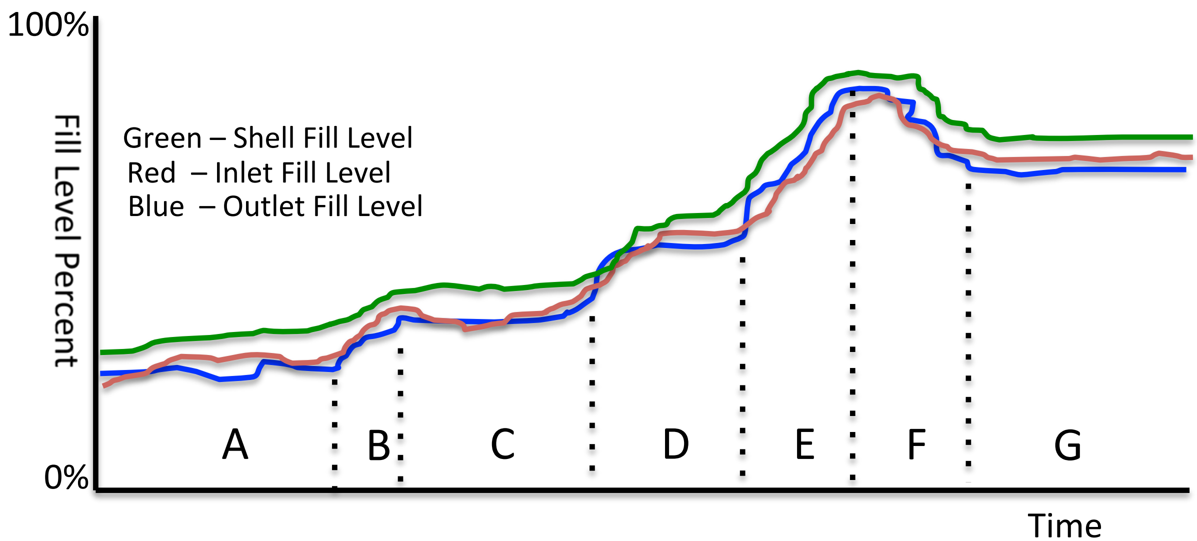
MineralScan Fill Level Signal Examples & Explanations - RNMC

Introduction

The MineralScan MillSlicer system normally consists of two fixed vibration sensors and one shell based sensor. The fixed sensors consist of a one placed on the inlet bearing housing and another sensor placed on the outlet bearing housing. From these three sensors, fill level signals are generated for each position. The inlet sensor fill level signal corresponds to the fill level in the first meter of the mill inlet. The outlet sensor fill level signal then corresponds to a fill level measurement taken at the one meter exit end of the mill. The shell fill level signal is taken from the center of the mill and therefore an average of the overall fill level in the entire mill.

What is the general procedure to optimize mill operation?



Time Zero – Set the ***feed rate*** to achieve the required downstream output.

A. Run the mill at a typically higher mill speed for an extended period of time to ensure all fill level signals are flat/stable and track one another. ~30 – 40 minutes.

B. Decrease mill speed to increase the fill level in the mill. i.e. Mill slows down and retains more material.

C. Allow the process to stabilize before making another change. ***Check bearing pressure and other key process variables.***

