



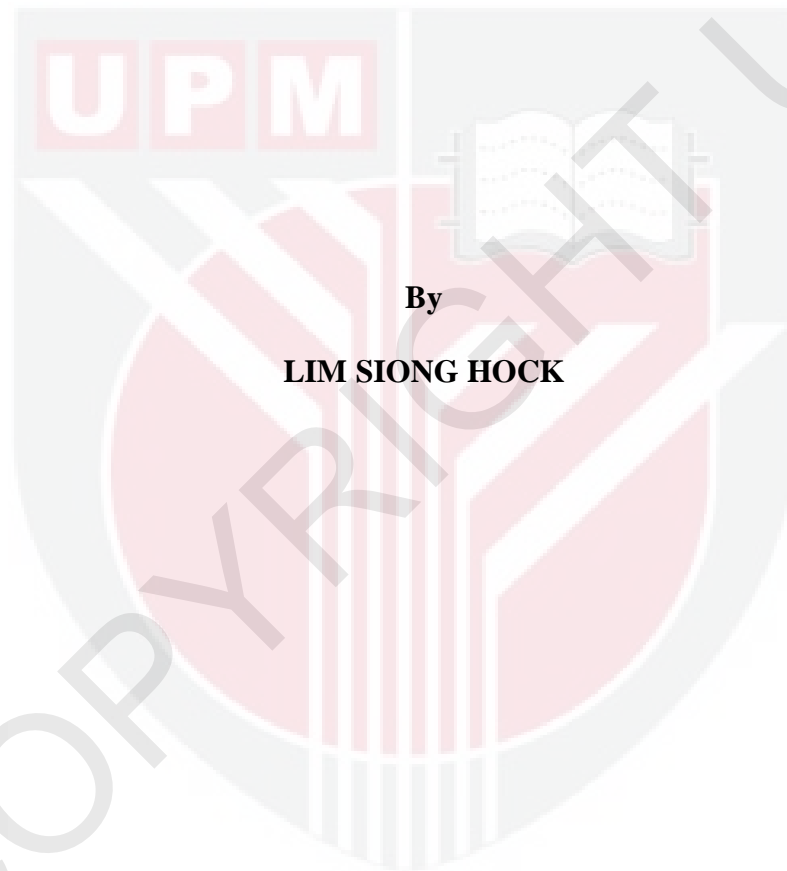
UNIVERSITI PUTRA MALAYSIA

***CO-COMPOSTING OF OIL PALM MESOCARP FIBER
AND PALM OIL MILL EFFLUENT ANAEROBIC SLUDGE***

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**CO-COMPOSTING OF OIL PALM MESOCARP FIBER AND PALM OIL
MILL EFFLUENT ANAEROBIC SLUDGE**



By

LIM SIONG HOCK

**Thesis Submitted to the School of Graduates Studies, Universiti Putra Malaysia
in Fulfilment of the Requirements for the Degree of Masters of Science**

January 2011

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

CO-COMPOSTING OF OIL PALM MESOCARP FIBER AND PALM OIL MILL EFFLUENT ANAEROBIC SLUDGE

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January 2011

Chairman: Professor Mohd Ali Hassan, PhD

Faculty: Faculty of Engineering

Utilization of oil palm mesocarp fiber (OPMF) in an alternative way as composting substrate for biocompost production was studied. Palm oil mill effluent (POME) anaerobic sludge is used as the nitrogen source and microbial seeding for the co-composting process. The windrow composting system was applied in this study due to lower operation cost and higher flexibility in controlling. In physicochemical study, POME anaerobic sludge additions promoted thermophilic condition (50 – 68°C) in compost piles and maintain moisture content around 50 - 60%. The pH was slightly alkaline throughout composting process. However, the compact and oily properties of OPMF have limited oxygen transfer (below 10 mg/L) and water absorption in the substrates, thus requiring extensive turning and mixing in composting piles for optimum composting process. The final compost with final C/N

