REFERENCES

Ahmad, A., Suzylawati, I., Bhatia, S. (2003). "Water recycling from palm oil mill effluent (POME) using membrane technology." Desalination 157: 87-95.

Ahmad, A., Sumathi, S., Hameed, BH. (2006). "Coagulation of residue oil and suspended solid in palm oil mill effluent by chitosan, alum and PAC." Chem Engin J. 118: 99-105.

Alvarado-Lassman, A., Rustrián, E., García-Alvarado, MA., Rodríguez-Jiménez, GC., Houbron, E. (2008). "Brewery wastewater treatment using anaerobic inverse fluidized bed reactors." Bioresource Technol 99: 3009-3015.

Amann, R.., Binder, BJ., Olson, RJ., Chisholm, SW., Devereux, R., Stahl, DA., (1990). "Combination of 16S rRNA-targeted oligonucleotide probes with flow cytometry for analyzing mixed microbial populations " Appl Environ Microbiol 56(6): 1919-1925.

Amann, R., Ludwig, W., Schleifer, KH. (1995). "Phylogenetic identification and in situ detection of individual microbial cells without cultivation." Microbiol Rev 59: 143-169.

Amaral, C., Lucas, M., Coutinho, J., Crespí, AL., Anjos, MR., Pais, C. (2008). "Microbiological and physicochemical characterization of olive mill wastewaters from a continuous olive mill in Northeastern Portugal." Bioresource Technol 99: 7215-7223.

Angelidaki, I., Petersen, SP., Ahring, BK. (1990). "Effects of lipids on thermophilic anaerobic digestion and reduction of lipid inhibition upon addition of bentonite." Appl Microbiol Biotechnol 33: 469-472.

Angelidaki, I., Ahring, BK. (1992). "Effects of free long-chain fatty acids on thermophilic anaerobic digestion." Microbiol Biotechnol 37: 808-812.

Antoine, E., Fleurence, J. (2003). "Species identification of red and brown seaweeds using ITS ribosomal DNA amplification and RFLP patterns." J Sci Food Agri 83: 709-773.

APH, A. (2005). Standard methods for the examination of water and wastewater. Washington, D.C, American Public Health Association (APHA).

ATV "Arbeitsbericht Fachausschuss 7.5." Geschwindigkeitsbestimmende Schritte beim anaeroben Abbau von organischen Verbindungen in Abwässern 1: 101-107.

Baldwin, B., Nakatsu, CH., Nies, L. (2003). "Detection and enumeration of aromatic oxygenase genes by multiplex and real-time PCR." Appl Environ Microbiol 69: 3350-3358.

Bodkhe, S. (2008). "Development of an improved anaerobic filter for municipal wastewater treatment." Bioresources Technol 99: 222-226.

Boone, D., Whitman, WB., Rouviere, P. (1993a). Diversity and taxonomy of methanogens. New York, Chapman & Hall.

Borja, R., Banks, CJ. (1992). "Comparison of an anaerobic filter and an anaerobic fluidized bed reactor treating palm oil mill effluent." Process Biochem 30: 511-521.

Borja, R., Banks, CJ. (1994). "Anaerobic digestion of palm oil mill effluent using an up-flow anaerobic sludge blanket (UASB) reactor." Biomass and Bioen 6: 381-389.

Borja, R., Banks, CJ. (1994b). "Treatment of palm oil mill effluent by upflow anaerobic filtration." Chem Technol Biotechnol 61: 103-109.

Borja, R., Banks, CJ. (1995). "Comparison of an anaerobic filter and an anaerobic fluidized bed reactor treating palm oil mill effluent." Process Biochem 30: 511-521.

Borja, R., Banks, CJ., Sanchez, E. (1996). "Anaerobic treatment of palm oil mill effluent in a two-stage up-flow anaerobic sludge blanket (UASB) system." Biotechnology 45: 125-135.

Borja, R., Banks, CJ., Scnchez, E. (1996a). "Anaerobic treatment of palm oil mill effluent in a two-stage up-flow anaerobic sludge blanket (UASB) reactor." J Immunol Metho 45: 125-135.

Borja, R., Banks, C., Khalfaoui, B., Matin, A. (1996a). "Performance evaluation of an anaerobic hybrid digester treating palm oil mill effluent." J Environ Sci Health A 3: 1379-1393.

Borja, R., Alba, J., Banks, C.J. (1996b). "Anaerobic digestion of wash waters derived from the purification of virgin olive oil using a hybrid reactor combining a filter and a sludge blanket." Process Biochem 31: 219-222.

Borja, R., Bank, CJ., Wang, Z., Mancha, A. (1998). "Anaerobic digestion of slaughterhouse wastewater using a combination sludge blanket and filter arrangement in a single reactor." Bioresour Technol 65: 125-133.

Borja, R., Rinc´on, B., Raposo, F., Alba, J., Mart´ın, A. (2002). "A study of anaerobic digestibility of two-phases olive mill solid waste (OMSW) at mesophilic temperature." Process Biochem 38: 733-742.

Borja, R., Mart´ın, A., Rinc´on, B., Raposo, F. (2003). "Kinetics for substrate utilization and methane production during the mesophilic anaerobic digestion of two-phases olive pomace (TPOP)." J Agric Food Chem 51(11): 3390-3395.

Breznak, J., Kane, MD. (1990). "Microbial HZ/COz acetogenesis in animal guts: nature and nutritional significance. FEMS." Microbiol Rev 87: 201-255.

Brooksbank, A., Latchford, JW., Mudge, SM. (2007). "Degradation and modification of fats, oils and grease by commercial microbial supplements." World J Microbiol Biotechnol 23: 977-985.

BTZ Waste Digester. (2009). Anaerobic Digestion, from <http://www.united-tech.com/wd-anaerobicdigestion.html>.

Bustin, S. (2000). "Absolute quantification of mRNA using real-time reverse transcription polymerase chain reaction assays." J Mol Endocrinol 25: 169-193.

Cammarota, M., Teixeira, GA., Freire, DMG. (2001). "Enzymatic pre-hydrolysis and anaerobic degradation of wastewaters with high fat contents." Biotechnol Lett 23: 1591-1595.

CDM feasibility study for palm oil mill effluent (POME) treatment co-benefits project. (2009). Japan, Tokyo Electric Power Environmental Engineering Co., Inc.

