Expanding Resource Utilization by Converting Sewage Sludge to Fuel/Fertilizer

(Research of FY 2017-2021)

1. Purpose

The Sewage Law amended in 2015 obligates wastewater administrators to make efforts for recycling sewage sludge as fuel or fertilizer. The amendment has led to establish a council system consisting of related local governments and develop the "Study Manual for the Wide-Area Utilization of Sewage Sludge. Efficient utilization of sewage sludge is desired.

This study aims to contribute to the further utilization of resources by developing technologies to convert sewage sludge into fuel and fertilizer.

2. Outcomes of This Year

(1) Study of a continuous test fertilizer production system

Fertilization of sewage sludge requires the production of test fertilizers from the raw sludge in advance to confirm that the quality of the fertilizer meets the registration standards under the Fertilizer Control Law/Fertilizer Regulation Act. Conventionally, test fertilizers were made by batch method, using several hundred kilograms to several tons of sludge and many sub-materials and return compost to ensure aeration. Therefore, the produced fertilizer's basic properties largely depended on sub materials and compost (seeds).

This year, an efficient test fertilizer production system was studied using a small composting unit to minimize secondary materials' impact by continuous fermentation.

The test fermenter with a capacity of 12L adopted two types of compost as seed fertilizers. They were acidulocomposting bacteria widely used for food waste composting and thermophilic bacteria proven in sewage sludge composting. While using these seed fertilizers, 1 kg per day of mixed raw dewatered sludge with an average moisture content of about 78% and an organic content of about 84% was applied from Monday to Friday.

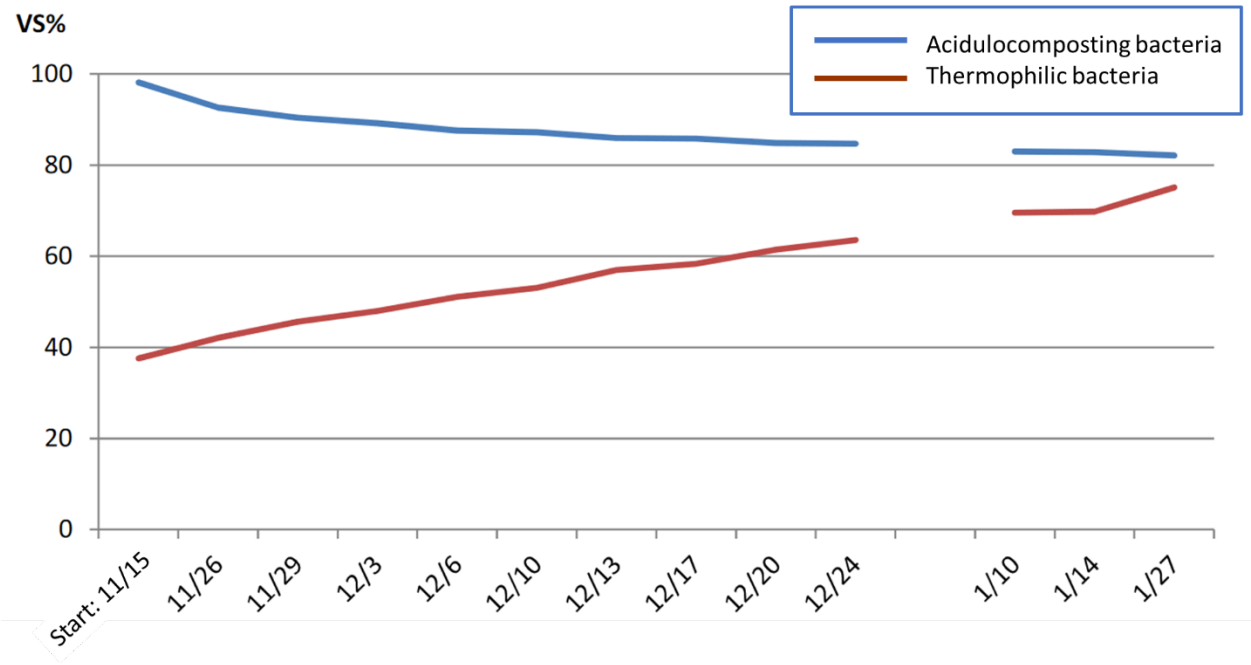

Figure 1. Transition of sludge fertilizer's organic contents in the fermenter
(Stirring and heating only during New Year holidays)

Figure 1 shows the measurement results of the organic fraction of the sludge in the fermenter. The measurements were made periodically under temperature control of 50-60°C by electric heaters with repeated stirring for 20 minutes and pausing for 40 minutes per hour. At the beginning of the test, the amount of seed fertilizer was 3 kg of acidophilus and 8.4 kg of the thermophilic bacteria. After two and a half months of testing, the total raw sludge input was 44 kg, which is 5 to 15 times more than its initial amount. The result shows that the test unit produced fertilizer with little impact from the seed bacteria properties.

The organic content of the fertilizer produced with acidophilic bacteria was 82.1%, while that with thermophilic bacteria was 75.1%

The raw sludge used in the test was collected about every month. It is assumed that the slightly fermented sludge fed into the fermenter inhibited the fermentation of aerobic microorganisms by organic acids and suppressed the decomposition of organic matter.

(2) Comparative study on the properties of various sludge fertilizers

The test fertilizer produced in this study was compared with various existing sludge fertilizers on the market. The comparison items included nutrient contents such as nitrogen, phosphoric acid, and potassium, C/N ratio, base exchange capacity, and effective form phosphoric acid. As a result, it was confirmed that the properties were generally the same except for their moisture content.

The moisture content of commercial sludge fertilizer is generally 20-30%, while that of the fertilizer produced in this experiment was 38-45%.

3. Conclusion/Future Issues

The continuous fermentation test using a small composting unit took more than two months to obtain a generally stable fertilizer property (organic fraction.)

In the future, we will continue to study the securing the fermentation temperature and the possibility of shortening the test period by reviewing the compounding conditions.

Keywords: **Fertilization test, Fertilizer property, Small composting unit, Continuous fermentation test, Thermophilic bacteria**