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A Study on Co-gasification Characteristics of Palm Mill Byproduct (EFB) and Coal

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INTRODUCTION
Biomass to convert to energy is the secondary abundant resource in renewable energy and is able to resources produce efficiently biofuels. However, the amount of biomass utilization is limited in Korea, so it is necessary to obtain stable biomass resources and to make application technology development for bio-energy supply goal 3.4% in 2030. On the other hand, as the demand rise sharply in recent for palm oil, palm oil industry becomes active in major countries of palm oil production such as Malaysia and Indonesia and demand amount is already produced the expected value in 2020 [1-3]. Accordingly various and significant amounts of by-products from palm mill have been generated, and if such palm byproducts after extracting palm oil could be used as a resource of biomass to energy, and economical production of bio-energy becomes a realistic alternative in biomass lacking resource country like Korea. Thus, the present study was performed to produce syngas at a bubbling fluidized bed reactor by using empty fruit bunch (EFB) as biomass energy sources. Also, it is expected to be unstable supply, therefore they could be mixed with other fuels or used as another alternative make- up for the short amount of fuels. The co-gasification experiments were carried out using EFB with coal. And the optimum operating conditions were derived from the comparison of syngas yield composition of syngas and heating values.

EXPERIMENT AND METHOD
The experiment equipment used in this study was divided into four parts. They are the preheating section, reaction section, purification section, and analysis section. A pre-heater is installed between the wind-box and gas inlet in preheating section. And for minimizing temperature drops, temperature of gas entering the reaction zone is risen by pre-heating. The schematic diagram of the experimental set-up is shown in Fig. 1. On the other hand, the ratios of coal and EFB were set to 9:1, 8:2, and 7:3, and the temperature range experimented was ranged from 700 to 1,000 °C. By the results of EFB gasification experiment because the auxiliary fuel is generally no more than 20 % of the mixing in the plant for the co-firing ratio. Table 1 shows the elemental analysis result and heating value and Table 2 is the proximate analysis result as the basic properties of EFB used in this experiment.

Table 1. Elemental Analysis result of EFB

<table>
<thead>
<tr>
<th>Elemental [wt. %]</th>
<th>C</th>
<th>H</th>
<th>O</th>
<th>N</th>
<th>S</th>
<th>HHV [kcal/kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>41.81</td>
<td>5.73</td>
<td>37.36</td>
<td>0.84</td>
<td>ND</td>
<td>3,930</td>
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</tbody>
</table>

Table 2. Proximate analysis result of EFB

<table>
<thead>
<tr>
<th>Composition [wt. %]</th>
<th>Moisture</th>
<th>Volatile</th>
<th>Fixed-Carbon</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>9.03</td>
<td>64.95</td>
<td>19.48</td>
<td>5.94</td>
</tr>
</tbody>
</table>

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Key Word; empty fruit bunch (EFB), Gasification, coal, syngas, fluidized bed
RESULTS AND DISCUSSION
Fig 2 shows the syngas composition and heating value with respect to temperature for EFB only. After EFB gasification experiment, the optimum condition was decided to 900 ~ 1,000 °C, as considering tar, gas composition, dry gas yield, and cold gas efficiency. And then, co-gasification was performed along this result. Fig 3 shows the result of co-gasification at the mixing ratios of coal and EFB, it needs a higher temperature and ER to get more amount of syngas. However, considering the economic and EFB efficient treatment, the optimum mix ratio is 8 to 2 at 1,000 °C and ER 0.6. Also, it is important not to exceed 20 % of mixing ratio, at general plant, so it is judged that the optimum mixing ratio is 8 to 2.

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REFERENCES