

STEAM GENERATION IN CANE SUGAR FACTORIES IN NATAL AND ZULULAND

It was the intention of the Committee to give the subject a rest for this year, but the experience of the past campaign caused the plan to be changed. As is well known, one of the factories crushing cane set aside a week, towards the end of the season, for milling only non-Uba canes. Observations conducted during that week confirmed what the Boiler Committee has preached repeatedly, namely, that the fibre of the new variety canes will not provide sufficient steam for factory requirements unless the whole steam position of the factory is put on a sound basis.

Further, it became necessary during the season to visit the factories to learn what information they had gathered concerning the milling and factory treatment of these new canes. Whilst discussing steam raising with those responsible for this department we were told again and again that sufficient steam could not be raised from the bagasse available and that this fuel had to be supplemented by coal or wood.

During the season just passed a very interesting test was carried out at Doornkop. At this factory an Usco Air-preheater had been installed, and the Board wanted to have figures on the work done by the plant, and as the results are worth publishing, it was decided to discuss the questions raised during the year on steam production in a paper at this Conference, and those are the reasons for the change of plan already referred to.

Two years ago, in 1933, Doornkop had no superheaters, and no air-heaters. Some time previous to this year a Cook's furnace had been installed, and the improvement over the Step Grate which this alteration effected had been obvious. There was, however, rather too much clinkering in the grate, but this trouble disappeared when fire-bars were put in. In 1933, a test was carried out on the Boiler Plant as it then stood, and the results are given in the accompanying table so as to enable a comparison to be made with the test carried out during the last milling season, 1935.

It will be noticed from the table that between 1933 and 1935 the company put in superheaters, and air-heaters, and since the records of the test show the results with the air-heater on and off, it is also possible to show what the superheaters contribute towards the increase in efficiency.

The steam superheaters raised the thermal efficiency from 54.6% in 1933 to 61.5% in 1935, so the percentage gain due to superheating is:—

$$\frac{61.5 - 54.6}{54.6} \times 100 = 12.6 \%$$

a good milling plant. It is a matter of considerable concern that we have such high moistures in our bagasse. Other countries get down to 46 per cent. It may be remembered that last year we reported

the effect of superheating at the Central Factory, and showed it to be:—

$$\frac{52.8 - 46.6}{42.6} = 13.3 \%$$

The conditions at the latter factory are practically those at Doornkop, so it is satisfactory to find the results of superheating so close.

The effect of the Usco air-heater was shown by raising the thermal efficiency from 61.5 per cent. to 71.5 per cent. (average of the two day's test), and the gain due to the air preheater is:—

$$\frac{71.5 - 61.5}{61.5} \times 100 = 16.2 \%$$

These results show the value of the installations as heat savers which will become more evident with time. When we first suggested the use of superheated steam the suggestion met with a good deal of opposition and it was even said that more fuel would be needed. To-day most of the large factories have installed superheaters and have not found any increase in their fuel bills.

Again, a good deal of trouble was caused in different parts of the world, including South Africa, when air preheaters were installed due to the rusting of the plant, and it has been reported from Australia and Java that they don't like air preheaters on this account. The corrosion troubles have now been conquered completely. The cause was due to the makers of the plant having to handle a fuel containing such a huge proportion of moisture as bagasse, in this country averaging 50 per cent., whereas coal, the fuel catered for before, contains so little moisture.

The Cook's furnace allows of considerable forcing, with the result, in many of the installations, that chimney temperature has exceeded 600° F. One has only got to look at some of our former reports for such figures. With gas at such a high temperature passing up the stack the loss of energy is considerable and the air-preheater is designed to take care of such conditions. Several of the larger factories in South Africa have put them in and others are following the lead.

An examination of the Government's Census will show what a lot of new variety canes are being planted and every company knows where it stands in this respect. They should know therefore how necessary it is to get this matter of the steam production balanced. This balancing of requirement of steam with the usage is not merely a question of setting the boiler house in order. There are many other factors which affect this result, such as a good milling plant. It is a matter of considerable concern that we have such high moistures in our bagasse. Other countries get down to 46 per cent. and less but we remain round an average of 50 per cent. There are also enormous losses due to radiation in the factory.

In view of the urgency for the consideration of these matters we suggest that companies should address themselves to obtaining a steam balance by measurement where possible, and for this purpose the Committee on Steam Balance and Boiler House Practice is pleased to offer its services as keenly as in the past when Boiler House Practice alone was the object of its existence.

Committee on Steam Balance and Boiler House Practice.

