The Storm Approach to Achieving Optimization Pulverizer Performance

Overcoming "Normal" Plant Challenges

Our company began in 1992 and for the last 22 years have been helping our customers achieve best environmental performance, reducing slagging, improving heat rate, increasing fuel flexibility and more.

The one common denominator in overcoming these "normal" plant challenges has been pulverizer performance. Our files are full of pulverizer test data that is well below accepted standards. A week has not gone by where we have not tested fuel lines and found fuel fineness in the range of 55 – 65% passing 200 mesh and with more than 1% remaining on a 50 mesh screen.

The "13 Essentials," which we have promoted for decades, remain our standard, and when combustion optimization of a pulverized coal unit is begun The 13 Essentials remain our primary checklist of working toward "Best Performance." The 13 Essentials are shown on the center of this page and it can be noted that nine of the 13 are pulverizer, primary airflow and fuel line related. Stated simply the precision of the fuel inputs to the furnace Matters!

IN THIS ISSUE:

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Thirteen Essentials of Optimum Combustion for Low NO_x Burners

1. Furnace exit must be oxidizing preferably, 3%.
2. Fuel lines balanced to each burner by "Clean Air" test ±2% or better.
3. Fuel lines balanced by "Dirty Air" test, using a Dirty Air Velocity Probe, to ±5% or better.
4. Fuel lines balanced in fuel flow to ±10% or better.
5. Fuel line fineness shall be 75% or more passing a 200 mesh screen. 50 mesh particles shall be less than 0.1%.
6. Primary airflow shall be accurately measured & controlled to ±3% accuracy.
7. Overfire air shall be accurately measured & controlled to ±3% accuracy.
8. Primary air/fuel ratio shall be accurately controlled when above minimum.
9. Fuel line minimum velocities shall be 3,300 fpm.
10. Mechanical tolerances of burners and dampers shall be ±1/4" or better.
11. Secondary air distribution to burners should be within ±5% to ±10%.
12. Fuel feed to the pulverizers should be smooth during load changes and measured and controlled as accurately as possible. Load cell equipped gravimetric feeders are preferred.
13. Fuel feed quality and size should be consistent. Consistent raw coal sizing of feed to pulverizers is a good start.

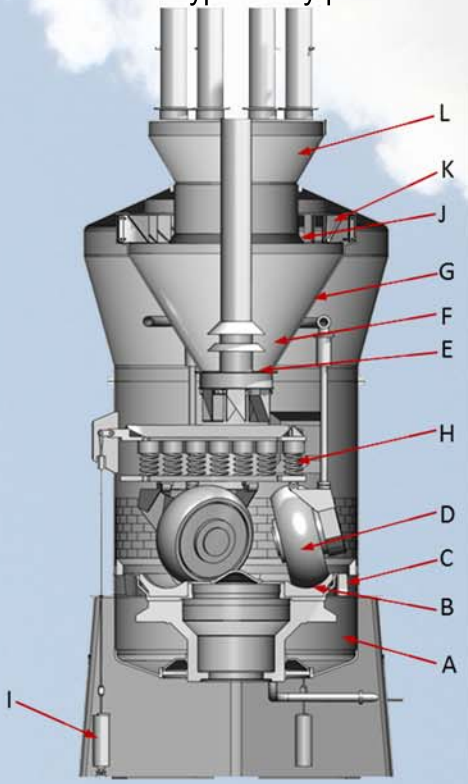
When pulverizers are overhauled, a normal pulverizer coal plant practice is to have new parts installed and it is often "assumed" that fuel fineness will be as designed or expected, greater than 70% passing 200m and less than 0.1% remaining on 50 mesh. After many years of testing freshly overhauled mills, I can report with great confidence and experience, acceptable fineness is NOT achieved by simply replacing worn mill parts. Nearly always expected and nearly always, in our experience, not the case. As I participated in our last seminar and listened to Shawn, Adam, and Danny's presentations, I thought perhaps it would be a good idea to write a newsletter on the Storm approach to let you know how and why we follow this procedure: This approach is what makes us different than other firms who are in the same business as us. The Storm approach does not make us less expensive or more competitive in price alone, but it has served us well for getting Results. Our mantra is SERVICE – QUALITY – RESULTS. Here is how we go about achieving Best Results.

