Proliferation of Microorganisms of Composting by Addition of Various Charcoals

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Abstract

Wood and bamboo charcoals have pores of several microns meter and several ten microns meter which are suitable size of microorganisms for making compost of biomass waste. We prepared various charcoals made from bamboo, concrete frame wastes, and corn-cob carbonized at 600 - 700°C. The charcoal was mixed with rice bran as nutrient with weight ratio of 1: 1.15. Moisture content of the mixture was adjusted to 65%. Aerobic complex microorganisms as seed were added to the mixture. The samples were maintained in ambient air at 23°C and stirred vigorously with spatula once a day in order to contact the system with air. It was observed by scanning electron micrograph (SEM) technique that the microorganisms proliferated on surface in the pores of the charcoal. The amount of the microorganisms was estimated by measuring adenosine triphosphate (ATP) concentration in the samples. The microorganisms proliferated by mixing charcoal with rice bran. It was also found that the proliferation depends on pH in the system.

Keywords: Charcoal; Compost; Microorganism; Proliferation; ATP

1. Introduction

In Japan charcoal and compost of biomass waste have been used for a long time as a soil improver and fertilizer in a farm [1][2]. Compost made from garbage generated by homes, restaurants and food industries and livestock waste and its utilization is receiving attention from the viewpoint of recycle of biomass wastes. As wood and bamboo have pores (several to several ten micron meter) which are the size that are suitable for microorganisms to support, by adding charcoal from the beginning of composting, the proliferation of microorganisms will be enhanced. It is expected, therefore, that the time required for making compost will be shortened and compost will contain a lot of microorganisms.

In this study, by mixing complex microorganisms used for compost with charcoal made from various kinds of biomass, the proliferation of microorganisms was studied.

2. Experimental

2.1. Sample preparation

Charcoal was prepared from bamboo, concrete frame waste and corn-cob as a raw material which were carbonized at 600°C to 700°C in furnace (Ventuer Viser Inc., type-VI). The charcoals pulverized and sifted into 1 - 3 mm of the size were used as a medium. Table 1 shows characteristics of various charcoals.

Microorganisms in the system are proliferated by mixing rice bran as nutrient with charcoal. Rice bran (16.7 g) was added into charcoal powder of 16.1 g in 300 ml flask. Weight ratio of the charcoal with the rice bran was 1: 1.15 [3]. Moisture content of the mixture was adjusted to 65%. The mixture was treated at 120°C for 60 minutes by a high pressure sterilizer.

Aerobic complex microorganisms (Kokubun Farm Inc.) were added as seed to the mixture. The samples were maintained in ambient air at 23°C and stirred vigorously with spatula once a day in order to contact the system with air.

2.2. Measurement

Microorganisms proliferated on surface of the charcoal were observed with a scanning electron microphotography (SEM).

Amount of the microorganisms was estimated by measuring adenosine triphosphate (ATP) concentration in the samples (Meidensha Corp., Luminometer UPD-4000) [4].

Table 1

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Bamboo</th>
<th>concrete frame waste</th>
<th>corn-cob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific surface area (m² g⁻¹)</td>
<td>420</td>
<td>580</td>
<td>230</td>
</tr>
<tr>
<td>Bulk density (g/ml)</td>
<td>0.17</td>
<td>0.25</td>
<td>0.18</td>
</tr>
<tr>
<td>pH</td>
<td>9.2</td>
<td>8.9</td>
<td>9.5</td>
</tr>
</tbody>
</table>

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3. Results and discussion

3.1. SEM observation of Microorganisms

Figs. 1(a), (b) and (c) show SEM photographs of microorganisms on surface of the charcoal made from bamboo, concrete frame waste and corn-cob, respectively, after 336 hours following addition of the microorganisms into the mixture of charcoal and rice bran. Morphologically rod and short rod microorganisms can be observed on the surface and in the pores of the charcoals. It was confirmed that charcoals can be used as the matrix for these microorganisms.

3.2. pH and ATP concentration

Time dependence of pH and ATP concentration in the samples are shown in Fig. 2 and Fig. 3, respectively. In the systems used charcoal as a medium the pH increases linearly and the ATP concentration increases continuously up to 200 hours, and then it decreases. The pH and ATP concentration in the system without charcoal increase up to 50 - 100 hours, and then both decrease. After 100 hours the ATP is almost zero value.

4. Conclusions

Charcoals made from bamboo, concrete frame wastes, and corn-cob and rice bran as nutrient was mixed in the ratio of 1: 1.15. Aerobic complex microorganisms were added as seed to the mixture. It was observed by SEM technique that the microorganisms proliferated on surface and in the pores of the charcoal in the mixture. Microorganisms proliferated by mixing charcoal with rice bran dependent on the pH in the system.

References