Abstract

The volume of slurry in a rotary mill has a bearing on the presence of a pool of slurry and therefore on milling efficiency. Load behaviour was investigated at different volumes of slurry. The insight gained was then used to evaluate the implications of slurry pooling on milling.

First, the effects of viscosity on mill charge behaviour were measured using photographic techniques applied to a Perspex mill. A model of the angular location of the free surface of the slurry pool, as affected by slurry filling was proposed. Next, a real ore was used and the load behaviour was measured using non-invasive sensors fitted to a pilot mill. At this point, the angular position of the pool and the net power draw were correlated to the volume of slurry for mill speeds ranging from 65 to 85 % of critical. An additional series of tests was carried out on a mill filled with grinding media only, for speeds spanning from approximately 24 to 110 % of critical. The aim here was to isolate and study the media charge. Lastly, a laboratory mill was used to run batch grinding tests on a Platinum ore for slurry fillings U between 1.0 and 3.0 and at 65 % solids content. Two ball fillings were considered for identical slurry volumes: J = 20 % and 30 %.

Results showed that not only did the proposed pool model work well using an artificial slurry in the Perspex mill, but it also worked for the Platinum ore tested in the Wits pilot mill. The behaviour of the media charge was not substantially affected by slurry viscosity and slurry filling. The net power drawn by the ‘dry mill’ compared well with DEM prediction for non-centrifuging speeds. The effect of slurry pooling on net power draw, on the other hand, was best accounted for using a Torque-arm model and an empirical model developed to this end. As for milling kinetics, results suggested that the slurry pool should be avoided because milling efficiency deteriorated as a result. However, the production of fines was not largely altered.