Applicability Evaluation of Processing Waste Biomass for Carbonizing Gasification Technology

Background

In order to control global warming and create a recycling society, the development of biomass energy utilization technology is strongly expected. CRIEPI has developed a small-scale and high-efficiency carbonizing gasification technology that uses woody biomass etc. as fuel. The food-processing waste generated in food factories and oil-plant dregs generated in plantations are energy resources that can be supplied stably at a low cost. Therefore, they are expected to provide good fuel that is suitable for the carbonizing gasification technology.

Objectives

The purpose of this study is to conduct carbonizing gasification tests using processing waste biomass (coffee dregs, beer dregs, PKS *1 and JSD *2) at the carbonizing gasification test facility of CRIEPI (Fig.1). The carbonizing gasification performance and the handling performance of pulverized carbide *3 of test fuels are shown from the experimental results. And also, the study aims to evaluate the applicability to the carbonizing gasification technology of test fuels from these performances.

Principal Results

1. Carbonizing Gasification Performance

The carbon conversions for test fuels are 99% or more (Fig.2) excluding the beer dregs of which the char gasification reaction rate is lower *4 than other fuels, and the cold gas efficiencies of test fuels excluding the beer dregs are equivalent to that of cedar (Fig.3).

2. Handling Performance of Carbide

(1) Grinding Power of Carbide: The grinding power of carbide for each fuel is less than that for cedar. Especially, the carbides of JSD and beer dregs can be ground by less than half power for cedar carbide grinding (Fig.4).

(2) Transportability of Pulverized Carbide: It is supposed that the transportability of the pulverized carbide of test fuels is good excluding the coffee dregs because the compaction *5 and homogeneity *6 of pulverized carbide of test fuels are equivalent to that of cedar carbide (Fig.5). In the carbonizing gasification test of the coffee dregs, it was confirmed that the pulverized carbide of the coffee dregs was stably transported by improving the powder transport system *7.

3. Applicability Evaluation of Processing Waste Biomass

The applicability of test fuels to the carbonizing gasification technology was evaluated from the carbonizing gasification performance and the handling performance of carbide (Table 1). All the test fuels show good applicability to the carbonizing gasification technology though the coffee dregs and the beer dregs need some improvement measures (Table 1) for pulverized carbide transportation and carbon conversion ratio.

Future Developments

To put this technology into practical use, we will tackle the following issues: decrease of installation cost, use of low grade (high moisture) fuel, and production of high-quality synthetic gas which can be use for chemical synthesis.

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Reference

M. Otaka, M. Ashizawa, K. Ichikawa, M. Nishita and T. Tanaka, “Development of Carbonizing Gasifier with Biomass and Waste”, Proceedings of International Conference on Power Engineering (ICOPE-09), Nov. 2009, Japan.

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*1：Palm Kernel Shell; a shell which surrounded a kernel of palm fruit. a residue generated in palm oil extract process.
*2：Jatropha Seed Dregs; a residue generated in Jatropha seed oil extract process.
*3：It is necessary to grind the carbide to adopt the entrained-flow type gasifier in this system.
*4：It is shown that the gasification reaction rate for the beer dregs carbide is about 1/10 of the cedar carbide by thermogravimetry.
*5：An index of the powder flowability. Generally, the powder flowability decreases when the compaction rises.
*6：An index of the powder flowability. Generally, the powder flowability decreases when the homogeneity rises.
*7：Installation of the air-driven vibrator, installation of the bridge breaker, and decrease of the piping curvature.

