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**Development of Biomass Conversion Technology and Industry in China
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Nowadays, development and utilization of renewable energy resources promises good opportunities for China. The Chinese Ministry of Agriculture (MOA) is promoting the “energy agriculture” policy, which focuses on biomass resources development.

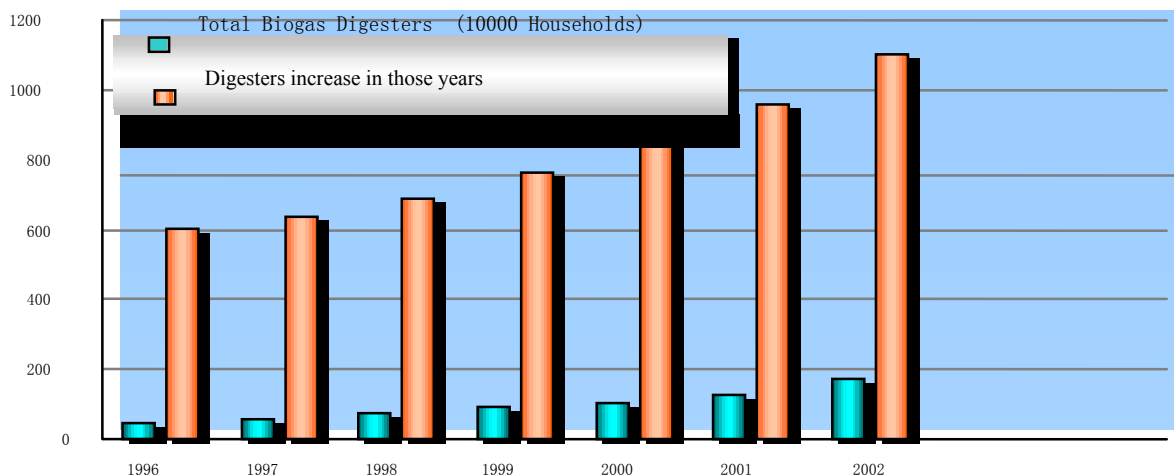
Biomass resources in China are characterized by a large variety, huge quantity and wide distribution. In terms of technological feasibility and economics, biomass that can be used for energy purposes is divided into 5 types: energy crops, agricultural straw, agricultural residues, forestry residues, human and livestock waste, industrial organic waste water and urban organic waste. In China, biomass is the major source of household fuel for rural people with a long history. With the urbanization of rural areas, intensification of agricultural production, and modernization of farmers’ lives, because of its “renewability” and the development towards large-scale, efficient, and clean utilization technology, biomass must play an important role in meeting energy demand, environmental protection and sustainable development.

Presently, technologies on biomass conversion widely used in China include: biogas, straw gasification and central supply, gasification and electricity generation, direct combustion for heating, briquetting and bio-fuel.

1. Biogas industry plays an important role in rural energy and environment construction in China

1.1 Biogas industry is developing into a new stage

In 2002, the central government invested 410 million RMB Yuan in rural energy construction. Local investment in rural energy also increased. More than 10 provinces such as Hebei, Liaoning, Hunan, Guangxi, Hainan, and Yunan provided special fund for biogas utilisation. The total amount of local investment in small commonwealth projects was 180 million RMB Yuan. In 2002, 1.7 million households became new biogas users, and there were 11 million biogas digesters in China, constituting an increase by 45.4% since 1999 (see figure 1). In 2002, there were 1859 large- and medium-scale biogas plants with the purpose to treat wastes from large livestock farms, increasing by 500 compared to 2001. The total capacity was 870,000 m³, with a production of 230 million m³ biogas and treatment of 46.56 million tons of waste water per year. Approximately 15,000 biogas digesters for household waste water treatment were built in 2002 adding up to 111,000 in China. The total capacity was 4.34 million m³, which treated 360 million tons of waste water per year.



1.2 New features and trends of biogas industry

Currently, biogas industry comprises of design and construction, biogas appliance production, supply, and operational service. The production capacity can meet the demand of construction of 300 large- and medium-scale biogas plants and 1.5 million biogas digesters and accessories.

- Strategy of “leading enterprises and brand products” has made good achievements.

The Jiangxi Provincial centre for Rural Energy and Environmental Protection Technology Development and its instrument factory increased their sales by 50% in 2002, and became the enterprise with widest market coverage in the field. The Beijing Hebaiyi Ecological Energy Science and Technology Development Company with its good performance concerning capital, technology, and management, was the only one named by the Ministry of Agriculture to have taken in tender enterprise for household biogas digester accessories. The largest gas apparatus enterprise in China, Zhongshan Huadi Gas Apparatus Company set up the Department of Biogas Apparatus Development. Because of its advantage in capital and technology, the company rapidly developed biogas stoves and accessories with good performance/price ratio.

