

Research On The Efficiency of Renewable Energy (Biomass) Power Generation

—————Take Jinzhou Biomass Power Plant In Hebei Province as an Example

ABSTRACT

The electric power is not only the second most important energy resource in our country, but also the pillar industry of our country's development, At the present stage, the methods of domestic power generation are mainly the fossil energy thermal power generation and the new energy hydroelectric power generation with relatively less advanced. But for the current national conditions of China, both methods have big disadvantages: China's energy consumption is huge. It cannot always rely on non-renewable resources. The fossil energy reserves (especially oil reserves) are not abundant. They cannot maintain the energy demand for the long-term production; Second, the relatively clean hydropower is greatly limited by natural conditions and the current technologies. It is impossible for us to effectively spread and use this type of clean hydropower throughout the entire country. Therefore, it is necessary for China to develop the clean, pollution-free, high-yield new energy. The renewable (biomass) power generation is being applied to solve the problem in this direction. Jinzhou biomass power plant is one of the first three straw power generation demonstration projects approved by the National Development and Reform Commission. In this study, we will use this company as a good example to deeply evaluate about advantages and disadvantages on biomass power generation. We will also deliberate the benefits provided by developing and using this type of green energy resources. Finally, I would like to propose suggestions on improving the current biomass power generation and its technology.

Keywords : Renewable (biomass) power generation , Survey , Environmental protection , fuels ,

measures

I. Background

A. National conditions and attitudes towards this technology

Under the background of Chinese current national conditions, the utilization and processing of oil and coal, China's main energy sources, can contaminate the surrounding environment, damage local geology and landforms, and further lead to the problems with agriculture, housing and foundation subsidence. However, the renewable energy (biomass) power generation has the characteristics of carbon free, clean, environmental protection and renewable. In this paper, renewable energy (biomass) power generation mainly refers to converting the chemical energy in the remaining parts of crops and trees except the food, the fruit, and the required wood, into a form of electricity for people to use.

Since the reform and opening, biomass power generation has been growing rapidly, with the installed capacity of China reaching 270 million KWH, five times that before the reform and opening. /From 1981 to 2002, the average growth rate of China's GDP was 9.6%, the growth rate of electricity generation was 8%, the growth rate of installed power was 7.9%, and the mean elastic consumption coefficient of electricity was 0.814 from 1981 to 2000, which has increased every single year. In addition, per capita household electricity consumption and social electricity consumption also showed an increasing trend./ [1]

B. Fuels for renewable (biomass) energy generation

Northern China is one of the main grain producing areas, which has the main crops of corn, wheat, cotton, fruit trees and some other resources. At present, some of these energy sources in China are used for return to the fields, private incineration, paper making, biogas production and animal

husbandry feed, but the actual benefits are not optimistic. The problem is these ways will extremely affect the growth of crops and pollute the atmosphere.

The use of renewable energy (corn straw, cotton straw, tree branches, tree waste and other agricultural production waste) as fuel for power generation will not cause the destruction of local vegetation and the reduction of local biodiversity. This kind of power generation method can not only improve the shortage of fossil energy in China, but also effectively alleviate the environmental problems. Moreover, the surplus of crop straw is abundant throughout the year, which is suitable for the promotion of this method. So renewable energy (biomass can be an effective alternative to fossil fuels for generating electricity.

C. Policy support for renewable (biomass) energy generation

/Since 2004, China has put the development and utilization of biological resources into the national energy policy. China has passed the “Renewable energy law of the People's Republic of China” and the “Renewable energy law of the People's Republic of China”. Both of them emphasized the importance of further development of renewable energy, maintaining energy supply, adjusting energy structure, providing economic support, protecting the environment and implementing the concept of sustainable development, thus fundamentally ensuring the rationality and legitimacy of renewable (biomass) energy development./ [2] As a result of the above policy support, along with the progress and development of science and technology, Chinese renewable energy has continued developing, and has formed a certain scale.

D. Technical support for renewable (biomass) energy power generation

After the reform and opening up, through the introduction of advanced technology and technology localization, China's crop straw power generation has made some progress, but the

theoretical research has not made substantial advance, which makes the progress of crop straw power generation project much more difficult. /Since many of the existing straw power plants were not rigorous enough in their initial survey on the biomass straw fuels, their fuel supply area radius is too large and the planning site is not good, resulting in a large increase in costs, low profitability, or even loss or no raw material available situation, which greatly restricts the promotion of straw power generation in China./ [3] However, its low pollution emission makes this kind of power generation has a broad prospect in our country.

