Composting Using Food Wastes and Sewage Sludge

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Abstract

Composting experiment was conducted with the mixing ratio of food waste versus sewage sludge being respectively 10:90, 30:70, 50:50, 60:40, 70:30 and 90:10 wt%. The fermentation temperature was 18-22℃ in the beginning, and then it was sharply increased to 44-66℃up to 1 day after fermentation, which was maintained for more than 3 days. Then, it was slowly decreased to 18-25℃ up to 8 days after fermentation, which was maintained all the time. In conclusion, it could be known from examination of various conditions, including reaction rate, salinity, C/N ratio, temperature, organic substance, etc. while composting of food waste that in case food waste and sewage sludge were mixed at the mixing rate of 60:40 wt%, the most ideal composting reaction occurred.

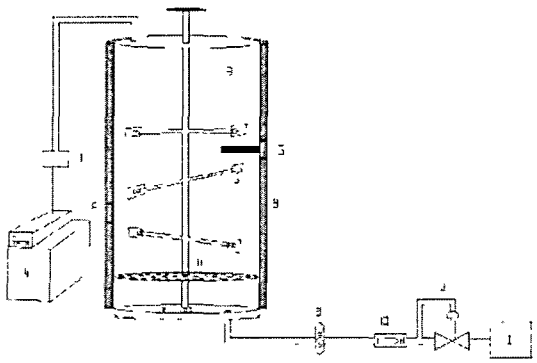
Introduction

During the past decade, production of food wastes in this country has significantly increase and become a major environmental concern today. Higher living condition has also increased the production rate of food wasted per capita accelerating the overall increase of food wastes quantity. In this study, sewage sludge, which met the requirements as set forth in the current regulations, was collected from a rural area, and food wastes were collected from garbage trucks for collecting food wastes which were operated by Sangju municipal government, where food wastes had been sufficiently mixed.

Materials and methods

Composting experiment was conducted with the mixing ratio of food waste and sewage sludge being respectively 10:90, 30:70, 50:50, 60:40, 70:30 and 90:10 wt%. The fermentation temperature was 18-22℃ in the beginning, and then it was sharply increased to 44-66℃ up to 1 day after fermentation, which

was maintained for more than 3 days. Then, it was slowly decreased to 18-25℃ up to 8 days after fermentation, which was maintained all the time.



1. Air compressor.
2. Mixing impeller.
3. Reactor(Composting material)
4. CO_2- O_2analyzer
5. Thermometer
6. Sampling port
7. Mixture absorbent($CaSO_4$)
8. Insulator
9. Air flow meter
10. Air filter
11. Distributor
12. Air box
13. Air regulator

Fig.1. Schematic diagram of composting unit using food waste.

Results and Discussion

In the case of a change in pH depending upon fermentation, pH got to be lowered to pH 4.5~6.2 due to production of organic acid at the initial stage of putting the mixture into a reactor, and it was increased to pH 7.3-8 due to production of ammonia up to 2 days after fermentation. Then, it was gradually lowered, and at the end of composting, the values were pH maintained at between 6.5 and 7.7. The content of harmful heavy metals in sewage sludge was much lower than the reference value of heavy metals as specified in the fertilizer process standards so that it could be used as an organic substance source. And, in all 6 reactors using different mixing rates respectively, a degree of salinity was much lower than 1%, the reference value as specified in the fertilizer process standards. Therefore, it was found that when composting food wastes, there was no problem resulting from salinity. The total cell count was maintained at $10^{8\sim9}$ cells/g during the composting process, which was shown to be similar to that as shown in other general studies. As a result of analyzing a change of temperature and a change of C/N ratio, it could be known that only when the mixing ratio of food waste was over 30 wt%, composting happened to go ahead, and that when it was below 30 wt%, a high temperature suitable for composting could not be maintained, because insufficient organic substance caused insufficient caloric power. Assuming that the decompose reaction, the reaction rate constant were as follows;

0.01179 in the reactor where food waste was mixed at 10 wt%, 0.00882 at 30 wt%, 0.01000at 50 wt%, 0.02051 at 60 wt%. 0.01087 at 70 wt%, and 0.01236 at 90 wt%. It could be, therefore, known that in the reactor where food waste was mixed at 60 wt%, it was shown to be the highest so that such reaction occurred most rapidly.

