Feature Report—Environmental Business
Woody Biomass Power Generation Technology

Woody biomass, including wood waste from lumber mills and thinned wood, is environmentally conscious energy resource that is recyclable and considered to generate no CO_2. Woody biomass power generation can be categorized into large-scale centralized and small-scale distributed types. Since collection and transportation costs for woody biomass are relatively high, a power generation system optimized for use at the small-scale sources of the biomass is needed. We are committed to research, development and commercialization of a power generation system that is compact but features higher power generation efficiency through gasification of woody biomass.

Features of small-scale distributed woody biomass power generation

①Can help decrease CO_2 emissions by superseding conventional power generation processes.
②Can cope with very small-scale woody biomass sources that were not previously utilized for power generation.
③Power generation efficiency can be as high as 20% and the waste heat can also be utilized.

Product Introduction: Pressurized Fluidized Bed Gasifier—Gas Turbine Power Generation System
(suitable for application where 5 to 20 tons of woody biomass are available per day)

Tar can also be utilized as an energy source

Woody biomass is unique in that its gasification temperature is low compared to solid fuels such as coal. This enables woody biomass to be converted into fuels capable of generating high temperatures, including hydrogen and carbon monoxide, at relatively low reaction temperatures.

In order to realize a highly efficient power generation system by fully utilizing the advantages of woody biomass, it is necessary to achieve gasification at a lower temperature. However, gasification at a lower temperature can promote the occurrence of tar, which poses problems of adhesion and blocking.

To cope with this problem, a conventional system must either incorporate a tar removal system or execute gasification at a higher temperature to inhibit the occurrence of tar.

Our system utilizes wood waste as a fuel and generates gas with a pressurized fluidized bed gasifier. The gasification occurs at a relatively low temperature of approximately 650°C. The generated gas, which contains combustible gas and tar, is directed to the gas turbine combustor while maintaining the temperature and pressure in order to avoid tar troubles that could occur from solidification and liquefaction by cooling.

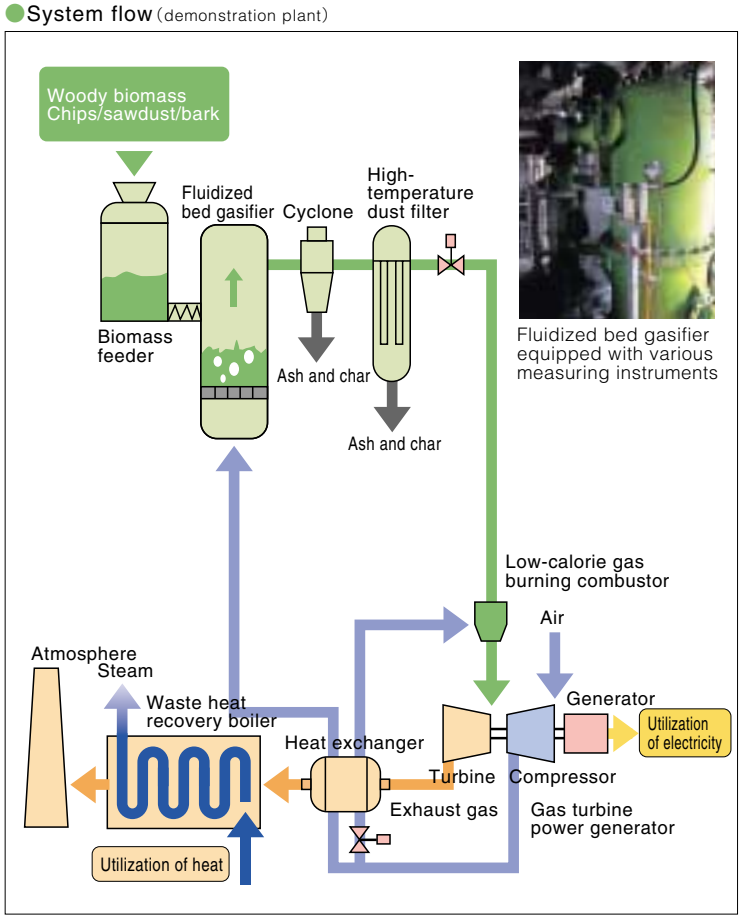
Our system is advantageous in that the tar removing system is eliminated and all the generated gas is utilized as a fuel for the gas turbine.

