



Charge Dynamics in Tumbling Mills

Simulation and Measurements with an In-Mill Sensor

Chargedynamiken i roterande trumkvarnar
Simulering och mätningar med en sensor inne i en kvarn

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Objectives

- To increase the understanding of events occurring inside the mill with the aid of a sensor installed in the mill
- To investigate how a pebble mill reacts to controlled changes in operating conditions
- To check if three-dimensional simulations of grinding bodies can be used as a tool to enhance the understanding of the charge dynamics

Grinding process

Reducing particle size distribution

Tumbling mill

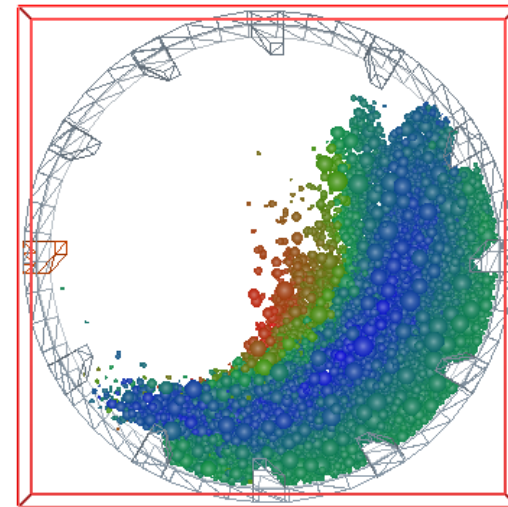
High power demand

Breakage by impact, chipping and abrasion

Influenced by size and mineralogy

Control product size by medium, speed of rotation and charge filling

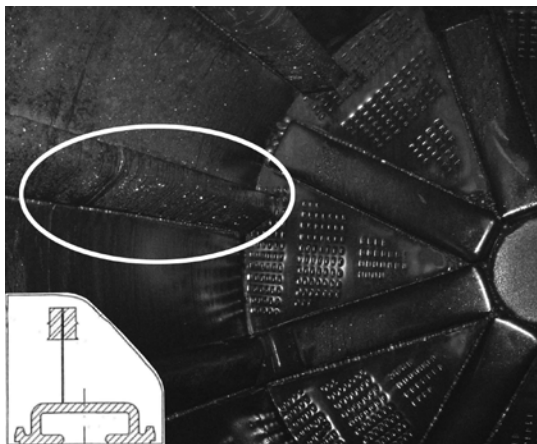
Difficult to monitor



Pilot scale mill

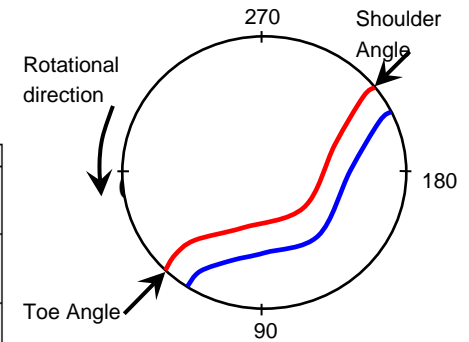
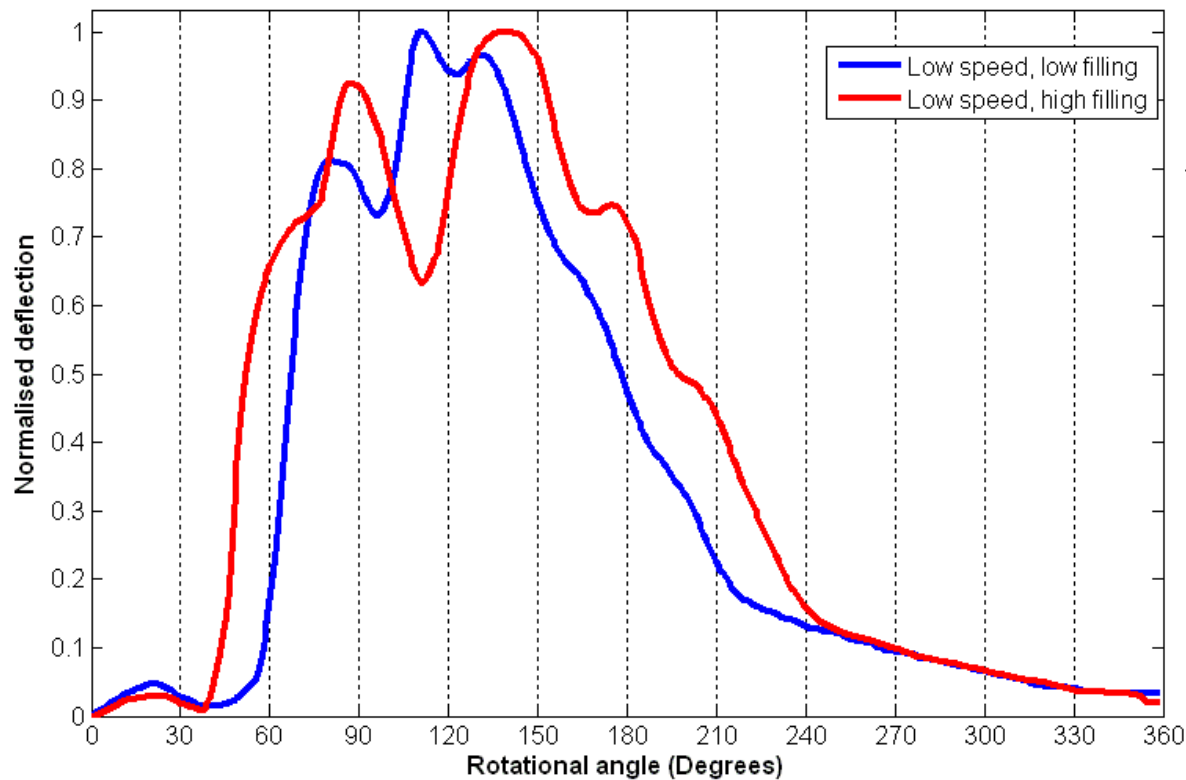
Performed at LKAB, R&D facility,
Malmberget

