Development of Innovative Gasification Process for Used Plastics by Using Fluidized Bed

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Abstract:

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1. In od c ion

In recent years, marine pollution caused by used plastics has become a serious issue, with an estimated 8 million tons of plastic waste entering the world's oceans annually[1]. The potentially significant impact of ingestion of these plastics by marine organisms on ecosystems is a global concern[2]. In 2018, the "Ocean Plastics Charter" was adopted at the G7 Summit held in Canada, calling for all signatory countries to make all plastics reusable, recyclable, and recoverable by 2030. Furthermore, in 2019, the Basel Convention was amended to prohibit the transboundary movement of contaminated used plastics. As a result, there is an urgent need for domestic processing of the large quantities of used plastics that were previously exported overseas for recycling purposes.

On the other hand, used plastics have a high calorific value equal to or greater than that of coal, making them a valuable potential energy source for Japan,

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duced by mixing and heating used plastics with wastepaper and is primarily used as a fuel for boilers in paper mills[3]. However, there are also challenges to

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by the decomposition of the plastic was collected periodically through a gas backflow system, and the contents of N_2, CO_2, H_2, CO, and light hydrocarbons (with carbon numbers ranging from 1 to 4) were measured using a gas chromatograph with a thermal conductivity detector (GC-TCD). The evaluation parameters for the generated gas were the LHV in kcal/Nm^3 and the carbon-to-gas conversion ratio in wt%. LHV is an indicator of the heat generation capacity of the generated gas, and was defined by the following equation based on the calculation method specified in JIS K2301 8.2.

represents the lower heating value (LHV) of the generated gas (kcal/Nm^3), represents the LHV of each gas component in the generated gas (kcal/Nm^3), and represents the volumetric content of each gas component in the generated gas (vol%). The carbon-to-gas conversion ratio indicates the proportion of carbon in the plastic that is transferred to the generated gas and serves as an indicator of gas generation efficiency. The carbon-to-gas conversion ratio was defined by the following equation based on the calculations reported by Koyama et al.[13].

$$\eta = \frac{\Sigma\left(\times \frac{}{.} \times \right) - \Sigma\left(\times \frac{}{.} \times \right)}{\times \frac{}{}} \times$$

η represents the gasification rate of the feedstock (wt%), represents the production rate of each gas component in the generated gas (NL/h), *C* represents the number of carbon atoms in each gas component in the generated gas (-), represents the quantity of each gas component in the gasifying agent (NL/h), *C* represents the number of carbon atoms in each gas component in the gasifying agent (-), ⁄ represents the amount of plastic used in the experiment (g/h), and *C* represents the carbon content of the plastic (wt%). The number of carbon atoms in each gas component refers to the number of carbon atoms contained per gas molecule, which is 1 for CH_4 and 3 for C_3H_8.

3. E e imen al Re l

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Fig. 3 shows the composition of gas product when crushed plastic was used as the feedstock, OG dust was used as the fluidizing medium, and the temperature was set at 600˚C (feedstock supply time: 59n-USra307.i20.6 (r) /P <<

the gasification rate was lower than when using γ-alumina, even when using Fe