# STUDY ON THE ENERGY BALANCE OF COAL MILLS FOR ENERGY GROUPS OPERATING WITH INFERIOR COAL

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**ABSTRACT:** The paper presents a case study on the energy balance of coal mills for energy groups operating with inferior coal. It is analyzed the steam boiler energy group of 330 MW lignite-fuelled. Burning lignite takes sprayed form, in burners with slits.

**KEY WORDS**: fake air, grinding fineness, lignite elemental analysis, lower power calorific value.

## 1. INTRODUCTION

The1035 t/h boiler is a tower type boiler with a single way of flue gas, fuelled by lignite powder. The preparation and the combustion of coal dust is carried out with the help of 6 fan mills and hammers with 12 burners with slits. The mills achieve simultaneously grinding and drying of coal with the help of the combustion gases from the fire-core boiler steam. For starting the boiler, fuel oil burners are used, the boiler being designed to operate also in full with fuel oil. The coal mills are located in the corners of the fire-core boiler, the directions of blowing of air-powder mixture of coal being tangential to an imaginary circle with the center axis in the fire-core.

The boilers of 1035 t/h composing the power units of 330 MW from the thermal power plants of Rovinari and Turceni. The coal required for boilers operation (the lignite) comes from surface mines of Oltenia Energy Complex. To Rovinari the coal is brought directly from quarries via conveyor belts. To Turceni, the coal is transported from quarries to the centrals by railway wagons.

From the coal deposits, the coal is transported by conveyor belt to the coal mills. From the coal mills, the coal dust is sent to the burners with slots. These burners reduce the concentration of NOx carried in the flue gas, through the combustion in stage.

In order to make the energy balance, experimental measurements were made at two coal mills DGS-100 from a boiler of 1035 t/h with lignite functioning at Rovinari.

The nominal parameters of the boiler at a load of 330 MW of the turbo-generator are:

- the flow rate of the high-pressure boiler 1035 t / h;
- the flow rate of the medium pressure boiler 974 t / h;
- Nominal live steam pressure 192 bar;
- 540°C nominal live steam temperature;
- water supply nominal pressure 246 bar;
- supply water temperature at the entrance to 260°C saver;
- intermediate pressure superheated steam at 50.1 bar entry;
- Intermediate superheat steam outlet pressure 48.2 bar;
- intermediate superheated steam inlet temperature 348°C;
- Intermediate superheat steam outlet temperature at 540°C;
- maximum allowable working pressure of live steam 211.7 bar;

- maximum allowable working pressure of 64.7 bar intermediate superheated steam.

The coal mill DGS-100 has the following technical characteristics:

- mill type with hammers and fan
- coal flow 97.0 t/h
- grinding fineness R1.000 = 5 %
  R0.090 = 55 %
- coal powder concentration 297 g/m3
- ventilation capacity 44 m3/s
- temperature at the separator 120ºC
- specific energy consumption 14.0 kWh/t
- electric motor power 1400 kW.
- speed 1490 rot/min

The design data regarding the characteristics of lignite basin No.3 are:

- carbon content 21,8-18,4 %
- hydrogen content 2,1 – 1,72 %
- sulfur content of fuel 0,8 - 0,7 %
- oxygen + nitrogen content 10,4 -8,9 %
- Total moisture 40 - 45 %
- ash 24,2 -25,5 %
- lower calorific power 1800-1400 kcal/kg

Figure No. 1 presents a schematic diagram of the preparation and burning plant fora dust coal mill.

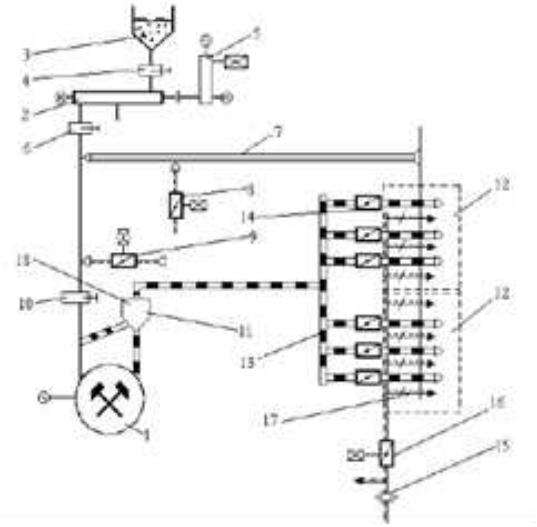

figure 1.

Drying is done using coal flue gas sucked from the core flame. Flue gas sucked from the primary hot air furnace with temperature regulation introduced after the separator, constitutes the coal transport environment. Through primary air channel is mounted a sybarite adjustable manually or automatically operated. In case of exceeding the temperature of 180 ºC after separator and sybarite hot air (primary) is fully open, it is introduced cold atmospheric air using the sybarite operated manually or automatically. After the mill, there is a separator sorting the coal dust. At the exit of the separator, there is a device with which it can be adjust the amount of coal dust. Burning coal dust is made in six coal burners with slots. Each mill feed two burners placed one above the other. The coal dust pipe branches out immediately after separator into six branches.

## 2. EXPERIMENTAL RESULTS

The measurement results for the two experimental coal mills are shown in Table 1.