D. Again, incrementally decrease the mill speed and allow the fill levels to stabilize.

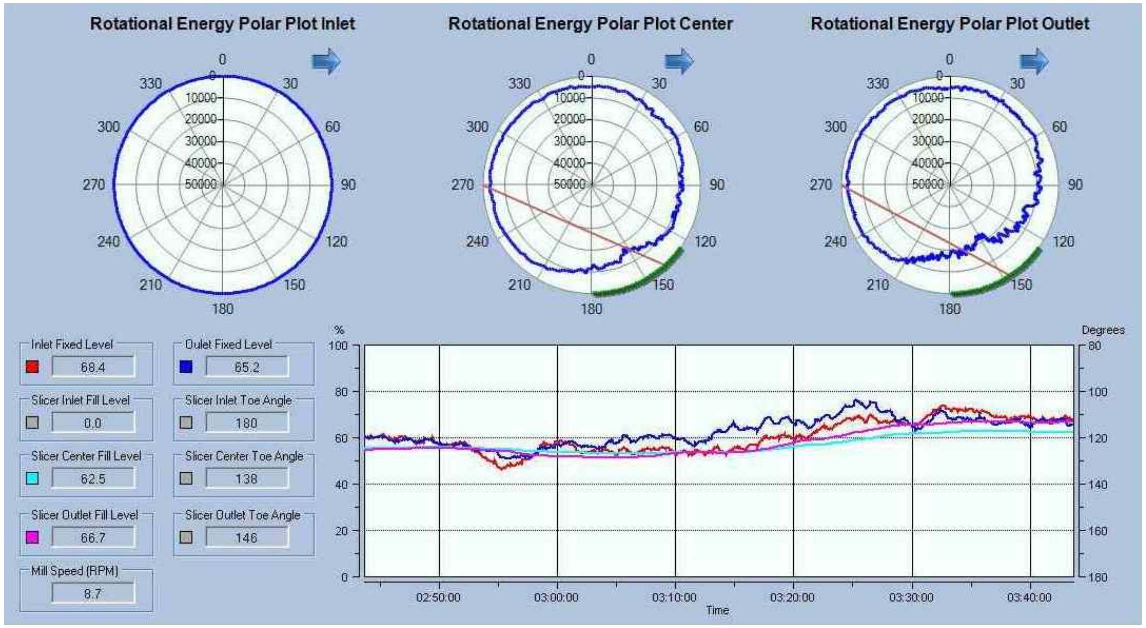
E. Further decrease in mill speed to fill the mill. Here it results in a non-stable, always increasing fill level signal.

F. Increase mill speed to bring the fill level back down to a stable comfortable level.

G. Mill operation is stable. ***Check bearing pressure and other key process variables.***

DIGITAL CONTROL LAB

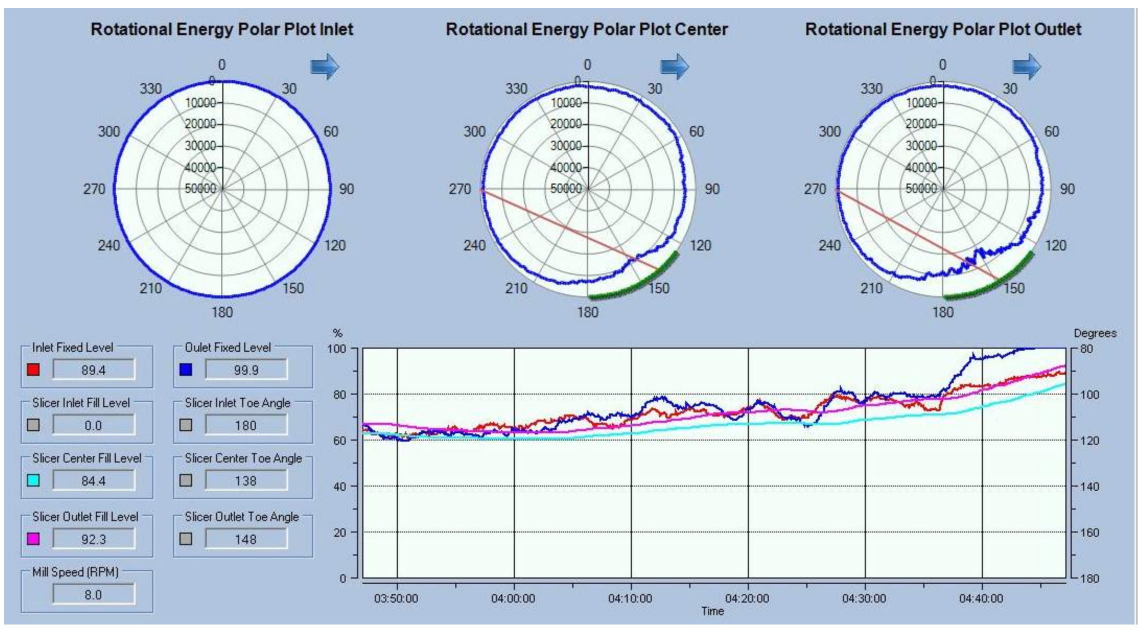
Slowly Filling the Mill (Real Trends)