- The product is up-graded and the quality improved

Based on its advantage in research, production, and technology, Luohe Yuli Instrument Company focussed on biogas barometers and developed a metal membrane barometer. Jiangxi Provincial centre for Rural Energy and Environmental Protection Technology Development produced erosion-proof biogas transmission components. Beijing Hebaiyi Ecological Energy Science and Technology Development Company developed adjustable cleaners that combine dehydrate, desulfate, pressure control and pressure display. Most of the enterprises that manufacture biogas stoves are paying attention to product quality, design of stove structure and improvement of product appearance.

- Improved techniques and engineering technology

Construction of household biogas digesters has been industrialized and commercialised. Research on large- and medium-scale biogas plant, equipment and post-treatment technology have made new achievements. Tsinghua University developed the 3-generation anaerobic fermentation techniques: ECSB and internal circulation reactors. ECSB has been practically used in China, and has reached a world leading level. The institute of Biogas Science of the Ministry of Agriculture, Shanghai Mingxing Energy Conservation and Environmental Protection Engineering Company, Hangzhou Energy and Environmental Engineering Company, Beijing Academy of Environmental Protection, Centre for Energy and Environmental Protection Technology Development of the Ministry of Agriculture, Department of Environmental Science and Engineering of Tsinghua University, and Beijing Meihuaboda Environmental Engineering Company are capable to design large- and medium-scale biogas plants. Besides, research and development of biogas generators also made good progress.

- Level and capability improvements for operational services

Government biddings and purchases have promoted the enterprise cooperation and industry developments, and therefore guarantee users' rights. Some strong enterprises catch the good opportunity to establish and perfect their own sale and operational service system while supplying biogas stoves into the market, which has dramatically improved the level of operational service. In the process of promoting industrialized management of household biogas digesters, some new management patterns such as township biogas associations were created.

- Improved systems of biogas industry standards

Improvement of the system of biogas standards has basically met the demand of development of biogas construction. Standards for Design, Construction, and Use of North Model of Household Rural Energy Engineering, Standards for Design, Construction, and Use of South Model of Household Rural Energy Engineering, and the National Standards for Household Biogas Stoves GB3606-83, which fully reflect up-grades of biogas stove technology, have been issued and implemented. Other relevant standards are to be issued soon. The institute of Biogas Science of Ministry of Agriculture and Centre for Biogas Product and Equipment Quality Test of Ministry of Agriculture have been working on the formulation, modification, and extension of biogas-related standards.

1.3 Planning of Biogas Construction Development provided good opportunities for biogas industry development

The 2003-2010 Biogas Construction Plan in Rural Areas of China, formulated by the Ministry of Agriculture, clearly stated that the government will actively promote the development of biogas industrialization, which provided excellent opportunities to industry development. According to the plan, 11 million household biogas digesters will be produced by the end of 2005, and then there will be a total of 20 million in China: one of every ten rural households will be a biogas user. In 2010, 50 million rural households (20% of the total) will use biogas as daily fuel. Meanwhile, the government will support the construction of large- and medium-scale biogas plants in "vegetable basket" livestock feeding base in suburbs of cities in East coastal areas and some other large and medium cities. 2500 biogas plants are to be constructed by 2005, which can supply biogas to 300,000 households; 5000 in 2006-2010, supplying 600,000 households. Implementation of such a great plan will strongly promote the progress of biogas technology and enable the biogas industry to improve further.

2. Biomass technology has made good progress

2.1 The Framework of standard systems has been established and relevant standards are gradually formulated

In this case biomass resources mainly refer to crop straw. Considering the current situation of biomass utilization in China, some of the biomass technology has not been technically mature enough to be widely applied. The technical limitation and management problems are too serious to realize a large scale application. Further experiments are necessary to decrease conversion costs and improve products' quality. At present, a framework of standardization systems has been established. Perfection of industrial standards ensures the further development of biomass utilization.

2.2 Diversified products variety and advanced technology

With the urbanization of rural areas, intensification of agricultural production, and modernization of farmers' lives, and because of its "renewability" and development towards large-scale, efficient and clean utilization technology, biomass must play an important role in meeting energy demand, environmental protection and sustainable development.

Currently, technologies on biomass conversion widely used in China include: biogas, straw gasification and central supply, gasification and electricity generation, direct combustion for heating, briquette for fuel and bio-fuel.

