CRUSH IT, PULVERISE IT and burn it!

Stephen K. Storm, Storm Technologies Inc., US, stresses the importance of following these simple steps.

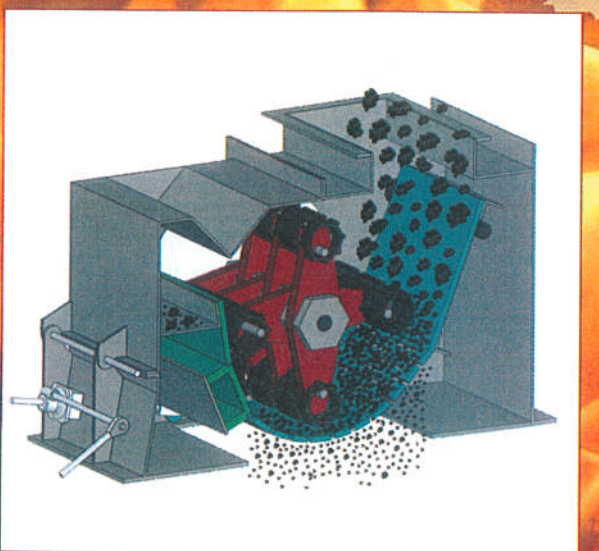

Figure 1. Typical crusher design used for large utility boilers to achieve < 0.75 in. raw coal sizing.

Typically, on pulverised coal-fired boilers, coal pulveriser performance encompasses at least 75 - 80% of most firing system opportunities for combustion and steam plant performance improvement. Considering this, the inter-relationships of coal pulverisation must be considered when attempting to optimise combustion, overall unit performance, operability, reliability and capacity. Pulveriser efficacy is challenging many plants in the US, which are undergoing drastic fuel changes. So, what do

Figure 2. Magnetic separator (typical).

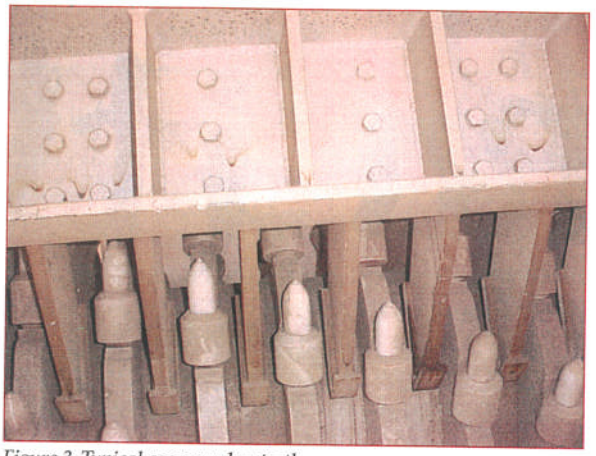

Figure 3. Typical cage crusher teeth.

Figure 4/5.

Figure 6.

we do about it? The solution is often very simple. Performance = C+P+B or in other words, 'Crush it, Pulverise it and Burn it like Hell!' For some it's not that simple. This is considering that many older units were not designed with fuels flexibility in mind. So, this often makes combustion optimisation a challenge whilst firing coals of varying qualities. Regardless, the basics of combustion still apply and approximately 75 - 80% of all the opportunities for improvement are related to coal pulverisation.

The essentials of combustion optimisation

- Raw coal sizing must be consistent and preferably less than 0.75 in. top size; consistent fuel size and removal of foreign matter such as tramp metal is essential.
- Fuel feed to the pulverisers must be smooth during load changes and measured and controlled as accurately as possible. Load cell equipped gravimetric feeders are preferred.
- The fuel lines balanced to each burner must be balanced by the 'clean-air' test ± 2% or better via square edge orifices.
- Fuel lines must be balanced by the 'dirty air' test, using a dirty air velocity probe, within ± 5% or better.
- Fuel lines must be balanced by fuel flows within ± 10% or better.
- Fuel line fineness must be greater than 75 - 80% passing a 200 mesh screen and < 0.1% on a 50 mesh screen.
- Primary air/fuel ratio shall be correct and accurately maintained when above minimum.
- The over-fire air system (if installed) must be controllable.
- The fuel line and/or burner minimum velocities shall be 3300 ft/min.
- Mechanical tolerances of burners and dampers must be within ± 0.25 in. or better.
- Secondary air distribution to burners must be within ± 5% to ± 10%.
- The boilers furnace exit must be oxidising, preferably ≥ 2%.

When pulveriser performance is poor, combustion and steam plant cycle performance is non-optimum. When the combustion process is non-optimum, the plant's performance, reliability and environmental control mechanisms are compromised. As a pre-requisite to combustion optimisation, raw coal sizing should be less than 0.75 in. and consistent. This is typically accomplished either at the mine or at the power plant using a coal crusher. Regardless of where it is done, the task is very important.

As discussed in the 13 essentials of optimum combustion, consistent raw coal sizing to the pulverisers is a good start. Once sizing is minimised to < 0.75 in. this will contribute to a smooth delivery of the coal to the pulverisers and enhance the effectiveness of the magnetic separators (Figure 2). This important fact is often overlooked and/or disregarded even though tramp metal, mining teeth and/or hardened crusher tips, such as those shown within Figure 3, are a nuisance to the critical tolerances, reliability and performance of vertical spindle pulverisers. When these tips or similar hardened mining tool tips come loose and end up within a vertical spindle pulveriser, they can wreck a pulveriser and/or create major long-term performance issues.

On a ball tube mill type coal pulveriser, tramp metal and large rocks become part of the ball inventory. These large rocks can reduce effective grinding surface of the grinding balls in the ball tube mill. However, if the crushers are optimised, rocks granulated and tramp metal separated, the pulveriser can be more effective in lifting tramp metal and crushing rocks. Furthermore, pre-crushing and/or drying coal can often yield a 5% or better true capacity improvement. However, often misunderstood true pulveriser capacity encompasses at least five factors, not simply throughput. These five main factors that comprise pulveriser capacity are: hardgrove grindability (HGI), throughput, fineness, raw coal sizing and moisture (Figure 4/5).