Inlet Sensor – Red, Outlet Sensor – Dark Blue, Shell Sensors – Light Blue & Pink

In the beginning of the trend all three signals are flat and parallel with one another. This indicates that ***material is passing over each sensor in a uniform and regular flow rate. The Mill is therefore operating in a predictable manner.***

At ~ 3:10 pm the set point for the bearing pressure was increased in the expert system further fill the mill. The mill therefore was slowed down by a fraction of an RPM and the change is observed in the fill level trends.

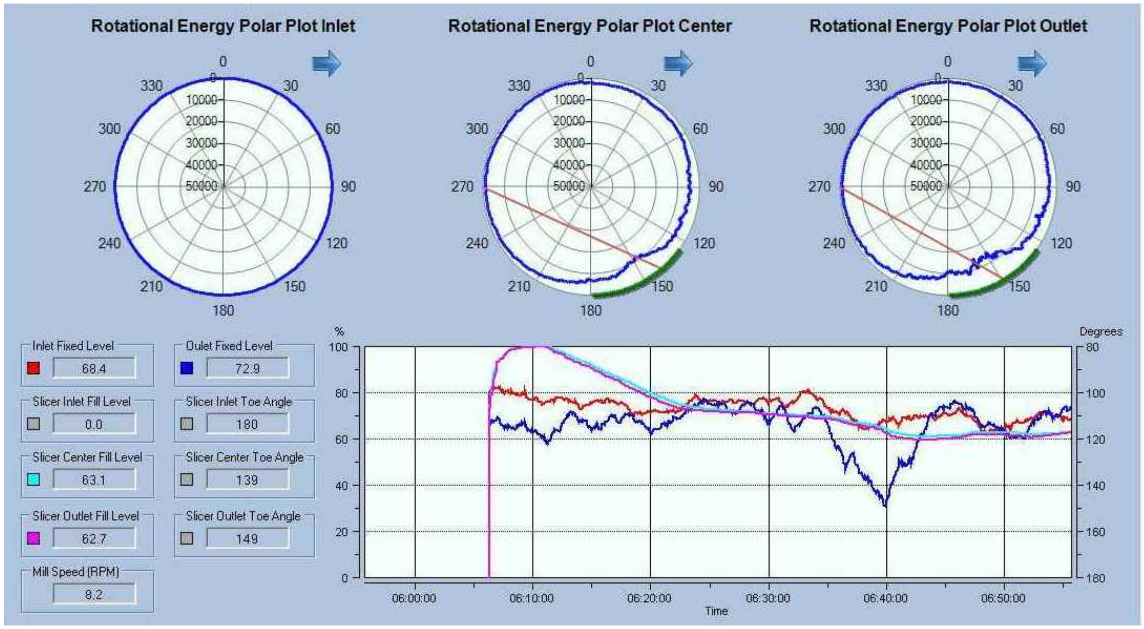


One hour later, all signals are still flat so the mill is still in control. The bearing pressure readings were well within normal levels and so the mill was further slowed down at 4:20 pm.

Notice that the toe energy levels in the polar plot are also decreasing when compared to the previous snapshot.

