Successful Application of Longking BF-ESP Technology in Brazil GA Steel Plant

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Abstract: The successful application of Longking BF model Electrostatic Precipitator (hereafter referred to as "BF-ESP") technology in Brazil GA Steel Plant fully illuminates the possibility of lower emission in metallurgy industry and structural security of enduring the working condition of high negative pressure at sinter main ESP. It is a successful application example of strategic cooperation between Longking and Chinese famous metallurgy design institute. This paper mainly dissertates the technical characteristics and technical guarantee measures of BF-ESP applied.

Keywords: Brazil GA, BF-ESP, technical characteristic, guarantee measures

1 INTRODUCTION

Our company won the contract of all the mechanic bodies, electric and pneumatic conveying equipments for three sets of ESP in the bit for 198 m^2 sinter plant project of Brazil GA with contractor of ChangSha metallurgy design institute in Sep, 2005. It makes the record of exporting whole set of sinter system (including pneumatic conveying equipment) among national environmental companies and it's the first time for LongKing to export metallurgy project to Latin America.

The main ESP, Discharge End & product EP, proportioning EP for 198 m^2 sinter plant project of Brazil GA had been placed in service together with the trial run of sinter system on 10:30 am,Oct.14, 2007.

The project-management department of Brazil GA and sinter factory summarize every performance of the project after strictly checked (120 h continuous check monitor one time per hour) on Apr.10, 2008. They all agreed that the project was totally qualified of all indicators and some had exceeded the target greatly. For example, the actual environment protection target is 30mg/Nm^3 ,which is less than original demand of 50 mg/Nm^3. Brazil customer awarded to Chinese contractor the check-and-accept certificate while completing the project. It indicates the successful application of Longking ESP project for 198 m^2 sinter plant project of Brazil GA.

2 PROJECT CHARACTERISTICS

The project has two notable characteristics:

(1) Performing lower emission strictly: The emission target is less than 50 mg/Nm^3 for all sets and this kind of low emission target is rarely required in Chinese steel factories.

(2) Competent for high negative pressure condition: The main ESP should endure a maximum of –22000 Pa so the intensity of structure is highly demanded. The result would be really serious if a structural security accident occurs.

Longking applied technical guarantee measures according to the characteristics to ensure a smooth performance. More details are as follows.

3 TECHNICAL CHARACTERISTICS AND GUARANTEE MEASURES

Fig. 1 shows gas cleaning system for sinter machine. The gas out of sinter machine mainly contains dust and sulfur dioxide.

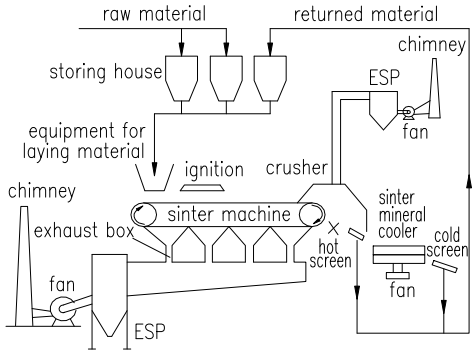

Fig. 1 Gas cleaning system of sinter machine

Sinter project of Brazil GA is equipped with three sets of ESP. One is used to dedust gas from main ESP (main ESP dust collecting for short); One is used to dedust gas from Discharge End, single roll crusher, hot screen, blending of cooling equipment, discharging site and product ESP process (Discharge End & Product EP dust collecting for short); Another is used to dedust gas from pollution original place including material depositary, material process, transportation, return mineral and blending system except main ESP and Discharge End & Product EP (proportion dust collecting for short).

3.1 Gas Characteristics Of Sinter Machine

Gas characteristics of sinter machine related to components of material and production process. The dust concentration, dust diameter and dust resistivity change greatly with conditions.

Dust concentration

Dust concentration depends on factors as follows:

The dust from sintering will be less and less as the increasing volume of the materials' granularity. The granularity will be smaller if materials are selected by magnetic method and the dust from sintering will be more. The granularity will be the smallest if materials are selected by floatation and the dust will be the most.