E. The present situation of Hebei

In 2017, straw energy utilization accounted for only 4.9% of the total usage, while the proportion of straw energy utilization reached 25.23% in Hubei province. The province administration should pay close attention to its potential (The substantial measure is listed in figure 1)

[4]

The Straws' Name	Output (%)	Available Share Of Electric Field (%)	Standard Coal Coefficient's Discount (%)
Wheat	36.59	64	0.50
Maize	43.51	45	0.529
Cotton	2.24	68	0.543
Rice	1.68	70	0.429
Beans	1.41	53	0.543
Tuber Crop	2.96	32	0.486
Oil Plants	4.41	23	0.529
Other Grains	0.05	28	0.50
Branches	7.15	48	0.682

Figure 1

Figure 1.1.1 shows the amount of different fuels that can be used for power generation in Hebei. Combined with the annual straw production in Hebei, we can figure out a practical strategy to improve the situation of raw material available for straw power generation.

/ Besides the 109 million tons of straw harvested in Hebei every year for paper making, feed, fertilizer returning to fields and natural consumption, the total amount of straw that can be used as energy reaches 376 million tons. According to the ministry of agriculture's grain output forecast, by 2020, the total amount of straw in Chinese main crop will reach 800 million tons, accounting for about 30 percent of the world's grain output./ 【5】

According to the current situation, the utilization rate of renewable energy is relatively low. Therefore, it is of great research value to make efficient use of renewable energy, discover and further popularize such technologies, explore the existing problems in this aspect and solve them.

In the research, we have chosen Jinzhou biomass power generation co., ltd. as our investigation object. China energy saving Hebei biomass energy generation co., LTD. is a professional cogeneration enterprise engaged in the comprehensive development and utilization of biomass energy in China. We have made a full investigation on its development and obtained ideal data. The following is the analysis and arrangement of the data after exploration.

This paper is divided into the following five parts, through which to explore the questions as below:

- 1) How to promote renewable (biomass) energy power generation?
- 2) Should renewable (biomass) power generation be promoted nationwide?

II. Basic situation of *China energy saving Jinzhou biomass power generation co. LTD*

In the survey, we interviewed a middle-level cadre named Jiahuan Bao, who is also the head of the fuel department of the straw power plant, from whom we learned: The main principle of straw power generation in this plant is that crushing the renewable energy (bark, branches, crop straw, etc.), putting it into the furnace to be burned as fuel, then using the heat generated from it to heat liquid

water to make it vaporize, and letting the overheated steam push the steam turbine to generate electricity.

The following contents will analyze the economic development and structure of the plant from four aspects: the main raw materials of biomass power generation, machine selection for the biomass farm, basic process of power generation and the comprehensive effect of this method.

A. The main raw materials of biomass power generation

The main raw materials of this biomass farm are bark, branches and crop straw (cotton stalk, corn and wheat) within a radius of 300 kilometers from the plant, which are basically acquired from the farmers and the surrounding wood processing factories and forest farms.

The Straws' Name	Moisture (%)	Ash (%)	Calorific Value (MJ/kg)	Utilization (%)
Branches	9.61	8.56	17.55	55
Cotton	9.03	20.02	18.08	35
Wheat	11	7.0	16.654	6
Maize	9.89	14.07	17.73	4

Figure 2 [7]

As can be seen from Figure 2, the principle fuels used in Jinzhou power plant are bark and branches. The main reasons are that the ash content and water content of these materials are much lower comparing with other fuels, and its calorific value is relatively high. Moreover, it has rich sources, thus it is very suitable for power generation.

Since the biomass power plant's raw materials have the constraints about space and time, which is mainly the acquisition of straw raw materials such as the radius, The distance is too far away from the power plant, and the bark freezes (Every year from June to October is the rich period of bark and other raw materials, but in the lunar calendar from December to February of the next year, the cold temperature causes bark to be frozen and cannot be used as power generation material, and

November to March is just the pruning season of trees, so the main material to be burned during this period is the branches and branches cut from trees. After February, the pruning season ends, but temperatures pick up and bark returns to power generation) so that it cannot supply enough fuel because of the growth of trees and trees periodically by the cold climate. The fuel source unable to provide the raw material effectively, increased the straw purchase cost of transportation, hindered the stable operation of power plant and reduce the economic benefit of power plants.

