# Ten Years' Experience Burning Lignite and Discarded Slack Coal

COAL BURNERS: Windbox and pulverized-coal burners of No. 3 boiler are in center background with No. 4 turbine on right. No wall divides boiler and turbine rooms

**Our plant normally burns lignite and subbituminous with high-ash, high-moisture content, but to lick a fuel shortage and high prices we bought a huge culm dump. This coal, with 36.2% ash and 6600 Btu, is pulverized and burned under our boilers**

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▶ TO SUPPLY STEAM AND POWER where they are needed, a plant engineer has to figure out many answers. Here's how we did just that for ten years at the 17,500-kw steam-electric plant of the Granby Consolidated Mining, Smelting & Power Co, Ltd. This plant, which serves the company's copper mine at Copper Mountain and its concentrator at Allenby, is on the Similkameen River near Princeton in southern British Columbia, about 200 miles east of Vancouver.

**Main Equipment.** The three boilers in the plant are:

One 40,000-lb-per-hr chain-grate stoker-fired Stirling boiler.

Two 80,000-lb-per-hr Combustion Engineering boilers, pulverized-coal-fired as follows:

No. 2 by two Raymond impact mills

No. 3 by two Raymond bowl mills.

In the power-generating plant are four steam turbine-generators:

No. 1: 500-kw Allis-Chalmers

No. 2: 2000-kw Fraser-Chalmers

No. 3 and 4: 5000-kw and 10,000-kw Allis-Chalmers.

Steam conditions are 250 psi, superheated to 600 F. All boilers are equipped with forced- and induced-draft fans, and Bailey manually operated combustion control. Feed pumps are turbine-driven 2-stage centrifugals. Three circulating pumps, of 10,000-gpm capacity each, provide cooling water for the condensers, one being enough in winter and two in July and August. One service and two fire pumps supply water to service and fire lines. All pumps are motor driven, installed in a pumphouse near the intake pond on the river bank.

**Local Coal Supply.** When erected in 1937, the plant contained No. 1 and 2 boilers, and No. 1, 2 and 3 turbines. Coal in the area is lignite and subbituminous, of high ash and moisture content and 7300 to 9000 Btu per lb.

Experience with the original two pulverized-coal-fired boilers taught that the coal's high inherent moisture required more drying than the plate-type preheater provided. A tubular primary air heater was subsequently installed in the second pass of No. 2 boiler to supply high-temperature air to its impact mills.

From 1937 to 1940, we purchased some power from the public utility serving the district. In 1940, we expanded the plant by adding No. 3 boiler and No. 4 turbine. This boiler is a Combustion Engineering VU type of 80,000-lb-per-hr steaming capacity, similar to No. 2; the turbine is a 10,000-kw Allis-Chalmers unit.

Experience with the high-moisture lignite dictated a high mill temperature. Therefore, the new boiler was equipped with a tubular heater for primary air in its first pass in addition to the plate preheater at the boiler outlet. Combustion-air temperature is raised to 375 F in the plate preheater, which is adequate for secondary air. Primary air from this source is raised in the tubular heater to 600 F; at this temperature it goes to the pulverizing mills.

Two 4.8-ton-per-hr Raymond bowl mills fire the new boiler. These are larger than bituminous coals require, but poor grindability and high ash and moisture content of local coals dictated ample mill capacity.

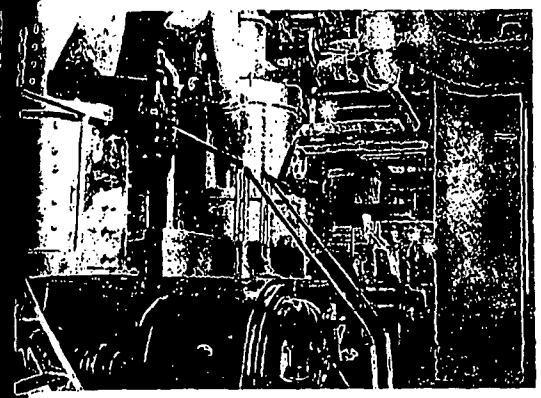
Experience at Granby has proved that subbituminous and lignite coals can be burned successfully in suspension by either the bowl- or impact-mill pulverizer. But ample mill capacity is required along with a primary air heater to supply 600-F air to the mill inlets. In spite of this coal's poor grindability mill wear need not be excessive. Because of high volatiles and low fixed carbon this coal is readily ignited; therefore, it is not necessary to pay too much attention to fineness.