The dust brought from smashing, separation and transfer will be less if sinter materials are fully burned in sintering machine and are burned to blocks. Contrarily, there would be more dust. The faster the wind speed at exsuction cross-section is, the more dust will be brought out and the higher the dust concentration is. The dust concentration is higher if original wind is weaker. The dust concentration of diluted gas is lower if original wind at dust collecting site is stronger.

The sinter dust concentration fluctuates heavily due to factors above and they must be considered in ESP's model-selection.

Dust diameter

The average dust diameter differs little. It is 15□20 μm at main ESP and 13□35 μm at Discharge End.

Dust specific resistivity

Dust specific resistivity at main ESP and Discharge End relates to sinter materials, alkalinity (CaO/SiO_2□ and working temperature. The resistivity is usually below 1010 Ω·cm at normal temperature and it can reach 1011Ω·cm -1012 Ω·cm at 100 □-150 □.

Fig. 2 shows the change of dust resistivity at main ESP and Discharge End with temperature.

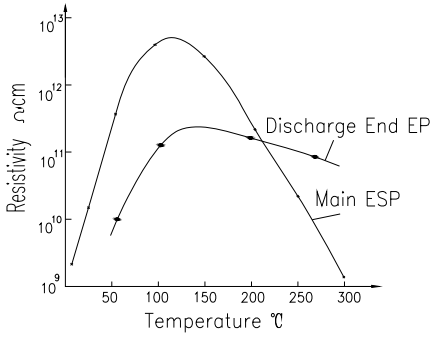

Fig. 2 Dust resistivity of sinter machine

Dust density

The real density of sinter dust is 3.8 g/cm^3-4.5 g/cm^3 and the accumulation density is 1 g/cm^3-1.5 g/cm^3. The density distribution of dust accumulating at each field differs greatly and it decreases from the first field to the third in turn.

Dust component

Dust component refers to the table below:

component	Content (%)	component	Content (%)
General, Fe	35-56	General, S	0.2-4
SiO_2	0.6-8	Pb	0.04-10
CaO	1.2-14	Zn	0.05-0.4
MgO	0.1-11	General, C	1.5-10

3.2 Technical Characteristic

According to the dust characteristic of sinter machine, process characteristic and the low emission demand, with 30-year experiences of producing ESP, collecting, analyzing and comparing process parameters and working performance of over ten sinter projects such as Baosteel company, Chengde steel company and Lianyuan steel company and comparing the characteristics of ESP technical of BE, BEL, BS, BF owned by our company synthetically, we finally select BF-ESP of LK company to bit the project. This technology has several notable points as follows:

- Both CE and DE use side-rapping model to guarantee enough rapping force and this is suitable for sinter condition with high stickiness dust especially. From ESP working status of many big national sinter factories, the working voltage is usually low and the current even approaches zero. The key point is that the rapping system can't clean the dust stratification on plates and electrodes effectively ,which is especially important to guarantee the target of low emission.
- Advanced plate-wire type: Use 480C rigid plate as collecting plate and "BS" prickly spike as discharge wire.480C plate's surface has many grooves which can make it easy to collect and clean dust. The hems at both sides raise the rigidity of plate and prevent re-entrainment as wind-proof channels. It is made of high quality material and has many characteristics such as good transferring for rapping acceleration, clean dust conveniently and strong capability against distortion under high temperature and rapping etc.
- The body of BS spike is punching formed by high quality light cold rolling plate and the dental sclerite are made of stainless steel. It has many characteristics such as high intensity of discharge, low onset voltage, good rigidity, hardly influencing plate-plate spacing, hardly dropping dental sclerite, enduring weariness, resisting corrosion, convenient to clean dust and no disconnection through working.
- The structure is safe and reliable. Main ESP for sinter machines in China were distorted or destructed at times in recent years. Besides neglecting high negative pressure of gas in main ESP and design deficiency of structural intensity, the resonable structural system of ESP is also a factor. Longking BF-ESP uses building-block-style combination structure with a reasonable load and an exact force transfer. It is applied to scores of sinter factories in China without any security accident which proves the structure is safe and reliable. This is an important reason to select Longking BF-ESP technology for the project.
- Locating frames of CE plate and DE wire should be assembled in workshop to ensure installation quality of plate-plate spacing and wire-plate spacing.

