Study of the Process, Design and Operating Parameters Effect on the Efficiency of the Process Mill

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Introduction: The process mill consist of a horizontal shell (stator) equipped with renewable liners and rotating hammers (rotor) for milling of drill cuttings. The TCC converts kinetic energy from the rotating arms of the hammer mill into thermal energy. The study is to investigate the velocity pattern and the velocity magnitude of the cuttings that is being processed in the process mill.

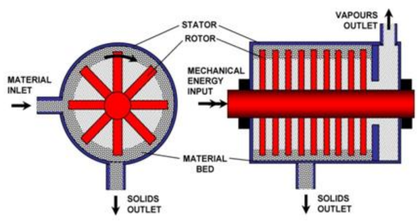

Figure 1. Principle sketch for TCC (Source: Kleppe, 2009)

Computational Methods: COMSOL CFD module was used and the physics interface that was used is Rotating Machinery Laminar flow (rmpf). The Frozen Rotor study was employed in simulation.

The Navier-Stokes equation below was solved by the software to calculate the velocity magnitude inside the process mill.

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho v) = 0$$

The reference simulation was done to model the process mill such that the studied parameters will have values equivalent to that of the process mill. The similarities in the parametric values helped to formulate a control for the subsequent models and to compare the effect of the studied parameters.

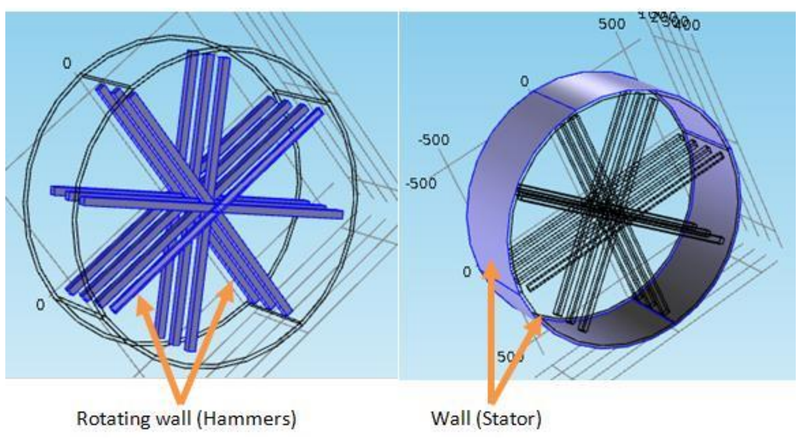

Figure 2. Model of the process mill

Results: The process mill was modeled successfully and the effects of varying the design, operating and process parameters were analyzed.

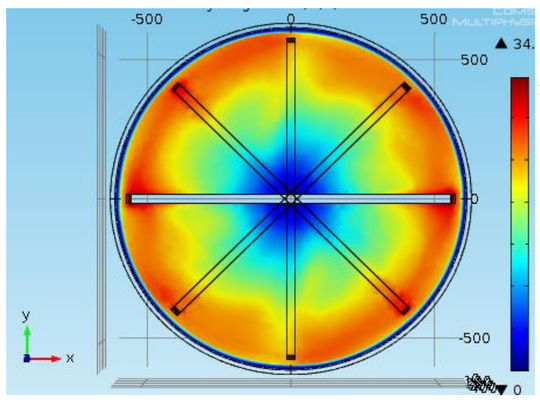

Figure 3. Velocity magnitude

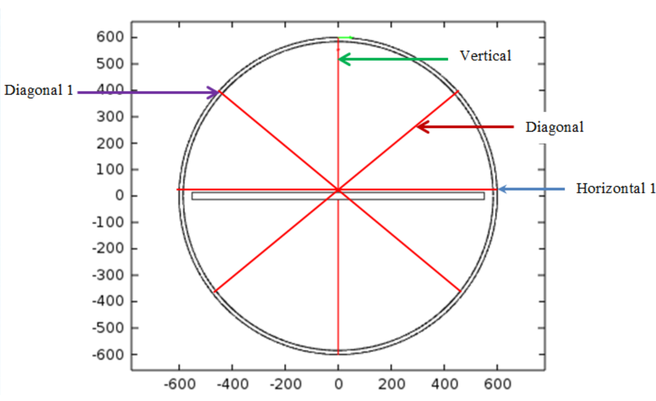

Figure 4. Defined cut lines

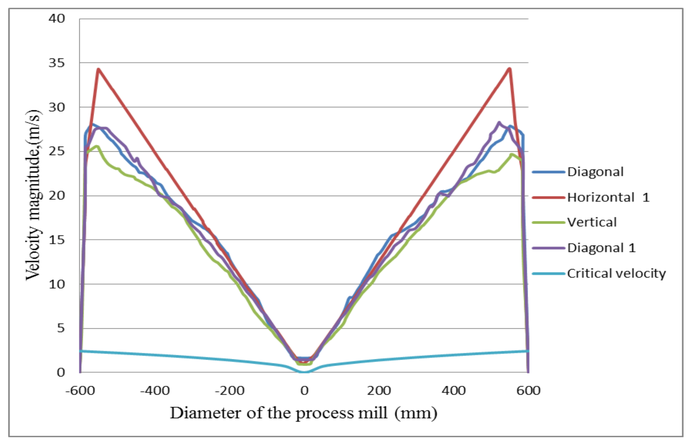

Figure 5. The critical velocity on the defined cut lines

Conclusions: Hammer design (number of hammers, hammer thickness, distance and angle between adjacent hammers) is a critical parameter that affects the velocity distribution of the cuttings inside of the process mill and the efficiency of the mill.

References:

1. COMSOL, Inc. (2013) COMSOL Multiphysics®, Version 4.4
2. KLEPPE, S. Re-using Recovered Base Oil from OBM Drilling Waste. 2009