Development and Application Features of High Power High Frequency Power Supply for ESP

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Abstract: This article briefly introduce the current development progress status of high power high frequency power supply for esp of fujian longking, illustrating comparatively its application characteristics and putting emphasis upon discussing its application features in former electric fields with specific cases. Furthermore, it makes a study of the application of high frequency power supply in large-scale coal burnt unit and makes an outlook of the application heading in other fields.

Keywords: High frequency power supply, High power, Coal-burnt Unit, ESP, Energy -saving

1 INTRODUCTION

With the state's new emission standards promulgated, and the mandatory implementation of the national environmental policy, atmospheric dust pollution control industry appears new features. Simply said: "No smoking is the most important", governance "smoke" and reduce energy consumption become the new demand for users. The successful development of high frequency power supply opens a new path for them.

Longking is in a leadership position in the exploiture of high frequency power supply in China, following the identification of 0.4 A high frequency power supply, we successfully developed 0.6 A, 0.8A products in 2006, 1.0 A products in 2007, and have a number of successful application of the project one after the other. Developing 1.6 A product in the coming two years will be our new goal.

Compared with the commercial frequency power supply, the high frequency power supply has obvious advantages. In addition to the superior technology and performance of equipment, it can also gain good energy-saving feature in the application, and has a significantly improving factor to the specific collection area. The overall energy saving advantages is apparent.

2 APPLICATION OF HIGH FREQUENCY POWER SUPPLY

Technical indicators and application performance compareson between High frequency power supply and commercial frequency power supply

Technical indicator comparison between High frequency power and commercial frequency power supply, refer to Table 1.

Application performance comparison between high frequency power supply and commercial frequency power supply, refer to Table 2.

Table 1 Technical comparison between High freq. power supply and com. freq. power supply

Specifications	Frequency	Power	Power Factor	Efficiency	DC voltage fluctuation	Intermittent pulse width	Sparks out of time
High freq. power supply	40 kHz	Three phase	0.9	0.9	3%	0.7 ms	30 μs
Com.freq. power supply	50 Hz	Single phase	0.8	0.8	30%	10 ms	10 ms

Table 2 Application performance comparison (Take the basis on the commercial frequency)

Application performance	Output voltage	Output current	Emission concentration	Equipment loss	Equipment weight	Control room area	Energy consumption	Cable usage
High freq. power supply	130%	200%	50%-70%	30%	35%	0	50%	50%
Com. freq. power supply	100%	100%	100%	100%	100%	100%	100%	100%

3 IMPROVING FACTOR OF HIGH FREQUENCY POWER SUPPLY

"Golden combination" mode integrated dual zone ESP technology and high frequency technology, the improving factor to the specific collection area is 10%-15%, basically coincide with the actual observation. As to the old ESP reform for improving efficiency, a power plant in Fujian Longyan whose #1 furnace adopted the high frequency power supply for comparison tests, showed that the improving factor of high frequency power to the specific collection area of entire precipitator is 6.7%, and reduced dust emissions by 32.6%; High frequency power supply comparison test of a power plant of #2 furnace in Henan Province was completed by Henan Power Research Institute, with its testing result showed as: declining the dust emissions by 36.7% and with 13.6% improvement factor of high frequency power supply to the entire ESP. Therefore, using high frequency power supply in the former electric field, it's reliable to take the improving factor of five percent of the entire ESP. Therefore, the mechanical body optimal design often adopts 5% improving coefficient in practice.

4 HIGH FREQUENCY POWER SUPPLY ENERGY-SAVING EFFECT

4.1 Give an example of 300MW unit with four sets of 0.8 A power supplies

In the 300 MW unit reform, often used four 0.8 A/80 kV high frequency power supplies to take place of four 0.8 A/80 kV commercial frequency power supplies, their parameters shown as Table 3, Table 4 below:

Table 3 Parameters comparison of rated capacity

Contrast parameters	Power factor	Efficiency	Output power	Input power	Set	Total input power	Total output power
High freq. 0.8 A/80 kV	0.9	0.9	64 kW	75.6 kVA	4	302.4 kVA	256 kW
Com. freq. 0.8 A/80 kV	0.8	0.8	64 kW	100 kVA	4	400 kVA	256 kW

Table 4 Parameters contrast in the same power output circumstances (70 per cent of the rated freq.)

