Research on Technology Economy Based on Centralized Gas Supply of Crop Fuel Energy

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Abstract. The crop fuel supply chain is the basic guarantee for the transformation of crop fuel resources, and it is the key to realizing the development and utilization of large-scale crop fuel energy in the future. This paper analyzes the technical issues related to crop fuels, and introduces the current status and existing problems of crop fuel harvesting, collection, storage, pretreatment and transportation. At the same time, it summarizes the technical economy of the supply chain, and compares the research methods that are often used in China. It is the main way of current research to establish energy-based gas supply by establishing quantitative technical and economic indicators. How to make full use of crop fuels and convert them into high-grade energy to meet the energy needs of farmers living and producing, and to promote the improvement of agro-ecological environment is of great significance.

1. Introduction
In recent years, with the increase of world energy demand and the depletion of petroleum resources, renewable crop fuel resources and energy have received more and more attention. Crop fuel energy concentration technology is the burning and reduction reaction of crop fuel in anoxic state. The energy conversion process converts solid crop fuels into flammable gases that are easy to use and clean. Crop fuel consists of carbon, hydrogen, oxygen and other elements and ash. When they are ignited, only a small amount of air is supplied, and the reaction process is controlled to turn carbon and hydrogen into a combustible gas composed of carbon monoxide, hydrogen, methane, etc., and most of the energy in the crop fuel is transferred to the gas, which is gas. Process. The ash, tar and other impurities in the combustible gas are removed, and they are sent to the farmer's home through the gas supply system, and the water can be cooked [1].

The worldwide energy crisis, environmental pollution and the destruction of ecological balance have made human beings aware that they cannot obtain energy from nature in an uncontrolled manner, but should establish a balance mechanism for energy use as soon as possible. In the world, people have reached a consensus that the development and utilization of crop fuel energy with high technology to replace fossil energy such as oil and coal is one of the important ways to solve energy and environmental problems. Therefore, the research and development of crop fuel utilization technology has attracted the attention of governments and scientists around the world. Recently, the
research direction of domestic and foreign scholars is mainly to use wood industrial waste to produce combustible gas for heating, drying or power generation [2].

2. Crop fuel energy centralized gas supply concept
China's lack of fossil fuel resources, while consuming petroleum and coal-burning fossil resources, will cause huge environmental pollution. China's coal-fired and oil-fired boilers emit about 2.5 billion tons of CO₂ per year. Therefore, the development and utilization of clean energy is of great significance for promoting national economic growth and environmental protection. As a kind of renewable and clean energy with abundant reserves, crop fuel is widely used by various industries and has become an indispensable part of sustainable energy systems [3].

2.1. Crop fuel energy concentration technology
China is a big agricultural country and cannot rely entirely on oil, electricity and natural gas resources to solve daily life needs. It is particularly important to change the rural fuel structure, seek new modes of comprehensive utilization of crop fuels, and reduce harmful gas emissions. Crop fuel energy concentration technology has emerged. The principle of crop fuel energy concentration is that under the high temperature conditions, the crop fuel is not completely burned, the molecular chain of high molecular weight organic hydrocarbon is cracked, and the combustible gas such as CO, CH₄ and H₂ with lower molecular weight is produced [4]. When the crop crop fuel is ignited in the furnace, under the condition of insufficient combustion and open flame, the small fan blows air to supply oxygen to continuously produce gas, and the gas enters the gas pipe through the gasifier to the gas pipe under micro pressure. The tar, water, impurities, etc. are separated into clean gas. The clean gas can be burned through the pipe through the nozzle of the special stove for boiling water, cooking, heating, and the like. The crop fuel gasifier adopts normal temperature and normal pressure technology, which can meet the increasing demand of humans for liquid fuel and effectively reduce the pollution caused by the use of fossil fuels [5].