Chaiprasert, P., Suraruksa, SW., Tanticharoen,BM., Bhumiratana, S. (2003). "Nylon fibers as supporting media an anaerobic hybrid reactor: it's effect on system's performance and microbial distribution." Water Research 37: 4605-4612.

Chan, K., Chooi, CF. (1984). Ponding system for palm oil mill effluent treatment. Proceeding of the Regoinal Workshop on palm oil mill Technology and Effluent Treatment.

Chynoweth, D., Pullammanappallil, P. (1996). Anaerobic digestion of municipal solid wastes. Boca Raton, Florida, Microbiology of solid waste.

De Bok, FA., Plugge, CM., Stams, AJM. (2004). "Interspecies electron transfer in methanogenic propionate degrading consortia." Water Res 38: 1369-1375.

Diaz, E., Stams, AJA., Amils, R., Sanz, JL. (2006). "Phenotypic properties and microbial diversity of methanogenic granules from a fullscale upflow anaerobic sludge bed reactor treating brewery." Wastewater Appl Environ Microbiol 72: 4942-4949.

Donald, C., Qureshi, F., Burns, MJ., Holden, MJ., Blasic-JR, Jr., Woolford, AJ. (2005). "An inter-platform repeatability study investigating real-time amplification of plasmid DNA." BMC Biotechnol 5(1): 15.

Droste, R. (1997). Theory and Practice of Water and Wastewater treatment. John Wiley and Sons, Inc.
Eckenfelder, W. (2000). 'Industrial Water Pollution Control, Mc-Graw Hill.

Enright, A., McGrath, V., Gill, G., Collins, G., O'Flaherty, V. (2009). "Effect of seed sludge and operation conditions on performance and archaeal community structure of low-temperature anaerobic solvent-degrading bioreactors." Syst Appl Microbiol 32: 65-79.

Ercolini, D. (2004). "PCR-DGGE fingerprinting: novel strategies for detection of microbes in food." J Microbiol Methods 56: 297-314.

Fadzilah, K., Mashitah, MD. (2010). "Cellulases Production in Palm Oil Mill Effluent: Effect of Aeration and Agitation." Journal of Applied Science 24: 3307-3312.

Fakhrul-Razi, A., Noor, MJMM. (1999). "Treatment of palm oil mill effluent (POME) with the membrane anaerobic system (MAS)." 39: 159-163.

Fannin, K. (1997). Start-up, operation, stability and control, In: Chynoweth DP, Isaacson R, editors.Anaerobic digestion of biomass. UK, : Elsevier.

Farhadian, M., Borghei, M., Umrania, VV. (2007). "Treatment of beet sugar water by UAFB bioprocess." Bioresource Technol 98: 3080-3083.

Freeman, T., Lee, K., Richardson, PJ. (1999). "Analysis of gene expression in single cells." Curr Opin Biotechnol 10(6): 579-582.

Fronhoffs, S., Totzke, G., Stier, S., Wernert, N., Rothe, M., Bruning, T., Koch, B., Sachinidis, A., Vetter, H., Ko, Y. (2002). "A method for the rapid construction of cRNA standard curves in quantitative real-time reverse transcription polymerase chain reaction." Mol Cell Probes 16(2): 99-110.

Galand, P., Fritze. H., Conrad. R., Yrjälä, K. (2005). "Pathways for methanogenesis and diversity of methanogenic archaea in three boreal peatland ecosystems." Appl Environ Microbiol 71(4): 2195-2198.

Garrity, G., Bell, JA., Lilburn, TG. (2004). Taxonomic outline of the prokaryotes. New York Berlin Heidelberg, Springer.

Gerardi, M. (2003). The Microbiology of Anaerobic Digesters. New Jersey, Wiley-Interscience,

Gilbride, K., Lee, DY., Beaudette, LA. (2006). "Molecular techniques in wastewater: understanding microbial communities, detecting pathogens, and real-time process control." J Microbiol Methods 66: 1-20.

Goodwin, J., Wase, DAJ., Forster, CF. (1992). "Pre-granulated seeds for UASB reactors: how necessary are they." Bioresource Technol 41: 71-79.

Grau, P., Dohanyos, M., Chudoba, J. (1994). "Kinetics of multicomponent substrate removal by activated Sludge." Water Res 9: 637- 642.

Greene, E., Voordouw, G. (2003). "Analysis of environmental microbial communities by reverse sample genome probing." J Microbiol Methods 53: 211-219.

Grotenhuis, J., Smit, M., Plugge, CM., Xu, YS., Lammeren, AA., Stams, AJ., Zehnder, AJ. (1991). "Bacteriological composition and structure of granular sludge adapted to different substrates." Appl Environ Microbiol 57: 1942-1949.

Head, I., Saunders, JR., Pickup, RW. (1998). "Microbial evolution, diversity, and ecology: a decade of ribosomal analysis of uncultivated microorganisms." Microb Ecol 35: 1-21.

Heid, C., Stevens, J., Livak, KJ., Williams, PM. (1996). "Real time quantitative PCR." Genome Res 6: 986-993.

Hori, T., Haruta, S., Ueno, Y., Ishii, M., Igarashi, Y. (2006). "Dynamic transition of a methanogenic population in response to the concentration of volatile fatty acids in a thermophilic anaerobic digester." Appl Environ Microbiol 72(2): 1623-1630.

Howe, M. (1997). Basic Genetics, in Microbiology: Dynamics and Diversity. USA, Saunders College Publishing.

Ianotti, E. L., Kafkewitz, P., Wolin, J., Bryant, MP. (1973). "Glucose fermentation products of Ruminococcus albus grown in continuous culture with Vibrio succinogenes: changes caused by interspecies transfer of hydrogen." J Bacteriol 114: 1231-1240.

Ibrahim, I. (1984). "Thermophilic anaerobic contact digestion of palm oil mill effluent." Water Sci Technol 17: 155-165.

Ibrahim, R., Maglad, MA., Adam, SEI., Mirghani, TE.m Wasfi. IA. (1984). "The effect of altered thyroid status on lipid metabolism in Nubian goats.

Jianlong, W., Hanchang, S., Yi, Q. (2000). "Wastewater treatment in a hybrid biological reactor (HBR): effect of organic loading rates." Process Biochem 36: 297-303.

Kalyuzhnyi, S., Skylar, VI., Davlyatshina, MA., Parshina, SN., Simankova, MV., Kostrikina, NA., Nozhevnikova, AN. (1996). "Organic removal and microbiological features of UASB-reactor under various organic loading rates." Bioresource Technol 55: 47-54.