Perform Baseline Tests

Using the Storm Isokinetic Coal Sampler we first obtain fuel fineness, distribution and dirty air velocities to determine the baseline performance. Often the fineness both before overhaul and after is far from optimum

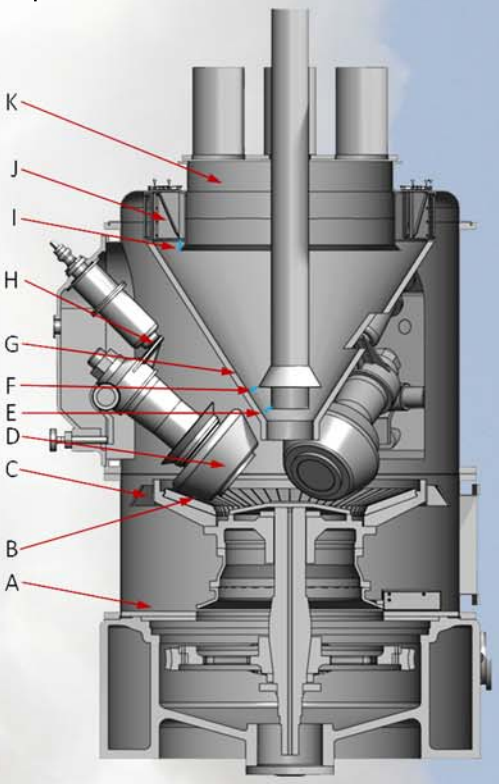
Perform Mill Internal Inspection and Repairs

Here are the typical key points to inspect and correct for two common vertical shaft pulverizers.



MPS Pulverizer

A. Pyrite Sweep Conditions/Clearances
B. Grinding Element Condition/Clearances
C. Throat Dimensions/Opening
D. Roll/Journal Condition
E. Feed Pipe Clearances
F. Inverted Cone/Conical Baffle Clearances
G. Classifier Cone Condition
H. Button Clearance/Spring Height
I. Preload of Spring Canisters or Hydraulic Pressure
J. Outlet Cylinder Height in relation to Classifier Blades
K. Classifier Blade Condition / Length / Stroke / Synchronized Angles
L. Outlet Smooth, free of any obstructions or spin arresting protrusions into the spinning two phase mixture of coal and air



Raymond Bowl Pulverizer

Measure and Control the Primary Airflow at the Preferred Air/Fuel Ratio

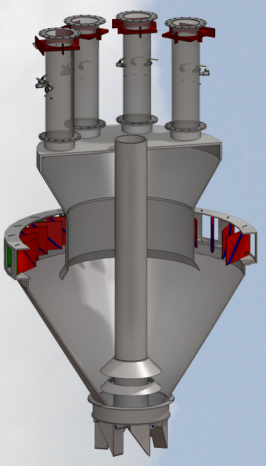
One of the most common problems we find is higher than optimum primary airflows. High primary airflow in nearly 100% of cases will cause carry over and entrainment of coarse particles leaving the classifiers. Of course, poor fineness then contributes to higher LOI (carbon losses) secondary combustion, high de super heating spray flows, increased soot blowing, and increased popcorn sized ash cinder entrainment in the flue gas, which can cause SCR fouling, APH fouling, increased draft losses and increased boiler dry gas losses from high tempering airflows.

Our Recommendation:

Install Flow Measuring Venturi's or Flow Nozzles, and perform "Hot – K" calibration checks.

We have done this for decades and I know of some flow nozzles installed in the mid 1980's, when I was with Flame, that still have the same reliable and accurate "K" factor. Not the least expensive but, they work, are accurate, and reliable. Power plant proven.

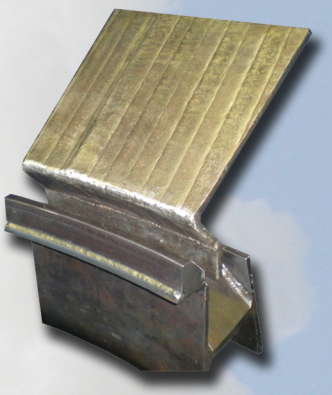
Storm Static Centrifugal Classifier Recommendations



The internal configurations and tolerances of the classifiers are critical. Interestingly many plants require very specific clearances and mechanical tuning. The basic Storm classifier retrofits include coarse particle guide blades, flared outlet cylinders and certain Storm and unit specific tolerances.

How do we know what the clearances should be? By testing, using the Isokinetic Coal Sampler to test all of the coal pipes. Basically, Test – Adjust – Test. As I said before; this is not the easiest or fastest way to achieve best furnace performance, but it is proven and few others in the business apply our approach.

Optimum Pulverizer Throat Configuration



This is a big deal. The pulverizer throat area and configuration must be right to minimize coal rejects at the optimum air/fuel ratio, must help turn down to minimum load without "Rumble" and must be configured to not have quiescent zones that contribute to mill fires. The Throat areas must be compatible with the fuel line and burner nozzle areas so that optimum velocities are achieved in all three pulverizer throats, burner lines, and burner nozzles.

Much thought and engineered solutions are applied by our staff of experienced P.E.'s on this to use not only our experiences, but also CFD modeling and continuously updated experiences from the field.

