LANDFILL METHANE OXIDATION USING BIOCOVER UNDER LABORATORY CONDITIONS

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2011

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DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF BIOTECHNOLOGY

INSTITUTE OF BIOLOGICAL SCIENCE

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ABSTRACT

Generation of waste continues to increase in response to rapid population growth. An estimated 10 million tonnes of total waste was produced in 2008 in Malaysia which was sent to 260 landfills. Malaysian landfills produce 1.3-7.5 L/kg/year of methane gas. Landfill gas consists mainly of methane (55%). CH_4 is recognized as the primary global warming contributor with CH_4 being 25 times more infrared absorptive capacity than CO_2. Using "Biocover" at landfills is one option for methane oxidation. Objective of this study is to analyze the physical and chemical characteristic of the Biocover material (garden waste compost and black soil) in order to propose suitable landfill covers for methane oxidation under tropical conditions. Batch incubation experiments using Wheaton bottles showed that garden waste compost was the best Biocover material because it took only 4 days for complete methane oxidation compared to black soil, which took 7 days. Meanwhile Wheaton bottle experiments using 3 different parameters (temperature, moisture content and pH) also demonstrated that compost was still the best material for Biocover. In addition to that, the optimum conditions for both Biocover materials used in this study was at 35°C, with 60% moisture content and pH 6. Biocover Performance Index (BPI) obtained for compost (2.08×10^{-3} $\mu g g^{-1} h^{-1}$) was higher than that for black soil (1.19×10^{-3} $\mu g g^{-1} h^{-1}$). Meanwhile the R_p (potential oxidation rate) value for compost (17.036 mL/d) was almost double the value for black soil (10.806 mL/d). This clearly indicates that garden waste compost was the most effective and suitable Biocover material for methane oxidation under tropical conditions.

ABSTRAK

Penjanaan sisa terus meningkat disebabkan pertumbuhan penduduk yang pesat. Dianggarkan 10 juta tan sisa jumlah telah dihasilkan pada tahun 2008 di Malaysia yang telah dihantar ke 260 tapak pelupusan. Tapak pelupusan Malaysia menghasilkan 1.3-7.5 L/kg/tahun gas metana. Gas tapak pelupusan terdiri terutamanya metana (55%). CH_4 diiktiraf sebagai penyumbang utama pemanasan global dengan CH_4 25 kali lebih banyak kapasiti menyerap inframerah daripada CO_2. Penggunaan "Biocover" di tapak pelupusan adalah salah satu pilihan untuk pengoksidaan metana. Objektif kajian ini adalah untuk menganalisis ciri-ciri fizikal dan kimia bahan Biocover (kompos sisa taman dan tanah hitam) untuk mencadangkan bahan Biocover yang sesuai untuk pengoksidaan metana di bawah keadaan iklim tropika. Eksperimen yang menggunakan botol Wheaton menunjukkan bahawa kompos sisa taman ialah Biocover terbaik kerana ia mengambil masa hanya 4 hari untuk pengoksidaan metana yang lengkap berbanding dengan tanah hitam, yang mengambil masa 7 hari. Sementara itu, uji kaji botol Wheaton menggunakan 3 parameter yang berbeza (suhu, kandungan kelembapan dan pH) juga menunjukkan bahawa kompos adalah masih bahan terbaik untuk Biocover. Di samping itu, syarat-syarat yang optimum bagi kedua-dua bahan Biocover yang digunakan dalam kajian ini adalah pada 35°C, dengan 60% kandungan kelembapan dan pH 6. Biocover Performance Index (BPI) yang diperolehi untuk kompos ($2.08 \times 10^{-3} \mu g g^{-1} h^{-1}$) adalah lebih tinggi daripada untuk tanah hitam ($1.19 \times 10^{-3} \mu g g^{-1} h^{-1}$) Sementara itu, Rp (potensi pengoksidaan kadar) nilai untuk kompos (17,036 mL/d) hampir dua kali ganda nilai bagi tanah hitam (10,806 mL/d). Ini jelas menunjukkan bahawa kompos sisa taman ialah Biocover yang paling berkesan dan sesuai untuk pengoksidaan metana di bawah keadaan iklim tropika.

ACKNOWLEDGEMENT

My sincere gratitude goes out to my supervisor Professor Dr. P.Agamuthu. He has given me support and guidance through out my thesis work. His experience in this field has helped me a lot to complete my thesis in an easier way.

I thank University of Malaya for funding this project through Postgraduate Research Fund (PPP).

I would also like to thank Dr Fauziah, and my fellow Solid Waste Lab members for their help, cooperation and guidance.

Last but not least, I am very thankful to my beloved parents who supported me endlessly and my beloved husband whom never failed to guide me and support me all the way, and the rest of my family and friends.

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LIST OF SYMBOLS AND ABBREVIATIONS

MSW	–	Municipal Solid Waste
LFG	–	Landfill Gases
GHG	–	Greenhouse Gases
SWM	-	Solid Waste Management
COD	-	Chemical Oxygen Demand
VOC	-	Volatile Organic Compounds
CO_2	-	Carbon dioxide
CH_4	-	Methane
NH_4	-	Ammonium
H_2S	-	Hydrogen sulphide
O_2	-	Oxygen
H_2O	-	Water
C	-	Carbon
N	-	Nitrogen
NH_3	-	Ammonia