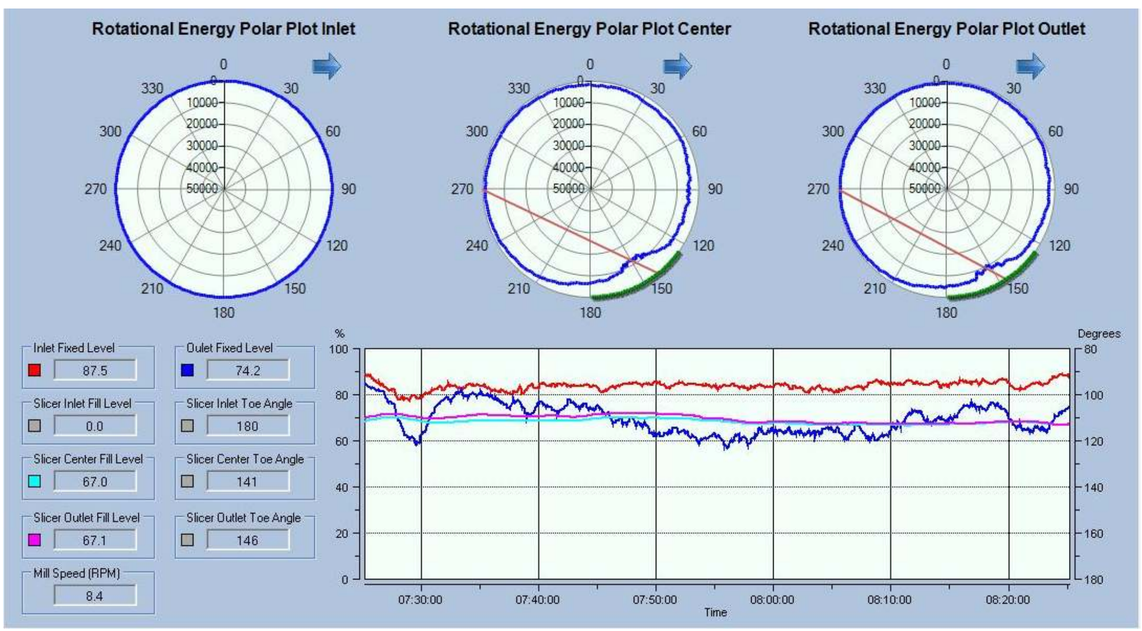
At the end of the trend, the fill level signals are deemed too high and therefore re-calibrated to lower levels.

Re-Calibration & Stable Operation



Friday 5:50 – 6:50 pm (above)

Friday 7:20 – 8:20 pm (below)

