

Prospect of Waste Heat Utilization in Cement Plant

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Abstract: The prospect of waste heat utilization in cement plant is very broad. In this paper, it is briefly summarized, and then the production system and equipment selection of waste heat power plant and the technical implementation analysis are discussed. It is hoped that this paper can have certain reference value for specific projects of the same type of waste heat utilization.

Keywords: Cement plant; Waste heat; Prospect

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1. Introduction

Cement in construction belongs to a very main material, China's construction industry in a rapid development, the market for the quality and quantity of cement requirements become very high. In order to further meet this requirement, many cement plants have been expanded. According to the specific characteristics of cement production process, cement kiln will emit high temperature and medium temperature flue gas in production. This part of the smoke carries a certain amount of heat (called waste heat); If this part of waste heat is fully utilized, it can increase the effective use of energy, reduce energy consumption and production costs, and further improve the environmental quality.

2. Summary

Waste heat emitted by cement plants mainly includes: waste heat of high-temperature flue gas (temperature greater than 650°C) and waste heat of medium-temperature flue gas (temperature between 200-650°C). The use method mainly includes: direct use and indirect use. The direct utilization of flue gas waste heat of cement kiln mainly includes the following aspects: (1) after the heat exchanger completes the recovery of flue gas waste heat, the furnace fuel is saved by heating the air. (2) The exhaust gas is recirculated back to the furnace to save fuel in the furnace. The indirect utilization scheme mainly

includes: (1) the flue gas is discharged into the waste heat boiler to generate steam. The heat energy of steam can be directly used to meet the needs of industrial and civil heating, and steam can also be used to drive a steam turbine to output electric energy or mechanical energy to the outside world; (2) The flue gas discharged from the furnace can be directly sent to the gas turbine to convert waste heat into electric energy or mechanical energy. It can be found that waste heat utilization in cement plants has many choices. The solution to be adopted should be determined after comprehensive technical and economic comparison and analysis according to the actual situation of each plant. But generally speaking, the waste heat of high temperature and medium temperature flue gas should be converted into mechanical energy or integrated electric energy first, rather than directly used as heat energy, mainly because power recovery and heat utilization are more reasonable.

It is very easy to use waste heat of high temperature flue gas of cement plant to generate electricity. Waste heat power generation device can use either gas turbine generator set or waste heat boiler - steam turbine generator set. The waste heat of medium temperature flue gas is not suitable for gas turbine because of the low flue gas temperature. Generating set, the mode of waste heat power generation efficiency is low, the general use of waste heat boiler - turbine generator, the mode of waste heat power generation, if you use the waste heat boiler, so its power and only part of the production of electricity, the power

consumption is mainly need to supplement the power by the power grid, if the temperature of flue gas waste heat power generation provides all the production of electricity, Then we must make use of auxiliary combustion waste heat boiler, but this will make the oil consumption in the production process increase. It can be found that in order to effectively and economically use the waste heat of warm flue gas in cement plant to generate electricity, it is necessary to comprehensively evaluate the different schemes, so as to ensure the rationality of the technical scheme. China's coal reserves are very rich, but the geographical distribution is not very reasonable. In many provinces, the reserves of high-quality coal are relatively small, but the reserves of low-quality coal are relatively large. In some areas, the expansion and construction of many cement plants, if the fuel (usually at a low price) can be used as supplementary heat boiler fuel, then all the electricity needs can be met, which can be used in cement production, which can bring very good social and economic benefits ^[1].

3. Production System and Equipment Selection for Waste Heat Power Plant

3.1 Coal Treatment System

Waste heat power stations use coal crushers, coal yards, coal storage and transport belts of cement fuel production lines. A horizontal conveyor belt can be added below the coal conveyor belt, so that the coal can be transported to the north side of the main plant, and then use the inclined conveyor belt to lift it to the required specific height, and then use a short horizontal conveyor belt to fall into the coal hopper. The coal that falls out of the scuttle, which has an effective capacity of about 170 cubic meters, is fed into the furnace using three spiral coal feeders in front of the furnace.

3.2 Ash Removal System

Ash removal system is mainly used for ash and slag separation, all used in cement production line. The hot slag discharged from the boiler falls into the slag cooler for cooling by the slag discharge pipe, and then enters the slag crusher for crushing, and is transported to the cement production line for use by the tank car. The dust discharged from the dust collector will enter the ash tank and be sent to the cement raw material homogenization warehouse for use.

3.3 Chemical Water Treatment System

The water source used in this project belongs to

groundwater. According to the specific characteristics of suspended solids in groundwater, coagulation filtration method is used for pretreatment, one-stage multi-bed desalting method is used for post-treatment, and positive double-layer ion exchanger is used for H ion exchange. Boiler water needs to be calibrated and treated with phosphate during treatment. The water is taken from groundwater and recycled after the cooling tower cools. A water stabilizer must be added to prevent scaling on the walls of the system.

3.4 Thermal System and Thermal Equipment

3.4.1 Auxiliary Combustion Boiler

At present, there is no specific product of waste heat assisted combustion boiler in China, so it is necessary to choose from the existing boiler products. Because the project uses medium temperature waste heat to heat the boiler water supply, it has been in a saturated state, so the specific exchange of coal economizer and water wall must be considered in the process of boiler design. In this way, the hot surface can be reduced and the specific heat exchange area of the superheater can be kept basically unchanged. After the above adjustment is implemented on the heating surface, the exhaust gas temperature and flue gas temperature at the furnace outlet are increased. In order to ensure the specific efficiency of the boiler, the temperature of the feed water must be appropriately reduced ^[2].

3.4.2 Thermal system

The heating system is connected by a unit system of one furnace and one machine. The water supply system is connected by two full-capacity feed pumps, one for operation and one for backup. The outlet of the feed water pump mainly consists of three ways, respectively into the economizer and two waste heat heaters. The high pressure heater needs to be replaced by waste heat exchanger at the end of kiln. The saturated steam-water mixture generated by the waste heater at the end of the kiln will be directly introduced into the steam drum, where the steam and steam generated by the boiler water wall will be merged again into the boiler superheater, and the superheated steam will be introduced into the steam, and then into the wait turbine.

4. Technical and Economic Analysis

4.1 Energy Saving Characteristics of Self-owned Power Plants

(1) fully use the waste heat of the medium temperature flue gas discharged from cement production, to ensure

that the temperature of each flue gas discharged into the atmosphere can not exceed 150 °C; (2) Choose the circulating fluidized bed boiler with relatively high combustion efficiency, which can burn anthracite and coal and stone, in order to ensure its full utilization (3) reduce the specific energy consumption of power plant; (4) The vacuum degree of the condenser is increased, greatly reducing the heat consumption rate; (5) Reduce the loss of steam and heat. Due to the use of efficient electrostatic precipitator, the concentration of dust discharged into the atmosphere is relatively low, so the specific air pollution emission of the power plant is very effectively controlled. In addition, all the ash and slag from the boiler can be used in cement production, thus overall pollution emissions are controlled. From the above analysis, it can be found that the project has very good environmental characteristics.

5. Conclusions

In a word, it is an effective way to use waste heat of

medium temperature flue gas in cement plant to generate electricity by supplementary combustion waste heat boiler and steam turbine generator set. For cement plants with relatively low fuel quality nearby, it is very necessary to use circulating fluidized bed boiler as auxiliary combustion boiler, and its cost is relatively low, which can save the cost of electricity purchase, and the internal rate of return is relatively high. The payback period of investment is relatively short, with very good economic benefits.

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