FIRST IMPRESSIONS OF A WET TYPE SCRUBBER ON A BAGASSE-FIRED BOILER.

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Abstract

The Peabody wet flue-gas scrubber at the Tongaat Sugar Mill is described. At time of writing performance data is not to hand, but general observations and comments are made.

History

In October 1970 it was learned that a new John Thompson boiler already on order for the Tongaat Factory would have to be fitted with extremely efficient smut arresting equipment before commissioning, in order to comply with the Air Pollution Control Act to which the Sugar Industry had just been declared subject. A hasty decision had to be taken, and on the recommendation of the boiler suppliers, a Peabody Scrubber was ordered. Despite some early misgivings regarding possible blockaging of waterways, the Mill Management have been extremely satisfied with the first four months of the scrubber's operation.

Description

A general arrangement of the Peabody scrubber is shown in Fig. I.

The boiler flue gases enter radially at the bottom of the tower. As they rise upwards, the velocity is reduced by an increase in the cross-sectional area of the tower.

Primary sprays of the solid cone type, directed downwards, serve to "desuperheat" the gases to some extent, and wet much of the suspended solids. This increases the density of absorbent particles, and many of the larger particles are probably precipitated at this stage. The cooling effect also reduces the specific volume and therefore the velocity of the gases.

The gases then enter the second and main scrubbing stage. In the Tongaat installation, this comprises a single pass through a stepped stainless steel plate, over which a 15 to 20mm deep flow of water is maintained by a series of weirs (see Fig. II). The number and diameter of the holes in the plate are such that litle or none of the water flowing over the plates drains through the holes against the upflow of the gases. A series of sprays directed up at the lower surface of the perforated plate wash away any large particles tending to block the holes from below. These sprays are of the vortex type.

To further ensure intimate contact of suspended particles with the 20mm water bed, submerged "target plates" are positioned approximately 5mm above and covering each hole (Fig. III). These minimise the chance of unbroken and hence "unscrubbed" gas bubbles passing through the water layer.

The third and final stage of the scrubbing process comprises a simple centrifugal spinner to separate droplets of entrained water.

To minimise the risk of choking, all apertures on the Tongaat installation have been made larger than usual for this type of scrubber — probably at some cost to scrubbing efficiency. The holes in the perforated plate are 10mm in diameter and the chokeless sprays have 12mm orifices.

The scrubber casing is of type 430 stainless steel, which proved to be no more expensive than the ebonite-lined mild steel construction originally proposed by the suppliers. The subsequent ducting and fan are epoxy-painted, and the stack has been internally gunited. It is too early yet to comment on the effectiveness of these anti-corrosion measures.

Performance and Efficiency

At the time of writing this paper, it has not yet been possible to undertake scientific measurements of the efficiency of the scrubber. However, a method has been designed and approved for measuring the emission levels from the scrubber, and the necessary measuring points will be installed on the stack this off-crop (April 1972). It is hoped that results will be available by the time the paper is presented at the Congress, but if not they will nevertheless be included in the Congress Proceedings.

General Observations

Firstly, the general comment can be made that the scrubber removes a great amount of smuts, and also a lot of sand. Unfortunately it has not yet been possible to quantify the amount, as the boiler ash has been added by the time the water is screened, so the solids removed are not from the scrubber only.

The Tongaat installation was designed to handle the flue gases from a 45 ton/hour bagasse-fired boiler. For this duty, the diameter across the perforated plate is about 4m, and the total quantity of water pumped through the two sets of sprays and over the plates is 3 000 l/min. The make-up water, however, is only about 10% of this, the remainder being recirculated.

The gases are cooled from ± 230° at inlet to the scrubber to ± 90° at the outlet. This cooling results in the condensation of most of the moisture in the boiler flue gases, which were generated by burning a fuel containing 50% moisture.