How About Burner Lines

The ultimate goal for optimization of the pulverizers is to achieve "Best Furnace Performance" so once the mills and primary airflows are optimized, the next steps are to balance the fuel lines.

<u>Our proven approach:</u>

1. Install fuel line – Quick Change Orifice Boxes
2. Perform clean air tests to balance fuel lines to +/- 2% balance of the same system resistances.
3. Operate at 75% or greater passing 200 mesh fineness and less than 0.2% remaining on the 50 mesh.

Summary

That my friends, is the Storm approach to optimizing the fuel inputs on a pulverized coal-fueled boiler. Of course, each unit is unique and many varied fuel properties require some tweaking of the foregoing. That is what our experienced field engineers do and of course for best results we recommend forming a partnership of our team and yours to work together for the mutually beneficial working relationship.

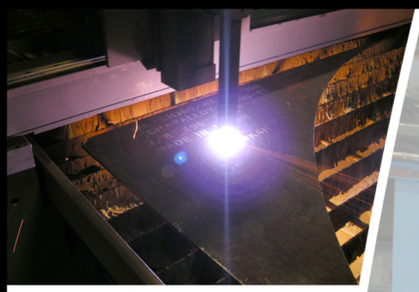
For a more in depth paper on balancing fuel lines you can refer to our website to download the white paper presented at RMEL in June 2012.

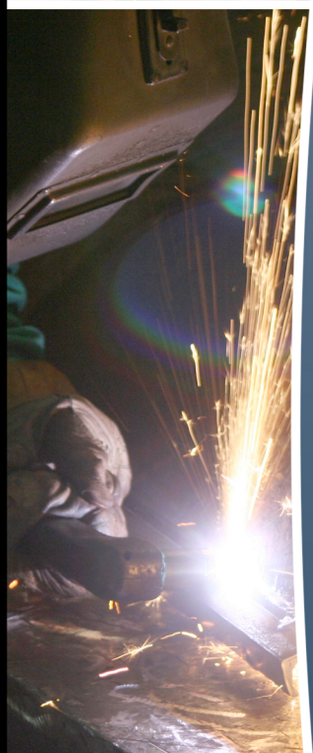
We wish you the best for the upcoming outage season so you can prepare for a winter of high demand.

Yours very truly,

Richard F. Storm

Dick Storm
Senior Consultant





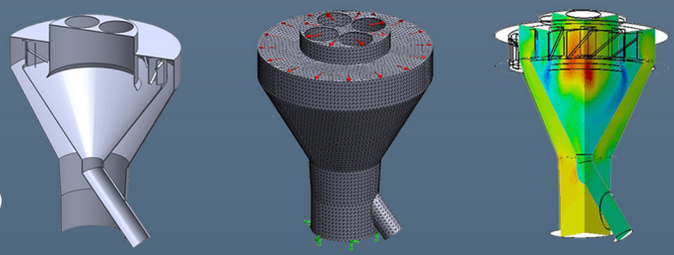
Fabricated Solutions

a division of Storm Technologies, Inc.

Fabricated Solutions, LLC is a 20,000+ sq.ft. ASME code shop and prides itself in its highly qualitifed staff insuring fast, accurate, reliable and quality products. Fabricated Solutions, LLC is a division of Storm Technologies, Inc, an engineering firm geared toward coal fire power generation, and is the core producer of all Storm's designed components. Once a concept and design of each specialized component is determined, our fabrication and quality control efforts provide fast, reliable and quality work for each specialized project.

Engineering Tools

- 3D Modeling
- Computer Aided Drafting (CAD)
- Finite Element Analysis (FEA)
- Computational Fluid Dynamics (CFD)



Fabrication Capabilities

- CNC Plasma cutting up to 1" thick metal of any shape
- 200 Ton Brake Press to up to 1/2" thick steel
- Plate Roll with capacities up to 3/4" thick steel
- Structural Tubing Bender up to 2"x2" carbon steel
- Metal Punch and Shear for up to 1 1/2" dia. holes and 6" angle iron in carbon steel
- ASME Code Stamp "S" and "U" Certificate Holder
- National Board "R" Stamp Certificate Holder
- Capable of welding and forming most materials Carbon Steel, AR plate, Carbide Overlay, and Stainless Steel

Fabricated Components

Airflow Management Systems • Fuel Line Orifice Housings • Chordal Thermocouples • Oil Atomizer Tips • Overfire Air Systems Duct Work • Replacement Riffles and Housings • Spinner/Spreaders • Pulverizer Optimization Components • Classifier Blades • Outlet Cylinders • Reject Doors • Rotating Throats and Deflectors • Inverted Cones • Classifier Cones • Serpentine Straps • Specialized Testing Equipment • Multipoint Probes

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