ratio of 12.6 and high nutrients content is obtained after 50 days composting. For microbial succession study during composting process, polymerase chain reaction–denaturant gel gradient electrophoresis (PCR-DGGE) analysis was carried out. The molecular finger printing analysis indicated that the dominant microbe communities shifted from *Pantoea* and *Termitomyces* at the beginning of the composting process to *Proteobacteria* like *Cupriavidus gilardii* and *Ralstonia basilensis*. It has been observed that strong hydrolytic microbes were dominant in thermophilic phase of composting process. For structural degradation study in composting material, scanning electron microscopic (SEM) revealed the penetration of microbial community and removal of silica body on composting material. The microbial penetrations disrupted the hard surface of OPMF and promote the exposure of more easily degradable compound for active metabolic activity. After all, OPMF and POME anaerobic sludge co-composting make a good combination for substrates degradation. The nitrogen sources in sludge support microbial growth and a number of active degrader microbes have been identified. The removal of oily substance has been suggested capable in accelerating composting process.

Abstrak tesis yang dikemukakan kepada senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENGGOMPOSAN SABUT MESOKARP KELAPA SAWIT DENGAN ENAP
CEMAR EFLUEN KILANG KELAPA SAWIT**

Oleh

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Januari 2011

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Pengkomposan sabut mesokarp secara alternatif bagi penghasilan baja kompos telah diselidiki. Enap cemar efluen kilang kelapa sawit telah digunakan sebagai penyumbang unsur nitrogen dan benih mikroorganisma bagi proses pengkomposan. Sistem pengkomposan batas telah digunakan dalam experiment ini sebab kos operasi yang rendah dan lebih fleksibel dalam pengawalan system. Dalam penyelidikan fizikal-kimia, penambahan enap cemar efluen buangan kilang sawit didapati mengalakan keadaan termofilik (50 – 68°C) dan mengekalkan kandungan air sebanyak 50%. pH adalah sedikit alkali dalam proses pengkomposan. Walaubagaimanapun, ciri-ciri padat dan berminyak dalam sabut mesokarp kelapa sawit telah menghadkan pengangkutan oksigen dan penyerapan air untuk proses pengkomposan yang optima, malah memerlukan kekerapan mengacau dan

mencampur aduk substrak dalam proses pengkomposan. Kompos akhir dengan nisbah C/N akhir sebanyak 12.6 serta kandungan nutrisi yang tinggi telah diperolehi dalam 50 hari pengkomposan. Dalam penyelidikan perubahan profil mikroorganisma, analisis tindak balas rantaian polimerasi – elektroporasi kecerunan gel denaturasi (DGGE) telah digunakan. Analisis mikrob telah menunjukkan bahawa mikroorganisma mutlak telah berubah dari *Pantoea* dan *Termitomyces* pada permulaan proses pengkomposan kepada *Proteobacteria* seperti *Cupriavidus gilardii* dan *Ralstonia basilensis*. Ini secara tidak langsung menunjukkan mikroorganisma hidrolitik telah menjadi dominan dalam fasa termofilik proses pengkomposan. Bagi perubahan struktur, mikroskop pengimbas elektron menunjukkan gambaran penembusan mikroorganisma dan penyingkiran badan silica dalam bahan pengkomposan. Penembusan mikroorganisma telah memecahkan permukaan kasar sabut dan mengalakan pendedahan bahan yang mudah degradasi untuk aktiviti metabolic yang aktif. Secara amnya, pengkomposan sabut mesokarp dan enap cemar kilang sawit merupakan kombinasi yang baik untuk degradasi substrak. Unsur nitrogen dalam enap cemar membantu pertumbuhan mikrob dan banyak aktif degradasi mikrob telah ditemui. Penyingkiran minyak dicadangkan dapat mempercepatkan proses pengkomposan.

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I certify that a Thesis Examination Committee has met on 3 January 2011 to conduct the final examination of Lim Siong Hock on his thesis entitled “Co-composting of Oil Palm Mesocarp Fiber and Palm Oil Mill Effluent Anaerobic Sludge” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institutions.



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Date: 3 January 2011



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