Contrast parameters	Power factor	Efficiency	Output power	Input power	Set	Total input power	Total output power
High freq. 0.8 A/80 kV	0.9	0.9	44.8 kW	52.9 kVA	4	211.6 kVA	179.2 kW
Com. freq. 0.8 A/80 kV	about0.6	about0.7	44.8 kW	106.7 kVA	4	426.8 kVA	179.2 kW

4.2 Combinatorial optimizing energization mode for achieving energy-saving

The experiments show that when high frequency power supplies energized in pure DC mode, even run with 70 % of the rated output power, equipment power factor and efficiency still hold the line. But the power factor and efficiency of commercial frequency power supply drop significantly with the decline of output power. Under normal circumstances, ESP power supplies without full-load power output, therefore the high frequency power supply has significant energy-saving effect. IPC smart control system can realize automatically energizing combination while ensure the collection efficiency, and promote the power system realizes energy conservation about 50 percent or even higher, which has substantial saving energy.

5 APPLICATION APPROACH OF HIGH FREQUENCY POWER SUPPLY APPLIED IN THE FORMER ELECTRIC FIELD

Working principle of high frequency power supply applied in the former electric field

The theory and practice of ESP prove that the drift velocity of ESP is directly proportional to the square of electric field strength, which is equal to the square of working voltage. High frequency power supply for the former electric field, before the charged dust particles reaching saturation, it can improve the collection efficiency of the former electric field by the following two ways: One is to enhance the attaching charged capacity of dust particles and the other is to increase the working voltage of the former electric field.

The peak voltage of the commercial frequency power supply trigger parks in electric field of ESP, significantly limit the average voltage on the electrode. High frequency power supply operating frequency is 30 kHz-40 kHz, ripple coefficient is less than 5%, and its second voltage wave is

almost a straight line in the pure DC energization mode, which makes ESP able to operate with spark critical voltage. High frequency power supply applied in the former electric field can improve the supply voltage of the former electric field, strengthen the charged current, improve the collection efficiency of the former electric field and reduce the burden of subsequence field, so that the dust emission concentration of the whole ESP has a significant reduction and the overall collection efficiency can be improved much. Theoretically, if the operating voltage of the former electric field increases 20 percent, the drift velocity of the charged particles in the electric field can be enhanced by 44 percent, which is equivalent to increase the specific collection area of ESP by 44 percent. At one time, the attachment charge capacity of dust particles can be increased by using high frequency power supply in the former electric field, although the collection efficiency factor due to the increased charge capacity can't be calculated quantificationally, but it's unassailable that using the high frequency power supply in the former electric field can improve the collection efficiency.

6 ILLUMINATE HIGH FREQUENCY POWER SUPPLY REFORM SITUATION

6.1The V-I curve after reforming

1 furnace (135 MW) ESP of Kengkou power plant in Fujian Longyan has been reformed, whose mechanical body adopted BEL mode ESP of Longking company, the homopolar space of the first and the second electric field is 410 mm, the original power supplies are K mode 0.8 A/66 kV equipment, the homopolar space of the third, the fourth and the fifths electric field is 450 mm, the original power supplies of the three electric field are K mode 0.8 A/72 kV equipment, the emitting wires are bared wires. On March 2007, we substituted 0.8 A/80kV high frequency power supply for the original power supply of Longking. Kengkou power plant 1 #, 2 # furnace are the same furnace, under the conditions such as: same load boiler, the same burning coal, basic equal coal volume, the same boiler flue gas temperature etc, we draw the two groups of load V-I characteristic curve, showed as Fig. 1, we find that: 1 # former electric field using high frequency power supply had a higher running voltage, with the running current about 800mA and without electric field flashover, which is conducive to the charged particles in the former electric field. The running current of the 2 # furnace which adopted commercial frequency power supply was about 200 mA, with a frequent electric flashover in the electric field and it is harmful for charging the dust particles; 1 # furnace onset voltage is low when using high frequency power supply, and is propitious to improve the running current; the running current of 1 # furnace former electric field is significantly larger than 2 # ,which can be considered that the collection efficiency increased may be greatly due to the largely improvement of the attaching charged capacity of dust particles.

