Main Problems Faced by Biomass Coupling Power Generation Metering

Hongmei Chen [a], Zhongming Gao, Qirui Wang, Yifeng Ding

Hubei Huadian Xiangyang Power Generation Company. Xiangyang 441000, China

[a] 34080575@qq.com

Abstract. Carry out in-depth research on the electricity metering project of the biomass gasification coupled power generation project of Hubei Huadian Xiangyang Power Generation Co., Ltd., and upgrade the existing metering capacity based on the requirements of the power industry standard "Calculation of biomass energy from coal-fired coupled biomass power generation Part 1: Gasification coupling of agricultural and forestry waste residues" to form a complete, accurate and advanced electricity metering capacity. In view of the shortcomings of the hardware and software of the current electricity metering, we will improve and upgrade them one by one. In this plan, the existing biomass energy and electricity metering system is planned to be modified by replacing the sampling system, pre-treatment system, adding missing parameters of the analyzer, adding power measuring points, replacing gas, steam and condensate flow meters, and arranging explosion-proof cabins.

Keywords: Biomass; Gasification; Concrete; Power Generation; Electricity Metering System.

1. Background

With the rapid growth of the global population and the rapid development of the times, the problem of energy shortage has become a problem that the world needs to face together. At the same time, energy security is also one of the problems that restrict the peaceful and stable development of a country. Therefore, how to reasonably and effectively develop and use new energy, research and develop new equipment, and explore new technologies is particularly important [1].

China is a large agricultural production country, and the biomass resources such as various agricultural and forestry wastes, forestry wastes and forest product processing wastes generated every year contain huge wealth and value, which not only provides material conditions for the development of low-carbon economy in China, but also provides a reliable development foundation and improvement space for China's biomass power generation technology [2]. Biomass clean energy mainly refers to biomass gas, biomass solid fuel and biomass liquid fuel. Compared with traditional fossil energy, biomass energy is a new type of clean energy, which has the advantages of renewable, low pollution and high added value. The rational use of biomass energy for power generation can not only reduce the harmful waste gas caused by the use of traditional fossil energy, but also greatly reduce carbon dioxide emissions [3].

Although coal, oil, natural gas and other fossil energies are also converted from biomass energy, unlike traditional fossil energies, biomass energy has the following characteristics [4]:

1. Cyclic regeneration. Biomass can be regenerated through plant photosynthesis. Like wind, solar and tidal energy, it is renewable energy, and its variety is more abundant, which can ensure the sustainable use of energy and sustainable economic development [1].

2. Energy conservation and emission reduction. As the amount of carbon dioxide required in the process of biological growth is basically equal to the amount of carbon dioxide emitted by itself. Therefore, in the production of biomass energy, the emission of greenhouse gases in the atmosphere is basically zero.

3. The content of sulfur, nitrogen and ash in biomass is low, especially after sulfur combustion, the emissions of sulfur oxides and dust are very low compared with fossil fuels, which is a very clean fuel.

4. The distribution is not only wide, but also the reserves of biomass resources in China are very large. Biomass power generation technologies are mainly divided into three categories: direct combustion of biomass for power generation, biomass gasification for power generation, and biomass coupled power generation (mixed power generation of biomass and other fuels).

In 2016, the National Development and Reform Commission and the National Energy Administration jointly released the 13th Five Year Plan (2016-2020) for China's power industry, according to the "13th Five Year Plan" for power development. China will launch a pilot demonstration project of biomass power generation in a large area. The key task is to solve the biomass resources generated from agriculture and forestry, while ensuring the increase in the quantity and quality of biomass power generation and grid connected installed capacity. By the end of 2016, the grid connected installed capacity of biomass power generation in China was about 12.2GW. By 2020, the total installed capacity of biomass power generation will reach 15GW, and the annual power generation will reach 90000GWh. Therefore, it will become an important strategy to make full use of biomass clean resources and help the sustainable development of biomass power plants [5].