To avoid the errors, locating frames of collecting plate and discharge wire of Longking BF-ESP are assembled in workshop. We only fix the locating frames to the casing and connect the plates and wires on site. Then plate-plate spacing

and wire-plate spacing can be guaranteed without adjusting on site. The installation quality and schedule can be enhanced greatly.

Table 1 shows the technical performance parameters of three sets of ESP for the project:

Table 1 **T**he technical performance parameters of three sets of ESP for the project

Project	Units	Main ESP dust collecting	Discharge End & product EP dust collecting	Proportioning EP dust collecting
Inlet mass flow (working condition)	m^3/h	1260000	528600	168000
Inlet dust concentration	g/Nm^3	≤2.5	≤20	≤10
Outlet dust concentration	mg/Nm^3	≤50	50	50
Inlet gas Temperature	□	80-200（normal 150）	≤150	Normal temperature
Inlet gas negative pressure	Pa	17000（Max 22000）	4000	4000
ESP model	m^2	312 m^2 two chambers three fields	185 m^2 one chamber three fields	60 m^2 one chamber three fields
De-dusting efficiency	%	≥98.0	≥99.75	≥99.5
Effective total collecting area	m^2	21060	11100	3150
Plate-plate spacing	mm	400	400	400
Gas flow velocity	m/s	1.122	0.794	0.778
Driving velocity	cm/s	6.5	7.93	7.85
SCA	$m^2/m^3/s$	60.17	75.6	67.5
Casing design pressure	Pa	-22000	-6000	-6000

3.3 Technical Guarantee Measures

According to this project, our company makes corresponding technical guarantee measures to guarantee the target of low emission, enduring high negative pressure and more steady operation. The measures, besides the technical characteristics referred above, play a crucial part to achieve a successful application. Specified as follows:

Selecting model with reasonable lectotype is a precondition to guarantee the collection efficiency

From "Deutsch" formula for ESP efficiency, we know that effective collecting area is a precondition to guarantee effective operation of ESP. So collecting area should be put as much as possible with the limited field scope stated in bit book. The model selection should satisfy the operation under the worst working condition especially for Discharge End & Product EP model, which is affected by changeable working condition and fluctuates heavily with inlet gas flow and density.

Sinter factory usually enhances sinter alkalinity (CaO/SiO_2) in order to upgrade the quality of sinter mineral , with dust resistivity about 10^{11} Ω·cm-10^{12} Ω·cm, low dust concentration at inlet and a part of smaller size dust. According to these characteristics of sinter gas, choosing reasonable electrode spacing and plate-wire type is also important.

This project adopts 480 C type collecting plate of 400mm plate-plate spacing with BS spike at one to three fields. 400mm plate-plate spacing is suitable for collecting dust of resistivity about 10^{11} Ω·cm-10^{12} Ω·cm, from the using experiences of ESP for sinter factory in recent years. Selecting 500 mm-600 mm plate-plate spacing not only decreases total collecting area but usually weaken the fields' electric performance evidently and the field match may not be the best without a high resistivity (about 10^{13} Ω·cm). 480 C-type collecting plate has uniform current density distribution on its face and it's very suitable for collecting smaller dust. BS spikes used in 1 to 3 fields are certainly to achieve the emission target of less than 50 mg/Nm^3 with high discharging intensity and low onset voltage.

Calculate scientifically to ensure structural security

Pressure endurance design of Discharge End & Product EP and Proportioning EP are considered as –6000 Pa. Pressure endurance of main ESP is designed as –24000 Pa for its heavy pressure at working. ANSYS, a finite element analysis software, is used to analyze the maximum loading for the main parts to guarantee a safe and reliable structure. By building whole models of nozzle and casing and analyzing actual loading situation of thin plate shell structure of ESP, we design a reasonable structure according to the result and design criterions of steel structure to guarantee both security and economy.

Simulate gas flow in the fields to guarantee the uniformity.

The collection efficiency will drop if the effect of collection efficiency at places with high wind speed can't counteract it at places with low wind speed, because gas speed is not uniform and re-entrainment is very serious at places where wind speed is high. By simulating experiments in factory, our company has designed the best combined distribution screen model for guiding and anti-leakage to guarantee a uniform gas distribution with $\sigma<0.20$, ensuring the

collection efficiency by uniform gas distribution with high equality.