Table 1

| No | Name | M.U. | Mill 2 | Mill 4 |
|---|---|---|---|---|
| **1** | Coal flow (measured) | t/h | 82,24 | 80,21 |
| **2** | Mill speed | rpm | 480 | 480 |
| **3** | Separator temperature | °C | 182 | 145 |
| **4** | Temperature of the combustion gases at the mill suction grinder | °C | 840 | 856 |
| **5** | No operating hours since the last the current repair of mills | h | 3186 | 2796 |
| **6** | Lower calorific power | kcal/kg | 2079 | 1996 |
| **7** | Total coal moisture | % | 42,3 | 40,6 |
| **8** | Ash content in coal | % | 19,4 | 19,2 |
| **9** | Hardgrove grinding coefficient | - | 32,8 | 32,8 |
| **10** | Power consumption of the mill engine | kW | 790 | 830 |
| **11** | Section coal layer on tape | $m^2$ | 0.416 | 0.409 |
| **12** | The time during which the drive wheel band performs a full rotation | s | 24,2 | 23,8 |
| **13** | The specific weight of coal on the in-feed tape | $kg/m^3$ | 0,852 | 0.851 |
| **14** | Analysis of the combustion gases at the mill suction grinder:<br>- $O_2$<br>- $CO_2$<br>- CO | % | <br>9,2<br>9.6<br>0.191 | <br>9,8<br>9,2<br>0.0984 |
| **15** | Excess of air at the mill suction grinder | - | 1,765 | 2,14 |
| **16** | Analysis of combustion gas at the mill pressure side grinder:<br>- $O_2$<br>- $CO_2$<br>- CO | % | <br>11,8<br>7,9<br>0.373 | <br>13,7<br>6,8<br>0.456 |
| **17** | Excess air at the mill pressure side grinder | - | 2,29 | 2,86 |
| **18** | Infiltrations in the mill and power supply | - | 0,486 | 0.892 |
| **19** | Fineness of grinding:<br>$R_{1.00}$<br>$R_{0.50}$<br>$R_{0.25}$<br>$R_{0.09}$ | % | <br>8,58<br>17,96<br>32,17<br>61,32 | <br>7,38<br>17,24<br>31,12<br>59,43 |
| **20** | Average particle size (grinding curve from Rosin-Rommler-Bennet) | μm | 226 | 214 |
| **21** | Specific energy consumption | kWh/t | 9,82 | 10,26 |
| **22** | Live steam flowrate (monitor) | t/h | 912 | 948 |
| **23** | Flue gas temperature at the end of the fire-core | °C | 862 | 865 |
| **24** | Separator temperature | °C | 186 | 152 |
| **25** | Coal mill flow (thermal control room monitor) | t/h | 84 | 81 |
| **26** | Secondary-air pressure | mbar | 4,8 | 4,2 |
| **27** | Opening air cold | % | 0 | 0 |
| **28** | Primary air opening at the tower | % | 19 | 21 |
| **29** | Mills in operation | - | 5 | 5 |
| **30** | Loading tape feeder | % | 95 | 96 |
| **31** | Charging adapter engine mill | % | 68 | 94 |
| **32** | Mill motor amperage shown in the 6 kV station | A | 86,5 | 88,4 |

## 3. CONCLUSION

To determine the smoothness of grinding dust was taken of coal by evenly spaced slits on the length of the discharge channel of the coal mill. The sampling was made for 4 minutes. Following the analysis of the functioning of the two coal mills results the following conclusions:

Mill no2
-coal flow measured was 88,24 t/h;
-infiltration of air into the mill and the coal feeder of the mill have values up to 0,486;
- regarding the smoothness of grinding: rest on sieve 0.09, with an average value of 59,43%, exceeds the limit imposed of 55% , and the rest on sieve 1 mm, with a value of 8,58%, exceeds the limit imposed of 5%;
- as a result of the increase in running speed of the mill is noticeably improves grinding smoothness;
- in the case the mills have the same speeds, the mill loaded at 80.21 t/h is grinding better than the mill loaded at 82.24th;
- as shown, the specific consumption of electricity worth 9.82 kWh/t, is below the recommended value of 14 kWh/t;

Mill no 4
-coal flow measured was 80,21 t/h;
- infiltration of air into the mill and the coal feeder of the mill have values up to 0,892;
- regarding the smoothness of grinding: rest on sieve 0.09, with an average value of 61,32%, exceeds the limit imposed of 55% , and the rest on sieve 1 mm, with a value of 7,38%, exceeds the limit imposed of 5%;
- as a result of the increase in running speed of the mill is noticeably improves grinding smoothness;
- in the case the mills have the same speeds, the mill loaded at 80.21 t/h is grinding better than the mill loaded at 82.24th;
- as shown, the specific consumption of electricity worth 9.82 kWh/t, is below the recommended value of 14 kWh/t;

In order to achieve optimum operation efficiency of the installation for the preparation and burning of coal dust, it is recommended:
- The avoidance of plant operation at reduced loads;
- Reducing the temperature of the flue gas after the air preheater;
- Reducing the coefficient of excess air;
- Control and maintenance of optimal combustion conditions;
- Eliminate uncontrolled air infiltration;
- Reducing the wear of hammer mills;
-Reduced the wear of the coal mills separators.

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