INFLUENCE OF IMPURITIES ON AEROBIC DIGESTION OF FOOD WASTE

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1. Introduction

Nowadays, it is a serious subject how to deal with waste in the earth scale. Especially in the developing countries, the amount of municipal solid waste (MSW) discharged increases tremendously due to the economic development and population increase. Since most portion of the MSW is landfilled without any treatment in these countries, it becomes difficult to make new landfilling site and there are serious environmental problems around the existing site, such as soil pollution, subterranean water pollution, bad smell. It is, therefore, necessary to introduce an alternative waste processing method, immediately.

In Bangkok, the aerobic digestion of MSW was tried, as the MSW contained large amount of food waste. However, this trial of new waste processing method did not succeeded because of the imcompleteness of the MSW separation.

In this thesis, the influence of the impurities on the aerobic digestion of food waste were studied experimentally in terms of the mass changes of model waste and chemical elements composing the waste, and so on.

2. Experimental

Model waste consisted of Okara (bean curd), paper, and polyethylene sheet (PE). Okara was the model of food waste because the carbon-nitrogen ratio (C/N ratio) of Okara was almost same as that of real food waste. Paper and PE were selected as model impurities. Lumber chip played a part in keeping interstitial ratio and water content of the solid residue in the apparatus appropriately. pH of the residue was adjusted by the addition of $CaCO_3$.

A commercial household digester (*Gomi-Nice* SNS-M15, SANYO Electric Co., Ltd.) was employed as an apparatus. This digester is equipped with a simple stirring tool and needs not to seed any microorganism before the runs.

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Table 1 Composition of model waste

Run No.	Composition
1	1.5 kg Okara
2 and 3	1.5 kg Okara and 0.15 kg Paper
4	1.5 kg Okara and 0.15 kg PE
5	1.5 kg Okara, 0.15 kg Paper, and 0.15 kg PE

At the beginning of the run, t=0 day, 4.5 kg of the lumber chip and 0.05 kg of $CaCO_3$ were put into the apparatus. After 0.5 kg of Okara was supplied to the apparatus everyday until t=8 or 9 day to propagate the aerobic microorganism spontaneously without seeding, the model waste with or without impurities was fed and was digested. The compositions of the model wastes in respective experimental runs are summarized in **Table 1**. During the run, proper amount of water was added to the solid residue to adjust the water content at higher than 0.4 (the range of 0.4~0.6 is best for the microorganism). The temperature of the residue was measured at 5 cm below the surface of the residue in the apparatus. The masses of the apparatus with and without the residue were weighed to know that of the residue. The negligible amount of the residue was sampled for the analysis to determine the water content, pH, and C/N ratio. In this way, the time courses of these factors were obtained.

3. Results and Discussion

The temperatures of the residues in the apparatus, T, are shown in **Fig.1** with the room temperature, T_a. Temperature of the residue to be digested is an index of the activity of the aerobic microorganism. The temperature, T, rose with time and reached to 45 °C at highest until t=10 day, so that the aerobic microorganism was propagated sufficiently to digest the waste, in all experimental runs.

Figure 2 shows the plot of pH of the residue against time. In the beginning stages of the runs, pH increased, after that, reached at about 8.5, and did not change, in all cases. During the digestion, after ammonia was generated in the first stage, then

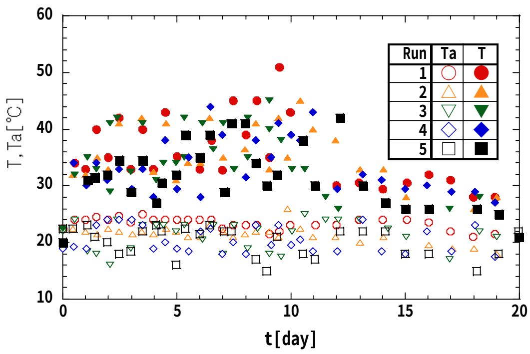

Fig.1 Time courses of temperature of solid residue, T, and room temperature, T_a

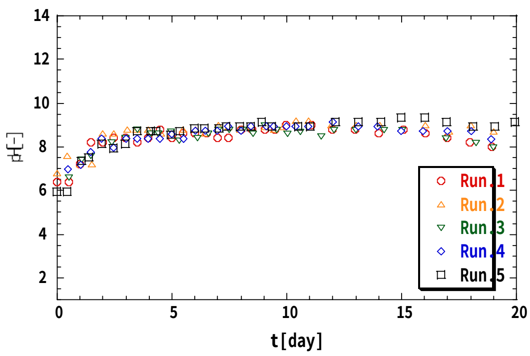

Fig.2 Time courses of pH of solid residue

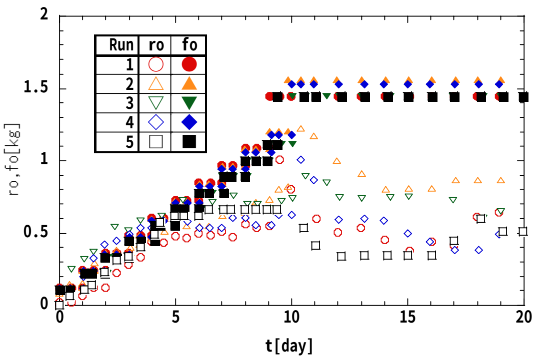

Fig.3 Time courses of dry masses of total amount of feed Okara, f_O, and solid residue from Okara, r_O

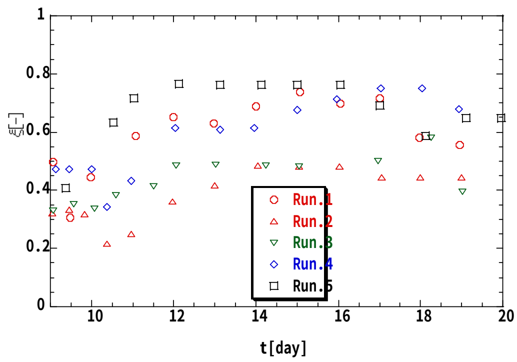

Fig.4 Time courses of mass reducing factors of Okara, ξ_O

organic acids were generated.

The total dry masses of Okara introduced into, f_O, and those of the residue converted from Okara, r_O, are shown in **Fig.3**. The r_Os were calculated with the assumption that the lumber chips, $CaCO_3$, paper, and PE were not digested. r_O without any impurities was smaller than those with the impurity of paper. The effect of PE and that of paper and PE on r_O could not be observed clearly.

The mass reducing factor of Okara, ξ_O, was defined as follows:

$$\xi_O = \frac{f_O - r_O}{f_O} \qquad (1)$$

Figure 4 shows this ξ_O for 9 to 20 day. Whereas ξ_O attained at around 0.7 in the case without any impurities, the maximum ξ_O was about 0.45 in the case with the impurity of paper. This result implied that paper obstructed the digestion of Okara. Paper may absorb water and the lump of the paper and residue may not breath well. The influence of PE impurity was obscure.

4. Conclusion

Paper impurity obstructed the digestion of food waste. It is necessary for the digestion of MSW to sort out paper impurity beforehand. The influence of PE impurity was not observed clearly in this study.

Nomenclature

f_O	=	total dry mass of fed Okara	[kg]
r_O	=	dry mass of residue converted from Okara	[kg]
T	=	temperature of residue in apparatus	[°C]
T_a	=	room temperature	[°C]
t	=	time	[day]
ξ_O	=	mass reducing factor of Okara	[–]

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