Keyser, M., Witthuhn, RC., Lamprecht, C., Coetzee, MP., Britz, TJ. (2006). "PCR-based DGGE fingerprinting and identification of methanogens detected in three different types of UASB granules.".Syst Appli Microbiol 29: 77-84.

Kincs, F. (1985). "Meat fat formulation." J. Am. Oil Chem. Soc 62: 815-818.

Kirk, J., Beaudette, LA.,Hart, M., Moutoglis, P., Klironomos, JN., Lee, H. (2004). "Methods of studying soil microbial diversity." J Microbiol Methods 58: 169-188.

Lai, K., Cook, L., Krantz, EM., Corey, L., Jerome, KR . (2005). "Calibration curves for realtime PCR." Clin Chem 51(7): 1132-1136.

Lee, C. (2006). Biodegradation of oil and grease in upflow anaerobic sludge blanket reactor for pail oil mill effluent treatment. Faculty of Civil Engineering. Malaysia, University of Technology Malaysia.

Lee, K., Gilles, HT., Levy, EM. (1993). Bioremediation application of slow release fertilizers on low energy shorelines. 1993 Oil Spill Conference Canada.

Lee, Z., Li, SL., Kuo, PC., Chen, IC., Tien, YM., Huang, YJ., Chuang, CP.,Wong, SC., Cheng, SS. (2010). "Thermophilic bioenergy process study on hydrogen fermentation with vegetable kitchen waste." Int. J. Hydr. Energy 34: 9696-9701.

Lettinga, G. (1995). "Anaerobic digestion and wastewater treatment systems." Antonie Van Leeuwenhoek 67(1): 3-28.

Lian-sheng, H., Hong-liang, L., Bei-dou, X., Ying-bo, Z. (2006). "Effects of effluent recirculation in vertical-flow constructed wetland on treatment efficiency of livestock wastewater." Water Sci Technol 54: 137-146.

Liu, H., Wang, G., Zhu, D., Pan, G. (2009). "Enrichment of the hydrogenproducing microbial community from marine intertidal sludge by different pretreatment methods." Int J Hydrogen Energy 34: 9696-9701.

Liu, W., Chan, OC., Fang, HHP. (2002). "Microbial community dynamics during start-up of acidogenic anaerobic reactors." Water Research 36: 3203-3210.

Lockey, C., Otto, E., Long, Z. (1998). "Real-time fluorescence detection of a single DNA molecule." Biotechniques 24: 744-746.

Loeffelholz, M., Deng, H. (2006). Advantaged Techniques in Diagnostic Microbiology. USA, Springer.

Lowe, S., Schmitt, EM., Smith, SW., Osborne, BA., Jacks, T. (1993). "p53 is required for radiation-induced apoptosis in mouse thymocytes." Nature 362: 847-849.

Lynd, L., Weimer, PJ.,Zyl, WH., Pretorius, IS. (2002). "Microbial cellulose utilization: fundamentals and biotechnology." Microbiol Mol Biol Rev 66: 506-577.

Ma, A. (1999b). Treatment of palm oil mill effluent. Kuala Lumpur, MOPGC.

Ma, A. (2000). "Environmental Management for the Oil Palm Industry." Palm Oil Dev 30: 1-10.

Mackay, I., Arden, KE., Nitsche, A. (2002). "Real-time PCR in virology." Nucleic Acids Res 30: 1292-1305.

Maidak, B., Cole, JR., Parker, CT., Jr , Garrity, GM., Larsen, N., Li, B., Lilburn, TG., McCaughey, MJ., Olsen, GJ., Overbeek, R., Pramanik, S., Schmidt, TM., Tiedje, JM., Woese, CR. (1999). "A new version of the RDP (Ribosomal Database Project)." Nucleic Acids Res 27(1): 171-173.

Malik, S., Beer, M., Megharaj, M., Naidu, R. (2008). "Molecular techniques to characterize the microbial communities in contaminated soil and water." Envi International 34: 265-276.

Markoulatos, P., Siafakas, N., Moncany, M. (2002). "Multiplex polymerase chain reaction: a practical approach." J Clin Lab Anal 16: 47-51.

McCarty, P., Mosey, FE. (1991). "Modelling of anaerobic digestion processes." Wat Sci Tech 24(8): 17-33.

McHugh, S., O'Reilly, C., Mahony, T., Colleran, E., O'Flaherty, V. (2003). "Anaerobic granular sludge bioreactor technology." Review: Environ Sci Biotechnol 2: 225-245.

McMahon , K., Stroot, PG., Mackie, RI., Raskin, L. (2001). "Anaerobic codigestion of municipal solid waste and biosolids under various mixing conditions-II: Microbial population dynamics." Water Res 35: 1817-1827.

Metcalf, EI. (2003). Wastewater Engineering-Treatment and Reuse. New York, McGraw-Hill.

Moyer, C. L., Dobbs, FC., Karl, DM. (1994). "Estimation of diversity and community structure through restriction fragment length polymorphism distribution analysis of bacterial 16S rRNA genes

from a microbial mat at an active, hydrothermal vent system, Loihi Seamount, Hawaii." Appl Environ Microbiol 60(3): 871-879.

Mustapha, S., Ashhuby, B., Rashid , M., Azni, I. (2003). "Start-up strategy of a thermophilic upflow anaerobic filter for treating palm oil mill effluent." Trans chem 81: 262-266.

Muttamara, S., Vigneswaran, S., Shin, HS. (1987). Palm oil mill effluent management in Thailand: a preliminary study. Bangkok.

Muyzer, G., De Waal, EC., Uitterlinden, AG. (1993). "Uitterlinden, Profiling of complex microbial populations by denaturing gradient gel electrophoresis analysis of polymerase chain reaction-amplified genes coding for 16S rRNA." Appl Environ Microbiol 53(3): 695-700.

Muyzer, G. (1999). "DGGE/TGGE a method for identifying genes from natural ecosystems." Curr Opin Microbiol 2: 317-322.

Nachaiyasit, S., Stuckey, DC. (1997). "The effect of shock loads on the performance of an anaerobic baffled reactor (ABR). 2. Step and transient hydraulic shocks at constant feed strength." Water res 31: 2747-2754.

Najafpour, G., Zinatizadeh, AAL., Mohamed, AR., Isa, MH., Nasrollahzadeh, H. (2006). "High-rate anaerobic digestion of palm oil mill effluent in an upflow anaerobic sludge-fixed film bioreactor." Process Biochem 41(370-379).

