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Problem solved

Gary Madden, Techinomics, US, details a testing regime conducted at a western US power plant for the company's rotating throats for vertical spindle mill pulverisers.

The IPSC coal-fired power plant in Delta, Utah, began operation in 1986, delivering power primarily to the southern California market. It uses two 950 MW units and 16 MPS 89 series G B&W pulverisers. In early 2010, Techinomics helped the plant solve a problem that had evaded plant management and consulting engineering: chronic ring seat breakage at the mounting point of the rotating throats and the outages that resulted in each case. The plant began replacing the existing rotating throats with Techinomics.

The Techinomics rotating throat operational and design characteristics, as well as mounting configuration, eliminated the ring seat breakage problem. As the plant began to replace the other throats, the performance and ancillary benefits became clear. After some discussion, the IPSC plant agreed to conduct a 90-day testing regime to evaluate the rotating throats in two main areas:

- **The Techinomics low pressure drop throat's ability to conduct the primary classification process with an improved air-to-fuel ratio, as compared to the original installed rotating throats.** This results in lowered primary air fan amperage and lowered mill motor amperage. All of this results in lowered parasitic load and more available power with no increase in fuel expense.
- **The ability to remove pyrite and other non-coal material early in the primary classification/milling process.** This ability affords advantages that include reduced wear in the system, as well as reduced slag and ash, which reduce fouling of heat transfer components. Pyrite removal reduces SO_2 emissions, lowers scrubber and waste disposal costs and lowers arsenic levels, which reduces catalyst poisoning and extends catalyst life. Mercury is removed with pyrites, lowering activated carbon injection rates.

Table 1. Averages of primary air flow data, August 2012 – October 2012		
Testing protocol averages	Techinomics equipped mill	Original rotating throat equipped mill
Coal processed (tph)	58.02	57.24
Primary air used to process coal (lbs/hour)	210,160	226,770
Average air-to-fuel ratio	1.85/1.00	1.99/1.00
Average mill motor (A)	55.71	61.15
Calculated primary air fan (A)	309.33	329.97

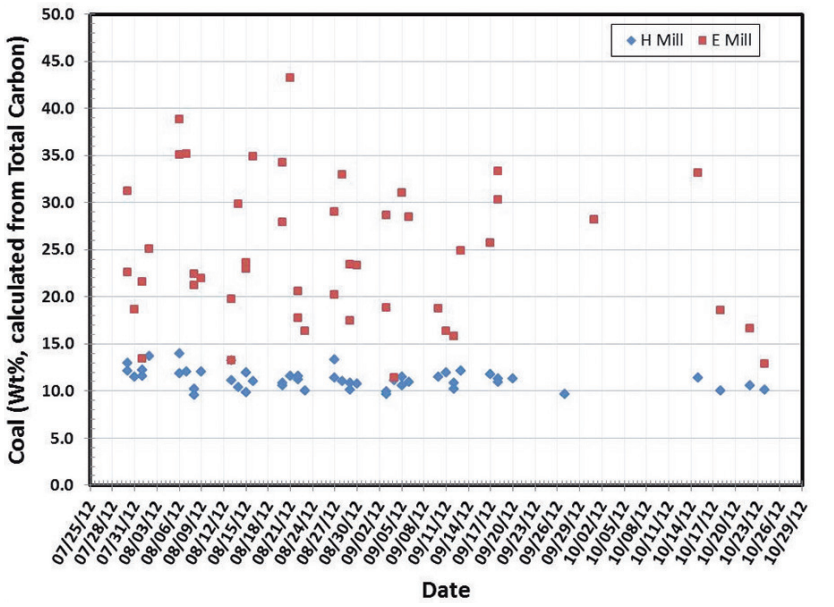

Figure 1. Coal (wt%), calculated from total carbon.

Testing protocols

The testing protocol was established by the IPSC power plant with a decision to make the testing comparative, measuring the performance of the original rotating throats compared with the Techinomics'. The plant selected a mill equipped with each throat, on the same unit, served by the same coal source with as close as possible to the same in-service time. The testing would be a 90-day cycle, one-hour a day each day of the week, beginning 30 July 2012 and ending on 30 October 2012.

