FLY ASH COLLECTORS FOR BAGASSE FIRED BOILERS

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Introduction

The purpose of this paper is to record the experience gained as a result of operating multi-cyclone dry collectors and a corrugated wetted louvre collector on sugar mill boilers owned by CSR Limited. Information is included on variations in inlet burdens and the particle size distribution of fly ash encountered over the period 1967-1973, inclusive. The results are also given of some trials in which higher temperature flue gas (265°C) was passed through the wetted louvre collector.

Variability of Inlet Burdens

Emissions from bagasse-fired boilers and the size distribution of the fly ash are both subject to extreme variability. Figure I shows the record of all emission level measurements carried out at CSR mills since 1967, about 200 in total. Emissions vary from less than 1 gram/standard cubic metre (gm/std m³) to 30 gms/std m³. The main factors which cause the variability are variations in

- Bagasse fuel properties.
- Boiler output and method of operation.
- Boiler type (refer figure 1).

Unfortunately, little control over fuel properties is possible in the short term. For example, high burdens usually follow periods of wet weather or a cyclone. Little quantitative data is available on the effect of boiler output and method of operation on fly ash emission; however, the authors believe that when boiler output is high, then fly ash emission also will be high.

Variability of particle size distribution is also high (refer fig. 3 and 5). There is a trend to coarse dust at high inlet burdens.

In selecting fly ash collectors, the variability of inlet burdens and particle size distribution should be taken into account. It is advisable to take inlet burden measurements over a period of two years, including periods when boiler ratings are high, following heavy rain. Once the variations in inlet burdens and particle size distribution are known, the performance of available collectors should then be evaluated.

Efficiency Trials on Multi-Cyclone Dry Collector

During the 1973 season, efficiency trials were carried out on the Joy 9VGR10T multi-cyclones fitted to the Thompson and multi-tubular boilers at Condong. The results are summarized in Figures 2 and 3. Measured efficiencies were generally above 93 per cent for the fly ash size distribution shown in Figure 3. The measured efficiencies were higher
than guaranteed and enabled the mill to comply with the requirements of the N.S.W. Clean Air Act, i.e., 0.4 gms/std m³.

Fractional efficiency was measured by sizing both inlet and outlet burdens with a Bahco analyser.

A plot of particle size efficiency based on the Condong results is shown in Figure 3, and this subsequently has been found to give a similar overall efficiency on the Condong fly ash to the efficiency guaranteed by the manufacturers. For comparison purposes, a curve representing fly ash given in SRI Report No. 107 Table 7.3 is also shown. On the fly ash sizing nominated in the SRI Report, the overall efficiency predicted by the particle size efficiency curve of Figure 2 is 91.2 per cent.

Inlet burdens are low (0.8 – 4.5 gms/m³) and, in some instances, particle size is extremely fine (35% < 10 μm) at Condong when compared to say the results at Macknade (see Figure 3 and 5). The elevated settings on the Thompson boilers and the low steam output ratings on the multitubular boilers is probably a major cause of the difference.

Wetted Louvre Collector

Description

This collector is of the wetted zig-zag passage type, the passage walls being characterized by sharp pointed corrugations running downwards in the direction of gas flow. Construction of the collector is shown in Figure 4. A full size arrestor (4 m² baffle area) has been installed on the 59 000 kg/h Riley Dodds boiler at Macknade.
TRIAL RESULTS JOY TYPE (SVGR 10T) MULTICYCLONE COLLECTOR - CONDONG MILL - 1973 SEASON.

THOMPSON STEPPED GRATE BOILER.

PARTICLE SIZE AT S.G.=2-MICRONS

Fig. 2—Particle size efficiency curve—dry multicyclone collector.

Fig. 3—Particle size distribution of bagasse fly ash inlet to dry multicyclone collector—Condong mill 1973.
Efficiency Trials

Efficiency trials were carried out during 1973 crushing season. Figure 5 gives upstream fractional sizing of the fly ash encountered in each of the trials. Figure 6 gives fractional size efficiency, together with other trial information. A curve has been drawn generally lower than most points on the graph. This can be regarded, on trial results, as the safe curve for the arrestor.

Overall efficiency of the collector when operating on SRI fly ash is 98 per cent. It should be emphasized that efficiencies have been measured on a prototype collector. Some changes are envisaged in future models.

Operational Features

The plume discharging from the stack is generally clear, although a steam plume forms away from the stack during cool periods.

Surfaces of the induced draft fan casing following the arrestor appear dry when the boiler is operating on oil and on bagasse. There have been no signs of erosion or corrosion in the fan motor or casing.

Elevated Temperature Trials

Because of the need to install collectors on incinerator-type boilers, which operate with exit gas temperatures up to 370°C, it was decided to carry out trials to obtain collector design data for these conditions.
Fig. 5—Particle size distribution of bagasse fly ash inlet to wetted louvre collector—Macknade mill 1973.

Fig. 6—Particle size efficiency curve—wetted louvre collector.
It was possible to bypass the airheater on the Riley boiler and operate with low excess air to obtain a gas temperature of 260°C instead of the normal 200°C.

Results of the trials are given in Figure 7. In Figure 7 flue gas temperature drop across the collector has been plotted against the difference between dry bulb temperature and the dew point of inlet gas. The latter parameter is closely related to vapour pressure difference between water and gas as discussed in Fan Engineering. Extrapolation of the results shown in Figure 7 allows the temperature drop across the collector to be estimated for the incinerator-type of boilers.

An estimate for water evaporation for the collector can then be made from a heat balance using values of temperature drop obtained from Figure 7.

Conclusion

The data presented in this paper cover some aspects of the work done by CSR Limited on fly ash variability and on the performance of two types of collectors installed on sugar mill boilers. Further work remains to be done on several areas to complete the story. These areas include fly ash handling and dewatering, effect of collector on plume rise, overall cost/benefit studies and collector operation at elevated temperatures.
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REFERENCES


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