The Characteristics of the Bio-char with the food waste by Hydrothermal carbonization

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1. Introduction

Despite amount of food wastes in Korea is increasing every year, the wastes recycle and disposal difficult because containing a large amounts of sodium concentration and moisture content. In this study, bio-char was produced using Hydrothermal carbonization (HTC) that is one of the low-temperature thermal decomposition method. Hydrothermal carbonization (HTC) is a method of carbonization with water-containing material in a relatively low temperature (180-250 °C) in a completely sealed reactor. The advantage of this method is that raw material can be used directly without pretreatment such as dehydrated and dried. So, It is economically advantageous process for treatment of water containing organic waste like food wastes, sewage sludge. Accordingly, objects of this study are making a laboratory scale bio-char reactor and analyzing the characteristics of bio-char that is produced the reactor refer to previous studies.

2. Material and Method

Food wastes used in this study are taken S university students restaurant in Seoul. And the physical properties of the food wastes are shown in Table 1. The capacity of bio-char reactor was made to be possible up to amount of 24L and a pressure of 2.0Mpa. However, previous studies derived appropriate amount that is up to 70% of the reactor's volume. So, bio-char were produced amount of 5kg, 10kg, 15kg and reacting time of 2 hours, 4 hours and 6 hours at 200 °C. Also pressure was retained 1.5 Mpa for derived appropriate condition. After deriving the appropriate conditions, reaction was carried out at pressure of 1.0 Mpa and 1.8 Mpa. If the pressure is higher than the reactor conditions, the decompression was performed venting for retaining pressure. After pretreatment, bio-chars were analyzed such as iodine adsorption capacity, scanning electron microscopy (SEM), salinity, ultimate analysis and heating value.

Table 1. Physical properties of food wastes

<table>
<thead>
<tr>
<th>Composition (%)</th>
<th>Grain</th>
<th>Vegetable</th>
<th>Fruit</th>
<th>Meat</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>66.22</td>
<td>13.92</td>
<td>0</td>
<td>18.35</td>
<td>1.49</td>
<td>100</td>
</tr>
</tbody>
</table>

3. Result and Conclusion

(1) Bio-char yield of 15kg when the amount of the raw material and the reaction time was 2hours, and when the pressure of 1.5Mpa is the highest. However, reaction time 2 hours was excluded because the time did not happen complete carbonization react. So, when amount of 15kg, reaction time of 6 hours and pressure of 1.5 Mpa showed the highest yield.

(2) Although the ultimate analysis results did not show a pronounced tendency, the carbon content of the food wastes is 10%, but the bio-char carbon content was increased by an average of 50% or more. Also the moisture content of food wastes are almost 80%, but the bio-chars moisture contents are decreased by 20% or less.

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(3) Iodine adsorption capacity carried out for determining whether soil amendments or adsorbent. Food wastes of 10kg, reaction time of 6 hours and the pressure of 1.5Mpa is the highest results that is 421.78 iodine mg/g. The result is significantly lower than iodine adsorption capacity of activated carbon that is 900~1100 iodine mg/g. So, bio-char need pretreatment for increasing the specific surface.

(4) Observation of the food wastes surface using Scanning Electron Microscopic (SEM) showed rough and plane, but surface of bio-char showed mostly spherical and distribution of fine pores was also confirmed. Porous characteristics of the bio-char to supply oxygen to the soil helps to root respiration. Also, bio-char is alkaline, so it can do excellent effect to acid soil.

(5) Initial concentration of Salinity of food wastes are over 2.24%, but after reaction decreased from 40.51%~66.00%. However, in fertilizer process specification since August 1998 implementation, if food wastes use soil amendments, salinity is regulated to 1% or less. Thus, it is required pretreatment process for making bio-char of lower salinity.

Fig. 1. The yield and salinity of bio-char with food wastes

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