IMPROVING THE GRINDING PERFORMANCE IN BALL MILLS WITH A CONDUCTIVE AND INDUCTIVE SENSOR

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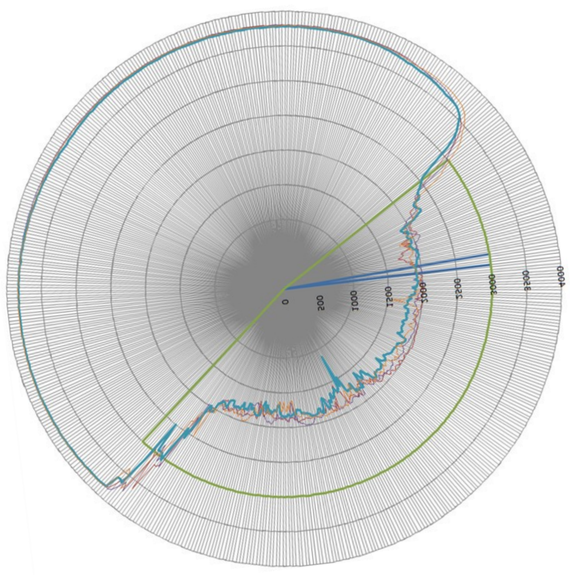
Introduction

The inside of a running ball mill was during a long time a black box with few ideas about the internal mechanisms in a mill. Some technologies appeared like noise level measurements *(Radhakrishnan and Sen, 1980)* or continuous charge measurements, but none could provide the pulp and balls positions together. New technologies like DEM *(Mishra and Rajamani, 1992)* intend to simulate the inside of a ball mill but they need validation in a real-scale environment.

Thus, the Sensomag and its understanding are important steps towards the exploration of the functioning of a ball mill and **improving its performance and its power efficiency**.

With the above objective on the background, **surveys have been realized** in a South African platinum mine (AngloPlatinum) by varying the density, the filling degree J and the liners wear on a secondary ball mill equipped with a Sensomag. These surveys indicated general running rules but also interesting conclusions which can be deducted only from the Sensomag data.

SENSOMAG®



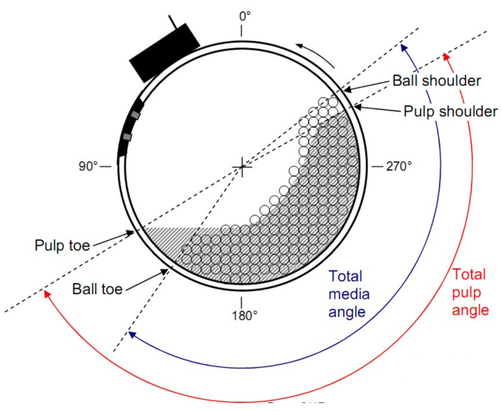
Raw signals from which ball and pulp angles can be deducted

Material & Methods

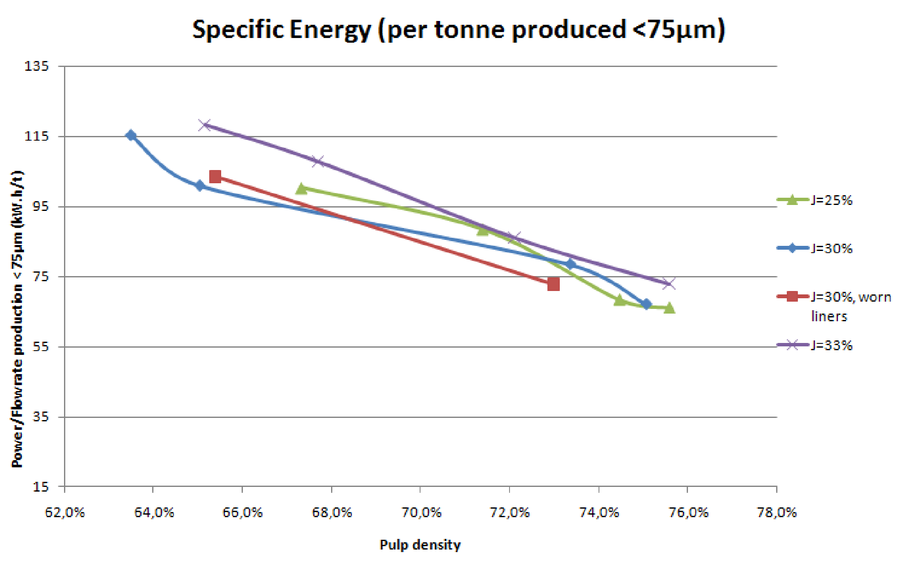
The **Sensomag** is composed of 2 sensors: An inductive sensor (which determines the presence of balls) and a conductive sensor (which determines the presence of pulp) - *left figure* (*Clermont and al., 2008)*. From these two raw signals, the positions of the angles of the loads are deducted — *right figure*.

