4. Livestock Environment Research

(1) Demonstration of slurry composting and biofiltration with methane production(SCB-M) system

The SCB-M system, whose treatment capacity is 10 m3/day, produced 370.8 L of biogas with CH_4 68.51% and CO_2 28.00%. After SCB passage of anaerobic digestion wastewater, removal efficiencies of BOD5, CODMn and SS were 98.2%, 75.5% and 86.4%, respectively. Also, organic pollutants such as chlorophenol, benzenedicarboxylic acid, dodecane were almost degraded.

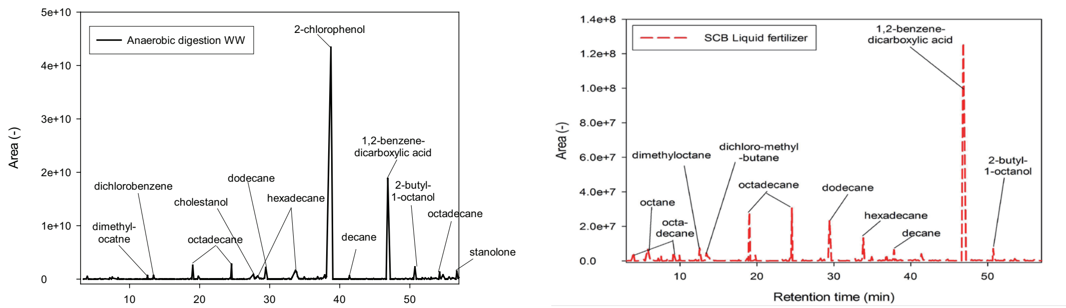


Fig. 4-1. GC/MS analysis for the (a) anaerobic digestion wastewater (y-scale : 5.0 x 1010) and (b) SCB liquid fertilizer (y-scale : 1.4 x 108)

Anaerobic digestion wastewater was evaporated by inner heat of SCB bed. The evaporation rate increased in the following order : summer (43.01 %) 〉 autumn (39.74 %) 〉 spring (38.15 %).

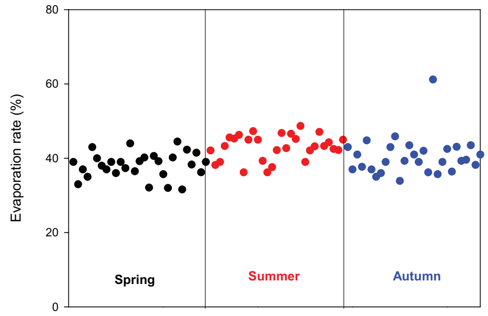


Fig. 4-2. Comparison of evaporation rate for the anaerobic digestion wastewater according to the seasonal effect.

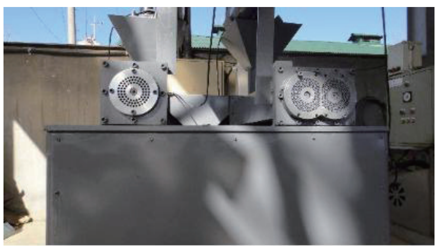
(2) Development of pelletizing technique for livestock manure compost

Most of the livestock manure is treated in a public or a private composting facility. Farmers spread the composted manure directly on their arable land as a powered compost. Application of the current powered livestock manure compost in crop land is very difficult work due to its heavy weight and its powdered form. For that reason, this study was carried out to develop pelletized livestock composted manure. In pelletizing process with composted manure, the optimal water content of raw material for pelletizing machine developed in this research was around 40~55%. After manufacturing experimental pelletizer, test operation was carried out. The quality of pellet produced in the test was good when the rotation speed of compression screw was about 15~20 rpm. The nutrient content of compost was not affected by pelletizing process.

The following table shows the change of nutrient contents of pellet composting process:

Table 4-1. Change of fertilizer ingredient content (Unit: %)

Calssicication	Organic Matter	N	P_2O_5
Compost	59.1	0.49	0.35
Pelletized compost	60.1	0.53	0.34



Pelletizer

Pellet

(3) A study on livestock odor reduction using water washing system

The odor problem in the livestock is increasing by 7% annually. Most importantly, the livestock odor problem in swinery accounts for the maximum ratio (54%). In this study, we reviewed the possibility of deodorizing swinery using an odor reduction device that can be used with the water washing system. First, the study confirmed that the solubility of odor gas, which was hydrogen sulfide, was very low regardless of the contact time with solvent, but the solubility of methyl mercaptan was found to increase along with the increase in time. The solubility of other odor gases, such as dimethyl sulfide, dimethyl disulfide and ammonia, was considerably high. Consequently, it is considered that if the odor reduction device for the water washing system deodorization is used in a swinery, the time during which the exhaust gas is in contact with usable water must be extended, or solvent quantity must be expanded. However, it is predicted that although hydrogen sulfide is easily generated in the anaerobic condition, it is difficult to expect high odor reduction efficiency because this gas has low solubility in water, especially when it is used in the deodorization of the water washing system.

