

## Adding calcium oxide combined with calcium peroxide for strengthening rapid biological drying of dairy cattle manure.

Guangfei Qu, Yingying Cai, Kang He, Haijun Gao, Ruosong Xie, Xiaotian Chen, Ping Ning\*

\*Ping Ning, Faculty of Environmental Science and Engineering, Kunming University of Science and Technology, China Tel: +86 13708409187

### Abstract

This research explored effects of adding calcium oxide (CaO) and calcium peroxide (CaO<sub>2</sub>) in the rapid biological drying of dairy cattle manure. Using the static aerobic composting system, the composting experiment was carried out by means of natural ventilation combined with composting piles turned. In the presence of the CaO and CaO<sub>2</sub>, the temperature rose faster and reached the high temperature fermentation stage in advance 4-6 days during the compost. At the end of compost, the water content of CaO and CaO<sub>2</sub> (cont.) group was decreased to 23.5% significantly. However, the diversity in four experiment group piles had little difference at the end of the compost, which only had some changes in the process of compost. In a word, it was CaO and CaO<sub>2</sub> that would shorten the composting time, extend the high temperature stage, provide sufficient oxygen to meet the demand of the growth of aerobic microorganisms, had a good effect on dairy manure rapid drying and provided a new idea for dairy manure efficient treatment.

With the rapid development of livestock breeding industry intensive and scale, livestock and poultry manure waste increased dramatically, which has become the main source of agricultural organic solid wastes in China. According to the statistics of the China Dairy Association, it was about 1.8 billion fecal waste that was produced in China's dairy farming every year, such as litter, feed residue and other waste. A large number of organic wastes piled up together could not be treated properly, which posed a serious of threats to the surrounding environment. Composting was an effective way to reduce livestock manure and realized harmless treatment and resource utilization. According to the determination that moisture content of non-water flushing livestock manure was about 65%~85% while the flushing livestock manure moisture content could up to 90%. The high water content had a great influence on the capacity, storage, transportation and processing effect. How to effectively reduce the moisture content of livestock and poultry feces was an important link in fecal treatment. At present, there are many methods for livestock droppings drying or reducing moisture in domestic and outside areas. In relative terms, the biological drying technology attracted people's attentions because of low processing costs, product safety and high efficiency. The term biological drying

of livestock manure was first proposed in 1984 by Jewell W J who was an American scientist, Cornell University. The principle was to use microbial decomposition of organic matter produce energy and increase the emission of moisture in feces, which was purposed to reduce water content then acknowledged dryness in the process of composting. Jewell thought that microbial degradation effect was the most active when the water content was 40% and the temperature was 60 degrees centigrade using the principle of bio-drying and taking batch compost, which based on the experimental research on mixing, temperature, air velocity and other factors. TL Richard thought composting, biological drying were related to physical and biological processes. Arrhenius enzyme kinetics equation and Albright stoichiometric equation were applied to describe the relationship between factors about temperature, ventilation rate and moisture emission rate. What's more, the corresponding model was built. It was inferred that every kilogram of volatile solids could get rid of 1 kg water every day. In other words, the moisture of manure could decrease from 75% to 57% when consumed every kilogram volatile solids every day. Richard et al and Choi et al put forward the continuous batch or semi continuous composting technology, which was based on the previous batch compost on. The fully mixed aerobic biological reactor was designed and manufactured as well. The experiment was done for 6 days in the reactor. The result showed that the moisture of manure could decrease by 0.46~0.78 kilogram when consumed every kilogram volatile solids. Many experiments had shown that moisture content was often higher than 30% after composting. For example, Singh took vegetable waste, sawdust and cow dung as raw material for composting. The initial water content was 63.5%~76%. After 20 days composting, the final moisture content was 47.5%~72%; Roca-Perez et al was in the test of straw and sludge composting, the initial moisture content was adjusted to 60.3%, after 90 days of composting, the final moisture content was 39.9%~42%. All physical indexes detected in the experiments were accorded with the national standard of organic fertilizer agriculture. The CaO and CaO<sub>2</sub> could accelerate the temperature rise, advance the reactor piles into high temperature stages and reduce water content of the composting piles rapidly. At the end of compost, the moisture decreased to below 30% and decreased by 6.0%~8.0% compared with the control group 1 and 2 piles.

What's more, no matter alpha or beta diversity in four experiment group piles had little difference at the end of the compost. They only had some changes in the process of compost. Combined with the physical and biomass properties analysis, it was had the strengthening effect on rapid biological drying of dairy cattle manure with the addition of CaO, CaO<sub>2</sub> as well as CaO and CaO<sub>2</sub>, of which the CaO and CaO<sub>2</sub> (cont.) had the best effects on cow manure composting in the research. It was in the second days that composting came into high temperature stage. In the heating stage, it was only in fourth days that the temperature reached the highest 65°C and the

heating effect was remarkable. At the end of the composting, the moisture was 23.5%. Compared with other treatment groups, the moisture content decreased to minimum value, which was far better than the specified value of agricultural organic fertilizer standard (30%). What's more, the pH values of all cow manure piles were only about 9.0 after composting rotten, which could be well neutralized by the gradually acidified soil in the southwest of China. The following researches we will study and analyze further about TN loss in group 2, TP increased greatly on group 1 and TK increased greatly on group 2 during the composting.