

A PRELIMINARY REPORT ON A NEW SIEVE PLATE SCRUBBER FOR BAGASSE FIRED BOILERS

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Abstract

A simple sieve plate type of wet scrubber has been developed for scrubbing smuts from bagasse fired boiler flues. Pilot plant studies have demonstrated that scrubbing efficiencies in excess of 97% are consistently attainable at pressure drops of less than 75 mm (3 inches) water gauge. Mathematical modelling of the experimental data is being undertaken to facilitate optimisation of the various design parameters.

Introduction

During the past 18 months the application of wet scrubbers to the problem of smut collection on bagasse fired boilers has aroused considerable interest in the local sugar industry. An examination of the commercially available designs shows that these may be classified broadly into the following categories:—

- (a) *Direct impingement scrubbers*—the flue gases impinge directly on the surface of the scrubbing liquid.
- (b) *Target type scrubbers*—the flue gases are accelerated on to an irrigated target plate.
- (c) *Cyclonic / vane scrubbers*—fly ash particles are wetted and separated under cyclonic action.

In reviewing these various designs it soon became apparent that in nearly every instance a considerable quantity of make-up/circulation water, sometimes at high pressure, was required or that a good deal of pressure drop was being incurred by mechanically altering the flow path of the flue gases. It occurred to us that it should be possible to design a wet scrubber which minimised gas flow disturbances whilst at the same time requiring only a moderate water rate.

We therefore wondered whether a single, irrigated sieve plate might not meet both the above criteria whilst at the same time providing the intimate mixing of the gas and liquid streams which is a prerequisite for efficient scrubbing. If successful such a scrubber would have the advantages of simplicity in design and operation, low maintenance requirements coupled with low capital and operating costs.

Experimental

A small experimental pilot plant of capacity 5 000 Nm³/hr (3 000 cfm) was set up at the Darnall Mill on their No. 1 boiler.

The scrubber consisted simply of a vessel in which a single water-irrigated sieve plate was mounted. The plate was removable enabling us to investigate the characteristics of a number of different hole sizes, free areas and so on. The vessel itself was made square in cross section so that the water flowed uniformly

across the plate (to an external weir) in order to facilitate extrapolation of the pilot plant studies to a full scale unit. A sketch of the pilot plant is shown in Figure 1.

The flue gases were taken as a slipstream from the main boiler flue duct. These flue gases had already passed through a Howdens Multi-Vortex cyclone set on the boiler. In order to ensure a high dust load to the test scrubber, arrangements were made to permit re-entrainment of large amounts of the smut.

The dust loads both up and downstream from the pilot plant scrubber were measured using a modified version of a commercially available isokinetic sampling apparatus. Flue gas rates were measured by conventional pitot tube traverses.

Results

It was found that this sieve plate scrubber removed better than 97% of the incoming fly ash from the boiler at inlet dust loads up to 7 000 mg / Nm³. Typically, outlet dust loads of better than 100 mg / Nm³ were readily achieved. The pressure drop across the scrubber was a well defined function of the design parameters (i.e. gas rate, water rate, hole size, hole free area etc.). In addition stable operation of the plate (i.e. uniform water distribution, acceptable weepage) could be maintained over a very wide range of operating conditions indicating a very good turndown ratio. A typical set of experimental results are depicted in Figure 2.

Mathematical modelling of the experimental results into a workable set of design equations is still in progress. However the results obtained to date indicate that there will be ample scope for optimisation of the design parameters to suit any particular set of required operating conditions.

Conclusions

A simple sieve plate type of scrubber has been shown in a pilot plant study to be a highly effective device for removing fly ash from bagasse fired boilers. Due to the inherent simplicity of the design, the only design parameters being hole size, free area and water rate, it is possible from our experimental work to calculate a design which will produce a desired scrubbing efficiency with the minimum of pressure drop.

Work on the project continues.

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FIGURE 1

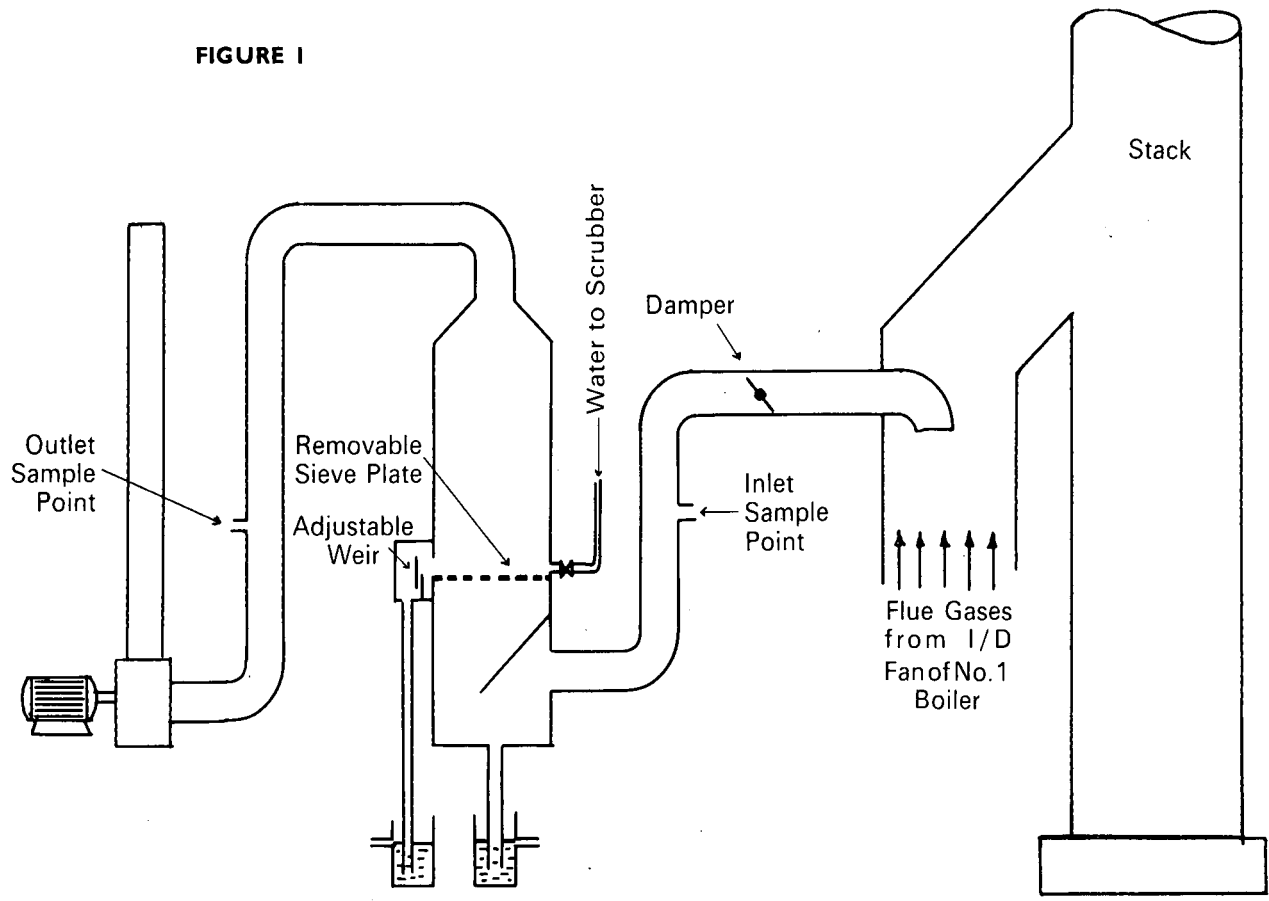


FIGURE 2

