywords: Comminution, superfine crushing, particle size distribution, comminution energy