Comparison of efficiency depending on presence of food wastes washing in aerobic composting

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1. Introduction
Food waste accounts for the highest portion of overall municipal solid waste in Korea, at 23% or 11,464 ton/day (in 2004).1) Food waste is easy to decay because of higher content of water and combustible matter, and due to the unique cuisine of Korea, its salinity ranges from 0.5 to 2.0%, which is much higher than other organic wastes.2) These characteristics of food waste have caused a number of environmental problems by unpleasant smells and extraction water as well as handling difficulties as in collection and transportation.

Accordingly, it is necessary that organic waste such as food waste is treated and controlled and the method of aerobic composting has been widely used for treatment of organic waste.

In this regard, this study aimed to compare the composting efficiency by wash-out in order to assess how salinity as a key factor in food waste treatment by aerobic composting would affect the efficiency of composting.

2. Experiment Method
2.1 Experiment Apparatus
Two cylindrical reactors made of acryl were employed for this study, with effective capacity of each reactor being 7L. Besides, control panel was used to control the direct driven stirrer, temperature sensor, and diffuser.

2.2 Characteristics of samples
Food waste used in this study were collected from a dormitory cafeteria of Kangwon National University and crushed evenly to produce 2 samples weighing 3kg each. One of the samples mixed with 6L of stilled water were left to be dried naturally after dehydration. After adding 6L of rice straw to the samples, wash-out sample W-1 was poured into Reactor 1 and nonwash-out sample N-1 into Reactor 2 for experiment. Each reactor was stirred for 1 minute at 20rpm daily,
with 1.5L/min of air infused. Table 1 showed physic-chemical characteristics of food waste and rice straw.

Table 1. Physical-Chemical properties of food wastes and rice straw

<table>
<thead>
<tr>
<th>Items</th>
<th>pH</th>
<th>Moisture content(%)</th>
<th>TS(%)</th>
<th>Ash Content(%)</th>
<th>TOC(%)</th>
<th>Salinity(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W-1</td>
<td>4</td>
<td>80</td>
<td>20</td>
<td>1.9</td>
<td>54.5</td>
<td>0.24</td>
</tr>
<tr>
<td>N-1</td>
<td>4</td>
<td>75.8</td>
<td>24.2</td>
<td>1.1</td>
<td>54.9</td>
<td>0.53</td>
</tr>
<tr>
<td>Rice straw</td>
<td>7.8</td>
<td>7.7</td>
<td>92.3</td>
<td>10.1</td>
<td>49.5</td>
<td>0.03</td>
</tr>
</tbody>
</table>

2.3 Analysis Method

Temperature was measured by a digital thermometer that allows for automatic measuring, with pH level being measured by ORION 720 model. In addition, the content of water, solid substances, and ash was calculated under the Act of Waste Treatment Experiment, with the content of NaCl being measured by Mohr's method and TOC content by Formula (1) below, respectively. ³)

\[
\text{TOC}(\%) = 100 - \frac{\text{Ash}(\%)}{1.8} \quad (1)
\]

3. Results and Discussion

Changes in external temperature and temperature of each reactor were indicated in Fig.1. Initially, temperature of W-1 and N-1 was 19°C and 17°C, respectively. Temperature of W-1 sharply increased 1 day later to 29°C and that of N-1 amounted to the maximum of 31°C. Namely, the result showed that stronger wash-out sped up aerobic composting, which implies that decreased salinity functioned to activate the effect of micro-organisms leading to rapid rise in temperature.

Initial pH level was 3.9 in W-1 and N-1 alike. The pH level of W-1 rapidly increased to reach optimal pH 7 for composting on the 5th day and maintained uniform pH level thereafter. The pH level of N-1 reached pH 8 on the 13th day and continued to maintain a uniform pH level. This result revealed that generation of organic acid in N-1 was maintained for a significant period at initial stages of reaction, which resulted in increase in time to reach optimal pH level.

Fig. 1. Temperature changes during the operation period

Fig. 2. pH changes during the operation period.
Table 2. Comparison of washing before and after composting

<table>
<thead>
<tr>
<th>Items</th>
<th>Samples</th>
<th>Salinity(%)</th>
<th>TOC(%)</th>
<th>Organic matter(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>W-1</td>
<td>0.21</td>
<td>48.1</td>
<td>63.1</td>
</tr>
<tr>
<td></td>
<td>N-1</td>
<td>0.33</td>
<td>47.6</td>
<td>63.6</td>
</tr>
<tr>
<td>After</td>
<td>W-1</td>
<td>0.28</td>
<td>43.3</td>
<td>46.2</td>
</tr>
<tr>
<td></td>
<td>N-1</td>
<td>0.44</td>
<td>44.2</td>
<td>58.2</td>
</tr>
</tbody>
</table>

Table 2 showed minimization of TOC and organic substances by salinity. As a result of experiment, lower salinity was found to be more effective for minimization of TOC and organic substances than higher salinity. Additionally, using rice straw lower in salinity as a bulking agent was more effective for dilution of salinity.4)

4. Conclusions
The result of this study indicated that if washed out, temperature increased to the maximum as well as optimal pH range more quickly. Moreover, lower salinity was found to more effective for minimization of organic substances. Therefore, controlling salinity by means of wash-out is considered more effective in the course of composting process of food waste.

References
1) Ministry of Environment, ENVIRONMENTAL STATISTICS YEARBOOK, 2004