B. Machine selection for the biomass farm

/According to the investigation, the biomass power plant boiler is the type of ug-75/3.82-jm vibration grate boiler with low combustion efficiency and medium-temperature and medium-pressure steam turbine generator set./ [8]

C. Basic process of straws power generation

Mr. Bao gave us a tour of the plant's power generation process. The first step of the basic process is to crush the branches, bark and stems of the tree into about 10cm in length outside the field and send them to the storage bin for solarization. Then the fuel enters the furnace through two slope roller belts and one horizontal roller belts; The second step is to dry the raw materials in the furnace, so that the water content basically falls below 43%, and then vibrate the fuel as needed through the horizontal plane connected to the off-axis (rotating device with the axis not in the center). Next, the raw material is blown up from below by manual air supply according to the specified quantity to increase its contact area with air and ignited. Then wind from the upper direction of the fire to prevent the burning being uneven incomplete; The third step is to heat the liquid water in the surrounding pipe, called the water wall. After three times of heating, the liquid water reaches the superheated steam temperature required by the steam turbine, pushing the turbine to rotate, so as to

achieve the purpose of generating electricity. The fourth step is the process outside the main line of power generation. After pushing the steam turbine, the steam is cooled into liquid again through the cooling tower, and then it continues to participate in the cycle of power generation. After combustion, waste materials are removed by physical and chemical means. The main way to use chemical principles is to add urea in the combustion process through acid and alkali neutralization to remove sulfur and nitrate and other elements, to prevent its emissions into the atmosphere causing acid rain; The physical method is the measure of cyclone separator combined with cloth bag dust removal. Cyclone separator is to separate the large and small particles in the residual residue, and cloth bag dust is to remove fine dust in remaining gas. In the end, water vapor containing very little dust is discharged through the chimney, while the slag left behind in the furnace is sent away for other utilization.

