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PII: S0032-5910(16)30442-9
DOI: doi: 10.1016/j.powtec.2016.07.050
Reference: PTEC 11812

To appear in: *Powder Technology*

Received date: 12 March 2016
Revised date: 20 July 2016
Accepted date: 21 July 2016

Please cite this article as: Ruichao Zhao, Yuexin Han, Mingzhao He, Yanjun Li, Grinding kinetics of quartz and chlorite in wet ball milling, *Powder Technology* (2016), doi: 10.1016/j.powtec.2016.07.050

Grinding kinetics of quartz and chlorite in wet ball milling

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Abstract

Under an invariant and self-similar mill environment, batch wet grinding studies were carried out by grinding mono-sized fractions of quartz, chlorite and their binary mixture at different blending ratios. The results obtained indicate that the breakage behavior of both minerals as well as their mixture followed a first-order model. The maximum breakage rate，S_{max}， for quartz and chlorite, obtained in the feed size fraction of -0.5+0.25mm, were 0.19min^{-1} and 0.33min^{-1}, respectively. It was also found that the breakage rate S_i of quartz or chlorite had a linear relationship with its mass ratio in the binary mix. The cumulative breakage distribution value, B_{ij} of quartz was independent of the absence or presence of chlorite in the quartz-chlorite binary mix. However, the presence of quartz led to a reduced cumulative breakage distribution value for chlorite. In the mixture, the calculated energy split factors for the quartz and chlorite components were found to be greater than one and less than one, respectively. These results seem to suggest that the quartz particles required more energy in order to break and were the rate determining component in the breakage process of a mixture. In addition, the simulated product size distribution data obtained，using the discrete-size, continuous-time Population Balance Model (PBM), were consistent with experimental data for quartz-chlorite binary mineral system.

Keywords: batch wet grinding; population balance model; First-order kinetics; Breakage rate; Cumulative breakage distribution

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