Fig. 4-3. Experimental deodorization system

(4) Research on greenhouse gas (GHG) emissions from swine manure treatment processes

To evaluate the influence of operation methods on GHG emissions, liquid fertilizer production systems were applied with different rates of aeration (store without aeration, 1m3/ton/h, 2.5m3/ton/h, and 5m3/ton/h) and composting systems were applied with different aeration methods (static and mixed piles, forced and passive aeration). Following are the results of this study. The liquid fertilizer systems (LFS) applied no aeration, 1m3/ton/h, 2.5m3/ton/h, and 5m3/ton/h aeration rates released 159, 24, 32, and 61 μg/m2/s of CH4 and 0.49, 0.13, 0.39, and 0.21 $\mu g/m^2/s$ of N_2O, respectively. LFS applied no aeration

released the most amount of GHG (3,448 $\mu g/m^2/s$ CO2-Eq.) and followed by 5m3/ton/h (1,334 $\mu g/m^2/s$ CO2-Eq.), 2.5m3/ton/h (760 $\mu g/m^2/s$ CO2-Eq.), and 1m3/ton/h (535 $\mu g/$m2/s CO2-Eq.). Our results reveal that the aerated system may reduce GHG emissions by 61-84% compared to the system applied no aeration. Static, forced aerated, passively aerated, and mixed piles released 216, 21, 19, and 76 $\mu g/m^2/s$ of CH4 and 31, 7, 13, and 9 μg/m2/s of N2O, respectively during the composting process. Static piles released the most amount of GHG (13,998 $\mu g/m^2/s$ CO2-Eq.) and followed by passively aerated piles (4,447 $\mu g/m^2/s$ CO2-Eq.), mixed piles (4,355$\mu g/m^2/s$ CO2-Eq.), and forced aerated piles (2,526 $\mu g/m^2/s$ CO2-Eq.). Our results reveal that the forced aeration and pile mixing may reduce GHG emissions by 68-82% compared to the static pile composting. Consequently, aeration and mixing were effective at reducing GHG emissions during liquid fertilizer production and static pile composting processes.

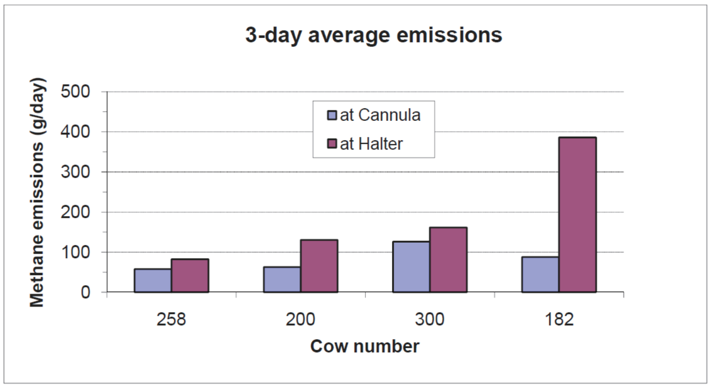
Fig. 4-4. The measurement of GHG emissions at LFS and Composting systems

(5) Development of a measurement technique to quantify greenhouse gas emissions from livestock agriculture

Methane emissions from lumen were different among cattle. There were difference in the ratio of CH4 emissions through respiration and through the gap of the cannula and cattle body in the individual was also different among cattle.

Methane emissions from the individual were between 139.53 and 473.47 g/day (50.9~172.8 kg/year), which were higher than the default value (47 kg/year) of North America in the IPCC guidelines. The ratios of the CH_4 emissions through the gap between the cannula and cattle body to the CH_4 emissions through respiration were between 0.18

and 0.44. Hence, it would be required to measure the CH_4 emissions at the cannula and be better not to use cannulated cattle for the study quantifying CH_4 emissions during enteric fermentation.



(6) Effects of tapioca levels in the pig diet on the fecal excretion of odor causing compounds in pigs

The objective of this study was to examine the effects of dietary levels of tapioca on animal performance, carcass characteristics and fecal excretion of major odor-causing compounds in growing-finishing pigs. Thirty six growing pigs with an initial body weight (BW) of 26.6 kg were fed three diets treated with 3 dietary tapioca levels (0, 10, 20%) according to a randomized complete block arrangement design in 3 blocks (4 pigs each). In the 4th week of the collection period feces samples were directly collected from the pigs and analyzed for indole, skatole and p-cresol concentrations. Daily mean feed intake were higher ($p<0.05$) for the tapioca treatments than control, but were not different between the tapioca levels ($p>0.05$). Tapioca treatment at BW of 80kg decreased ($p<0.05$) p-cresol concentration (5.48, 0.71 and 1.35 ppm for control, Tapioca 10% and Tapioca 20%, respectively). However, at BW of 120kg, tapioca treatment affected none of parameters. Present results indicate that tapioca intake may play a role in odor reduction from pig feces.

Table 4-2. Effects of dietary levels of tapioca on average daily gain in growing- finishing pigs

	Tapioca level (%)		
	0	10	20
Initial BW, kg	26.5	26.3	26.8
Final BW, kg	112.5	115.0	116.9
ADG, kg	0.84	0.87	0.88

Table 4-3. Effects of dietary levels of tapioca on fecal excretion of p-cresol in growing-finishing pigs

	Tapioca level (%)		
	0	10	20
BW 50 kg	1.33	1.24	0.61
80 kg	5.48[a]	0.71[b]	1.35[b]
120 kg	0.52	0.46	0.55

a,b,c Means in the same row with different superscripts differ ($p<0.05$).