![Technology for centralized gas supply of crop fuel energy](image)

2.2. Crop fuel curing molding technology
After the crops and fuel raw materials are dried and pulverized, they are heated and processed under isolated air and extruded into various shaped coals, which changes the waste of resources and environmental damage caused by burning crop fuels, and opens up new development of China's coal energy sustainable development [6] At present, crop fuel solidification molding technology is divided into rod-shaped solidification molding fuel technology and pellet fuel production technology. The production of rod-shaped solidified fuel firstly grinds the crop fuel with a pulverizer, then dries or sprays the water, and finally produces a rod-shaped fuel by curing the rod unit. The crop fuel pellet fuel solidification system is in the research demonstration and pilot stage in China. At present, its scale and marketization are not high, and the promotion speed is slow [7].
2.3. Crop fuel biogas technology
The production of crop fuel biogas is based on crop fuel as the main fermentation material. The crop fuel is pretreated by various microorganisms to effectively decompose part of hemicellulose and cellulose, and finally the anaerobic microorganisms are used to decompose the pretreated product. Biogas. According to the form of the crop fuel material in the reactor, it can be roughly divided into liquid digestion, solid digestion and solid-liquid two-phase digestion. Liquid digestion refers to the anaerobic digestion process of crop fuel materials in the presence of flowing water. Solid-state digestion refers to the anaerobic digestion process of crop fuels with no or almost no running water. Solid-liquid two-phase anaerobic digestion refers to the process of anaerobic digestion of solid and liquid fermentation raw materials in different devices.

3. Principles of centralized fuel supply technology for crop fuel energy
Pyrolysis energy concentration of crop fuels for low-quality crop fuels Chemically, the elemental composition of crop fuels is not significantly different from the wood-based materials in that the ash content is higher and the calorific value is slightly lower. Its main elemental composition is basically the same in terms of carbon, hydrogen and oxygen, and has a fairly stable atomic weight ratio. CH1, this formula is also generally used as a fuel formula for crops in the energy concentration reaction. Pyrolysis energy concentration of crop fuels involves a complex series of combustion, reduction, cracking, and even polymerization. These reaction changes interact with each other under complex phase equilibrium conditions, so that a complete reaction model has not been described. However, in a fixed bed reactor using air as a medium, the overall reaction formula can be written as follows:

$$CH_1 \cdot 4O_0 \cdot 6+0.4O_2+(1.5N_2)--0.7CO+0.3CO_2+0.6H_2+0.1H_2O+(1.5N_2)$$

(1)

Where Wn represents the hydrocarbon product with a carbon number of n accounting for the total mass of the hydrocarbon product.

The mass fraction, α is the carbon chain growth probability factor, and n is the number of carbons.

In the literature, CO consumption is obtained by material balance and parameter estimation. Kinetic equations,

$$W_n = (1 - \alpha)^2 n\alpha^{n-1}$$

(2)

There is a self-balancing mechanism between the combustion (oxidation) reaction and the energy concentration (reduction) reaction of the centralized fuel supply technology of crop fuel energy. That is, when the combustion reaction is intense, the heat released increases the temperature of the reaction zone, which happens to increase the rate of the endothermic energy concentration reaction, thereby maintaining the gas composition leaving the reduction zone and the temperature is substantially stable. The key to the process design of the centralized fuel supply technology for crop fuel energy is to ensure the combustion conditions and the stability of the combustion layer and energy concentration layer. Therefore, the fuel energy concentration of crops is not difficult in principle. In the past, the energy concentration process could not be used for crop fuels, The best return f(x) is:

$$f'(x) = \sum_{i=1}^{n} (CI - CO) t (1 + IRR) * W_n$$

(3)

(1) The bulk density of crop fuels is too small, so that the amount of feed by volume is too large, and the heat capacity of the reaction zone is small and the amount is not stable;
(2) The reaction zone is easy to bridge, perforate, etc.
(3) The carbon particles are fine and scattered, affecting the gas permeability of the reaction zone. The focus of the research work is to find a reasonable reactor structure and operating conditions
through a large number of experiments, to improve the heat capacity of the reaction zone, to overcome
the shortcomings of the physical characteristics of crop fuels, and to ensure a stable reaction bed and
combustion conditions. Through experiments and improvements, the energy concentration reactor
studied successfully gasified low-quality crop fuels such as corn stover and wheat straw, and expanded
to cotton straw, corn cob and wood raw materials in the experiment, and all achieved satisfactory
results.

4. Design plan for centralized fuel supply technology for crop fuel energy
Each kilogram of crop fuel can produce about 2 cubic meters of flammable gas, and a household of 4
families needs about 5 to 6 cubic meters of gas per day. The centralized gas supply system cannot be
liquefied at room temperature because of the crop fuel gas. It must be sent to the user through the gas
pipeline network. Therefore, the basic mode of the centralized gas supply system is: set up the energy
concentration station in the natural village as a unit (the gas cabinet is set in energy concentration)
Inside the station), laying the pipe network. The system includes raw material processing machine
(mower), feeding device, energy concentration unit, fan, gas cabinet, safety device, pipe network and
stove.