D. HESLOP.
J. BIHL.
W. MACKESY.
P. MURRAY.
E. CAMDEN SMITH.
G. C. WILSON.
E. P. HEDLEY (Convener).

		1935.		1933.
	Air-heater on, Nov. 5th.	Air-heater off, Nov. 6th.	Air-heater on, Nov. 7th.	No Superheaters, no Air-heaters.
Duration of test (hours)	6	4	6	8
Type of boiler	B. & W.	B. & W.	B. & W.	B. & W.
Number of boilers on range being tested	3	—	—	3
Heating surface, sq. ft. per boiler (or per test)	3 × 2,531	—	—	3 × 2,531
Heating surface, superheater	3 × 154	—	—	None
Type of furnace	Cook	—	—	Cook
Grate surface, sq. ft. per boiler	3 × 28	—	—	—
Combustion space, cu. ft. per boiler	796	—	—	—
Water apparently evaporated—lbs.	265,010	148,910	242,986	244,807
Moisture in steam %	Nil	Nil	Nil	15.6
Water evaporated—lbs. (corrected for moisture)	265,010	148,910	242,986	206,618
Feed water temperature—°F.	188	200	199	181
Superheat temperature—°F.	430 415 410	425 410 405	430 423 411	—
Factor of evaporation from and at 212° F. into dry steam	1.114	1.099	1.101	1.07
Water evaporated from and at 212° F.	295,221	163,660	267,527	221,681
Steam pressure by gauge	112	100	117	86
Weight of bagasse burnt—lbs.	102,000	55,440	90,922	101,520
Moisture in bagasse, per cent.	46.5	46.6	46.8	48.7
Weight of dry bagasse—lbs.	54,570	34,945	48,370	52,080
Rate Results.				
Water evaporated from and at 212° F. per sq. ft. heating surface per hour	6.48	5.42	5.87	3.64
Water apparently evaporated—lbs. per hour	44,168	37,475	40,497	30,601
Water apparently evaporated, lbs. per sq. ft. heating surface per hour	5.81	4.93	5.33	4.00
Water actually evaporated—lbs. per hour	44,168	37,475	40,497	25,827
Water actually evaporated, lbs. per sq. ft. heating surface per hour	5.81	4.93	5.33	3.40
Efficiency Results.				
Water evaporated, apparently, per lb. bagasse	2.58	2.27	2.67	2.40
Water evaporated, from and at 212° F. per lb. WET bagasse	2.89	2.50	2.94	2.17
Water evaporated, from and at 212° F. per lb. DRY bagasse	5.40	4.68	5.46	4.20
Thermal efficiency, Prinsen Geerlig's formula	70.6	61.5	72.3	54.6
Thermal efficiency, gross cal. value	62.9	52.2	64.3	—
Temperature of flue gases, °F.	326	560	350	630
Temperature of furnace, °F.	—	—	—	2,178
CO ₂ %	12.5	11.0	12.1	10.3
O ₂ %	—	9.0	7.6	8.2
CO %	—	—	—	—
Excess air %	—	—	—	61.4

Mr. COIGNET: I should like to ask Dr. Hedley whether a combination of crushing and diffusion would not assist in getting a better bagasse for fuel?

Dr. HEDLEY: Mr. Coignet is evidently not aware that in 1926 or 1927 a diffusion process was tried at Tinley Manor which presented so many practical difficulties that it was abandoned.

Mr. WILSON: Was it a single diffusion or combination? Mr. Viger was one of the gentlemen in charge of that.

Mr. VIGER: In 1928 the moisture in the discharged bagasse was so high that after three hours we had to shut down and the bagasse had to be spread to dry before burning.

Mr. WILSON: In 1912 the Reunion Factory carried out some experiments in connection with diffusion but I have no recollection as to the results. Does anyone here remember them?

Mr. CAMDEN SMITH: I recollect them Mr. Chairman, and I know it was not much of a success economically owing to the fact that so much extra fuel had to be bought to keep the furnaces going. It was eventually abandoned. In theory it is quite a feasible proposition, but it was killed economically by the fact that the bagasse was too wet to serve as an efficient fuel.

Mr. HESLOP: This is very satisfactory report and developing on the lines it should and I suppose that after air-heating feed water heating will probably be the next line. A most satisfactory point in the report is the exceedingly low flue gas temperature.

Mr. GRANT: I noticed that the flue gas temperature is very low. I was wondering whether there was a possible combination of Economiser and

Air Pre-heater. I do not know why it is not done, there may be some reason for it.

Mr. WILSON: I understand that at Mount Edgecombe they have Economisers installed. They had some trouble years ago with external corrosion on the tubes due to the temperature on the ingoing feed being too slow, which caused external corrosion. Mr. Camden Smith also had Economisers installed at Sezela.

Mr. GRANT: Is there any reason why there should not be the combination of the two?

Dr. HEDLEY: It all depends on the temperature of the flue gas. If the gas is too near the dew-point an economiser can't be used. Esperanza has got them and Illovo has them and as the flue gas temperatures are sufficiently high both are satisfied.

Mr. MUNRO: A comparatively simple arrangement we use beyond the Air Pre-heater in the flue is about 350 square feet of tubing, copper tubing and steel tubing connected to the Boiler feed tank with a very small Centrifugal pump so that actually there is very little pressure just necessary to overcome the pressure in the tank and we circulate the boiler feed water through these pipes. Due to that we are able to obtain a temperature of 200 degrees F. It is very cheap and very satisfactory, and uses only a 5 horse power motor.

Mr. MURRAY: There is one point I should like to draw attention to. Mr. Sutherland on his return from Australia and Java reported 60-70 per cent. steam per ton of cane. You will notice that in this test we got one ton of steam for a ton of cane.

Mr. WILSON: I cannot ask you to propose a vote of thanks to the Committee because I am a member myself, but I would like you to join me in a hearty vote of thanks to Dr. Hedley for reading the report.