ME800 MV Drives Steel Industry Solutions

Abstract:

Mainly introduces the transformation example for Tangshan, Hebei province Qian 'an Xinda iron & steel Co. LTD. Through the technical analysis and test verification of the transformation, it is shown that the energy saving effect is obvious after using the MV frequency drives system, and the operating condition of the equipment is also greatly improved.

During the process of smelting, hot molten iron and the air produce a great deal of flue gas. The smoke will pollute the environment, and it will cause harm to the workers on site. In order to reduce pollution and improve the working environment, it is necessary to add dust removal fan to the smelting furnaces.

1. Dust removal fan process

In the process of smelting in a steel plant, each smelting cycle can be divided into different time periods, in different time periods; the work of the dust removal fan will also be different. We use Hebei Tangshan Qian an Xinda iron & steel Co.LTD as example.

The converter primary dust removal system has two sets of dust removal fans, one of which is used as standby;

The secondary dust removal system has a dust removal fan.

<u>The converter blowing process is as follows:</u>

A to B is the time for adding iron and scrap, about 2 minutes;

B to C is the fan speed time, about 30 seconds, adjustable;

C to D is oxygen blowing time, about 15 minutes;

D point fan starts to decelerate, about 30 seconds, adjustable;

D to E is the sampling time for temperature measurement in the furnace, about

2 minutes;

E to F is tapping times, about 2 minutes;

F to G is slag splashing time, about 3 minutes;

The entire blowing process cycle is about 25 minutes, of which the high-speed time (C to D) is 15 minutes.

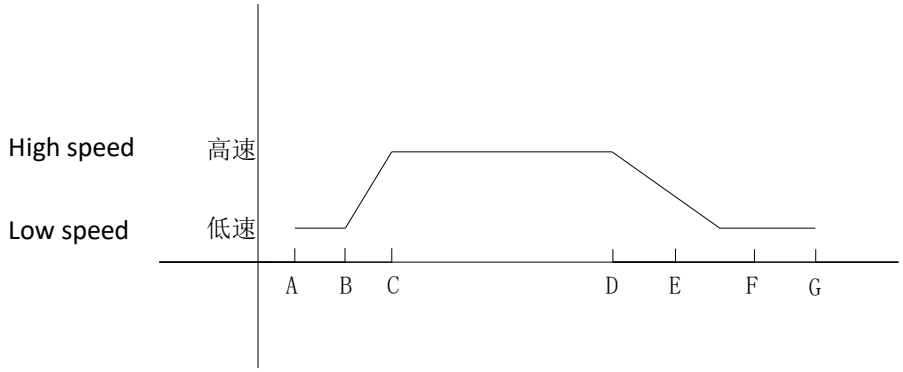

Figure 1 Blowing process cycle

There are high requirements for dust removal during the oxygen blowing process, and the dust removal fan is required to run at high speed. However, in the process of adding iron and scrap steel, temperature measurement and sampling in the furnace, tapping, and slag splashing, the requirements for dust removal are lower, low speed is enough. According to the actual measurement, the rise and deceleration time of the dust removal fan can be combined with the calculation of the low speed operation time, which has less influence on the result.

2. Transformation solution

2.1 System parameters

Motor model	YKK500－2	Rated voltage	10KV
Ranted current	51．9A	Rated power	800KW
Rated power factor	0．87	Rated speed	2985rpm

Actual working current	30～32A	Actual power factor	0．82
Manufacturer	Jiangsu Xianda explosion-proof motor co. LTD		

Table 1 parameters of the primary dust removal fan nameplate

Motor model	YKK500－6	Rated voltage	10KV
Ranted current	45．2A	Rated power	630KW
Rated power factor	0．856	Rated speed	994rpm
Actual working current	40～45A	Actual power factor	0．83

Table 2 parameters of the secondary dust removal fan nameplate

Besides:

Annual running hours of primary dust removal fan: 7500h;

Annual running hours of secondary dust removal fan: 5000h;

Electricity price: 0.5 yuan / kWh

Before the transformation, the dust removal system mainly used a hydraulic coupler to adjust the operation speed of the dust removal fan. There were disadvantages such as poor control accuracy, narrow speed adjustment range, low efficiency, and large loss.