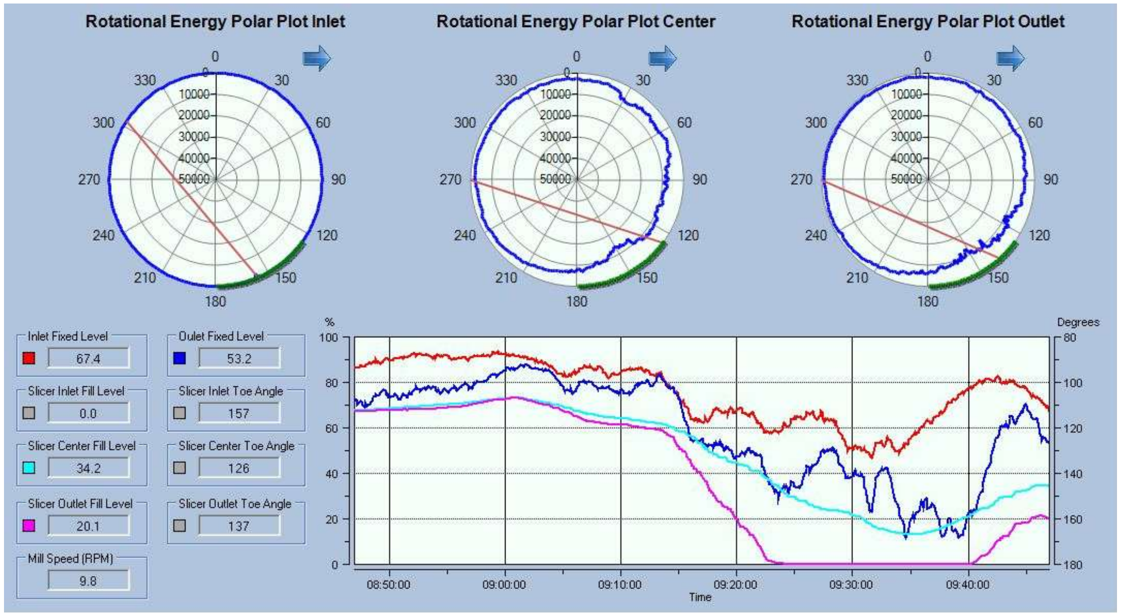


At ~ 6 pm, all three sensors we calibrated down from 95 – 100% to 80-85%. This was needed because: This mill had a complete liner change earlier in the week. The bearing pressure and mill power readings indicated that the mill could be filled to a significantly higher level.

Near the end of this trend we observe a major dip in the outlet sensor fill level which indicate that the mill is purging material at the discharge end of the mill.

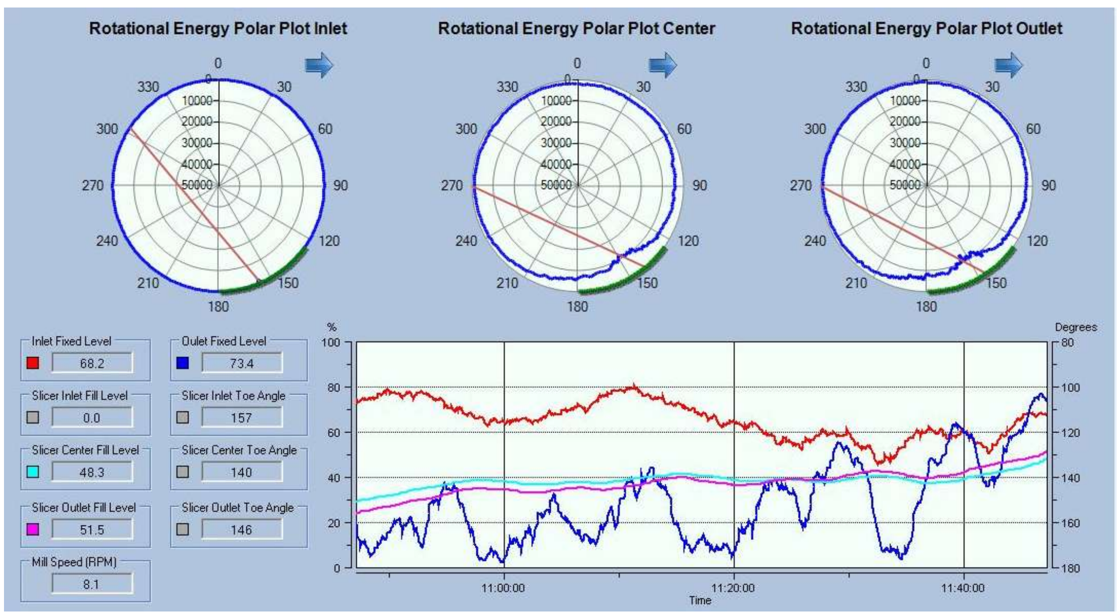
After 30 minutes of stable flat/operation (past the ending of the above trend), the mill was further slowed down and stable operation was achieved at a much higher production level than that typically set in the expert system.

The polar plots show minimal liner strikes and all fill level signals are flat and stable.