The plant has an internal testing department, so it was well suited to the task. To ensure accuracy, it had its systems serviced and certified for accuracy two-weeks before testing began. Its internal electronic monitoring capabilities measured and recorded tonnes of coal processed, feeder speed, mass flow of air used to process the coal and primary air fan amps (A) used during the test cycle, all of which gave the the air-to-fuel ratio for each test cycle for each mill. It also measured mill motor amps used to process the coal during the 60 min cycle. In addition, it measured hot and cold air damper positions, inlet and discharge temperatures and burner line velocities to ensure optimum combustion performance was being maintained for the unit with both mills.

The IPSC plant collected and weighed material caught in the reject device for both mills during each hour-long test cycle, packaging the 97 samples collected separately. They recognised that determining the exact chemical content of what each sample contained required an expertise and experience that the plant lacked. It turned to Consol Energy's R&D laboratory in South Park, Pennsylvania, for this part of the analysis. Consol's laboratory is recognised for its work in identifying metals and other constituents in coal material. The reject material was shipped to Consol, in their individual collection units, with a specific log for each sample.

Consol noted the weight of the collected samples, for both tested mills and then measured each mill sample for:

- Concentration of coal.
- Concentration of pyrite.
- Concentration of arsenic, mercury and antimony.
- Correlation between the concentrations of arsenic, mercury and antimony in each sample with the concentration of pyrite.
- Composition of the reject from the Techinomics mill (H mill) as compared to the composition of the mill equipped with the other rotating throat (E mill).
- Particle size distribution of reject material from the Techinomics mill (H) compared to the mill equipped with the other throat (E).

Results of IPSC testing department analysis

IPSC generated specific data for every hour-long test cycle for each mill and they also provided averages for the complete cycle. As an example, there were several cases where the E mill produced no rejects during an hour-long test cycle. This was noted on the log and recorded. Each mill was operated so as to provide optimum performance, without causing the mill to falter. There were attempts to operate both mills at the same total primary air flow when it became apparent there were significant differences.

These attempts resulted in an increase in DP pressure in the E mill and a tipping of the mill and automatic shutdown at approximately 30 min into the test cycle. After several attempts the effort was abandoned and the E mill was operated at the primary air settings, which gave it the best results. The primary air fan was common to both mills and the mill motors were exactly the same unit, both having had the original mill motor replaced during the same calendar week. The differences

in averages for each mill were dramatic and consistent as shown in Table 1.

These differences are significant and represent a mill-to-mill comparison. The reduction in mill motor amps and primary air fan amps represent two additional MW of power available every hour of operation at no additional fuel cost, projected over the 16 mills in operation.

Results of laboratory analysis

Consol found the first and most obvious difference in the reject samples for each mill were: the differences in total average weight of rejects per test cycle for each mill and the average particle size for each sample. The Techinomics-equipped H mill rejected an average of 144.23 lb/hour of dry weight, while the E mill averaged 18.67 lb. The difference in reject particle size for each mill was that the E mill particle size averaged 0.125 – 0.25 in. in 55% to 65% of rejects and the H mill averaged more than 50% of its rejects in the 0.5 – 1 in. size range. Consol concluded that the Techinomics rejection of a higher mass of larger particles was consistent with the reduction in mill motor amperage that IPSC observed for the Techinomics-equipped mill.

While the H mill rejects represented a larger mass and particle size, the percentage of coal content was lower with the H mill. As shown in Figure 1, the Techinomics mill rejected a fairly consistent percentage of coal per reject sample (9% to 14%), while the E mill rejects contained twice as much coal (30% to 35%) at low concentrations of pyrite as it contained at high pyrite concentrations.

Consol also concentrated on identifying mercury, arsenic and antimony in both mill's reject samples. In all cases, there was a strong correlation between the presence of mercury and aresnic and the mass of pyrite rejected. The presence of antimony was not nearly as strong or indicative. Both mills rejected nearly an equivalent percentage of mercury and aresnic per mass of pyrite rejected. However, since the H mill typically rejected 8 – 10 times more mass than the E mill, it rejects a considerably larger mass of mercury and arsenic than the E mill. The value of this rejection of additional mercury and arsenic becomes apparent when viewed with the positve impacts of reduction of catalyst wear, prolonged scrubber life and reducing the need for activated carbon. The reduction of pyrite, calcium and silicon seen with the H mill also reduces slag and ash, fouling of the econimiser and superheater and the amount of erosion in the boiler. The Techinomics technology is coal-base friendly, applicable to a wide variety of coals throughout the world.

IPSC has replaced 90% of their rotating throats with the Techinomics throats, with the remainder scheduled by the spring of 2014. They will conduct additional testing soon, with the goal of using variable speed fans to save even more additional power. WC

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