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EFFECT ANALYZE OF COKE-OVEN WASTE GAS APPLY TO STD-CMC[1]

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Abstract
Introduced the aim of coke-oven waste gas apply to STD-CMC. Analyzed the apply effect of waste gas through oxygen content control, heat energy utilization and dew point regulation.
Key words: Coal moisture control; Coke-oven waste gas; Apply effect.

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1 INTRODUCTION

The coal moisture control(CMC) technology have been applied to Baosteel in Steam Tube Dryer(STD) type. The problems of oxygen content fluctuated acutely and overstep criterion and the high dew point of bag filter fume were found in trial operation period. It's harmful to the stable operation of bag filter and have safety risk to equipments.

2 THE AIM OF INDRAUGHT COKE-OVEN WASTE GAS

The coke-oven waste gas was been used to cope with problems above. It's able to control the oxygen content of dryer system depend on low oxygen content characteristic of waste gas in one hand, and reduce the steam consume by waste heat utilization of waste gas in another hand. At the same time, the inlet waste gas diluted the water vapour, the water ratio of vapor gas would be decrease, the freezing point of vapor would be declined too. The coke-oven waste gas components analysed in Table 1.

Table 1. Component of coke-oven waste gas

N_2（%）	CO_2（%）	O_2（%）	H_2O（%）	CO（PPM）	NO_X（PPM）	NO（PPM）	t（°C）
70.5	22.1	4.1	～3.3	223.6	255.4	197.7	～220

3 APPLY EFFECT OF COKE-OVEN WASTE GAS

3.1 Oxygen Content Control of Dryer System

The gas of dryer system was mainly make up of vapor and air, the oxygen content was influenced by air flow rate which is used for transport vapor and the leaked-in air. The oxygen content of dryer discharge gate in trial operation period was showed in Figure 1.

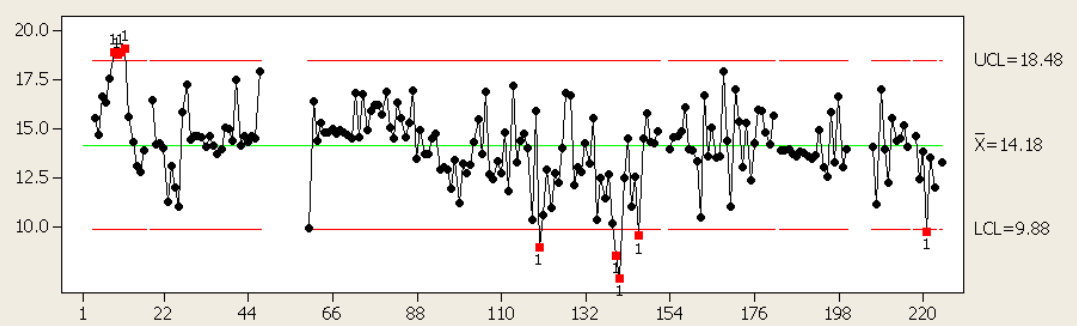

Figure 1. Distribution of oxygen content for dryer system in trial operation phases.

We can saw that, the average level was 14.18%, the three sigma upper limit was 18.48%,the three sigma lower limit was 9.88%. When oxygen content overstep 13.5% control criterion, the nitrogen gas will be inject automatically, and when oxygen content overstep 15%, the nitrogen gas will be inject more rapidly for decrease the oxygen content. The 14.18% average level was gone beyond

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13.5% control criterion, the oxygen content overstep 15% has been appeared contingently, and the frequently nitrogen gas injecting was harmful for the stable operation of CMC system.
After coke-oven waste gas leaded into dryer and replaced the air, the oxygen content of dryer discharge gate display in Figure 2, the operation parameter was show in Table 2.

Table 2. Operation parameters of CMC system

parameter / stage	Processing rate（t/h）	moisture （%）	after dry （%）	transport gas blowing rate （m3/h）	O2 (%)	total system blowing rate (m3/h)
trial operation	330	9.8	6.8	5,000	14.18	27,000
indraught waste gas	330	9.8	6.8	12,000	10.83	34,000

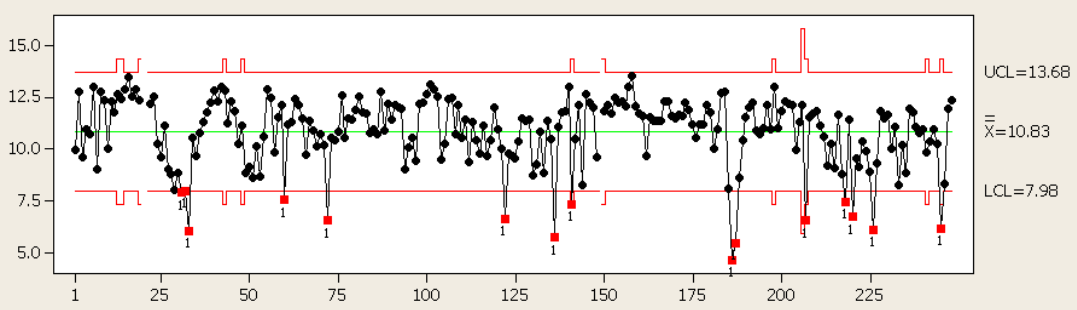

Figure 2. Distribution of oxygen content for drier system after use waste gas.