Saturday 8:40 – 9:40 am (above)

Saturday 10:40 – 11:40 am (below)



Unstable Mill Operation (Clay)

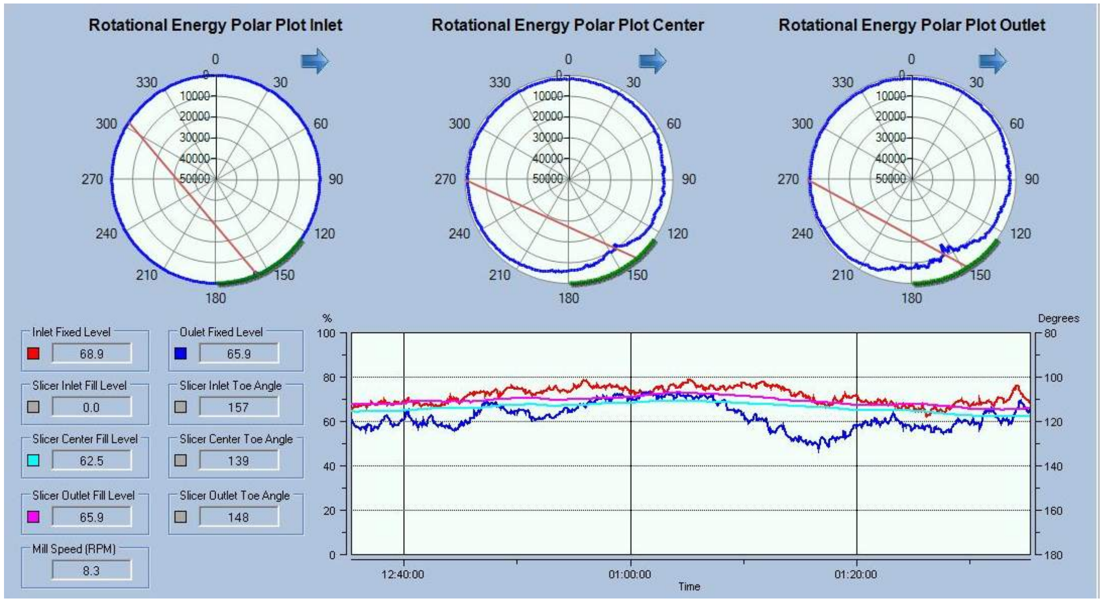
After an evening and night of relatively stable operation, the following morning, the operator determined that the fresh feed entering the mill contained a large amount of clay. This was determined through density and other process variables. The decision then was to drastically speed up the mill and reduce the fill level.

While the signals do appear to correlate with one another, there now are wide gaps between the values of each signal near the end of the trend.

One hour after the end of the above trend, we still have very unstable operation in the mill. It isn't until another hour later later that the operator decides to significantly increase the water and flush the mill.

This results in the signals beginning to track one another in a more uniform/close manner.

Very Important: Notice that for the several hours of un-stable operation, the outlet sensor (dark blue) shows a much lower fill level than the inlet sensor (red). The shell sensors appear to be an average of the two.



Back to Stable Mill Operation

Once the mill was flushed, stable operation ensued and the mill was placed back in expert system control.

Saturday 12:30 – 1:30 am (left)

Procedure Summary

1. Set the desired fresh feed TPH to a value that satisfies the downstream production requirement.
2. Slowly begin to decrease the mill speed in small incremental steps over time. Also increase feed as needed to meet the required output targets.
3. Upon decreasing the mill speed, observe the fill level trends to ensure that they remain parallel to one another and flat over time.
4. Use the other process variables (bearing pressure, mill power, recirculating load) to determine what optimal fill level should be finally held over an extended period of time.

Conclusions

1. Changing the mill speed by definition will increase (mill is sped up) or decrease (mill is slowed down) the vibration signal observed for the mill. Therefore speed changes should be done in small steps over 30+ minute intervals to allow the fill level signals to stabilize.
2. There is no ideal absolute fill level set point that should be used again and again on a daily basis. Instead the fill level signals should be used for real-time control while the "ideal" fill level set point should be determined by analyzing the other slower process variables.
3. If the fill level signals are consistently too low or high for a particular set of process conditions, they may require re-calibration. Contact DCL directly to learn how this is performed. We have a short video online that can guide you through this process and can also instruct you on how to calibrate a signal over the phone. This is a quick/easy process!