Flow Chart Of JinZhou Biomass Power Plant Mapper: YangTan

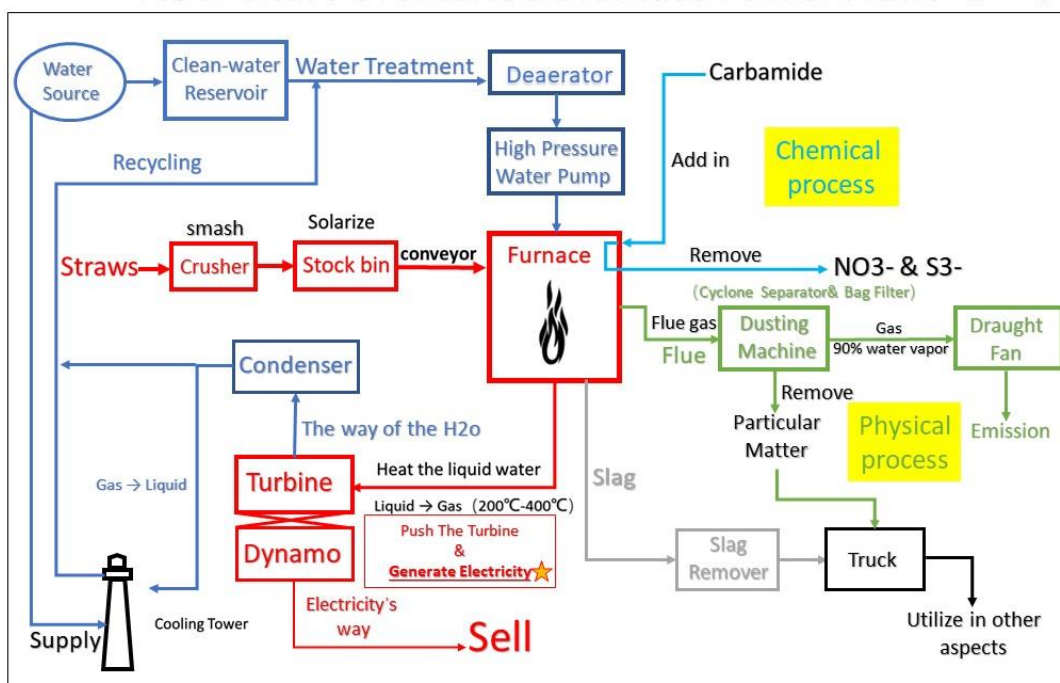


Figure 3

D. the comprehensive effect of this method

1. Environmental benefit

According to the study, /straw is a good clean renewable energy source, with an average sulfur content of only 3.8 percent, while the average sulfur content of coal is about 1 percent, and the dust content in the waste gas generated by straw combustion under standard conditions is 3.6 percent that emitted by coal-fired power plants./ ^[9] Based on the straw itself as a clean fuel, the plant further treated the flue gas discharged from power generation, making the final emission of gas basically achieve zero pollution emission, effectively reducing the probability of acid rain generation and improving air quality. In addition, this way of power generation not only reduces the emission of gases to the surrounding environment pollution, but also does not exist in the process of fossil energy mining local geology and geomorphic damage, inhibit agriculture, limit the settlement and foundation subsidence and other problems.

2. Economic benefit

According to the relevant data provided by Jinzhou power plant during the investigation and the relevant national technical standards (depreciation), as well as production costs and management costs, it is calculated that the annual profit of Jinzhou power plant is about 9.5 million yuan, which is in the state of low profit loss. However, these biomass materials are processed and burned for power generation, which costs much less than conventional coal-fired power generation or direct combustion power generation investment.

3. Social benefits

China has a vast territory, uneven distribution of population, rugged terrain, and there are still no electricity in some rural areas. Therefore, the construction of point-type straw power plants can not

only increase the income of farmers, provide jobs and improve living standard, but also play a significant role in improving the regional power construction, ensuring the electricity supply for various production and living, stabilizing the rural economy and realizing common prosperity.

III. Reflections on the investigation of Jinzhou biological power plant

A. Existing problems

According to the investigation, China's biomass power generation has the following problems

1. In the initial stage, the fuel survey in this field was insufficient. The fuel acquisition radius of biomass power plants in the early period was large, and the fuel varieties and available fuel supply data obtained during the research were not accurate, which has increased the transport cost of straw purchase, not been able to guarantee the fuel supply efficiently, hindered the stable operation of the power plant, and reduced the economic benefit of the power plant.

2. At present, according to our investigation, due to the initial biomass power plant equipment (namely boiler) technology is not mature, mostly it is used for the use of low thermal efficiency of the medium temperature and medium pressure vibration grate boiler.

3. The supervision of fuel quality and storage process is not in place, which can be divided into two aspects: Due to the previous fuel purchase system, which is not sound, and China's biomass power plant access to the fuel impure, containing impurities (sediment) more, water is too high (about 40%), fuel quality is difficult to ensure. Such fuel into the furnace, not only can not fully be combusted, but also produce heat absorption phenomenon; In order to reduce investment, during the construction of early biomass power plants in China, the fuel storage facilities (small storage capacity, poor ventilation effect) and crushing equipment technology were not considered thoroughly, which resulted in mildew in the storage of biomass fuel and uneven particle size of raw materials

into the furnace.

These problems affect the thermal efficiency of biomass power generation and the economic efficiency of power plants, which is the bottleneck of biomass power generation construction.

B. Personal suggestions for further development ^{【10】}

1. Fuel volume survey

The purpose of the fuel volume survey is to determine the main basis for the size and stable operation of biomass power plants.

After discussion and research, we thought that we should determine the planting area and crop yield of these varieties respectively, and calculate the straw volume after calculating the proportion of grain and grass according to the planting spacing and other measures. Then, based on the actual situation in the local area, we should continue to calculate the straw quantity of crops that cannot be acquired, such as returning fields, biogas, feed, household combustion, natural loss and loss of purchasing time of crops, In order to improve the accuracy of the data that can be used as fuel, and to determine the scale, and to facilitate the stable operation of biomass power plants.

2. Survey on fuel varieties

The purpose of the fuel variety survey is to determine the boiler selection of biomass power plant according to the results of the fuel variety survey and their low heating value and fuel amount survey, that is to choose the secondary high temperature and high pressure or high temperature and high pressure cycle vulcanization bed boiler with high thermal efficiency, in order to improve the thermal efficiency and economic benefits.

After discussion and research, we believe that the fuel survey is to test the relevant indicators of different fuel varieties, so as to determine the type selection of the unit

3. Survey of fuel radius

The purpose of the fuel supply radius study is to reduce the transportation cost of bio-fuels and improve the fuel acquisition advantage.

