Smart Vertical Roller Mill

A virtual engineer, fully dedicated to the state-of-health of your installation: **InfraLytics®**
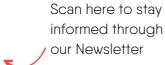

The Context

A Vertical Roller Mill (VRM) is an essential tool in the production of fine powders, like in lime, bentonite, cement, cokes, metal oxides... In this type of machine the concept of <u>product quality</u> and <u>availability</u> are closely related. A smooth running results mostly in uniform and high product quality, where unforeseen standstill leads to reduced income for the site. How can one achieve high product quality and avoid unexpected stops of production runs?

Bed uniformity

The uniformity and height of the bed during rolling operations has an enormous impact on product quality. By using inclination data, vibrations as well as RPM and motor currents, the process is tracked continuously. Classification algorithms determine what stage the process is in and by tracking the difference in behaviour between rolls and the evolution of the parameters with time, process deviations are identified. When coupled with product quality data, suggestions are generated towards optimal running conditions per product type and to obtain maximal uniformity. After a month of running also the startup process can be improved significantly, to further increase the yield of the mill.

The Solution

At Zensor we provide a dedicated, modular, product for the continuous follow-up of VRMs. The product comes in the form of a dedicated software and a hardware add-on if not enough data would be available. At first the client indicates which of the aspects (listed below) are relevant to their mill, and subsequently the Zensor specialist configures the product. When required additional hardware is installed. Once launched, the software continuously crunches the incoming data and translates it into suggestions in case of quality issues and warnings in case of upcoming damage or breakdowns.

Filter Health

In a lot of sites the final material is recovered using (bag) filters. Issues with the filter (installation) lead to product loss and sub-optimal working conditions. Using flow rates of compressed air, temepratures as well as pressure drops in the primary production circuit, dedicated models are fed. The output are warnings when bags are damaged, product is lost, filters get clogged or even in calse of small leaks in valves, helping to reduce compressed air losses.

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Classifier Health

The classifier is used to separate the fine product from the one still to be treaded in the main body of the mill. When the classifier operation is distorted or one of its components gets damaged, the entire process is affected. Product quality issues or downtime because of repair are often the result. Using currents from the classifier motor, 3D vibrations, product type information and air flow or pressure drops in the main circuit, models are continuously crunching the data. As a result warnings are send in case of distorted operation or upcoming damage in motors, bearings, couplers or other principle rotating parts. Action can be taken well ahead of time.

Product Quality

The product quality is reflected mostly in an accurate and uniform particle size distribution (affecting for example particle fluidity). Almost the entire mill can affect the product quality, including the milling speed and the way the table and rollers interact, the calssifier, the air flow in the main ducts as well as the filter and/or cyclone system and the additives flow (when used). When coupled to the material quality database and a number of operational parameters such as air flow rates or pressure dorps, motor currents, roller vibrations and inclination as well as additive flows, the software learns the relationship between operational conditions and product quality parameters. Disregarding the startup and shutdown period, deviations affecting product quality are detected and operators are warned such that the can act and rectify the situation, before yield is affected in a negative way.

Bearing health

Bearing damage is best detected in an early stage, such that blockages or breakages can be avoided. Including a module for automated and continuous spectral analysis on vibration data these type of issues can be detected in an early stage, making maintenance life much easier.

Clogging of ducts

The main principle of a VRM is connected to a continuous flow of air through the main ducts, moving the finely ground material around, towards the filters and/or cyclone. When the ducts in this system get clogged the process becomes less uniform and efficiency is reduced, with a potential impact on product quality. Using a trained model to track pressure differences in the system, deviations are tracked and triggers are sent in case cleanup is needed.

Gearbox health

The main gearbox is critical for the operation of VRM installations. It converts a rotation around a horizontal axle into one around the vertical axle of the main grinding table. It is a large gearbox, often difficult to service or replace. As such significant damage is to be avoided. In an optimal case, gearbox degradation is detected in an early stage, such that repairs or replacements can be planned and failure can be avoided. Using data about product type and RPM as well as temperatures, currents drawn by the main motor vibrations on multiple locations, the software performs a continuous follow-up. Using classical spectral analysis together with models trained on how the specific machine operates, deviations are detected in an early stage and operating conditions that lead to damage development are identified in an early stage.

Roller health

As this type of installation is used to grind materials, wear cannot be avoided. In reality however, one tries to make the wear of the internals as slow as possible and also as uniform as possible: all individual rolls degrading together, at the same rate. Using data as main motor currents, product type, inclinations, vibrations, table RPM, classifier RPM as well as the incoming material flow rate the software knows exactmy what's going on. Through applying filtering steps the evolution of the roller degradation is tracked continuously and warnings are sent in case of unexpected issues. As a plus, blockages or process deviations that affect product uniformity are detected as well in the same package.

Motor health

The main motor is driving the heart of the operation: the milling table. This is a high-power motor that is essential for mill operations. Combining a follow-up based on vibrations, temperatures and electrical currents the software tracks the state-of-health of the motors continuously. Deviations are detected in an early stage and unwanted standstills or major damages are prevented.

Cyclone health

In a number of cases a cyclone is used to evacuate the fine product from the main air flow. Malfunctioning results in a less efficient material recovery, or even standstill due to breakages. Feeding the software with pressure drops, motor currents and vibration data, issues are detected in an early stage and clogging or structural damage can be avoided.