2.2 Speed control requirements

This project adopts two sets of medium-voltage frequency drives equipment produced by Shanghai STEP Electric Co., Ltd., ME800-0800-T10-PA for primary dust removal fan and ME800-0630-T10-PA for the secondary dust removal fan.

The dust removal fan has two main working states. Correspondingly, the drives presets two speed points. Speed point 1 corresponds to the high speed operation status of the dust removal fan, and speed point 2 corresponds to the low speed operation status of the dust removal fan. After field measurement, for the first dust removal fan: when the input frequency is 40Hz, the dust removal fan can be guaranteed to run at a high speed; when the input frequency is 25Hz, the dust

removal fan can be kept at a low speed. For the secondary dust removal fan: when the input frequency is 45Hz, the dust removal fan can be guaranteed to run at a high speed; when the input frequency is 25Hz, the dust removal fan can be guaranteed to run at a low speed. In each blowing process cycle, the proportion of dust removal fan working at high speed is: 15/25 = 60%; the proportion of dust removal fan working at low speed is: 1-60% = 40%. At the same time, due to the different roles of the primary fan and the secondary fan, their actual operating conditions also differ. The details are as follows:

Speed point	Fan model	Fan operating state	Corresponding frequency	Proportion
1	Primary fan	High speed	40Hz	60%
2	Primary fan	Low speed	25Hz	40%
1	Secondary fan	High speed	45Hz	60%
2	Secondary fan	Low speed	25Hz	40%

Table 3 operating state diagram of the dust fan

At the same time, the drives also provides excellent HMI.

The staff can modify relevant parameters through the HMI according to the field conditions, and adjust the running state of the dust removal fan in time to ensure the dust removal effect.

2.3 System configuration and site photos

According to the site working conditions and motor technical parameters, our company is equipped with two ME800 series medium -voltage drivess on the site after field inspection, the models are: ME800-0800-T10-PA * 1, ME800-0630-T10-PA * 1 and equipped with an automatic bypass system to ensure the safety and continuity of production.

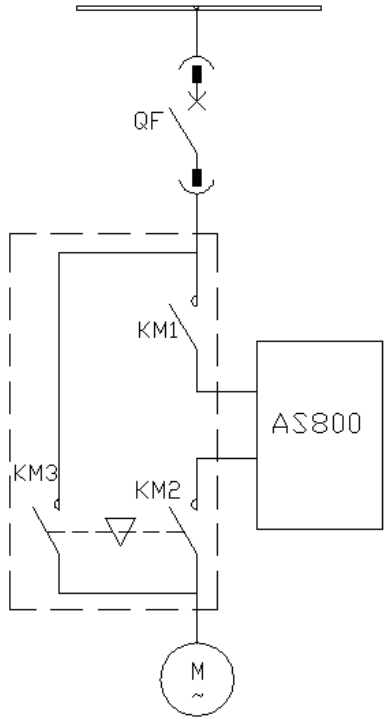

FIG. 2 Automatic bypass cabinet

The automatic bypass system is mainly composed of three vacuum contactors: KM1, KM2, and KM3. KM2 and KM3 have a mechanical interlock function and cannot be closed at the same time to protect the drives.

- In the frequency conversion state: KM1 and KM2 are closed, KM3 is open, and the load runs in the frequency conversion state;
- In the power frequency state: KM1 is disconnected from KM2, KM3 is closed, and it runs in the load power frequency state.

FIG. 3 photos of the scene

FIG. 4 photo of field equipment

3. Energy-saving effect

3．1 Power consumption of dust removal fan before transformation

According to the operation parameters in table 1 ~ 4, it can be obtained：

（1）The annual power consumption of the first dust removal fan

$$W_{前1}=1.732\times U\times I\times\cos\varphi\times H$$
$$=1.732\times10KV\times32A\times0.82\times7500h$$
$$=455\times7500KWh$$
$$=3412500KWh$$

（2）The annual power consumption of the secondary dust removal fan

$$W_{前2}=1.732\times U\times I\times\cos\varphi\times H$$
$$=1.732\times10KV\times43A\times0.83\times5000h$$
$$=618\times5000$$
$$=3090000KWh$$

3．2 Power consumption of dust removal fan after transformation

After transformation, the power consumption calculation is performed according to the engineering experience formula.

