THESIS APPROVAL

GRADUATE SCHOOL, KASETSART UNIVERSITY

Doctor of Engineering (Environmental Engineering)

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TITLE: Experimental Investigations of Microbial Methane Oxidation in Vegetated Landfill Cover Soil Operated in the Tropical Region

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THESIS

EXPERIMENTAL INVESTIGATIONS OF MICROBIAL METHANE OXIDATION IN VEGETATED LANDFILL COVER SOIL OPERATED IN THE TROPICAL REGION

NATHIYA TANTHACHOON

A Thesis Submitted in Partial Fulfillment of
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This study aims to improve landfill cover soil for effective and sustainable methane oxidation. Laboratory column experiments were conducted to investigate (1) the effect of compost as the final cover on methane oxidation compared with sandy loam soil, (2) the effect of vegetation with tropical grasses on methane oxidation and (3) methane oxidation efficiency under dry condition for comparison with the two former experiments under wet condition. Application of rainwater or leachate under wet condition was also performed to investigate the effect of leachate on methane oxidation and plant growth.

The results indicated that high methane oxidation efficiency about 12 mol CH_4/m^3.d (85% methane removal) for more than 240 days was achieved in compost both with and without vegetation, while sandy loam provided the lower efficiency of 9 mol CH_4/m^3.d (65% methane removal) over a shorter period of about 100 days. Compost clearly encouraged higher methane oxidation efficiency and maintained sustainable methane oxidation in long-term operation due to its beneficial properties of high porosity, water holding capacity and organic content. Furthermore, vegetation also revealed its advantage on sustaining methane oxidation throughout almost the entire soil depth over the longer active period of 300-400 days. Moreover, leachate irrigation compared with rainwater practice successfully extended the active period of methane oxidation by providing supplemental nutrients for methanotrophic bacteria. Application of leachate on landfill cover soil not only encouraged methane oxidation, but also substantially reduced its volume (by about 60% through evaporation and accumulation) which needed to be treated further. In dry condition without any irrigation, lower methane oxidation efficiency of 8 mol CH_4/m^3.d (60% methane removal) was observed over a period of 160 days in both vegetated and non-vegetated cover systems.

It could be summarized that introduction of compost as landfill cover soil with vegetation application successfully promoted and maintained methane oxidation for over a year duration in tropical region. Leachate irrigation was also practiced for minimizing methane from landfill as well as its contaminants in case that rainfall being absent. It should be noted that the operation under natural dry condition could also provide a moderate capacity of methane oxidation. These landfill operations were the alternative options for controlling emissions, specifically methane gas, from landfill especially in developing countries.

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Student's signature Thesis Advisor's signature

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