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# A Method of Primary Air Adjustment under Abnormal Conditions

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**Abstract.** The paper provides a case of primary air velocity adjustment under abnormal conditions. In case primary air leveling cannot be completed under primary air shrinkage cavity failure, the method has achieved the uniformity of temperature field in the furnace to the greatest extent, which greatly relieves coking in the furnace and provides a reference for primary air velocity leveling and operation adjustment of the offset boiler under the condition of air velocity deviation.

**Keywords:** Primary air, heating adjustment, temperature field.

## 1. Introduction

The primary air leveling test is an important test to adjust the primary air velocity by adjusting the shrinkage cavity on the primary air duct at the outlet of the coal mill, so as to ensure the air volume balance of all burners of the boiler. It directly affects the temperature field distribution in the furnace and the safe and economic operation of the boiler. In routine performance test of air boiler, coking is a long-term problem which has plagued the safe and economic operation of the power plant. There are many factors affecting coking, including coal quality, air distribution mode, air velocity deviation, etc. Boiler # 1 of a power plant has a serious coking problem. Through analysis of boiler operating parameters, it is found that the wall temperature of spiral water cooling wall has a large deviation when the boiler is operating at low load, but the wall temperature deviation is not obvious when the boiler is operating at high load. Therefore, while checking the composition and ash melting point of the coal entering the furnace, primary air measurement and leveling test have been conducted on boiler # 1 under hot conditions.

## 2. Equipment Overview

Boiler # 1 of a power plant is variable-pressure direct current boiler with ultra-supercritical parameter manufactured by Babcock & Wilcox Beijing Company Ltd, which is a type-II boiler with single hearth, primary reheat and solid slag discharge structure.

The boiler adopts a medium-velocity mill positive-pressure direct-blow coal pulverizing system with front and rear walls opposed firing, equipped with double-air swirl burner from B&W Company and NOx nozzle (OFA). Each furnace is equipped with 5 MP235B coal mills, which are configured according to the front three and the rear two. Each layer has 6 burners (30 in total) and the front and rear walls each are provided with 12 NOx nozzles (SOFA, 12 more after retrofit of low nitrogen burners). When burning the designed coal, with 4 sets for operation and 1 set for standby, the total output of 4 mills (considering the 5% output reduction factor) shall not be less than 110 % of the coal consumption of the boiler under B-MCR operating conditions. When burning checked coal, 5 mills are run, and the total output of 5 mills (considering the 5% output reduction factor) shall not be less than 100% of the coal consumption of the boiler under B-MCR operating conditions. One coal mill is provided for one layer of burners.

# 3. Test Process and Result

## 3.1 Test Method and Process.

This test is carried out under the normal operation of the boiler to ensure the stability of the coal quantity and air volume of the coal mill being measured. According to the principle of equal ring section, a standard pitot tube is used to measure the dynamic pressure and calculate air velocity in each primary air duct, so as to calculate the primary air velocity deviation of the six air ducts at the outlet of the same mill. Then, adjust the shrinkage cavity of the primary air duct according to the measurement results, and measure again so forth after adjustment, so as to reduce the deviation of air velocity between the primary air ducts at the outlet of the same coal mill within ±5%.

## 3.2 Test Results and Analysis.

The primary air velocity of coal mills A～E has been thermally leveled. The test results are shown in Table 1.

