Maintenance vs. Manpower

How Can Performance Driven Maintenance Be Accomplished with Lean Power Plant Staffing?

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Pulverizer Performance Indicators

Competing in today's power markets requires minimum operations and maintenance costs. This means that there is a slim chance of weekly pulverizer fineness testing. We thought you might appreciate some tips on early indicators of declining pulverizer performance.

Monitoring pulverizer performance by power inputs has been a "Hot Topic" lately regarding pulverizer performance indicators, mainly concerning a pulverizer's power consumption and fineness levels. From our experience, the power required to pulverize the coal is proportional to the surface area of the ground particles. When increasing the fineness, creating a greater surface area, the power required to pulverize the fuel is increased. As with any pulverizer a great indication to how hard it is working, is to review its power consumption (HP/ton). We should add here that never have we seen reduced power of a pulverizer drive motor possible with a given coal HGI and fineness level. Although some manufacturers of pulverizer components may state so in sales literature, our experience has been that optimum performance for a given pulverizer design requires a certain amount of power input. Pulverizer optimization requires adequate input drive power. Due to this fact the performance of a coal plant's pulverizers can be monitored and early warning of declining mill fineness used as a leading indicator of the need to perform repairs or mechanical tuning.

There are several key factors that contribute to a pulverizer's capacity or throughput such as feed size, Hardgrove Grindability Index (HGI), moisture content and the desired fineness level but these would provide consistent power consumption. It is important to establish the fact that "Pulverizer Capacity" is not simply "Throughput" in tons per hour. Pulverizer capacity encompasses at least five factors as shown in Figure 1: HGI, fineness, raw coal size, coal feed rate and moisture. The power consumption varies with different mill types but are influenced by fuel feed rates, HGI variations, spring pressures, grinding elements, mechanical tolerances, etc. Figure 1 to the right illustrates the approximate changes in how the pulverizer capacity varies as the HGI, moisture, fineness and feed size changes.

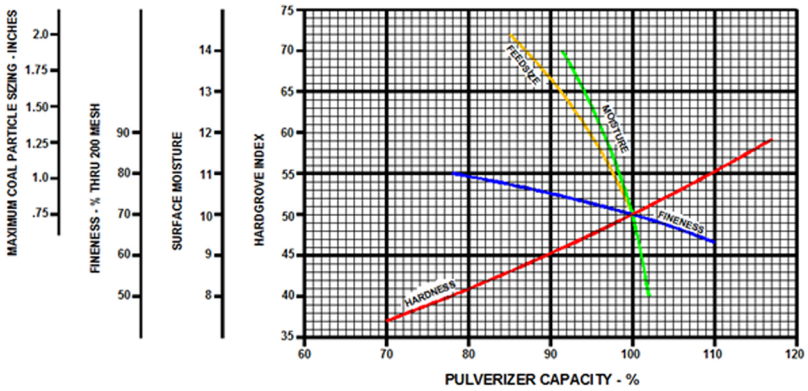
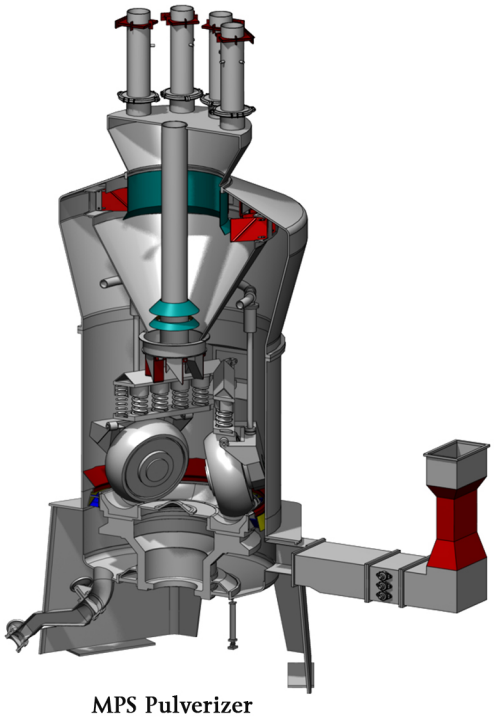


Figure 1: Interrelated Pulverizer Capacity Factors

Six Fundamentals for Coal Pulverizer Performance or Efficiency of Grinding

1. Grinding elements must be in first class contour and condition.
2. Sufficient grinding pressure must be applied to the tire/roll.
3. Proper primary airflow quantity and direction at the throat must be applied.
4. Coarse particles entering the classifier must be removed and returned to the grinding zone smoothly and continuously.
5. Primary air must not bypass into the coarse particle path of the classifier and entrain course particles into the outlet. (such as holes in the classifier cone or primary air short circuiting up through the classifier discharge)
6. Grinding element clearances must be optimum. (Minimum clearances)



MPS Pulverizer

When these fundamentals are met, then the specific pulverizer drive power is predictable. The graph below shows some typical power inputs for different mill designs that were tested.

The two main mechanical factors that affect pulverizer power consumption are spring preload and/or grinding pressure and grinding surface area. Pulverization occurs when coal particles are compressed and ground together. That is, the actual grinding that takes place is the crushing of coal particle against coal particle. It is not individual particles of coal crushed between two metal surfaces. Therefore the loading on the grinding elements by spring or hydraulic pressure and the "foot print" of the grinding elements are what produce coal pulverization.