Mill: Diameter: 1.41 m
 Length: 1.57 m
 12 rubber lifters
 Grate-discharge
 In-mill sensor installed



Sensor system used is a
Continuous Charge
Measurement system
(CCM) by Metso Minerals

Degree of filling – CCM curves



Simulations – in 3 dimensions

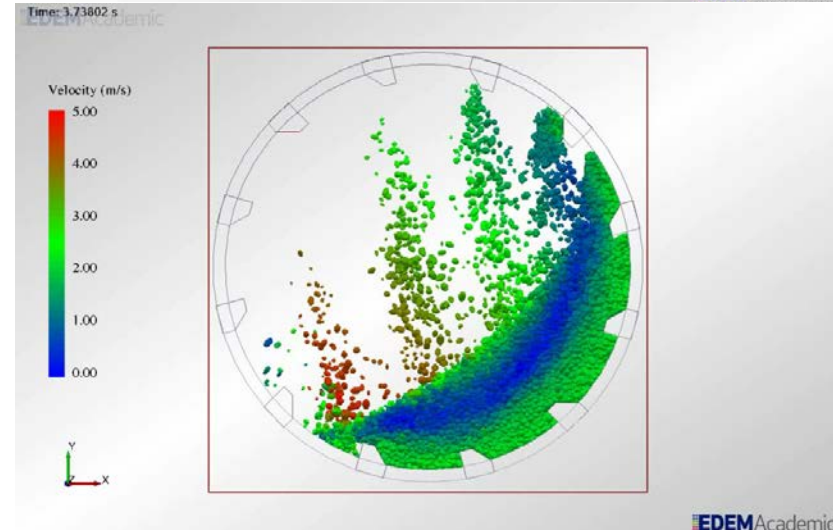
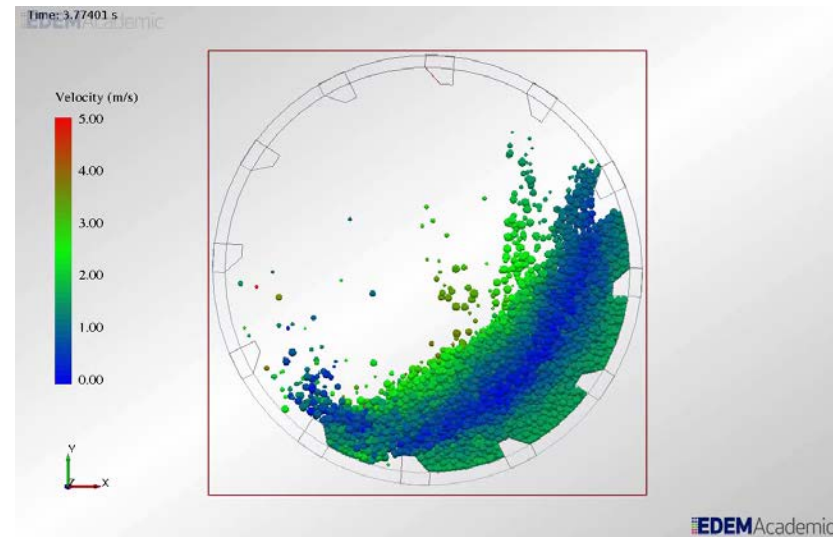
Simulations done with DEM -
Discrete Element Method

All information about each particle
is known at every point in time

Very illustrative

Limitations

- Absence of slurry
- No breakage of particles





Conclusions

Increase of amount $< 45 \mu\text{m}$ – probable increase of production rate

Increase of fines at low speed, especially with a high filling level in the mill

3-4% better energy efficiency in this grinding system

Changes in simulation correspond to changes detected in pilot mill runs => validation of the simulation model



Acknowledgement

LKAB for the financial support

Metso Minerals for the use of the CCM system