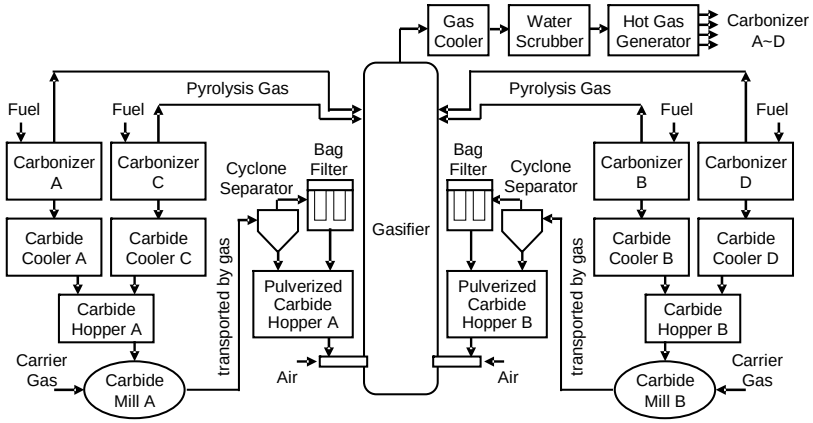

Fig.1 Flow Diagram of Biomass/Waste Carbonizing Gasification System

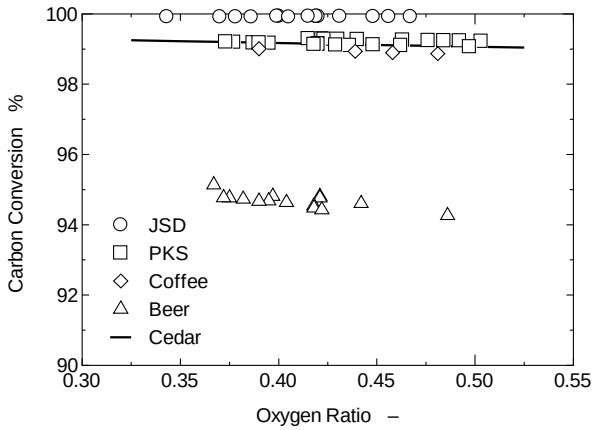

Fig.2 Comparison of Carbon Conversion

Oxygen-enriched air and installation of char recycle system are necessary to improve carbon conversion of beer dregs.

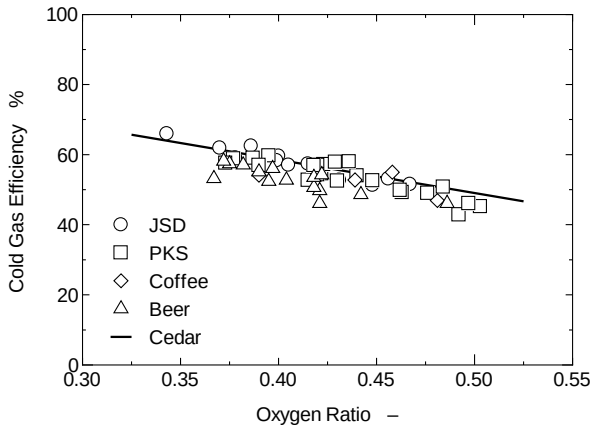

Fig.3 Comparison of Cold Gas Efficiency

Cold gas efficiency of beer dregs is 5-10 points lower than other test fuels.

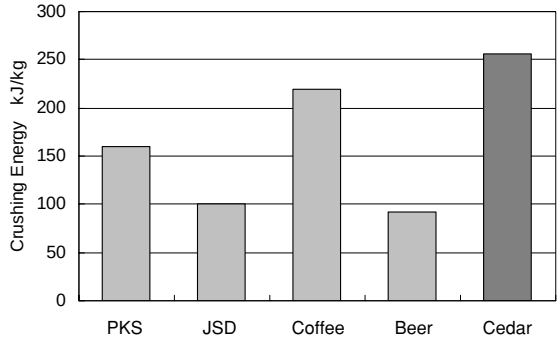

Fig.4 Comparison of Grinding Energy

Beer dregs and JSD of which carbide grinding energy is low have an advantage in the power consumption of the system.

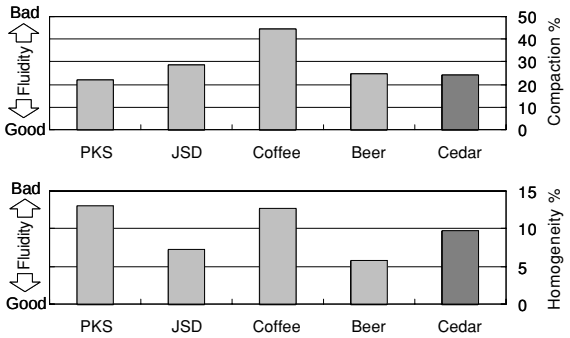

Fig.5 Comparison of Pulverized Carbide Flowability

In case of coffee dregs test, vibrator was installed in the transport system of pulverized carbide.

Table 1 Applicability Evaluation of Processing Waste Biomass

Fuel	Gasification Performance		Handling of Carbide		Total	Improvement Measures
	CC	CGE	Grinding	Flowability		
PKS	○	○	○	○	○	Unnecessary
JSD	◎	○	◎	○	◎	Unnecessary
Coffee	○	○	○	△	○	Bridge breaker, vibrator
Beer	△	△	◎	◎	△	Oxygen-enriched, char recycle system

◎:better than cedar ○:equivalent to cedar △:worse than cedar