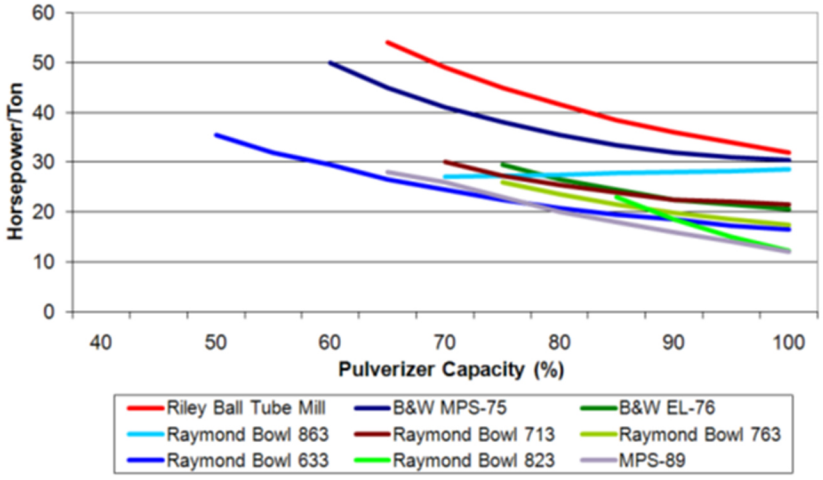


Figure 2: Different pulverizers comparing horsepower per ton vs. pulverizer capacity. *This is actual data for pulverizers using different fuel with different fuel Hardgrove Grindability Indices.

Spring pressure applied to the grinding elements is one of the most critical elements in obtaining acceptable fineness and without the correct pressure the grinding elements cannot create the required pressures to grind effectively and efficiently. When there is insufficient grinding pressure on the grinding elements comprehensive testing will show the size and quantity of the coarse particles leaving the classifier which overloads the classifier and makes it impossible to achieve the needed fineness.

The second mechanical factor is the surface area for grinding, which uses the available contact pressure between the grinding elements. Worn grinding elements cannot create the required pressures to reach the required grinding effectiveness. The surface profiles must be in good condition and parallel. Optimum performance won't be obtained when grinding elements are well-worn or "flat". Unusual wear patterns are often the result of uneven spring frames tolerances, alignment issues, pressure variations, geometry, and/or eccentricity issues.

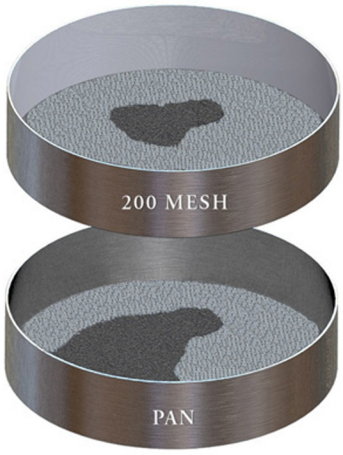
Monitoring pulverizer HP/ton consumption for a given fuel flow (or if individual mill coal feed rates are not available, then power input to the mills at full generator output can be compared) can serve as a great performance indicator. Non Optimization of mechanical tolerances of clearances or roll and grinding segment condition is proportional to the total hours in use and fuel throughput. As the grinding elements wear, the power consumption should drop.

In our experience low pulverizer drive power input is always synonymous with poor grinding effectiveness.

How About Flyash Unburned Carbon? Can this be Useful?

Another useful indication of pulverizer performance is determined with collecting a flyash sample. This can be used to diagnose pulverizer performance problems or combustion issues. A flyash sample can provide the carbon content (LOI) of the flyash and when a representative flyash sample is sieved through a 200 mesh sieve, the test results and observation of coal particles in the flyash can provide an indication of mill performance. A 50 gram sample can be sieved through a 200 mesh sieve and if the LOI is higher (and raw carbon char particles apparent) on the particles retained on the 200 mesh screen and the LOI is low on the particles passing 200 mesh screen, then it shows there is a pulverizer or fineness issue.

Monitoring power consumption and periodic testing will help determine the approximate pulverizer performance. There are many factors which are interrelated and Storm recommends that a comprehensive approach be taken to monitor pulverizer fineness. However, the relationship between mill power and coal throughput is a very helpful tool.



Place 50 grams of ash on the 200 mesh for sieve analysis

Determine L.O.I. of residue on 200 mesh sieve and in pan

L.O.I. of fine ash must be less than 2% (low volatile eastern fuels); or leass than 1% (high volatile western fuels)

Figure 3: Three Part Flyash Sieve / LOI Analysis

Yours Truly,

Richard F. Storm, PE
CEO/Senior Consultant

Disclaimer: These suggestions are offered in the spirit of sharing our favorable experiences over many years. Storm Technologies, Inc. does not accept responsibility for actions of others who may attempt to apply our suggestions without Storm Technologies' involvement.

Large Electric Utility Boiler Combustion and Performance Optimization Short Course

Course Topics:

- Basic Steam Generation
- Evolution of Steam Generators
- Boiler Fundamentals & Design
- Water & Steam Properties
- Basic Thermodynamics
- Boiler Reliability
- The Fundamentals of Combustion
- Typical Plant Performance Challenges
- Comprehensive Diagnostic Testing
- Heat Rate Awareness
- Applying the Essentials
- Coal Quality Fundamentals
- Coal Pulverizers
- Boiler Design
- Fuel / Ash Properties
- The Solid Fuel Injection Systems Approach to Air & Fuel Flow Management
- Low NOx Firing Systems
- Biomass Combustion
- Case Studies
- Circulating Fluidized Bed Boilers (Time Permitting)
- Oil & Gas Firing (Time Permitting)
- Energy, Economics and the Enviroment (Time Permitting)

Registration:

To Secure a seat for the short course, please fill out the bottom information and either email, fax, or mail or entry. For any further information, please feel free to call the office at (704) 983-2040.

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*Limited to 25 participants and first come availability to Storm customer base

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