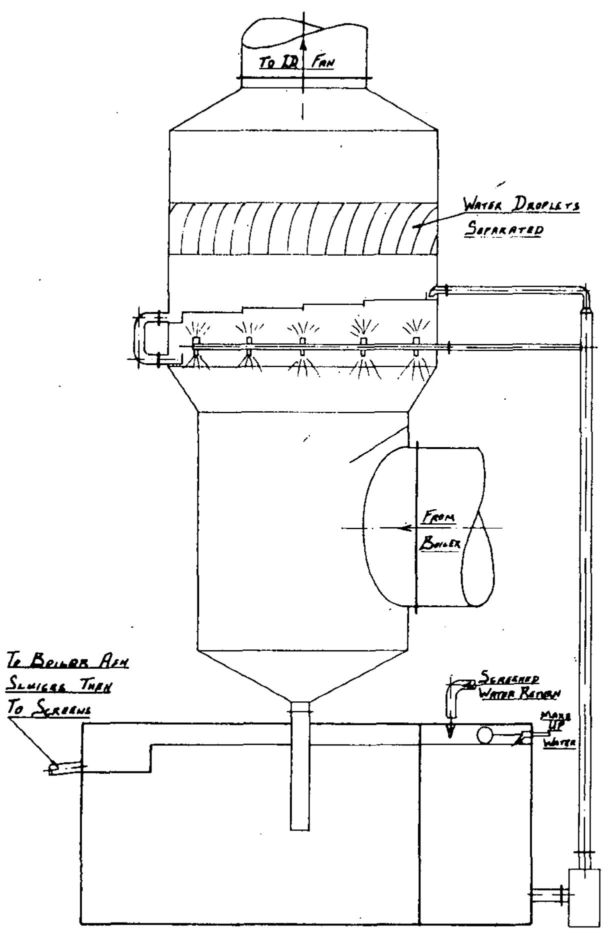
Two boilers of nearly equal output share the stack from the scrubber. When the "scrubbed" boiler only is on, a gentle white plume of vapour wafts from the stack. However, with both boilers or with the "unscrubbed" boiler alone, the smoke reverts to a light brown higher velocity plume. Clearly, the hotter flue gases re-superheat the vapour, rendering it invisible.

Perhaps the most significant observation so far is the low pressure drop across the scrubber. At a steaming rate of 35 tons/hour (the boiler's stated M.C.R.), the drop across the scrubber is only 37mm. At the designed optimum load for the scrubber (45 tons/hour steaming) the drop would probably be only about 60—65mm, which is less than for most wet or reasonably efficient dry collectors. While one would expect some correlation between energy absorbed and scrubbing efficiency, the low pressure drop on this (presumably!) high efficiency scrubber is probably due to the low velocities at the main scrubbing stage. Most other designs require a high velocity for high efficiencies.

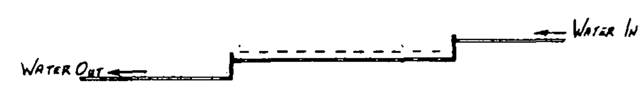
Advance fears that trouble might be experienced with spray nozzle blockages have proved groundless. Both the spray nozzles and the perforations in the scrubbing plate have been free of chokes in the four months of operation to date. However, quite a heavy build up of fines has occurred on the large spinner vanes in the top section over this period.

Problems were experienced with a gradual build up in the concentration of fine sand in the circulating water system. The vibrating screens failed to separate the sand and fine ash, and the system had to be flushed completely every two to three days when the "porridge" became too thick to pump. However a small settling trough cleared by a scraper conveyor was introduced into the system to handle tramp iron and lumps of clinker in the boiler ash, and this now removes all surplus sand and most of the smuts. In general, settling (and floating) would appear to be a better means of removing solids from the system than screens.

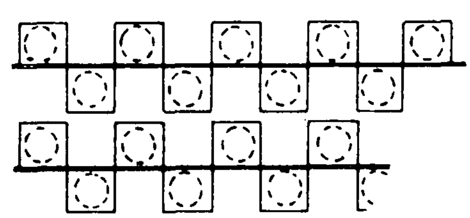
The only other problem encountered so far has been considerable erosion of the stainless steel spray nozzles. This could possibly be reduced by a minor design modification, and the problem will be pursued with the agents.



— FIG. I —



— FIG II —



— FIG III —