Dewatering-in-oil Modification Technology for Biomass with High Moisture Content

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Biomass is carbon-neutral and its energy conversion is expected to be an important measure for reducing carbon dioxide which causes global warming. However, biomass contains a large amount of water, which reduces heat value, inhibiting the use of biomass as an energy source.

A gasification technology, using the dewatering-in-oil modification technology for biomass with high moisture content, has been developed by a collaboration among Kobe Steel, Central Research Institute of Electric Power Industry (CRIEPI), Ishikawajima-Harima Heavy Industries Co., Ltd., Hokkaido University and Kyoto University, under the "Development of Elemental Technology for Bioenergy Conversion" led by the New Energy and Industrial Technology Development Organization (NEDO).

Kobe Steel proved that our dewatering-in-oil technology, developed for upgrading brown coal (UBC) technology[1], is applicable to food waste, such as coffee and tea extraction wastes, with the same level of efficiency as for brown coal.

Dewatering-in-oil process

The outline of the process is shown in **Figure 1**. The process involves preparing a slurry mixture of medium oil, such as light and heavy oils, and highly moist biomass and heating the mixture to vaporize water. A high energy efficiency has been achieved by reutilizing the latent heat of evaporation by pressurizing the vapor. The process is versatile and can produce either solid dewatered biomass fuel or slurry fuel containing biomass, depending on the method for oil removal.

Biomass to be dewatered

Dewatering behavior was studied on highly moist biomass, including drink product wastes, such as tea and coffee wastes, and bagasse, a waste from sugar manufacturing. The autoclave test using a large scale dewatering test apparatus (**Photo 1**) indicates that a dewatering rate higher than 90% is achieved as shown in **Figure 2**.

Photo 1 Large scale dewatering test apparatus

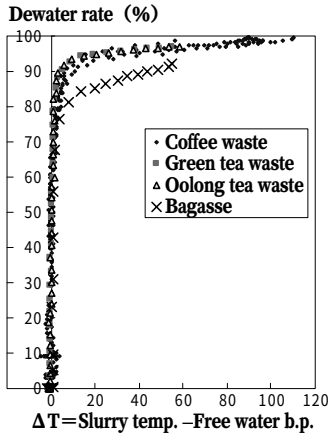

Fig. 2 Dewatering behavior of coffeewaste, tea waste, and bagasse

The feature of the dewatering process

In general, the energy efficiency of the dewatering process, which is expressed by the following formula, declines as the water content in biomass increases.

$$\text{Energy efficiency} = \frac{\text{Energy of the raw biomass}}{\text{Energy of the raw biomass} + \text{Energy required for dewatering}}$$

The Steam Tube Dryer (STD) method is a typical dewatering method. Its energy efficiency is compared to that of the dewater-in-oil method. As shown in **Figure 3**, the dewater-in-oil method, which utilizes the latent heat of water vaporization, has higher energy efficiency as the moisture content of the raw biomass increases.

Thus, the dewater-in-oil method is advantageous for dewatering of biomass containing a large amount of water. It is expandable to larger scale and is expected to be used as an energy conversion technology for biomass, such as food wastes.

References

1) T. Deguchi, et al., R&D Kobe Steel Engineering Reports, Vol.53, No.2, p.41(2003).

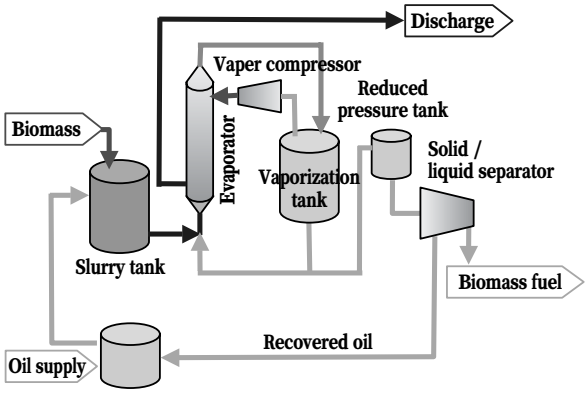

Fig. 1 Dewatering-in-oil process flow

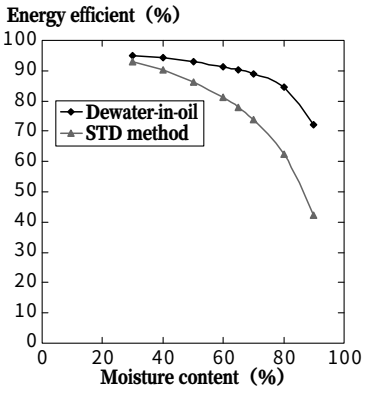

Fig. 3 Comparison in energy efficiency