With this information, the Sensomag can determine **the ball filling degree.**

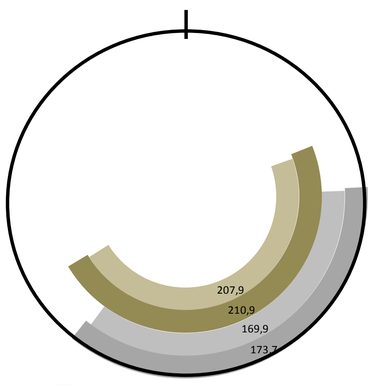
The **surveys** consisted in varying the filling degree (25%, 30%, 33%) and for each value of J, the solid density was varied from 65% to 75% (average values). The mill was relined ahead of these tests and some surveys with worn liners were also realized before relining took place.



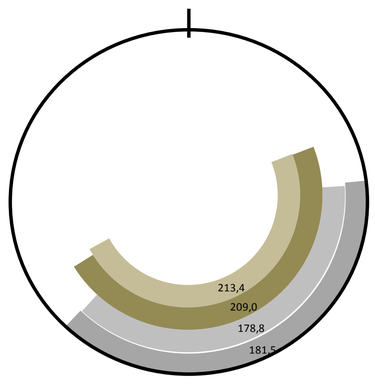
Measures detected by the Sensomag



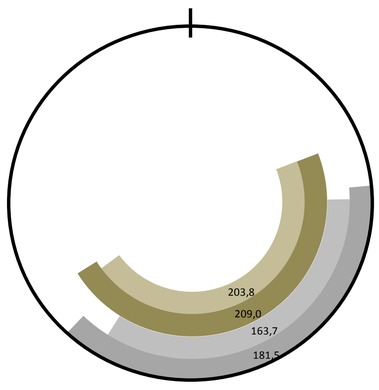
The higher the density, the more efficient the grind. It's not the case for J which requires compromise between production and cost. The worn liners provide a better grind



Worn liners compact the load and favour the abrasion between particles—thus finer grinding



A higher density provides a compacter pulp better mixed with the balls —thus finer grinding



The pulp sticks to the balls and is expanded together with the media load, improving ball—pulp interactions.

Results & Conclusions

Observations have been done without the use of the Sensomag, suggesting a **better efficiency of the ball mill for a higher density**, a better grind for worn liners and high J. A semi-linear model has been built

However, the Sensomag has allowed

1) To understand the effect from parameters variations and to deduct that **better interactions** between the pulp and the balls are leading to a better grind, pointing out the importance of tracking the load angles,
2) To observe consequent variations in the angles which are meaning that we can **model and estimate the density and J online,** based on Sensomag use only.

References

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- *Mishra B.K., Rajamani R.K., 1992.* « The discrete element method for the simulation of ball mills ». *Appl. Math. Model. 16, pages 598-604*
- *Watson J.L., 1983.* « An analysis of mill grinding noise », *Powder Technology, Volume 41, Issue 1, pages 83-89*

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