We obtain a somewhat higher efficiency from No. 3 boiler, equipped with bowl mills, than from No. 2, which has impact mills. At first we attributed this difference to the mills, but experience over a number of years leads to the conclusion that for this class of fuel one mill has practically no advantage over the other.

No. 3 boiler, with four burners instead of two, with a better primary air heater, and a variable-speed hydraulic coupling on the induced-draft fan, can be expected to show a slightly higher efficiency than No. 2. If No. 2 had four burners and impact mills of a larger size, we believe the difference in the two boilers' efficiency would be negligible.

Where bituminous coals are burned, fineness remains constant over a longer period in a bowl mill, with one adjustment of the classifiers, than in an impact mill. This is an advantage for the bowl mill, but with high-volatile low-fixed-carbon coals, fineness is not of paramount importance. On the other hand, impact mills have the advantage of simpler construction. Our experience has been that outages for an impact mill are more frequent, but of shorter duration than for a bowl mill.

When burning pulverized coal the operating staff keeps an accurate log of hours' operation and tonnage through the pulverizers. Without such records, repairs could not be scheduled intelligently. We completely overhaul the bowl mills every 10,000 hr of operation or every 22,000 tons of coal, whichever comes sooner. This overhaul includes new liners, bull rings and grinding rolls. The impact mills do not have as definite overhaul periods. The hammers are turned at 1200 to 1500 tons, and renewed at 2300 to 2500 tons. At each hammer renewal, liners are inspected and renewed where necessary.



PULVERIZING MILLS: Coal-pulverizing mills that use 600-F primary air are in basement below burners. Bowl mills in foreground; impact mills in right background

**Coal Handling.** Coal supplied by truck from local mines and by rail from outside is delivered by elevator and screw conveyor to the boiler bunkers. Under normal load conditions from 185 to 200 tons are burned daily. From 15,000 to 20,000 tons are usually stored in the yard adjacent to the plant. This coal is handled by dragline scraper. We have had some trouble with spontaneous combustion in the stockpile. Certain local coals cannot be stored deeper than 6 ft. Others give no trouble when properly spread and compacted by a bulldozer, even when piled to a depth of 15 to 20 ft. When coarse and fines segregate in the stockpile, spontaneous combustion invariably follows.

As originally built the boilers were not equipped with flyash precipitators. We soon found, however, that we had to reduce the flyash nuisance. Space limitations precluded installing standard precipitators ahead of the induced-draft fans, a problem solved by installing water-spray gas scrubbers between fans and stacks. Discharge from the scrubbers is pumped to a series of settling ponds from which nothing but clear water returns to the river. The pulverized-coal-fired boiler furnaces have hopper bottoms, as in cross section, p 78, to take care of the large quantity of ashes, which are removed to a hopper outside the plant from which they are trucked away.

Operating straight condensing with no process-steam requirements, the plant has no serious feedwater problems, raw makeup water being only about 3% of total evaporation. The Hall system of internal treatment is adequate. Boiler water is tested daily for phosphate, alkalinity, sulphite and sulphate. An excess of phosphate is maintained to combat calcium carbonate hardness and to prevent precipitation of sulphates. An excess of sulphite is maintained to scavenge oxygen from the water. Caustic soda controls desired alkalinity. We use dispersive tannin as an embrittlement inhibitor and as a mechanical means of preventing scale. Amount of blowdown is determined by the sulphate reading.

No. 2 and 3 boilers are taken out of service every four months for washing. On the first outage of the year, drum internals are removed to turbine first-pass and roof tubes. On the second outage, waterwall tubes are turbined, and on the third outage, floor tubes. Thus, every tube in contact with radiant heat is turbined once a year. The downcomers in the rear pass are never turbined because washing them at each washout period is sufficient. During each outage the induced-draft fan and other auxiliaries are inspected and repaired.

**Boiler Plant Operation.** The table gives a fair picture of the boiler availability, steam production and tons of coal burned by each boiler during the 10-year period, 1937-46. No. 1 boiler has become a standby since No. 3 was installed. Its long outage in 1943 was due to renewal of the mud drum.

In the boiler plant's operation we have had to iron out the usual bugs. Slagging of the first-pass tubes was one of our most serious difficulties. Some improvement resulted from lowering the first-pass baffle to reduce gas ve-