Nicol, G., Glover, LA., Prosser, JI. (2003). "The impact grassland management on archaeal community structure in upland pasture rhizosphere soil." Environ Microbiol. 5: 152- 162.

Nopharatana, A., Pullammanappallil, WPC., Silvey, PC.,Chynoweth, DP. (1998). "Evaluation of methanogenic activities during anaerobic digestion of municipal solid waste." Bioresource Techno 64: 169-174.

Oil World. 2009. "Palm oil, from worldbank.org/INTGLBPROSPECTS/.../palmoil_EN.pdf.

Orphan, J., Taylor, LT., Hafenbradl, D., Delong, EF. (2000). "Culture-dependent and culture-independent characterization of microbial assemblages associated with high-temperature petroleum resevoirs." Appl Environ Microbiol 66: 700-711.

O-Thong, S., Prasertsan, P., Intrasungkha, N., Dhamwichukorn, S., Birkeland, NK. (2007). "Improvement of biohydrogen and treatment efficiency on palm oil mill with nutrient supplementation at thermophilic condition using an anaerobic sequencing batch reactor." Enzym Microbiol Tech 41: 583-590.

Ovreås, L., Forney, L., Daae, FL., Torsvik, V. (1997). "Distribution of bacterioplankton in meromictic lake Sælenvannet, as determined by denaturing gradient gel electrophoresis of PCR-amplified gene fragments coding for 16S rRNA." Appl Environ Microbiol 63(9): 3367-3373.

Paepatung. (2006). Assessment of palm oil mill effluent as biogas. 33rd Congress on Science and Technology of Thailand., Thailand.

Paparaskevas, D., Christakopoulas, P., Kekos, D., Macris, J.B. (1992). "Optimization production of extracellular lipase from Rhodotorula glutinis." Biotechnol Lett 14: 397-402.

Paramsothy, A., Wimalaweera, RM., Basnayake, BFA.,Wijesinghe, DTN. (2004). "Optimizing Hydrolyss / Acidogenesis Anaerobic Reactor with the Application of Microbial Reaction Kinetics." J Agri Res 16: 327-328

Pavlostathis, S., Giraldo-Gomez, E. (1990). Kinetics of Anaerobic Treatment - A Critical Review. Anaerobic Treatment Technology for Municipal and Industrial Wastewater. Spain, IAWPRC International Specialized Workshop.

Pender, S., Toomey, M., Carton, M., Eardly, D., Patching, JW., Colleran, E., O'Flaherty, V. (2004). "Long-term effects of operating temperature and sulphate addition on the methanogenic community structure of anaerobic hybrid reactors." Water Res, 38.

Pereira, M., Sousa, DZ., Mota, M., Alves, MM. (2004). "Mineralization of LCFA associated to anaerobic sludge: kinetics, transport limitations, enhancement of methanogenic activity and effect of VFA." Biotechnol Bioeng 88(4): 502-510.

Perspectives on the Thai Palm Oil Industry. (2010). Oil palm situation field trip report from <http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Oil%20Palm%20Situation%20Field%20Trip_Bangkok_Thailand_8-9-2010.pdf>.

Pfaffl, M., Horgan, GW., Dempfle, L. (2002). "Relative expression software tool (REST) for group-wise comparison and statistical analysis of relative expression results in real-time PCR." Nucleic Acids Res 30(9): 36.

Pfaffl, M. (2004). Quantification strategies in real-time PCR. In: Bustin SA (ed), A-Z of Quantitative PCR, International University Line.

Poh, P., Chong. (2009). "Development of anaerobic digestion methods for palm oil mill effluent (POME) treatment." Bioresource Technol 100: 1-9.

Powell, S., Ferguson, SH., Bowman, JP., Snape, I. (2006). "Using real-time PCR to assess changes in the hydrocarbon-degrading microbial community in antarctic soil during bioremediation." Microb Ecol 52: 523-532.

Puetpaiboon, U., Chotwattanasak, J. (2001) "Anaerobic treatment of palm oil mill wastewater under mesophilic condition" Master thesis, Civil engineering. Prince of Songkla University. Thailand.

Pozo, R., Diez, V., Beltr, S. (2000). "Anaerobic pre-treatment of slaughterhouse wastewater using fixed-film reactors." Bioresource Technol 71: 143-149.

Raskin, L., Poulsen, LK., Noguera, DR., Rittmann, BE., Stahl, DA. (1994). "Quantification of methanogenic groups in anaerobic biological reactors by oligonucleotide probe hybridization." Appl Environ Microbiol 60: 1241-1248.

Reyes, O., Sánchez, E., Rovirosa, N., Borja, R. (1999). "Low-strength wastewater treatmentby a multistage anaerobic filter packed with waste tyre rubber." Bioresource Technol 70: 55-60.

Rinc´on , B., Raposo, F., Borja, R., Gonz´alez, JM., Portillo, MC., Saiz-Jimenez, C. (2006). "Performance and microbial communities of a continuous stirred tank reactor treating two-phases olive mill solid wastes at low organic loading rates." J Biotechnol 121: 534-543.

Rincon, B., Borja, R., Gonz´alez, JM., Portillo, MC., S'aiz-Jim´enez, C. (2008). "Influence of organic loading rate and hydraulic retention time on the performance, stability and microbial communities of one-stage anaerobic digestion of two-phase olive mill solid residue." Biochem. Eng J. 40: 253-261.

Rittmann, B., McCarty, PL. (2001). Environmental Biotechnology. New York, McGraw-Hill Book Co.

Rollo´ n, A. (1999). Anaerobic digestion of fish processing wastewater with special enphasis on hydrolysis of suspended solids. Netherland, Wageningen Agricultural University.

Rossello-Mora, R., Amann, R. (2001). "The species concept for prokaryotes." FEMS Microbiol Rev 25: 39-67.

Sanders, W., Geerink, M., Zeeman, G., Lettinga, G. (2000). "Anaerobic hydrolysis kinetics of particulate substrates." Water Sci Technol 41: 17-24.

Sayed, S., Zanden, JVD., Wijiffels, R., Lettinga, G. (1988). "Anaerobic degradation of the various fractions of slaughterhouse wastewater." Biol Waste 23: 117-142.

Schallmey, M., Singh, A.,Ward, O.P. (2004). "Developments in the use of Bacillus species for industrial production." Can. J. Microbiol 50: 1-17.

