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THE RESEARCH & DEVELOPMENT AND APPLICATION OF MINIMAL-OIL IGNITING PULVERIZED-COAL BURNERS

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ABSTRACT

It is very important for China to reduce the consumption of petroleum under the pressure of hers fundamental realities of lean-oil--rich-coal and the consistently increasing price of international crude oil. For this reason, we developed series of minimal-oil igniting burners applied on the boilers in power stations to reduce the oil consumption for ignition. The most significant characteristic of the burners is the average igniting-oil reduction by over 95%. This superior performance can be assured by some built-in igniting oil guns and by some novel designs for the minimal-oil burners. Up to now, the technology has achieved remarkable success on over 30 power units in China.

INTRODUCTION

China is lack of crude oil and rich in coal. with the consistently increasing price of international crude oil, it is very important for China to reduce the consumption of petroleum. The minimal oil igniting technology applied on units in power plants was developed under this circumstance by Zhejiang Electric Power Test & Research Institute. Minimal amount of fuel oil（20～60kg/h）was injected into burn room for fuel oil by oil gun and then burn to high temperature flame. The high temperature flame first ignited a small part of pulverized coal in burn room for coal specialized design to produce heat which then ignited more pulverized coal. That is, it adopted the principle of power magnification to realize the purpose of igniting a large amount of pulverized coal（2～10t/h）with minimal amount of fuel oil. The technology can greatly reduce the fuel oil used for igniting and starting in power plants. Minimal oil technology reduces the cost of power plant and gains social and economic benefits.

THE PRINCIPLE AND EFFECT OF THE MINIMAL－OIL GUN

The specialized design of the oil gun and oil burn room assured the instant atomization of the fuel oil when it was injected from the oil gun into the oil burn room. The oxygen was supplemented by high speed injection of compressed air to support the early burning of the oil gas. In this case, the burning efficiency and flame temperature were greatly increased. The flame produced by oil gas was rigid and diffused rapidly. The center temperature of the flame can be over 1600℃. The flame looked like apparent as represented in Figure 1 whose root was blue but the middle and tail were apparently white.

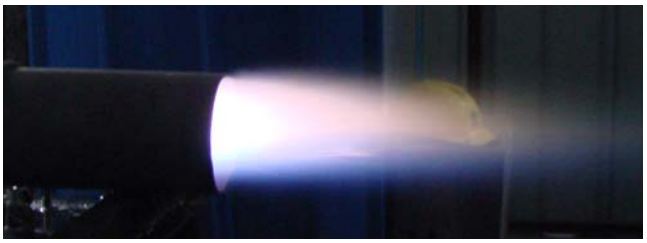

Figure 1 Burning Condition of Minimal- oil Gun on Laboratory Bench

THE PRINCIPLE OF THE MINIMAL-OIL BURNER

The minimal-oil burner adopted series novel designs to achieve the concentration of the pulverized coal and the grading input of primary air. During the start-up of the units in power plants, the high temperature flame described above first ignited a small part of the pulverized coal in the first stage burning room to produce heat, and then the produced heat ignited more pulverized coal in the second stage burning stage room. Like this, energy was enlarged step by step so that the boiler in power plant can be cold started with consuming minimal

amount of fuel oil finally. This technology can save fuel oil vastly. Figure 2 illustrated the structure of a minimal-oil burner.

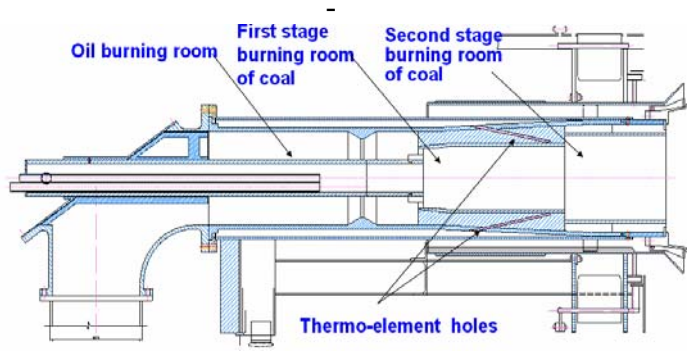

Figure 2 Structure of a Swirl Minimal Oil Burner

AN APPLICATION EXAMPLE

The minimal oil technology has been successfully applied on many power units in China. The following one is representative.

The 2# boiler in Honghai Bay, a power plant in Guangdong province in China, is a super-critical –pressure boiler whose type is DG1900/25.4－Ⅱ2. The characteristics of the boiler are described as follows: a middle reheater, opposite firing boiler, single furnace, balanced ventilation, solid deslagging, and the maximum continuous rating(MCR) is 1950 t/h, cold primary air fan with positive-pressure direct feed coal pulverizing system. Table 1 lists the main parameters of the boiler.

Table1 main parameters of the 2# boiler

Item	B-MCR condition	B-ECR condition
MCR (t/h)	1950	1715
Superheater outlet steam pressure(MPa)	25.41	25.41
Superheater outlet steam temperature(℃)	571	571
Reheating steam flow(t/h)	1590	1410
Reheater inlet/outlet steam pressure(MPa)	4.85/4.66	4.30/4.11
Reheater inlet/outlet steam temp.(℃)	328.5/569	316.6/569
Feedwater temperature(℃)	287.7	282.9
Economizer inlet pressure(MPa)	28.87	27.88
Feedwater temperature(℃)	287.7	282.9
Economizer inlet pressure(MPa)	28.87	27.88
Hot primary air temperature(℃)	324	317
Hot secondary air tem.(℃)	336	327
excess air ratio	1.14	1.14
Flue gas tem.（revised）(℃)	129	124
Unburned carbon loss (%)	0.70	0.70
Boiler guaranteed efficiency (%)		93.55

The designed fuel is Shenfu Dongsheng bituminous coal which has large quantity of volatile, large quantity of heat and is apt to slagging. Revised fuel is Jinbei bituminous coal. The oil used for igniting and for start is ＃0 light diesel. Table 2 lists analyzed data of the two types of coal.