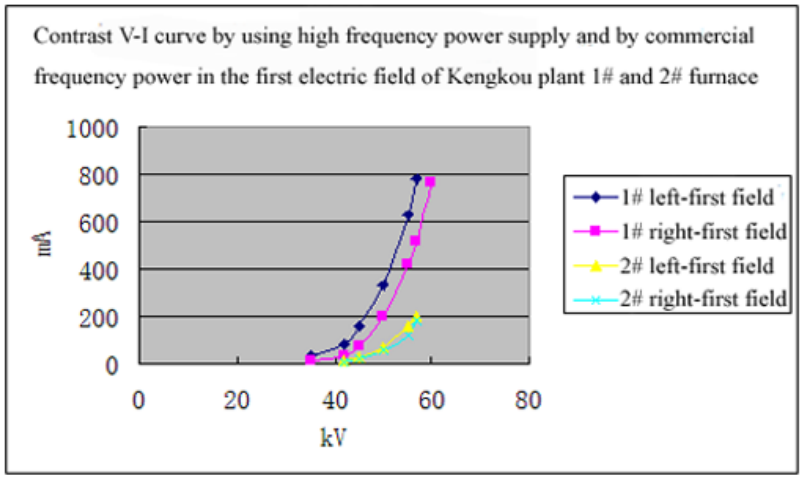

Fig. 1 Contrast V-I curve of the first electric field

6.2 Operation comparison

Compared with 1 # and 2 # furnace ESP electric operation data and the electric input power shown as table 6, it can be seen that: The input power of subsequence field increased after using high frequency power supply. From the data of the field operation, we found that it not only substantially increased the input power in the former electric field of 1 # furnace ESP after using high frequency power supply, but also increased the input power of subsequence fields on a certain degrees. And the flashover sparks rate of 1#furnace is low, the operating parameters is stable; Input power of 2 # furnace are lower than 1#, also it flashover frequently and with a higher sparks rate and instable operating parameters.

Table 6 Operation data and input power comparison of 1# and 2# furnace ESP

Electric field	1# furnace（using high freq. power supply in the first field）			2# furnace（using com. freq. power supply in the first field）			Input power of 1# furnace electric field P_{21}	Input power of 2# furnace electric field P_{21}	P_{21}/P_{22}
	U_2（kV）	I_2（mA）	SP time/s	U_2（kV）	I_2（mA）	SP time/s			
Left-1	58.3	782	17	54.2	231	81	45.59 kW	12.52 kW	3.64
Left-2	46.5	640	0	47.4	321	29	29.76 kW	15.22 kW	1.96
Left-3	43.6	638	0	48.9	347	11	27.82 kW	16.97 kW	1.64
Left-4	42.8	639	0	48.5	115	48	27.35 kW	5.58 kW	4.90
Left-5	46.6	640	0	45.1	146	55	29.82 kW	6.58 kW	4.53
Right-1	58.9	782	0	58.2	294	80	46.06 kW	17.11 kW	2.69
Right-2	46.6	640	0	48.2	271	10	29.82 kW	13.06 kW	2.28
Right-3	47.4	639	0	50.7	371	1	30.29 kW	18.81 kW	1.61
Right-4	49.0	639	0	40.3	212	31	31.31 kW	8.54 kW	3.67
Right-5	47.1	639	0	48.5	401	34	30.10 kW	19.45 kW	1.55

6.3 Effect Comparison

From the dust collection effect observed in practical, 1# furnace ESP after using high frequency power supplies has a markedly improvement of the dust collection efficiency, which can also be reflected concretely in the following two circumstances: 1 # furnace ESP opacity meter displayed that, the opacity value has dropped from the original 26%to17%, and the decline of opacity value is obvious. Ash conveying capacity of the # 1 furnace was significantly increased after reform, the frequency of the feed-in times increased significantly after reform, the feeding-in capacity after reform is 1.25 to 1.33 times that before reform, the dust collection effect improved significantly and reduced the burden of the subsequent field greatly, and thus improved the collection efficiency of the entire 1# furnace ESP.