Schink, B. (1997). "Energetics of syntrophic cooperation in methanogenic degradation." Microbiol Mol Biol Rev 61: 262-280.

Schmittgen, T., Zakrajsek, BA., Mills, AG., Gorn, V., Singer, MJ., Reed, MW. (2000). "Quantitative reverse transcription-polymerase chain reaction to study mRNA decay: comparison of endpoint and real-time methods." Anal Biochem 285(2): 194-204.

Seetha, N., Bhargava, R., Kumar, P. (2010). "Effect of organic shock loads on a two-stage activated sludge-biofilm reactor." Bioresource Technol 101: 3060-3066.

Shaji, J. (2000). Development of a high rate anaerobic reactor for biomethanation of cassava starch factory effluent. Department of Bioenergy. India, College of Agricultural Engineering. Ph.D.: 94-102.

Shigematsu, T., Tang, Y., Mizuno, Y., Kawaguchi, H., Morimura, S., Kida, K. (2006). "Microbial diversity of mesophilic methanogenic consortium that can degrade long-chain fatty acids in chemostat cultivation." J Biosi Bioeng 102(6): 535-544.

Singh, B., Cox-Singh, J., Miller, AO., Abdullah, MS., Snounou, G., Rahman, HA. (1996). "Detection of malaria in Malaysia by nested polymerase chain reaction amplification of dried blood spots on filter papers." Trans R Soc Trop Med Hyg 90(5): 519-521.

Somporn, P., Shabbir, H., Gheewala, Savitri, G. (2004). Environmental Evaluation of Biodiesel Production from Palm Oil in a Life Cycle Perspective. Thai National News Bureau Public Relations Department Thailand.

Song, H., Clarke, WP., Blackall, LL. (2005). "Concurrent microscopic observations and activity measurements of cellulose hydrolyzing and methanogenic populations during the batch anaerobic digestion of crystalline cellulose." Biotechnol Bioeng 91: 369-378.

Song, M., Shin, SG., Hwang, S. (2010). "Methanogenic population dynamics assessed by real-time quantitative PCR in sludge granule in upflow anaerobic sludge blanket treating swine wastewater." Bioresource Technology 101(1): 23-28.

Song, Y. W., JH., Kwon, SJ., Koh, SC. (2006). "Microbial Activity and Population Structure of Anaerobic Sludge Alternately Exposed to Mesophilic and Thermophilic Conditions." KSCE J Civil Engin 5: 319-323.

Spiegelman, D., Whissell, G., Greer, CW. (2005). "A survey of themethods for the characterization of microbial consortia and communities." Can J Microbiol 51: 355-386.

Stephen, F., Gish, AW., Miller, W., Myers, EWDJ. (1990). "Basic local alignment search tool." J Mol Biol 215(3): 403-410.

Steuerwald, N., Cohen, J., Herrera, RJ., Brenner, CA. (1999). "Analysis of gene expression in single oocytes and embryos by real-time rapid cycle fluorescence monitored RTPCR." Mol Hum Reprod 5: 1034-1039.

Sun, Y., Polishchuk, EA., Radoja, U., Cullen, WR. (2004). "Identification and quantification of arsC genes in environmental samples by using real-time PCR." J Microbiol Methods 58: 335-349.

Suraraksa, B. (1998). Bangkok, Thailand, King Mongkut's University of Technology Thonburi. Master.

Suraruk, B., Wangnai, C., Chaiprasert, P., Tanticharoen, M. (1998). Performance of an anaerobic hybrid reactor combining a filter and a sludge bed. Proceeding of the 10th Annual General Meeting of the Thai Society for Biotechnology for a Self-Sufficient Economy, Thailand.

Tay, J. (1991). "Complete reclamation of oil palm wastes." Resources Conserv Recycling 5: 383-392.

Thailand Environmental Management Guideline for the Palm oil Industry. (1997). Environmental Advisory Assistance for Industry. Thailand.

Tchobanoglous, G., FBurton, L., Stensel, H.D. (2009). "Wastewater Engineering: Treatment and Reuse, Fourth Edition. New York: McGraw Hill Companies, Inc. Thailand alternative energy situation."

Tong, S., Jaafar, AB. (2006). "POME Biogas capture, upgrading and utilization." Palm Oil Engin Bulletin 78: 11-17.

Torkian, A., Eqball, A., Hashemian, S J. (2003). "The effect of organic loading rate on the performance of UASB reactor treating slaughterhouse effluent." Resource Conversation Recycling 40: 1-11.

Ugoji, E. (1997). "Anaerobic digestion of palm oil mill effluent and its utilization as Fertilizer for environmental protection." Renewable energy 10: 291-294.

Veeken, A., Kalyuzhnyi, S., Scharff, H., Hamelers, B. (2000). "Effect of pH and VFA on hydrolysis and organic waste." ASCE J Environ. Eng 126: 1076-1081.

Vijayaraghavan, K., Ahmada, D., Aziz, MEBA. (2007). "Aerobic treatment of palm oil mill effluent." J Envi Manage 82(1): 24-31.

Vogels, G., Keltjens, JT., Van Der Drift, C. (1998). Biochemistry of methane production. New York, John Wiley&Sons.

Wang, Z., Banks, CJ. (2007). "Treatment of a high-strength sulphate-rich alkaline leachate using an anaerobic filter." Waste Management 27: 359-366.

Whelan, J., Russell, NB., Whelan, MA. (2003). "Method for absolute quantification of cDNA using real-time PCR." J Immu Method 278: 261-269.

Whitman, W., Boone, DR., Koga, Y., Keswani, J. (2001). Taxonomy of methanogenic Archaea, Springer.

Winograndsky, S. (1925). "Etudes sur la microbiologie du sol." I. Sur la method, Ann. inst. Pasteur 39: 299-354.

Winter, J., Wolfe, RS. (1979). "Complete degradation of carbohydrates to CO2 and methane by syntrophic cultures of Acetobacterium woodii y Methanosarcina barkeri.Arch." Microbiol Biotechnol 121: 97-102.

Wong, P., Sulaiman, NM., Nachiappan, M., Varadaraj, B. (2002). "Pre-treatment and membrane ultrafiltration using treated palm oil mill effluent (POME)vSongklanakarin." J Sci Technol 24(891-898).

Wood, H., Ljungdahl, LG. (1991). Autotrophic character of acetogenic bacteria. San Diego, Academic Press.

