Industry Analysis of Recycling Application of Organic Waste Pyrolysis Co-production

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Abstract. Pyrolysis technology is a new development direction in recent years, through the specific analysis of the technology in the industry, to guide the development of technology and enterprise investment. According to the application of the technology in the industry, the application of technology, market size, national industrial policy, industry barriers and market competition are analyzed comprehensively. The results show that the first, organic waste pyrolysis technology has a high operating cost and has no obvious advantages in market competition compared with incineration. The second, technology is not mature enough, poor reliability and stability. Third, the lack of relevant industrial policies on pyrolysis technology has an adverse impact on the promotion and application of technology. Fourthly, as a new environmental protection and green treatment method, pyrolysis is being paid more and more attention by relevant departments and enterprises.

1. Introduction
Under the dual pressure of environmental pressure and energy pressure, waste incineration power generation, one of the technologies of waste thermal treatment, has attracted attention from all walks of life due to its dual aura of environmental protection and new energy. At present, it has become the mainstream way of waste treatment in China. However, the air pollution caused by the waste incineration project makes the application for construction difficult, and the waste incineration has caused mass incidents and a large number of petitions and lawsuits, causing great social impact. In this context, new safe and environmentally friendly technologies are needed to address waste disposal. Then pyrolysis technology began to get the attention of experts in various countries and input related research. Since pyrolysis is a chemical reaction under the condition of reduction, the emission of atmospheric pollutants is lower and cleaner. Pyrolysis can not only deal with garbage but also produce the available resources of gas or tar. Therefore, the technology has received widespread attention at home and abroad, and has been carried out related research and application.

2. Project application of pyrolysis technology
The research on pyrolysis and gasification technologies of organic wastes such as household garbage, straw and waste tires began in the 1970s, aiming to solve the world oil crisis and finding new energy sources that can replace oil [1]. Nowadays, with the gradual exhaustion of fossil energy, the search for new energy sources is once again concerned [2-3]. Throughout the development process of pyrolysis
technology at home and abroad, the purpose mainly focuses on two aspects [4-6]: first, the recovery and storage performance sources (fuel gas, combustion oil and carbon black) as the purpose of anaerobic pyrolysis technology; In addition, it is the reduction of secondary pollution caused by incineration and the amount of waste to be disposed of in landfills, aiming at the development of a technically pollution-free treatment system, pyrolysis and gasification technology [7-9].

In developed countries such as Europe, America and Japan, the research progress of pyrolytic gasification has reached a certain level, with a full set of mature technical equipment. Three pyrolytic gasification incinerators in shenzhen waste thermal gasification and incineration power plant use canada-based CAO technology, with a single capacity of 100 tons per day. The refuse pyrolysis gasification and incineration power plant in nanhai city, foshan, has two American Basic throwing grate pyrolysis gasification incinerators, with a single capacity of 200 tons per day [10-11]. Japan developed a variety of waste pyrolysis technology and equipment, is a typical pyrolysis technology and equipment mainly include: ishikawa island sowing grinding heavy industry company developed rotary kiln pyrolysis gasification and melting device, Ren fluidized bed gasification and melting of the original production of the developed device, kawasaki, direct melting pure oxygen pyrolysis device developed by sg company, kawasaki type gasification and melting device developed by kawasaki heavy industries company, Nippon steel, research and development of the blast furnace type gasification and melting device, and yoshikawa, a professor at the university of Tokyo industrial heat enthalpy recovery technology, developed more sections (MEET) [12-14].

China's organic waste pyrolysis and gasification technology started late, the development process only more than 10 years, but also made some achievements. Pyrolytic gasification technology has achieved demonstration project construction in China, mainly in small and medium-sized projects. At present, there are ningbo telai environmental protection co., LTD., Shanghai longyang environmental protection engineering co., LTD., ji Ming environmental protection engineering co., LTD., and fujian datian zhengren environmental protection engineering co., LTD. Can domestic waste pyrolysis gasification few demonstration project case number, respectively is 100 tons/day of shanxi xiangyuan life garbage incineration projects, 200 tons/day of jinan city life garbage incineration power plant, 80 tons/day of fujian field life garbage pyrolysis plant, 10 tons per day of zhoushan Xu Gong island resort living garbage incineration projects, shanxi hongdong county solid waste treatment plant 100 tons/day, 25 tons/day of zhoushan shengsi county first phase of the life garbage disposal, etc.