The existing village-level straw gasification and central supply plants can normally supply fuel gas to 100 - 1,000 households. The thermal conversion efficiency is more than 70%, the thermal value of fuel gas more than 4600kJ/Nm³, and CO and O₂ content is less than 20% and 1%, respectively. Compared with old straw gasification systems, the new ones have a better performance, especially for carbonisation gasification systems, and operation is more steady. However, the problems of low thermal value and high tar treatment costs still exist.

China is researching and developing two types of biomass gasification systems for electricity generation: fixed bed gasification and electricity generation systems, and fluidized bed gasification and electricity generation systems.

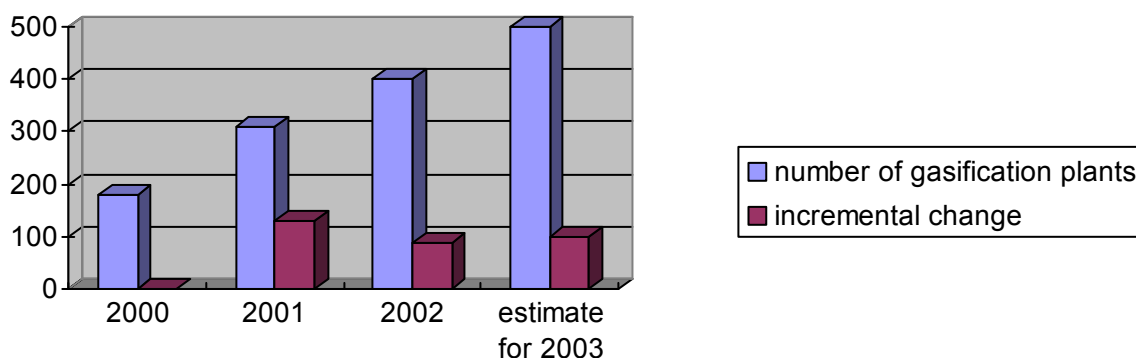
Biomass direct combustion is used for heating and drying. As an effective approach to consume large amounts of crop straw, this method has a promising prospect.

The prominent problem of biomass briquetting machines is that the press screw and sleeve do not have a sufficient life-time.

The technology of biological liquid fuel from biomass is now a research project funded by the State Planning Commission and Ministry of Science and Technology.

2.3 Industrialization process is seeking turning point

In recent years, industrialization of biomass conversion technology in China made good achievements, and a variety of enterprises and research organizations are able to conduct technology development, equipment production and plant construction. The involved fields are: biological liquid fuel from biomass, biomass gasification, biomass briquetting and fuel gas drying, biomass direct combustion boilers, etc. In particular, companies in the field of biomass gasification equipment production and technological service developed very fast, and industrialization and socialization of small-scale biomass boiler has achieved good progress.



Trend of Gasification Plant Development in China

By the end of 2002, there were more than 400 biomass gasification and central supply plants in China, which produced 150 million m³ of fuel gas per year and involved equipment manufacturing output of 900 million RMB yuan. There are more than 40 companies and research institutions able to undertake the design and construction of crop straw gasification and central supply plants in China. There are 15 biomass gasification and electricity generation plants in operation. 5 organizations are able to design and construct biomass gasification and electricity generation plants. Among them, Guangzhou Energy Institute of the Chinese Academy of Science is the best.

Biological liquid fuel mainly refers to bio-ethanol. China has issued national standards: *Denaturalized Fuel Ethanol* and *Vehicle Ethanol Gasoline*. The State Planning Commission has approved 4 demonstration projects, in Heilongjiang Province (200,000 tons per year), Jilin Province (600,000 tons per year), Henan Province (300,000 tons per year), and Anhui Province (60,000 tons per year), respectively. These projects produce fuel ethanol from old grain and the petroleum industry uses the ethanol to produce vehicle ethanol gasoline for sale at local gas stations.

The Chinese Academy of Agriculture Engineering and Beijing Taitiandi Energy Technology Development Company are undertaking a National 863 Project “Fuel Ethanol from Sweet Sorghum”. The technology uses sweet sorghum as raw material and produces fuel ethanol through biological conversion technology. The project is established on the base of biomass conversion technology, agricultural residue recycling technology, and ETBE (non-pollution ethanol gasoline additive) conversion and synthesis technology. A straw briquetting machine developed by Henan Agriculture University has been manufactured in several scales. Beijing Laowan Biomass Science Company has developed efficient biomass grain fuel automatic combustors and a series of stoves, characterized by high efficiency and environmental protection.

The development of renewable energy technology and industry in China has made good achievements with the help of international organizations such as UNDP, FAO, UNIDO, ESCAP, WORLD BANK and in cooperation with other countries. We are willing to carry out better and more effective cooperation with Latin countries to serve the whole world.