Yacob, S., Hassan, MA., Shirai, Y., Wakisaka, M., Subash, S. (2005). "Baseline study of methane emission from open digesting tanks of palm oil mill effluent treatment." Chemosphere 59: 1575-1581.

Yacob, S., Hassan, MA., Shirai, Y., Wakisaka, M., Subash, S. (2006a). "Baseline study of methane emission from anaerobic ponds of palm oil mill effluent treatment." Sci Total Envi 366: 187-196.

Yacob, S., Shirai, Y., Hassan, MA., Wakisaka, M., Subash, S. (2006b). "Start-up operation of semi-commercial closed anaerobic digester for palm oil mill effluent treatment." Process Biochem 41: 962-964.

Yejian, Z., Li, Y., Lina, C., Xiuhua, L., Zhijian, M., Zhenjia, Z. (2008). "Startup and operation of anaerobic EGSB reactor treating palm oil mill effluent." J Envi Sci 20: 658-663.

Zhang, Y., Lynd, LR (2005). "Cellulose utilization by Clostridium thermocellum: bioenergetics and hydrolysis product assimilation." PNAS 102: 7321-7325.

Zhang, Y., Yan, L., Chi, L., Long, X., Mei, Z., Zhang, Z. (2008). "Startup and operation of anaerobic EGSB reactor treating palm oil mill effluent." J Envi Sci. 20: 658-663.

Zheng, D., Angenent, LT., Raskin, L. (2006). "Monitoring granule formation in anaerobic upflow bioreactors using oligonucleotide hybridization probes." Biotechnol Bioeng 94: 458-472.

Zhou, J., Bruns, MA., Tiedje, JM. (1996). "DNA recovery from soils of diverse composition." Appl Environ Microbiol 62(2): 316-322.

Zinatizadeh, A., Mohamed, AR., Abdullah, AZ., Mashitah, MD., Hasnain-Isa., M., Najafpour, GD. (2006). "Process modeling and analysis of palm oil mill effluent treatment in an up-flow anaerobic sludge fixed film bioreactor using response surface methodology (RSM). " Water Res 40: 3193-3208.

Zinder, S. (1994). Syntrophic acetate oxidation and ''Reversible Acetogenesis''. New York London, Chapman & Hall.

APPENDIX A
Results data

1. Microbial population

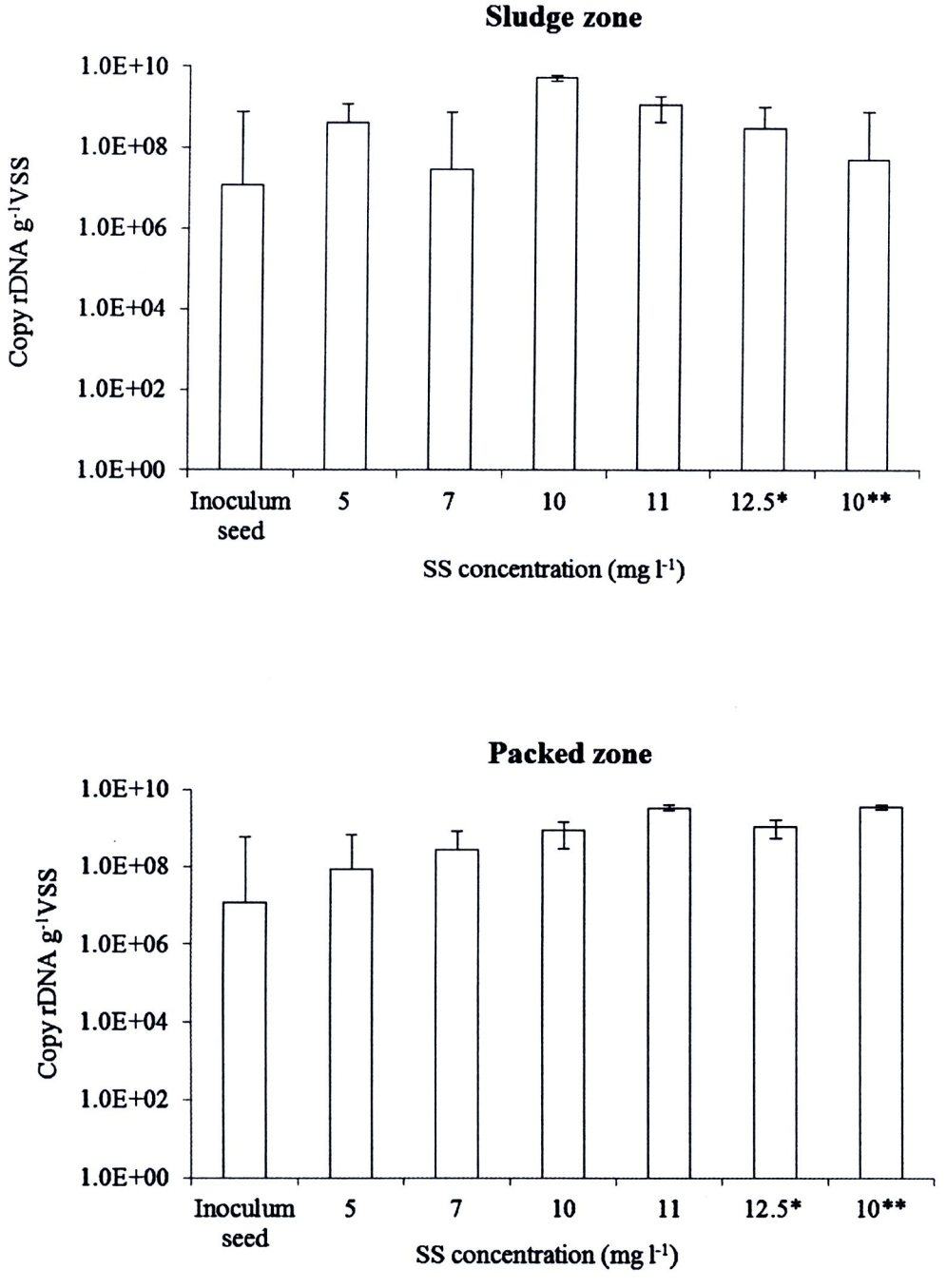


Figure A1. Eubacterial populations in AHR of POME;
Remark: * shock load, ** recovery and operational back to 10 g l^{-1}