The function of the gas cabinet is to store a certain amount of gas, adjust the gas consumption at the
peak of the accident, and maintain a constant pressure to make the gas stove work stably. The pipe
network consists of main and branch pipes buried in the ground. The use of hard plastic pipes can
reduce the cost. Steel pipes for pipelines entering the kitchen. Because of the different gas
characteristics, the burning of crop fuel gas requires special stoves. The energy value analysis method
overcomes the problem that the energy of different types and different properties cannot be directly
compared and calculated with SolarEmergy.

Figure 2. Principle of crop fuel energy cycle

Figure 3. Crop fuel energy decomposition
As a unified unit of measurement, the natural environment resources, social economic resources and ecosystem services are included in the scope of systematic evaluation, and the ecological environment is realized. Economic system scientific and comprehensive analysis of boundary determination and data collection Through literature research and field investigation, collect the input, output and other aspects of the natural environment, geographical conditions, process technology, engineering construction and operation process of the centralized fuel supply system for crop fuel biogas. Data and data on materials, energy and capital inputs related to the input and output of crop fuel biogas systems. Conduct a comprehensive analysis.

4.1. Crop fuel energy centralized collection technology
In this study, the boundary of the crop fuel biogas engineering system is taken as the starting point for the collection and transportation of crop fuels, and the end point of direct fertilization by the biogas of the fermentation product and the direct application of the biogas slurry. The whole crop fuel biogas project is divided into the collection of crop fuel raw materials, crop fuel pretreatment, anaerobic fermentation, purification storage, biogas utilization, and biogas utilization. Collect data needed for energy value calculations for crop fuel biogas projects within established system boundaries. The energy input of biogas projects can be divided into two categories according to their sources: First, environmental resources provided by nature without compensation, including renewable natural resources R and non-renewable natural resources N, called "free value"; The human socio-economic system, that is, the energy value F of the human economic and social feedback input, including the non-renewable industrial auxiliary energy FN and the renewable organic energy FR, through the field research and literature research, the basis of the centralized fuel supply project for crop fuel biogas The data, including the basic data of engineering construction and operation, is collected and collected. The system energy value analysis table generally includes the project number, project name, raw data, and energy conversion rate.

4.2. Crop fuel energy energy concentration process
The preparation steps of the energy analysis table of the crop fuel biogas engineering system are as follows: First, the renewable natural resources R, the non-renewable natural resources N, the renewable industrial auxiliary energy FR, and the non-renewable industrial auxiliary energy FN invested in the crop fuel biogas project, The energy value index system is constructed from three aspects: economic benefit, resource utilization, and sustainability. The sustainability and operational efficiency of the centralized fuel supply system for crop fuel biogas are analyzed and analyzed, and the energy value index is used to compare the system with other The biogas supply system is compared, and the characteristics of the system, the competitive advantages of development, and the direction and measures for process optimization and improvement are analyzed and evaluated. The heat treatment heat treatment method includes a heating method, a steam explosion method, a liquid high temperature water method, and a hot wet oxidation treatment method.

4.3. Crop fuel energy hot wet oxidation treatment
The hot wet oxidation treatment refers to the treatment of the raw materials after the addition of water at a certain temperature and oxygenation conditions. Biogas project can increase methane yield of raw materials by 35%-40%. Crop fuel biogas centralized gas supply process. Crop fuel biogas centralized gas supply technology refers to the use of crop fuel as the main raw material, using anaerobic fermentation technology to produce biogas for farmers. Provide anecdotal energy. A complete crop fuel biogas supply system, regardless of size, basically includes four parts: raw material pretreatment system, anaerobic fermentation system, biogas purification and distribution system, and biogas residue and biogas utilization system. The qualified biogas station can be used. Equipped with intelligent control system.
5. Analysis of technical economic research
The crop fuel biogas centralized gas supply project has a fermenter with a volume of 800m³, which adopts a vertical push-flow full-mix fermentation process. The bottom heating is carried out, and the fermentation temperature is maintained above 28°C all year round. It belongs to near-medium temperature fermentation, and the raw material fermentation concentration is 8%-12%, the gas production rate of the tank is 0.6-0.8m³/(m³.d); the daily processing of crop fuel is 1200kg, the annual consumption of crop fuel is 450t, and the annual output of biogas is 184,000 m³. The biogas slurry reflux is used to mix the fermented raw materials, and the annual output of the biogas residue is 300t, which is used for vegetable greenhouse fertilizer. The crop fuel is pretreated by pulverization, and the particle size is 3-5 mm. The dry gas storage bag is used to store the biogas and is directly delivered to the user through the underground pipe network.