Add groovy channel plates at the end of the fields to upgrade collection efficiency

Add groovy channel plates at the end of the fields to catch the last dust that could escape. After large numbers of experiments and actual operation on site, it proves that adding groovy anti-leakage at outlet of the field has two functions. One is that it can fill the fields with airflow and reduce the loss of collecting area. The other is to collect electric slender ash so as to upgrade collection efficiency. The device is suitable for situation of slender ash or low emission (less than 50 mg/Nm^3) and contributes to upgrading the whole collection efficiency.

Reduce air leakage rate of ESP

Open as few holes as possible on ESP to reduce air leakage site and meanwhile apply double-layer structure to all doors and holes. The sealing material adopts well flexibly silicone fiberglas rubber seal which has great airproof capability and won't be aging or distorted under high temperature for long time. The measures above are used to guarantee air leakage rate to be less than 2.5%. Reducing air leakage onsite as much as possible is more important if main ESP works under high negative pressure long time.

Ensure the heating and thermal insulation for hopper

To make sure the dust in hoppers at a flowing state, the lower side of hopper is designed as double-layer structure which is heated at the middle by electric. It is evenly heated all around and the temperature is controlled by temperature control device. Lay thermal insulation of 100mm thick outside the hoppers and add to hoppers with ash holes, rapping anvils and emergency ash-discharging device which can be opened when it is necessary to clear accumulated dust at the outlet in time.

Take full advantage of the electromechanical predominance of our company and adopt corresponding technical guarantee measures to the electrical equipments

Meet the demand of rapping clearance with power-down or power-off controlling technology.

a) Power-down rapping is rapping in lower voltage or different control mode.

b) Power-off rapping is rapping in a state that the export voltage is shut down.

Adjust every field's rapping frequency according to actual working condition and increase floors of discharge frame so as to increase the electrode's rigidity and upgrade collection efficiency. Additionally, linkage-control is used on discharge and collecting rapping to reduce re-entrainment as much as possible.

Respond the change of dynamic resistance rapidly and increase breakdown voltage of the field.

Field's breakdown voltage may be lower because of ESP's changeable working conditions and high resistivity, which is prone to leading to frequent sparking, so as to affect collection efficiency. According to such conditions, together with many years' experiences of producing ESP power supply, fast-sensitive function of 16bit MVC-196 has been developed by our company to control spark and get reasonable resistance, low breakdown voltage which affects collection efficiency can be well solved and also make the ESP work effectively under any condition.

Company's latest technology is applied to high voltage control equipment to guarantee a good operation.

a) The latest anti-corona technique is applied to high voltage control equipment to restrain the corona caused by high resistivity dust and then upgrade collection efficiency.

b) High voltage control equipment has self-adaptable function and can automatically calculate the best duty cycle ratio of intermittent power-supply according to working condition so as to save energy and upgrade collection efficiency at a large amount. Adopt intermittent pulse power-supply to fully charge the dust to upgrade efficiency and save energy.

c) Linkage of HV control equipment and LV rapping equipment can realize power-down rapping or power-off rapping, which can advance the effect of rapping and dust clearing remarkably.

d) Well select and match high voltage power supply to get a better electric equipment operation and upgrade collection efficiency.

The successful application of Longking BF-ESP technology in Brazil GA Steel Plant fully illuminates the possibility of lower emission in metallurgy industry and structural security of enduring the working condition of high negative pressure at main ESP of sinter The overseas project shows the power of our company as a top enterprise in national environment protection industry. The application has a signified meaning. It will establish a firm foundation for Longking's dedusting technology applied in metallurgy industry as well as exploring the international market and exerting a positive effect that spread Longking's products to whole world.

The ESP project for Brazil GA Steel Plant is a successful application example of strategic cooperation between LongKing and Chinese famous metallurgy design institute. The win-win cooperation mode will be a good example for Longking product to open the world market. In a word, serving with the best technology and product for the world's environment protection is our struggling and ceaseless aim.

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