While the gas turbine is driving the generator, the waste heat is used to preheat the gasifying air introduced into the fluidized bed gasifier. Gasification at a lower temperature and reuse of waste heat help achieve a power generation efficiency of 20%. This energy conversion efficiency is much higher than 10% that is achieved by conventional boiler and steam turbine systems.

In FY2003, we constructed a test plant with a generation output rated at 24 kW. During FY2004, we are going to verify the performance of the whole system, and in FY2005, will start a demonstration test at an actual lumber mill.

Test plant during tests of gasification reaction characteristics

●System flow (demonstration plant)



Fluidized bed gasifier equipped with various measuring instruments

A system that can be operated with just three buttons

A gasification reaction test using a fluidized bed is currently in progress for the development of this system. During FY2004, we will begin a commercialization test. I think the highlight of the development work—when we offer the system at a lower price and complete an easy-to-operate system— will come soon. Because I myself was previously involved in the development of large-scale cement plants, I believe I must switch from a "large plant mind-set" to a "home appliance mind-set." Since our system will be used at lumber mills or the like, we have to complete a "system that can be operated with just three buttons."

Biomass technology is now attracting attention. About 50 years ago, Japanese were using firewood and charcoal for fuel, but these were replaced by coal and petroleum. Ironically, we are going to return to wood as a fuel. I hope that this trend becomes firmly established, and that society comes to use energies and resources that fit within natural cycles.

Tatsuya Watanabe
Senior Manager, Advanced Project Progressing Group
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Tar: A highly flammable macromolecular hydrocarbon that is likely to occur when wood is burned. When cooled, its components with high boiling points solidify and liquefy, resulting in high viscosity that can cause problems due to adhesion and blocking.

Product Introduction: Fixed Bed Gasifier—Gas Engine Power Generation System
(suitable for application with 1 to 5 tons of woody biomass per day)

Development of a gasifier that produces less tar

This system utilizes fuels, including wood residues, thinned wood and cut branches, with its fixed bed gasifier performing gasification. The main reason why gasification technique with woody biomass has not yet been commercialized is the problems caused by the tar in the gas generated from woody biomass. For this system, we have demonstrated, in partnership with a foreign venture company, a unique gasification technique that generates less tar. Thus, we have successfully designed with a much more compact tar removal system and reduced the initial and running costs.

The whole process is carried out at a pressure lower than atmospheric pressure. This decreases the possibility of gas leakage, attaining a higher degree of safety.

The calorific value of the gas generated from the gasifier is as low as 1/10 that of natural gas. To cope with this limitation, we have also developed a unique gas engine in partnership with a foreign company.

Currently, our system is undergoing a demonstration test with a test plant that has a power generation efficiency of 20% and a generation output of 80 kW, which is equivalent to the power requirements for about 30 households. A commercial version of our system will be released during FY2005.

Our system is suited for small-scale distributed power generation plants rated at 50 to 200 kW, and the waste heat from a gas engine in this system can also be utilized for various purposes, including steam generation, hot water supply and air conditioning.

Fast commercialization will contribute to the reduction of greenhouse gases

As the First Commitment Period (2008-2012) of the Kyoto Protocol will begin soon, effective greenhouse gas reduction efforts must start now. As can be expected from the establishment of "Biomass Nippon," a comprehensive strategy, in 2002, demands for bioenergy will expand significantly during the next several years. In order to shorten development lead-time and enable faster commercialization, with our foreign partners, we have been committed to R&D efforts for gasification and power generation technology, and started a commercialization program in FY2004.

In addition to working for Kawasaki, I am a Hyogo Prefecture global warming prevention activities advisor and an Environmental Counselor of the Japanese Ministry of the Environment. Citizens, local governments and businesses must each play their roles in decreasing greenhouse gas emissions. Still, fulfillment of the objectives of the Kyoto Protocol appears to be difficult in the current circumstances. As a researcher working at our company, I have been addressing how to decrease emissions of greenhouse gases by developing new products and new technologies. I believe it important to commercialize this product as soon as possible in order to help contribute to the reduction of emissions of greenhouse gases.

Satoshi Hirata
Manager, Bioenergy Group
Business Development Department

Test plant in demonstration trials

System flow