7 APPLICATION EXPANSION OF HIGH FREQUENCY POWER SUPPLY

7.1 Application of high frequency power supply in smoke control, prolongation reform market approach

In most cases, application of high frequency power supply in the first electric field effect remarkably. In addition to high resistivity (such as Zhungeer coal, Huaibei Coal, the Zhengzhou region coal, Xuanwei coal) circumstances, the first electric field show low voltage and high current situation, the current of the electric field in most coal-fired boiler ESP is small. Application of high frequency power supply, the current can be increased more than double, while the second electric field current can also be increased.

As the early high frequency power supply capacity is small and plate current density selected residual is greater, it cannot help but adopting small bus section power supply, which requires a large number of high frequency power supplies, and it's difficult to layout. With the appearance of 1.0 A high frequency power supply, the scope of application expands a lot. It can be applied to a single field or a larger bus section of single electric field. If the current density of board selects much smaller, the application scope will be greater, the number of high frequency power supply will reduce, and easily layout.

7.2 High frequency power supply in electrostatic bag ESP

High frequency power supply is taken as a rich-power supply while to be used in the electrostatic bag precipitator. The application of critical flashover-DC energization can improve corona power of the first electric field, improving the collecting efficiency, reducing the dust capacity enters the bag field by half, declining the dust load of bag field and cutting down the pressure losses on the equipment. Moreover, the high frequency power supply strengthen the dust charge effect, which makes the surface dust of the filter bag attached loosely and orderly , get a high-rate aperture, easily clean, and also further reduce the equipment running resistance.

0.8 A high frequency power supply played as the rich power has been used for electrostatic bag precipitator in a Nanjing power plant. The entire resistance of precipitator has been reduced at about 100 Pascal while running, decreased the energy consumption, and has achieved the desired results. 1.0A high frequency power supply has been applied in electrostatic bag precipitator in a power plant in Huainan, with a stable and reliable running.

7.3 Wilde applications in industries and entirely applied in electric field of ESP

High frequency power supply of Longking has been

most applied in the power industry. Due to the state's policy of "encourage large and restrict small", the power capacity of the new ESP unit always choose relatively larger, so the application of high frequency power supply mainly focus on the 300 MW unit and reform projects. The next step development is mainly on the small and medium-sized ESP of metallurgical, petrochemical, cement, light industry and other industries. The others ESP are relatively small, which is less constrained by their capacities.

At present, more than 100 sets high frequency power supply won outstanding applications in the industry and has accumulated valuable experience, which significantly showed the advantages of high frequency power supply. The larger capacity of the subsequence electric field always requires a large-capacity power supply; the high frequency power may be used for the entire channels or even the entire ESP by adopting the waveform line or ZT24 plate equipped with V0 lines, which can decline the running current by15 to 20 percent. It should also accelerate the improvement of the high frequency pulse intermittent energization control strategy study and related tests, and implement the combination of high frequency pure DC energization and intermittent pulse energization, while the former field adopts pure DC power energization and the subsequence field adopts intermittent pulse energization, then achieves high efficiency and energy-saving, and strive to apply the high frequency power supply in the whole channels.

7.4 Application in large unit and cost-effective

Promoting to apply the high frequency power supply in large units which is more than 300 MW, including the trial of 600 MW units. After releasing 1.0 A high frequency power supply, there is no problem in applications of 300 MW, of which the five percent improving coefficient can reduce consumption capacity considerably.

The quantities of the high frequency power supply must be increased multiply when applied in the former electric field of 600 MW units ESP because of the capacity constraint. Assume that specific collection area reduces by 5 percent when adopt the high frequency power supply, on the condition that the collection efficiency unchanged, then the entire ESP will save cost about 50,000 RMB to 110,000 RMB. The cost-effective is better than the commercial frequency power supply.

8 CONCLUSIONS

Sum up the above, Longking high frequency power supplies have been applied on-site for more than two years, in which it's highly efficient and reliable performance has been verified. The energy saving indicator is marked, with a higher cost-effective, which conforms to the state energy-saving and emission-reducing demands. All these achievements have attracted the attention of industry both domestic and foreign. Longking high frequency power supply in the country has formed a special leading pattern, which has a broad expansion space, need vigorously promote and widely apply, and can finally turns the technology advantages into economic benefits.

REFERENCES

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