Anaerobic pyrolysis has been applied in France, Poland, the United Kingdom, Lebanon, Israel, Indonesia, dubai, Indonesia, central Africa and other places. The scale of processing is less than 1.5 tons of household garbage per hour and other organic wastes. In particular, it is worth mentioning that ETIA of France, DG of Germany, mesto of the United States, and klean of the United States have adopted anaerobic pyrolysis technology to establish operating projects for pyrolysis technologies of household waste, rubber, plastics, plastics, biomass, etc. Garbage pyrolysis technology has entered the stage of application, engineering and commercial promotion [15-16].

Domestic anaerobic pyrolysis technology has been applied to a small range of biomass such as straw, rubber and plastic and other single material field, the technology is mature, stable operation. However, there are no mature operation cases of the complex material components such as household garbage.

Most of the domestic waste anaerobic pyrolysis technology projects in China are in the pilot stage. Only Beijing shenfu group co., ltd. has set up a pilot plant of 50 tons in bazhou and a demonstration project with a scale of 200 tons in bazhou, hebei province, which is now in the pilot stage.

3. Pyrolysis gasification and anaerobic pyrolysis processes

3.1. Process description

Main technological process of anaerobic pyrolysis: comprehensive sorting of domestic waste + granulation of organic combustible RDF + anaerobic pyrolysis equipment + purification of
combustible gas and collection of carbon cooling. The products are used for relatively economical utilization of electricity generation.

Main technological process of pyrolysis and gasification: comprehensive separation of domestic waste + pyrolysis and gasification of vertical rotary pyrolysis gasifier + waste heat utilization power generation + flue gas purification, and making bricks with ash and slag.

Pyrolysis mainly USES high temperature to conduct material pyrolysis in an environment without oxygen, while pyrolysis gasification USES high temperature generated by domestic garbage combustion at the bottom of the furnace to conduct material pyrolysis, which is still combustion in essence, but the emission of pollutants has been greatly reduced compared with incineration, and the overall investment is lower. The principle of pyrolysis of the two pyrolysis technology routes is the same, but only the use of heat source is different. The main part of these two processes is the pyrolysis equipment, which is also the key point to distinguish the above two processes. After the comprehensive sorting of domestic garbage, inorganic materials, recyclable objects such as iron, glass, organic combustible materials such as organic matter, fabric, rubber, plastic are sorted out. Organic combustibles are transported to the pyrolysis unit for pyrolysis, and energy such as oil, gas and carbon are obtained; inorganic materials such as brick, sand and stone are made into bricks; recycled iron glass is taken out.

The comparison between anaerobic pyrolysis and pyrolytic gasification is shown in Table 1 below.

| Item                      | Anaerobic pyrolysis | Pyrolytic gasification |
|---------------------------|---------------------|------------------------|
| Feeding way               | Continuous feed     | Interval feed          |
| Raw material required     | RDF with a diameter of less than 10mm, a length of 20mm, and a 10% moisture content | Just sort and crush slightly |
| Heating mode              | The indirect heat transfer | Direct combustion heat transfer 20% |
| The air consumption       | 0                   | Initial combustibles are blended with gas or coal or wood Yes, The value that meets the standard discharge |
| Energy consumption types  | Electricity or coal |                        |
| Dioxins emission          | 0                   | 0                      |
| Fly ash                   | 0                   | About 1%-2%            |

Under the ideal condition of no inorganic matter, the output of each ton of domestic waste after treatment is shown in Table 2 below.