After discussion and research, we believe that the fuel supply of biomass power plants should be within 50 kilometers, which is used to determine whether to build biomass power plant or its construction scale. For instance, if there are wood-processing plants within a few kilometers of each other, the company can use the remaining "offcuts" as burning materials to generate electricity. This way, the annual waste of wood in each region can be saved and further waste can be used. However, if the power plant is located in a remote location, considering the economic losses caused by the transportation process, the supply of such raw materials cannot be effectively guaranteed. As the result, this advantage becomes impossible.

4. Fuel quality purchase supervision

The purpose of the fuel quality purchasing supervision is to reduce the water and impurities of the fuel in the furnace to improve the combustion efficiency of the boiler.

After the discussion and research on biomass fuel procurement into the factory, the biomass power plant should be formulated to ensure the quality (less water, less impurities, weighing) of strict management system and based on the measures from the testing of low calorific value of the different biomass (yuan/kilojoules) to purchase, so as to reduce heat loss caused by impurity absorption of heat and the factors affecting the thermal efficiency of the boiler.

IV. Feasibility and practicability of biomass power generation

Although biomass energy power generation has some deficiency, through the above research and discussion, we believe that it has certain advantages compared with fossil energy power

generation

A. Planting of crops straw coverage area is large, the number is more than 17 hundred million mu in recent years, thus the origin of raw materials is wide, straw grain by-products such as production is very rich. As long as the plants do well in the survey of biological fuel of prophase (fuel varieties, planting area of fuel, fuel volume), it won't appear the problem of supply disruptions.

B. Straw power generation uses branches and stalks from plants, compared with non-renewable resources used for oil power generation, straw maintains the sustainable development of resources more effectively. Moreover, the exploitation of fossil resources such as oil and coal will inevitably destroy the local ecological landscape. Straw is directly available biological renewable resources, which will hardly affect the local biodiversity and topography.

C. The residue after burning straw is divided into slag and ash, and these residues can be used for other purposes. After combustion, the slag generates 260t every day, which can be applied to road construction as a good building material, reducing the construction cost. The ash filtered by physics can continue to be used as fertilizer. The ash rich in organic matter can produce dozens of tons a day, which not only reduces the economic pressure of farmers, but also provides a good advantage for the development of agriculture.

D. Straw power generation not only can effectively reduce rural straw accumulation phenomenon, its gas contains sulfur and nitrate less than the gas cause by burning coal and oil, which could alleviate the harm of acid rain. Moreover, before gas emission, residual air pollutants are filtered out through multiple ways, which is in line with the concept of green development and ecological civilization.

E. Renewable energy power generation can supply the electricity demand of users and

construction, reduce the pressure of coal power generation, and bring clean energy to the overall development of the country, which not only guarantees the people's livelihood, but also maintains the current basic line of economic construction as the center.

V. Conclusion

Through our research and discussion, I think biomass power generation has certain economic benefits or better social benefits is feasible, although there are many disadvantages in this field at the present stage, but can play its original benefits through certain methods. This is mainly reflected in ensuring the implementation of detailed research in various aspects, reducing the drawbacks caused by incomplete data understanding, and realizing the combination of efficient energy production and environmental protection.

VI. The vision of the future

In addition to the measures described above, I have other thoughts on economic issues. In the process of straw power generation, different forms of industry can be carried out through the same equipment to subsidize the low profit brought by straw power generation and improve the overall income of factory production. For example, a pipe carrying hot water is built in the boiler, and the heat generated by burning the straw is used to heat liquid water in both containers. One turns into superheated steam, and the other is heated to a boil (not vaporized) before being transported out, providing hot water and heat to the surrounding residents during the cold winter months. This ensures heating for the local population and adds further benefits to the factory's production beyond electricity generation.

Moreover, the government should support the development of this field, provide relevant supporting policies for the establishment of biomass energy power plant and the investigation system

of various aspects, increase relevant inspection efforts, supervise the operation of power plant, and ensure its sustainable development and stability.

Biomass energy straw is not only low sulfur content, and easy to get, is an ideal raw material for power generation; This technology combines the concept of green development, sustainable development and Shared development organically, which is helpful to solve the three major problems of energy shortage, environmental protection and farmers' income, and has a broad development prospect.

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