Conclusion

Composting experiment was conducted with the mixing ratio of food waste and sewage sludge being respectively 10:90, 30:70, 50:50, 60:40, 70:30 and 90:10 wt%. The results were summarized as follows. In conclusion, It could be known from examination of various conditions, including reaction rate, salinity, C/N ratio, temperature, organic substance. Optimum mixing ratio of composting during food waste and sewage sludge were 60:40 wt%.

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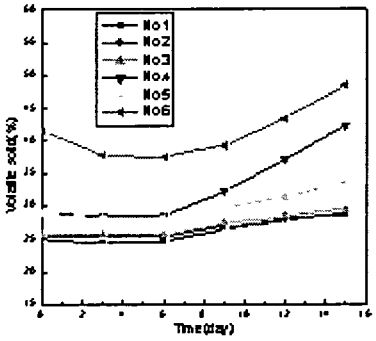

Fig. 1. Changes of organic matters during the compost period.

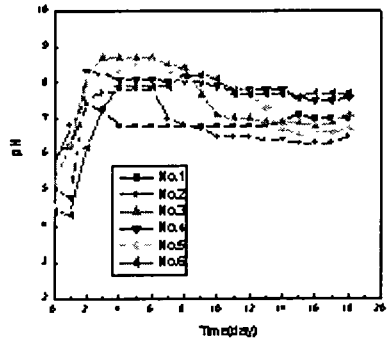

Fig. 2. Changes of the pH values during the composting period.

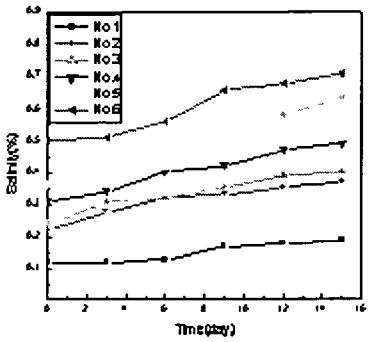

Fig. 3. Changes of salt concentration. during the composting period.

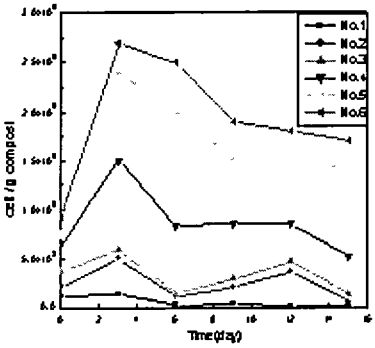

Fig. 4. The number of total bacteria during the composting period.

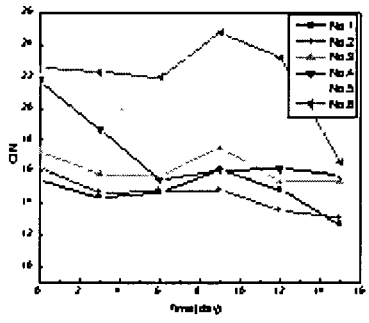

Fig. 5. Changes of the C/N ratio during the composting period.

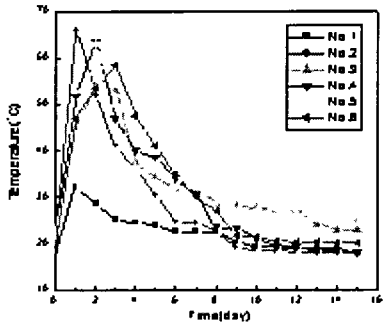

Fig. 6. Changes of temperature during the compost period.

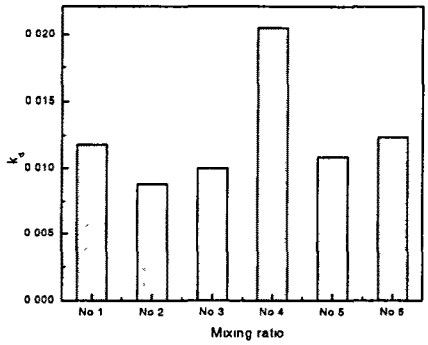

Fig. 7. Variation of k_d with mixing ratio.