(1) Annual power consumption of the first dust removal fan

When the dust removal fan runs at a frequency of 40Hz, the speed is 2450rpm.

$$W_{11}=P_{10}\times(N_2/N_1)\times60\%\times7500$$
$$=455\times(2450/2985)\times60\%\times7500$$
$$=374\times60\%\times7500$$
$$=1680528KWh$$
$$W_{12}=P_{e1}\times(25/50)^3\times40\%\times7500$$
$$=800\times(25/50)^3\times40\%\times7500$$
$$=100\times40\%\times7500$$
$$=300000KWh$$
$$W_{后1}=W_{11}+W_{12}=1980528KWh$$

The efficiency of the drives is $\eta=0.96$

$$W_{后1}'=W_{后1}/\eta=2063050KWh$$

(2) Annual power consumption of the secondary dust removal fan

According to on-site calculations, when the dust removal fan runs at a frequency of 45Hz, the speed is 900rpm.

$$W_{21}=P_{02}\times(900/995)\times60\%\times5000$$
$$=618\times(900/995)\times60\%\times5000$$
$$=559\times60\%\times5000$$
$$=1677000KWh$$
$$W_{22}=P_{02}\times(25/50)^3\times40\%\times5000$$
$$=630\times(25/50)^3\times40\%\times5000$$
$$=157500KWh$$
$$W_{后2}=W_{21}+W_{22}=1834500KWh$$

The efficiency of the drives is $\eta=0.96$

$$W_{后2}' = W_{后2} / \eta = 1910938KWh$$

3．3 Energy-saving effect

Energy saving of the primary dust removal fan:

$$\Delta W_1 = W_{前1} - W_{后1} = 3412500 - 2063050 = 1346450KWh$$

$$F_1 = \Delta W_1 \times 0.5 \approx 67万元 \text{ (95,000USD)}$$

Energy saving of the secondary dust removal fan：

$$\Delta W_2 = W_{前2} - W_{后2}' = 1179062KWh$$

$$F_2 = \Delta W_2 \times 0.5 \approx 59万元 \text{ (84,000USD)}$$

The above calculations are based on the situation that the primary dust removal fan runs 24 hours a day and the secondary dust removal fan runs 16 hours a day. The energy-saving is about 179,000 USD/year.

3．4 On-site energy saving operation data

STEP performed a comparative test on the power consumption of the motor under the power frequency condition and the frequency conversion condition. The details are as follows:

Medium-voltage drives model	ME800-0800-T10-PA		ME800-0630-T10-PA	
Load type	First dust removal fan		Secondary dust removal fan	
Motor power	800KW		630KW	
Running condition	In power frequency state	In frequency conversion state	In power frequency state	In frequency conversion state
Starting time	2011/4/20 12：15	2011/4/21 10：27	2011/4/24 12：15	2011/4/23 10：27
Meter reading	1431.3	1418.1	473.1	454.8
Finish time	2011/4/20 18：15	2011/4/21 16：27	2011/4/24 18：15	2011/4/23 16：27
Meter reading	1432.2	1418.8	475	456.1
Total power consumption	0.9×4000＝3600	0.7×4000＝2800	1.9×2000＝3800	1.3×2000＝2600

（KWh）				
Average power consumption (per hour)	3600/6＝600	2800/6＝437	3800/6＝634	2600/6＝434
Energy saving per hour （KWh）	600－437＝163		634－434＝200	
Power saving rate	163/600＝27.2％		200/634＝31.5％	

The electricity price is calculated at 0.5 yuan / KWh, and the annual electricity savings are:

(1) Electricity saving of the first dust removal fan: 163 × 7500 × 0.5 = 61.125 million yuan(86,692 USD)

(2) Electricity saving of the secondary dust removal fan: 200 × 5000 × 0.5 = 50 million yuan(70,913 USD)

Total: The annual electricity saving is 111,125 million yuan(157,605 USD).