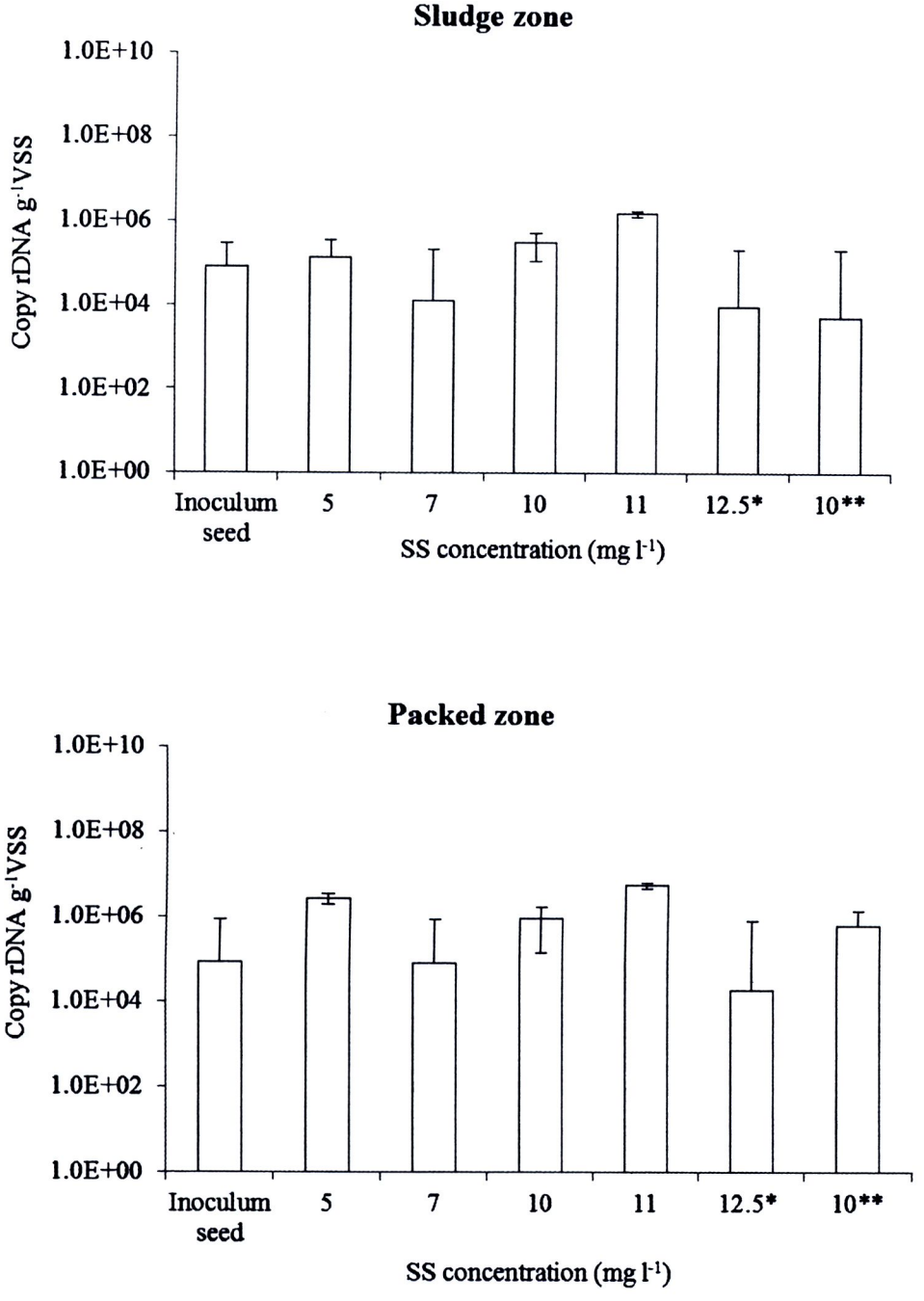


Figure A2. Archaeal populations in AHR of POME
Remark: * shock load, ** recovery and operational back to 10 g l^{-1}

1. Suspended solid removal

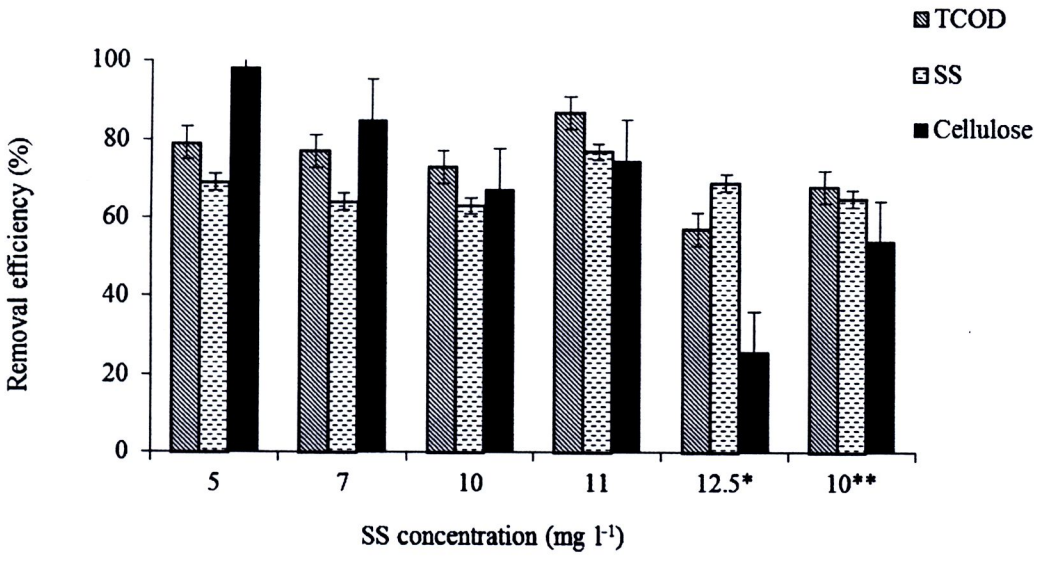


Figure A3. Suspended solid organic matters removal efficiency

Table A1. Effluent characteristic and overall organic removal of reactor operations