It's showed that the average level of oxygen content was 10.83% ,it's coincide to the 13.5% control criterion, and reduced 3.35% opposite to 14.18% of trial operation stage. The three sigma upper limit was 13.68%,the three sigma lower limit was 7.98%. The fluctuation region of oxygen content reduced remarkably, the situation of oxygen content overstep 15% and frequently nitrogen gas injecting disappear, the CMC system degree of safety increased prominently, the dryer system operation stably.

3.2 Waste Heat Utilization of Coke-Oven Waste Gas

The heat of CMC system was mainly used for coal moisture vaporize, coal heating up and water vapor heating up. The inspiratory waste gas was able to accelerate the water vapor's flow and the waste heat was mainly used for the water vapor's heating up. The parameters of CMC system was showed in Table 3: the first row was the practical parameters and the second to fourth rows were the variable parameters by theoretical calculation,the blowing rate of waste gas was restrict by 71,000 m3/h which the maximal blowing capacity of equipment.

ISSN 2176-3135

Table 3. Variable operation parameters of CMC system

items	Processing rate (t/h)	moisture (%)	after dry (%)	waste gas blowing rate (m^3/h)	waste gas temperature (°C)	system flow rate (m^3/h)	steam consume (t/h)	heat energy supply by waste gas (%)
practical	330	9.8	6.8	12,000	120	34200	18.1	1.83
variable1	330	9.8	6.8	24,000	140	46300	17.4	5.39
variable2	330	9.8	6.8	36,000	170	58500	16.2	12
variable3	330	9.8	6.8	48,000	205	70700	14.3	22.08

We can found that the heat energy supply by waste gas was only 1.83% which the dryer system needed, the waste heat utilization effect of coke-oven waste gas was not notable.

This phenomenon was result by the long distance between coke-oven chimney and dryer,and the small blowing rate of waste gas. If we increas the blowing rate of waste gas as table3 showed in row 2 to row 4, the waste gas temperature would increased form 120°C to 205°C when waste gas flow rate increased form 12,000 m3/h to 48,000 m3/h, and the heat energy supply by waste gas would achieve to 22.08%, the energy saving effect would be very remarkable.

3.3 Dew Point Regulate of Bag Filter Fume

When processing rate, coal moistrue and coal moistrue after dry keep constant, the water vapour quantity would be constant too. The blowing rate of inspiratory waste gas would influence the dew point by influence the vapor pressure. The dew point of bag filter fume was important for CMC system's stable operation, the relation between waste gas flow rate and dew point of bag filter fume was showed in Table 4.

Table 4. Relation between waste gas flow rate and bag filter fume

waste gas flow rate (m3/h)	5,000（air）	12,000	24,000	36,000	48,000
system flow rate (m3/h)	27,000	34,200	46,300	58,500	70,700
dew point（°C）	89.5	82.5	75.8	71.2	67.5

It's showed that when waste gas didn't indraft the transport gas was air, the flow rate of air was limited by oxygen content, the dew point was up to 89.5°C when system flow rate was 27,000 m3/h. Considering stable operation of bag filter the practical operation temperature should be higher 10°C to 15°C than dew point of fume, it's means that the appropriate opeation temperature should be 100°C to 105°C. The actual opeation temperature was 95°C, lower than the appropriate temperature, which would result in dew,dust deposite and oxygenation burning.

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After coke-oven waste gas been used, the flow rate of waste gas no longer limited by oxygen content.The dew point was 82.5°C when waste gas flow rate was12000 m3/h, the actual opeation temperature was 95°C which in the best operation temperature range, the bag filter work normally. If increaseing the waste gas flow rate sequentially up to maximal blowing capability 70,700 m3/h, the dew point of bag filter fume would decline to 67.5°C, the temperature of fume at bag filter entrance would be inceas at the same time which influenced by waste heat of waste gas. The actual fume temperature would overstep the dew point a lot, the temperature of bag filter entrance could regulate simultaneously.

4 CONCLUSION

The practical production approved that:

- First, the oxygen content declined form 14.18% to 10.83% after coke-oven waste gas been used, achieved the 13.5% control criterion,the fluctuation range decreased and the degree of safty of drying system improved remarkably.
- Second, the coke-oven waste gas only supplied 1.83% heat energy that the drying process needed with current operation parameters. Actually, the waste gas was able to supply 22.08% heat energy which been needed by regulate operation parameters and the effect of saving energy would be more prominent.
- Third, the dew point of bag filter fume declined form 89.5˚C to 82.5˚C after coke-oven waste gas been used, the bag filter work work normally.

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