The National Energy Administration and the Ministry of Environmental Protection proposed to rely on the active coal power efficient power generation system and centralized pollutant treatment facilities to absorb agricultural and forestry waste residues, domestic garbage, sludge and other biomass resources to promote the low-carbon and clean development of the power industry, especially coal power. The Notice identifies 84 pilot projects for technological transformation, with a total investment of 13386.88 million yuan and an annual consumption of 13.27 million tons of biomass. There are 55 biomass gasification coupled combustion projects, which consume 6887000 t/a of biomass, with a total investment of 7955.44 million yuan and a unit investment of 1155 yuan/t of biomass; One biomass boiler steam coupling project, consuming 220000 t/a biomass, with a total investment of 189.3 million yuan and a unit investment of 860 yuan/t biomass; There are two projects of mixing and burning agricultural and forestry wastes in the furnace, which consume 408000 t/a of agricultural and forestry wastes, with a total investment of 104.28 million yuan and a unit investment of 256 yuan/t of agricultural and forestry wastes; Conventional biomass power plants treat biomass of 150000 t/a, with a total investment of 107.5 million yuan and a unit investment of 717 yuan/t. There are 2 waste incinerator steam coupling projects, which consume 1533000 t/a of waste, with a total investment of 2425.84 million yuan and a unit investment of 1582 yuan/t of waste; The conventional garbage power generation project treats garbage of 1.46 million t/a, with a total investment of 2063.12 million yuan and a unit investment of 1413 yuan/t. There are 24 projects adopting sludge drying coupling and mixing burning, which consume 3.620 million t/a of sludge, with a total investment of 255071 million yuan and a unit investment of 704 yuan/t of sludge; There are 4 projects using dry sludge mixed burning, which consume 476000 t/a of sludge, with a total investment of 101520000 yuan and a unit investment of 213 yuan/t of sludge; The conventional sludge incineration power generation project treats 250000 t/a of sludge, with a total investment of 230 million yuan and a unit investment of 920 yuan/t. It can be seen from the comparison of the above projects that when biomass and garbage are used for coupling power generation in conventional coal-fired power plants, if they are directly mixed with coal for power generation, the investment is lower than that in conventional power generation projects. If gasification, steam coupling and other forms are used, the investment is equivalent to that in conventional power generation projects.

On September 2, 2020, the National Energy Administration issued the Measures for the Administration of National Energy R&D and Innovation Platforms, specifying that the technical fields of the national energy innovation platform include advanced renewable energy technologies.

On September 10, 2020, the International Energy Agency (IEA) released the Energy Technology Outlook 2020 report. The report proposes that to achieve the goals of energy transformation and climate change, the world needs to vigorously develop and deploy clean energy technologies. The report systematically assesses a range of different clean energy technology options to seek feasible solutions to achieve net zero emissions around 2050 while achieving the flexibility and security of the energy system. The report shows that in the sustainable development scenario, fundamental

technological change is necessary for the energy sector to achieve zero net emissions by 2050. In addition to energy efficiency and renewable energy technologies, it also covers a wide range of end sector technologies such as electrification, CCUS, hydrogen energy and related fuels, and bioenergy. The key research contents of bioenergy include: production of biomass and biofuel; Low carbon power generation; Bioenergy infrastructure construction; The application of bioenergy in industry, transportation, construction and other fields. The report shows that the power sector will be one of the earliest industries to complete decarbonization by using low-carbon technologies such as renewable energy, CCUS and nuclear energy.

In recent years, in order to give full play to China's leading advantages in clean and efficient technology of coal power and absorb biomass resources such as agricultural and forestry waste residues, the national energy authorities have organized a number of pilot projects to build coal-fired biomass power generation technology. The separation interface between coal-fired power generation and biomass power generation of coal-fired coupled biomass power generation is not clear, leading to the inability to directly measure biomass energy. How to scientifically and accurately calculate biomass energy alone, there is still a lack of systematic guidance standards or specifications in China. According to the requirements of the Notice on Issuing the Supplementary Plan for the Preparation (Revision) of the 2018 Energy Industry Standard (the first batch) (GNZT Science and Technology [2018] No. 157), the General Electric Power Planning Institute Co., Ltd., as the chief editor, drafted and prepared the power industry standard Coal fired Coupling Biomass Power Generation Biomass Power Calculation Part I: Gasification Coupling of Agricultural and Forestry Waste Residues. The preparation of this standard fills this gap and is conducive to ensuring the full purchase of biomass energy.