| Item    | Anaerobic pyrolysis | Pyrolytic gasification |
|---------|---------------------|------------------------|
| Oil (g) | 300                 | 0                      |
| Gas(m³) | 200                 | 800                    |
| Carbon(g) | 500               | 0                      |
| Dust    | 0                   | 200                    |

3.2. Kinetic model of pyrolysis integral method
At present, the integral method and differential method are mainly used to solve the pyrolysis kinetic process, in which the integral method is used for the calculation and analysis on the overall macro
level, and the differential method is used for the calculation on the micro level. As for the pyrolysis process, the integral method can more directly reflect the target effect, so this paper USES the integral method to solve the pyrolysis process. The kinetic solution model of integral pyrolysis is shown in Formula (1).

\[ F(a) = \int_{0}^{a} \frac{1}{f(a)} da = \frac{a}{\beta} \int_{0}^{\frac{E}{RT}} e^{\frac{E}{RT}} dT \]  

(1)

4. The target market and scale of pyrolysis technology and competition status

The target market of pyrolysis technology is mainly small cities such as counties, districts and towns. Affected by the structure of pyrolysis equipment and combustion process, the daily processing capacity of a single pyrolysis plant is less than 150 tons, and the scale of new domestic waste treatment plants is less than 600 tons, of which the processing scale of 100-300 tons accounts for the majority.

The processing capacity of more than 600 tons is mainly due to the fact that the investment of pyrolytic gasification and anaerobic pyrolysis is greater than that of incineration grate, and the system integration is more complicated than incineration.

At present, the competition pattern of waste incineration power generation industry presents the situation that foreign capital tries to enter, large domestic enterprises try to monopolize competition, and small domestic enterprises try to grab market share by price war. Therefore, when incineration is the mainstream process and the total amount of garbage is less than 300 tons, pyrolysis technology has certain competitive advantages.

5. Industry barriers

In general, BOT or PPP mode is adopted for urban waste treatment, and franchised by government-authorized enterprises. The sources of revenue are fees for disposing of waste (charged to the government), electricity for selling electricity online (charged to the grid) or sales of gas.

According to the current situation in China, the franchise agreement of municipal solid waste treatment generally takes the project operation period of 25-30 years, and the internal rate of return is between 8% and 9% as the pricing standard. The domestic waste business has the advantages of regional monopoly, certain control of profit margin and stable project return. Therefore, the leading enterprises in the industry rely on their brand and management advantages to achieve sustained growth of revenue and profit through regional expansion.

High barriers to entry, mainly including:

Technology: domestic waste treatment technology is relatively complex and has high technical content. Especially, pyrolysis technology has just started construction projects in China, and most of them have a short running time. The process maturity and integrity need to be further verified and improved.

Capital: the investment amount of garbage power generation project is relatively high, the investment requirement of medium scale garbage treatment plant is over 100 million, so the construction of garbage treatment plant investment capacity requirements are higher.

Performance: waste disposal often produces secondary pollution (such as leachate and carcinogen dioxins), and the nature of utilities makes the government's track record of technology providers very demanding.

6. The conclusion

There is a large market space in the field of household waste treatment, and there are only a few demonstration projects established by pyrolysis technology. In the domestic market background where incineration is the mainstream, pyrolysis technology and incineration do not have any obvious advantages in market competition.
Due to the lack of industrial policies and immature technologies, such as the failure of normal operation and high operating costs, pyrolysis technology, as an active field for experts and enterprises to discuss and develop, can continue to pay attention to the development of technology application in this field.

Pyrolysis, as a new method for the treatment of organic matter, has been paid more and more attention by relevant departments of the state. Since pyrolytic gasification has been applied in practical projects and has a large processing capacity, the nature of this method is consistent with that of incineration, which requires the treatment of flue gas such as fly ash and dioxins. Therefore, the environmental performance of this technology will be greatly reduced, and the pollution caused by garbage incineration cannot be fundamentally solved. Therefore, it is necessary to intensify the research and development of technology and equipment in anaerobic pyrolysis technology to expand the adaptability, economy and environmental protection of technology and equipment.

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