5.1. Economic Analysis Process
According to the current stage of the discount rate i, the financial analysis of this study is 10%, and the estimated service life of the project is 20 years. The payback period is calculated from the year of production.

(1) Project operation costs The operating costs of the centralized fuel supply project for crop fuel biogas in Dongjie Village mainly include raw material costs, power costs, personnel salaries and equipment maintenance costs. Raw material costs. The raw material of the biogas project energy concentration station is mainly corn stover, the price is 250 yuan/t, the annual consumption of raw materials is 438.00t, and the annual raw material cost is 110,000 yuan. - Energy costs. The main power of the biogas station comes from electricity, and the annual power cost is 30,000 yuan. -- staff salary. The annual salary of the biogas station is 60,000 yuan. -- maintenance fees. Biogas equipment needs regular maintenance, and the annual maintenance cost of the entire system is about 12,000 yuan. - Other expenses are 15,000 yuan.

![Figure 4. Analysis of Combustion and Decomposition Process of Crop Fuel](image)

(2) Biogas sales revenue and profit The results of the 2012 survey showed that the price of biogas was 1.5 yuan/m³, the average gas consumption per household was about 0.9m³, the number of gas households was 560, and the annual output of biogas was 184,000 m³. The income is 275,900 yuan; the annual operating cost is 227,000 yuan, the fixed cost per unit of gas is 0.87 yuan/m³, the variable cost per unit of gas is 1.23 yuan/m³, and the total cost per unit of gas is 2.10 yuan/m³. According to the current gas charging price, the project can only be guaranteed to operate.

(3) Financial analysis when only biogas sales revenue is used as biogas project revenue According to the cash flow data, it is calculated that only biogas sales revenue is used as engineering. The net present value, internal rate of return and investment recovery period of the project at the time of income, the specific calculation results.
Figure 5. Economic Analysis of Crop Fuel Combustion Technology

5.2. Technical analysis process
The main differences in technical and economic aspects of crop fuel pyrolysis crop fuel biogas centralized gas supply project are as follows: the process category is anaerobic digestion and decomposition; the main combustible components and calorific value of gas are large. The calorific value of crop fuel biogas is about 4 times of the calorific value of crop fuel air energy concentration gas. Therefore, the daily utilization of biogas is about 1 m³ per household, and the daily utilization of crop fuel gas (air energy concentration) is about 1 m³ per capita; The difference is large: the crop fuel biogas contains almost no tar, while the crop fuel gas has a high tar content in the crude gas, and must be defocused before the input pipe network supplies gas to the farmers; the H2S content in the crop fuel biogas is high, and the biogas supply must pass through Desulfurization treatment.

6. Conclusion
The pyrolysis energy concentration of crop fuels and the utilization of crop fuel biogas are all in the category of new energy-efficient utilization of crop fuel resources, but the former is a single-chain economy and the latter belongs to circular economy. In summary, various programs have been tested, and biofuels have a significant role in controlling climate change and reducing greenhouse gases. It can guarantee national energy security, develop rural economy and improve ecological environment. And alternative fuels that currently meet the requirements for renewable, clean, and large-scale supply are only biofuels. The energy concentration and gas supply technology using crop fuel as raw material has achieved good development in recent years, which is more suitable for rural reality in China. It is the best way to realize fuel energy concentration in rural life, pipeline gas supply, and change the rural energy structure and energy use mode. With the development of the rural economy, the proportion of fossil fuels such as coal and petroleum in the cooking energy of rural residents is increasing. The promotion and application of centralized fuel supply technology for crop fuel energy concentration is undoubtedly a substitute for fossil fuels and a large use of fossil fuels. The pollution problem brought about provides an effective way.

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