Table 1. Test Result of Primary Air Leveling

| Mill | Pipe Number | Before adjustment | | After adjustment | |
|---|---|---|---|---|---|
| | | Primary air velocity | Deviation | Primary air velocity | Deviation |
| | | m/s | % | m/s | % |
| Mill A | A1 | 24.44 | 0.00 | 25.63 | 0.00 |
| | A2 | 21.12 | -13.70 | 24.40 | -4.80 |
| | A3 | 23.93 | -2.19 | 22.88 | -10.72 |
| | A4 | 26.80 | 9.52 | 29.72 | 15.99 |
| | A5 | 23.91 | -2.26 | 25.16 | -1.83 |
| | A6 | 26.46 | 8.13 | 25.97 | 1.36 |
| Mill B | B1 | 25.49 | -2.50 | 25.89 | -7.01 |
| | B2 | 28.16 | 7.69 | 30.07 | 8.01 |
| | B3 | 25.49 | -2.50 | 27.01 | -3.00 |
| | B4 | 26.00 | -0.57 | 26.82 | -3.69 |
| | B5 | 26.25 | 0.38 | 29.33 | 5.33 |
| | B6 | 25.49 | -2.50 | 27.95 | 0.37 |
| Mill C | C1 | 20.02 | -14.44 | 24.22 | -8.46 |
| | C2 | 28.32 | 21.00 | 26.58 | 0.47 |
| | C3 | 20.35 | -13.03 | 28.12 | 6.30 |
| | C4 | 25.85 | 10.46 | 27.76 | 4.91 |
| | C5 | 20.02 | -14.44 | 29.35 | 10.96 |
| | C6 | 25.85 | 10.46 | 27.04 | 2.22 |
| Mill D | D1 | 18.80 | -22.99 | 18.47 | -26.61 |
| | D2 | 19.15 | -21.58 | 20.07 | -20.27 |
| | D3 | 27.55 | 12.87 | 28.17 | 11.92 |
| | D4 | 27.32 | 11.89 | 27.90 | 10.84 |
| | D5 | 26.83 | 9.91 | 30.13 | 19.71 |
| | D6 | 26.83 | 9.91 | 26.28 | 4.40 |
| Mill E | E1 | 22.88 | -8.75 | 22.27 | -17.85 |
| | E2 | 24.27 | -3.22 | 23.60 | -12.92 |
| | E3 | 26.59 | 6.02 | 28.61 | 5.58 |
| | E4 | 28.26 | 12.68 | 31.64 | 16.76 |
| | E5 | 25.58 | 2.02 | 27.76 | 2.42 |
| | E6 | 22.88 | -8.75 | 28.73 | 6.00 |

The test results show that: mill ABC is basically balanced; mill D is similar to mill E; tubes 1 and 2 are obviously lower and tubes 4 and 5 are higher.

During the adjustment of shrinkage cavity, it is found that it is difficult to adjust the shrinkage cavity and the adjustment range could not meet the requirements of leveling, resulting in less improvement of the deviation of primary air after adjustment. According to the arrangement direction of pulverized coal pipes D and E and the air velocity deviation of each pulverized coal pipe, the air velocity deviation of the two rows of burners is complementary, as shown in Fig. 1. In order to ensure the uniformity of the temperature field in the furnace, it is recommended that the two mills are run at the same time.

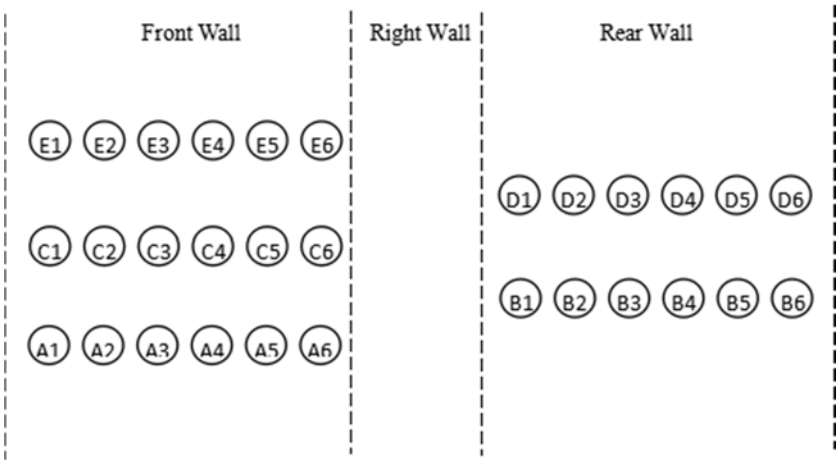


Fig. 1 Burner Arrangement Diagram

## 4. Conclusion

There is a large regular deviation in the pulverized coal tube of the coal mill E. Under the condition that shrinkage cavity cannot be leveled under corrosion, due to the complementary air velocity deviation between burners D and E, it is recommended to stop mill C and allow mills D and E to run at the same time, especially when the 4 mills are required to run at low load, in order to ensure the uniformity of the temperature field in the furnace.

After adopting this suggestion, the temperature deviation of the inner wall of the boiler is obviously reduced when the boiler is running at low load, which shows that the temperature field in the boiler is improved.

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