2. Equipment Stability

The operation cycle is short. After nearly a year of operation observation, it was found that the sampling filter screen and pipeline of the front-end sampling device of the gasifier gas metering station were blocked due to the influence of tar and ash, and the sample gas could not enter the analyzer smoothly. The whole set of device cannot operate for a long period, and the maintenance is heavy; The impurities in the fuel gas are not filtered out by the front-end sampling and filtering, and the sample gas entering the analyzer brings the risk of polluting the precision instrument, which shortens the equipment maintenance cycle and service life. In addition, the metering station equipment is placed in the open air, resulting in a bad working environment, which affects the service life of the equipment.



Figure 1. Comparison of Existing Sampling and Filtering Devices before and after Use

According to the current application technology related to gas metering stations of the same type of projects in China, the gas metering method has become mature and is worth learning. The pre-treatment of tar and ash in gas is too simple in the preliminary design of this project. The filter screen has poor filtering effect on ash. The sampling circuit is cleaned with superheated steam, which is manually input without program control, which brings great inconvenience to the operation, and also easily pollutes the subsequent sample gas pipeline. In addition, because the steam pipe for soot blowing is long, it is easy to condense water and mix with the ash deposited in the sampling pipe to form mud, which is not conducive to maintenance and cleaning. The sample gas pretreatment system considers water removal and further ash removal, but the effect is poor in application. When the sample gas enters the gas analyzer, the pressure cannot meet the design requirements, and the analysis data is seriously low, which not only risks polluting the precision optical instruments, but also affects the correct judgment of the operating personnel on the working conditions. As a result of the above reasons, it is necessary to manually and frequently monitor whether the gas component display is normal and check the local sample gas pressure during the operation of the gasifier.

The flow measurement is unstable. The existing flowmeter is a constant velocity pipe flowmeter, and the flute hole is easy to be blocked by soot, which will affect the measurement accuracy. It is found that the flow is significantly increased after soot blowing during operation, indicating that the influence of soot deposition does exist. In addition, the actual operating differential pressure is about 60Pa, which is obviously lower than the design differential pressure of 167.66Pa. The existing flowmeter must be further calibrated through the cold state experiment to determine the cause of the low differential pressure.



Figure 2. Existing Delta Bar Flowmeter

3. Equipment Comprehensiveness

The gas detection component is missing. Through investigation and research, it is found that the calorific value gas analyzer provided by Xuedilong Company cannot analyze the C2H2 and C2H4 gas components in the gas. Referring to similar projects in China, the C2H2 and C2H4 gas components account for about 10% of the calorific value of the gas. It is equivalent to that when the gasifier operates with rated load, the fuel consumption is nearly 15% more, which seriously affects the economy of the gasifier operation and cannot meet the requirements of the new standard. The gas analyzer is not selected according to the actual composition of the gas, and some combustible components cannot be analyzed. The calorific value of the gas calculated by the metering station has errors with the actual calorific value of the gas.

Analyzer pretreatment transformation. To further process the sampled gas, a sample gas pretreatment unit must be set. The gas analyzer requires that the gas be subject to dust removal, oil removal and water removal before entering the sensor of the analyzer. At the same time, the components of the gas to be measured shall not be changed during the process of dust removal, water removal and oil removal. The quality of pretreatment technology directly affects the accuracy,

reliability and service life of the analyzer. The tar content of the gas at the outlet of the gasifier is 2g/Nm3. The pre-treatment unit is equipped with water and kerosene cleaning devices to effectively remove the tar in the gas.

The gas processed by the former system enters the post-treatment system and then enters the functions of water washing, secondary filtration, fast loop, cooling, condensation and dehumidification, tertiary fine filtration and dust removal, desulfurization and drying, flow control, instrument calibration, automatic safe discharge, etc.

4. Conclusion

The dew point of the treated sample gas shall be controlled below 5 ℃, the concentration or composition shall not be affected, and the flow, pressure, temperature, etc. shall meet the technical requirements of the analyzer detector for the sample gas. It can ensure the reliable operation of the Analyzer to the maximum extent and improve the service life of the Analyzer. The sample gas processing system can remove oil, water, oil mist and water mist from the sample gas under normal or abnormal process conditions, and has the ability to filter mechanical impurities and dust in the sample gas, so as to ensure the long-term and stable operation of the analyzer. The sample gas processing system is equipped with high-precision filter, and the dust filtering accuracy is 0.1um. Anti corrosion materials shall be used for gas analysis instrument and parts contacting with atmosphere and medium.

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