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KEYWORDS

Vertical stirred mill, comminution, population balance model, product size distribution

Paper — 343

A CONSOLIDATED SUMMARY ON THE MECHANISTIC MODELLING FOR TUMBLING MILLS

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ABSTRACT

A mechanistic model for tumbling mills was developed during PhD studies at the JKMRC. The concept was presented at the IMPC of 2014, followed by progress in a sub-process of the model presented at the IMPC of 2016. Additionally, a number of papers on the sub-models and breakage function have been published. This paper provides a consolidated summary of the outcomes and status of the model.

The overall model structure is presented along with the sub-models such as appearance functions, breakage rate functions, energy distribution, transport, and multicomponent grinding interaction model. The strengths and capabilities of the model structure as achieved to date are presented. The gaps in knowledge and sub-processes are also presented, providing a guide to the areas that require further research and development.

It is proposed that the approach developed in this paper provides a structure that can accommodate future mechanistic, dynamic mill model evolution that can incorporate the latest research outcomes and provide a platform to test modelling improvements. This can assist in substantially improving the predictive mill modelling capability in the industry, the importance of which should not be underestimated for this workhorse of mineral processing.

KEYWORDS

Mechanistic modelling, tumbling mills, generic model structure, dynamic modelling, multi-component models

Paper — 359

COMPARISON OF TWO METHODS ESTIMATING SPECIFIC ENERGY AND THROUGHPUT OF REGRIND BALL MILLS

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ABSTRACT

The most common technique for selection of grinding equipment is the Bond method implying determination of a ball mill work index (BWi). The method is perfect for greenfield projects where a ball mill is must be sized to grind an ore to 80% passing 75–100 μm. Finer grinding will require application of specific correction factors to a standard equation since initially the method was not designated for sizing of fine (minus 75 μm) grinding mills. Significant issues are related to selection of grinding equipment for treatment of originally fine materials when the standard procedure is not applicable.

In 1984, Levin published his special technique titled as "A proposed test for the determination of the grindability of fine materials", where he offered to use the standard Bond ball mill for determination of a specific grinding energy. However, this method did not meet with wide recognition.

In 2017, Institute TOMS under guidance of JKMRC's specialists performed a testwork aimed at verification of a new universal technique for determination of grindability of initially fine materials. An object was to test three aged tailings samples for the subsequent modelling of comminution circuit and evaluation of potential throughput of the existing ball mills with final grind size of P80 passing 53 μm. In parallel with development of the universal approach, TOMS' specialists carried out tests according to the Levin method in order to compare the data resulted from two methods.

The results from lab ball mill testing on three products following the alternative test methods are presented in this paper along with the testing methodology and results analysis. Specific energy was calculated for regrinding of the materials to the required size. Difference of the examined methods and assessment of their applicability for sizing of full-scale equipment are explored.

KEYWORDS

Grindability, ball mill, fine grinding, specific energy, Bond method, Levin method.

Paper — 437

DEVELOPMENT OF A LABORATORY TEST TO DESIGN VERTICAL STIRRED MILLS FOR IRON ORE REGRIND CIRCUITS

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ABSTRACT

The use of vertical stirred mills in the mining industry has increased remarkably over the past few decades, as a result of growing requirement for finer ore grinding. This equipment delivers higher energy efficiency in fine grinding operations when compared to conventional tubular mills. Methods for designing vertical stirred mills involve operational experience, pilot plants and bench tests. An important issue is that these tests require, at a laboratory scale, at least 10–20 kg of material, depending on its density, which is not available in many cases, particularly in the early stages of greenfield projects. For

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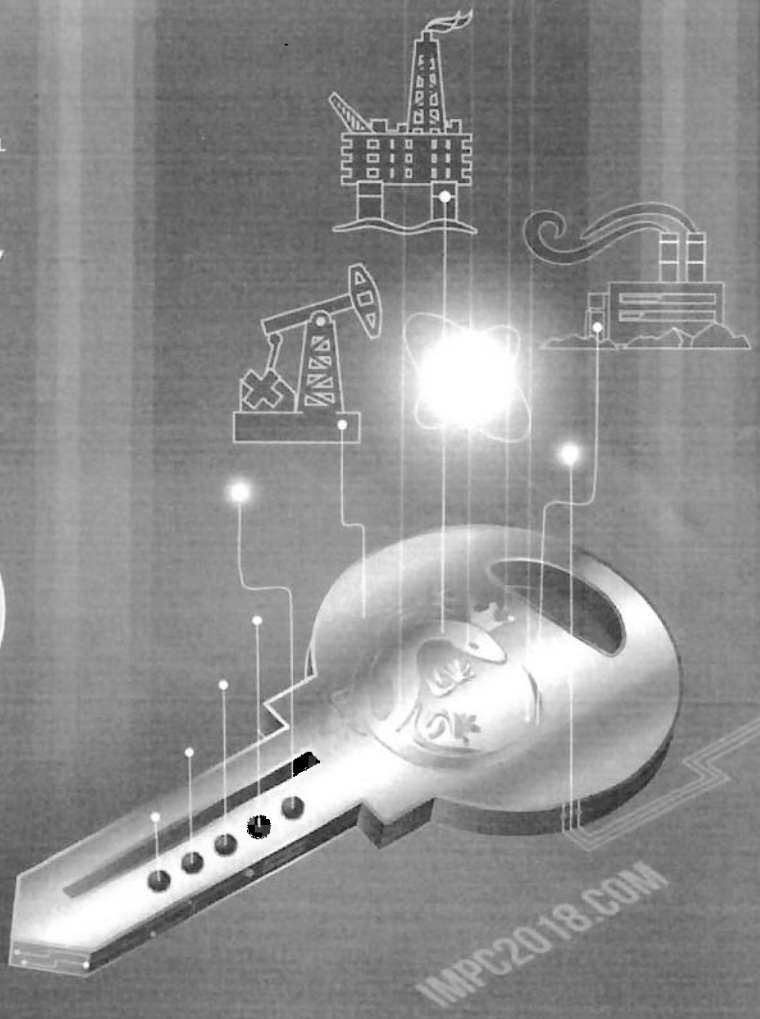

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