Table 2 analyzed data of the two types of coal

Item	Designed fuel	Revised fuel
Mar	12.70	9.61
Mad	7.80	2.85
Aar	12.54	19.87
Vdaf	27.33	32.31
Car	60.51	58.56
Har	3.62	3.36
Oar	9.50	7.20
Nar	0.70	0.79
St，ar	0.43	0.61
Qnet，ar	22.80	22.41
HGI	54	57.64

Firing equipments were arranged on front and rear wall in the furnace, and opposite firing, swirl burners were adopted. Independent flame was produced in the furnace by every burner when the mixture of air and pulverized coal was injected into furnace from burners. 3 layers HT－NR3 burners were built in on front and rear wall respectively, and 6 burners in every layer. Simultaneously, 2 side overfire air (SAP) inlets and 6 overfire air inlets (AAP) were arranged on front and rear wall respectively. A small mechanical atomization oil gun (250kg/h) was equipped on every burner to start a big oil gun (2200kg/h), ignite and maintain the stability of flame. Total 18 oil guns (steam atomization) were arranged in the center of burners on front and rear wall, and every oil gun is 2200kg/h. When minimal oil technology was adopted, 6 bottom burners on rear wall were changed into minimal-oil burners, and accordingly, oil guns with 2200kg/h single were changed into minimal oil guns with 50 kg/h single. The arrangement of the minimal-oil burners was illustrated in Figure 3. Table 3 lists main burner parameters after adopting minimal oil technology.

Table 3 main burner parameters after adopting minimal oil technology

NO.	Item	data	remark
1	Primary air velocity(m/s)	18～30	
2	Primary air tem.(℃)	60～77	
3	Primary air flow(t/h)	72～90	Up to boiler load
4	Pulverized coal flow by single mill(t/h)	16～48	Up to boiler load
5	Pulverized coal concentration(Kg/kg)	0.2～0.6	Up to boiler load

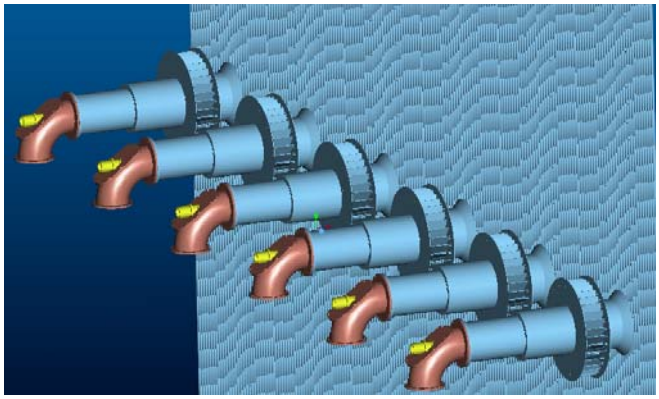

Figure 3 The arrangement of the minimal-oil burners

The 2# unit in Honghai Bay power plant was started on 28th March 2007 adopting the minimal oil technology. At the very start, 6 minimal-oil oil guns were run to igniting pulverized coal successfully. The burning condition showed well as in Figure 4 which is the factual firing photograph. The burn-out ratio of pulverized coal is over 94%.

Figure 4 Minimal oil igniting condition

The effects of minimal oil technology on 2# unit can be included as follows: the consumption of fuel oil is 280t during the start of the unit, and that of fuel coal is1835t. Fuel oil consumption by minimal oil system is only 20t. Contrasting with this, the 1# unit in this power plant which does not adopt the minimal oil technology consumed 1500t fuel oil under the same condition. As a result, the effect of saving fuel oil by adopting the technology of minimal oil is prominent shown In Figure 5.

In addition, adopting the minimal oil technology to start the unit can help pulverized coal burnt entirely as possible during the initial stage. Thus, the common phenomenon of black soot in the case of cold igniting can be well controlled. At the same time, electrostatic precipitator can be run at the initial start stage due to the minimal oil consumption and complete combustion, which efficiently solves the problem of pollutant emission during the start stage of unit. This also verified the technology's performance of protecting environment.

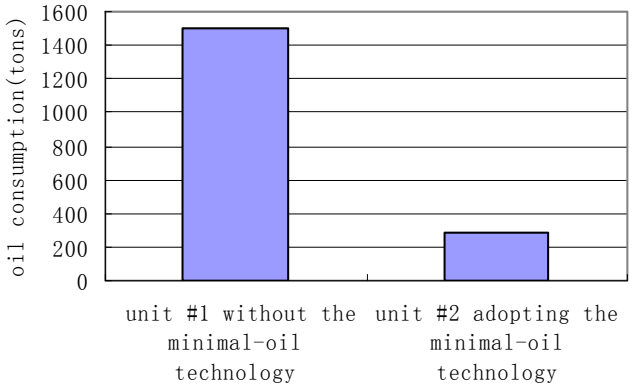

Figure 5 the comparison of oil consumption with and without the technology

CONCLUSION AND PROSPECTION

The advantages of the minimal-oil technology can be concluded as follows:

the minimal oil system is simple and no maintenance is needed;

the notable performance of saving fuel oil;

the notable performance of protecting environment;

the economized investment;

the safety and reliability;

Up to now, the minimal oil technology has been applied on over 30 units whose capacities vary from 125MW to 660MW in power plants. From the performance and effect point of view, minimal oil technology will be extensively adopted in the near future.

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