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FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 22 OF 1967.

OPERATION OF A BOILER AT THE WALVIS BAY POWER STATION ON ANTHRACITE-BITUMINOUS COAL MIXTURES

BY:

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1. PURPOSE OF TEST.

At the request of the Anthracite Producers' Association, an officer of the Institute demonstrated the feasibility of firing mixtures of anthracite and bituminous coal at this power station.

In view of the relative costs of coal (R9.12 per ton) and oil (R16 per ton), the economic merits of these two fuels are rather delicately balanced. Since freight charges account for a major portion of the cost of solid fuel, the use of a product of high calorific value is of obvious interest. The use of coal/anthracite mixtures could thus in this case be considered on economic grounds, provided such a fuel could be burnt in the plant.

The brief trial described here indicated that this could be done without trouble.

In this context it may be mentioned that at present, most of the power generated by the Municipality is derived from Diesel engines (total installed capacity approximately 10,000 kW). The present boiler plant consists of four boilers (one of which is on standby duty) of a generating capacity of 20,000 lb. of steam per hour each, but additional boiler plant (90,000 lb/hour capacity) is being installed.

2. DESCRIPTION OF PLANT:

The boiler, made available for test purposes, was according to the following specification:

Manufacturer: ../

Manufacturer: John Thompson
Type: Water Tube Boiler
Steam Pressure: 420 p.s.i.g.
Steam temperature: 770°F
Firing method: Chain Grate Stoker, 16 ft long.
Grate speed 15 to 30 ft/hour.

The unit on which the test was carried out, had been operated for a period of 4,500 hours out of the normal 5,000 hour duty cycle. Consequently, fly ash deposits were present on the water tubes, and the air distribution boxes under the grate were to a large extent filled with cinders. Combustion on the grate consequently was concentrated on the sides and the fuel in the centre portion was not completely burnt when it reached the end of the grate. The efficiency of the boiler was consequently not as good as could be achieved with a clean unit.

3. PREPARATION OF FUEL MIXTURES:

A 1:1 anthracite-coal mixture was prepared by depositing equal increments (of approximately 600 lb) of Douglas coal and Natal Ammonium anthracite into a bunker by means of a front-loader. The mixture was transported from this bunker to the boiler bunker by means of a belt conveyor, having several transfer points. As far as could be judged, a reasonably consistent mixture arrived at the boiler.

A 1:3 anthracite-coal mixture was prepared in a similar manner.

Both fuels were of pea size.

4. OPERATION OF BOILER ON VARIOUS FUELS:

Trial runs were performed on bituminous coal only and with 1:3 and 1:1 anthracite-coal mixtures. Since at peak loads the full generating capacity of the boiler plant is required, experiments had to be conducted with care as loss of ignition in the test boiler would have led to a power cut. No difficulties were experienced however, and the peak load demands could be met with the fuel mixtures.

Operation .../

Operation on mixtures containing anthracite was entirely satisfactory when the grate speed is slightly reduced, the fuel bed thickness increased and the furnace kept at atmospheric pressure.

The draught at the boiler outlet was 0.45 to 0.5 inches water column during the tests.

The CO_2 content and the flue gas temperature were substantially the same in all trials (respectively 10.5% CO_2 and 650°C approximately). It may thus be assumed that the efficiency (at least relative to the fuel actually burnt on the grate) was the same in all cases.

The bituminous coal used in the trials has a calorific value of the order of 13 lb/lb, that of the anthracite is of the order of 14.2 lb/lb. It may thus be expected that the use of a fuel mixture will lead to a slightly reduced fuel consumption.

No accurate heat balance could be drawn up, as the instrumentation available in the boiler house was insufficient for this purpose and it was impossible to carry the necessary equipment in the light charter plane on which part of the flight was made.

The data presented in Table No. 1, however, support the conclusion that a reduction was indeed achieved. Here the relative evaporation E_1 (e.g. pounds of steam generated per pound of fuel fired) are based on the Lea Coal meter readings. Since these instruments are not always very reliable, the evaporation has also been expressed in terms of the product of Grate Speed and Fuel Depth given in figures E_2. These figures indicate the same trend.

5. CONCLUSIONS

From the foregoing it may be concluded that anthracite mixtures, containing up to 50% anthracite can be fired without impairing the ignition characteristics or the steam production and that a reduction in fuel consumption, commensurate with the higher calorific value of the mixture can be attained.

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TABLE NO. 1.

DATA ON FUEL CONSUMPTION.

Fuel		Bituminous Coal			1:3 Anthracite		1:1 Anthracite	
Bed Depth	inches	4½	4⅞	4	4½	4½	5	4½
Grate Speed	ft/hour	20	18.3	20	15	17	15	17
Fuel Consumption	lb/hour	2664		2664	2232	2448	2448	
Steam Production	lb/hour	17,000-18,000	19,500	17,000-18,000	17,000-18,000	20,000	19,000	20,000-20,500
Evaporation E_1	lb/lb	6.5		6.5	7.9	8.2	7.8	
Depth x Speed		90	89	80	67.5	76.5	75	76.5
Evaporation E_2		1940	2190	2190	2600	2610	2540	2650