Zone	O&G (mg l^{-1})	SS (mg l^{-1})	TCOD (mg l^{-1})	SCOD (mg l^{-1})	Organic removal (%)			
					O&G	TCOD	SCOD	SS
5 g SS l-1								
Sludge	171 ± 0.3	1500 ± 0.1	2700 ± 0.4	1080 ± 0.2	81 ± 13.5	82 ± 11.5	88 ± 10.6	70 ± 6.5
Packed	266 ± 0.1	1200 ± 0.1	2580 ± 0.3	810 ± 0.3	70 ± 14.5	83 ± 3.0	91 ± 6.0	76 ± 4.0
Overall	300 ± 0.1	1560 ± 0.1	3120 ± 0.5	820 ± 0.2	67 ± 13.0	79 ± 4.5	91 ± 9.5	69 ± 4.5
7 g SS l^{1}								
Sludge	634 ± 0.1	11800 ± 0.6	27500 ± 1.0	1324 ± 0.3	50 ± 18.5	50 ± 4.8	92 ± 8.8	75 ± 10.2
Packed	285 ± 0.1	2450 ± 0.2	2406 ± 0.5	1004 ± 0.2	70 ± 10.0	89 ± 9.9	90 ± 6.6	65 ± 8.9
Overall	700 ± 0.1	2800 ± 0.2	4600 ± 0.9	2100 ± 0.4	58 ± 24.5	77 ± 9.7	88 ± 8.7	64 ± 11.5
10 g SS l^{1}								
Sludge	1100 ± 0.1	6800 ± 0.5	10500 ± 0.4	2800 ± 0.1	41 ± 12.5	50 ± 10.4	77 ± 8.4	40 ± 10.6
Packed	1470 ± 0.1	1630 ± 0.4	2300 ± 0.2	540 ± 0.2	60 ± 11.4	77 ± 8.9	81 ± 4.5	73 ± 7.2
Overall	2300 ± 0.1	4300 ± 0.4	5300 ± 0.4	2070 ± 0.6	56 ± 8.1	73 ± 5.5	80 ± 9.5	63 ± 10.0
11 g SS l^{1}								
Sludge	1200 ± 0.1	2780 ± 0.3	4550 ± 0.3	1900 ± 0.2	48 ± 11.0	81 ± 6.0	85 ± 4.0	68 ± 4.0
Packed	340 ± 0.1	970 ± 0.1	1720 ± 0.3	240 ± 0.1	68 ± 9.7	70 ± 5.6	89 ± 8.2	71 ± 10.5
Overall	1030 ± 0.1	2400 ± 0.3	3120 ± 0.3	1200 ± 0.1	55 ± 9.6	87 ± 12.5	89 ± 8.5	77 ± 8.8
12.5 g SS l^{1}								
Sludge	1788 ± 0.1	6357 ± 0.4	13907 ± 1.0	4070 ± 0.2	34 ± 9.7	54 ± 3.9	72 ± 3.2	49 ± 8.8
Packed	1043 ± 0.1	1990 ± 0.2	4098 ± 0.2	1110 ± 0.2	43 ± 5.6	71 ± 5.7	73 ± 7.0	69 ± 7.0
Overall	1180 ± 0.1	2464 ± 0.2	10662 ± 1.0	2290 ± 04	30 ± 10.2	57 ± 2.0	68 ± 6.5	49 ± 3.6
10 g SS l^{1}								
Sludge	1170 ± 0.1	4672 ± 0.2	10320 ± 0.8	3130 ± 0.3	39 ± 10.0	48 ± 5.0	61 ± 16.0	53 ± 5.2
Packed	452 ± 0.1	1582 ± 0.2	3154 ± 0.2	1280 ± 0.1	60 ± 4.4	70 ± 5.0	84 ± 10.2	57 ± 5.5
Overall	670 ± 0.1	2740 ± 0.3	4860 ± 0.3	2010 ± 246.6	52 ± 9.5	68 ± 4.0	80 ± 8.5	53 ± 7.4

Remark: Values are the mean of *n* values ± standard deviation (%); whereby *n* in the range of 20-30 values.

Table A2. Overall process stability of reactor operations

Zone	TVA (mg l^{-1})	Alkalinity (mg l^{-1})	TVA/Alk	pH
5 g SS l-1				
Sludge	700 ± 0.1	2593 ± 0.4	0.27 ± 0.07	7.2 ± 0.5
Packed	320 ± 0.1	1702 ± 0.4	0.19 ± 0.06	7.4 ± 0.4
Overall	570 ± 0.1	2818 ± 0.4	0.2 ± 0.06	7.3 ± 0.4
7 g SS l^{1}				
Sludge	1380 ± 0.6	2141 ± 0.5	0.64 ± 0.12	6.6 ± 0.4
Packed	953 ± 0.3	1842 ± 0.4	0.52 ± 0.17	6.9 ± 0.2
Overall	1200 ± 0.5	2800 ± 0.3	0.43 ± 0.17	7.1 ± 0.3
10 g SS l^{1}				
Sludge	2100 ± 0.2	3200 ± 0.5	0.66 ± 0.18	6.5 ± 0.2
Packed	1600 ± 0.4	3100 ± 0.3	0.52 ± 0.14	7.0 ± 0.3
Overall	1980 ± 0.5	3060 ± 0.5	0.64 ± 0.15	6.2 ± 0.3
11 g SS l^{1}				
Sludge	1450 ± 0.1	2700 ± 0.1	0.91 ± 0.07	5.4 ± 0.3
Packed	1250 ± 0.3	2300 ± 0.3	0.54 ± 0.12	6.7 ± 0.3
Overall	1300 ± 0.2	2520 ± 0.3	0.55 ± 0.10	6.9 ± 0.3
12.5 g SS l^{1}				
Sludge	2337 ± 0.3	1963 ± 0.1	1.17 ± 0.22	4.42 ± 0.2
Packed	1284 ± 0.4	2032 ± 0.1	0.63 ± 0.30	6.41 ± 0.2
Overall	1850 ± 0.3	2008 ± 0.2	0.88 ± 0.28	5.02 ± 0.3
10 g SS l^{1}				
Sludge	2000 ± 0.2	2750 ± 0.2	0.72 ± 0.14	6.3 ± 0.5
Packed	1200 ± 0.1	2425 ± 0.2	0.5 ± 0.12	7.1 ± 0.3
Overall	1450 ± 0.2	2550 ± 0.1	0.57 ± 0.16	6.8 ± 0.3

Remark: Values are the mean of *n* values ± standard deviation (%); whereby *n* in the range of 20-30 values.

APPENDIX B
Analytical methods

Quantitative real-time PCR (qPCR) analysis of EUB & ARC

1. Standard curve generation of eubacteria (EUB)

1. Measurement initial DNA concentration of standard EUB (*E.coli* DH5α clone no. ES1) by using Nano drop machine at 260 nm. Initial EUB DNA concentration was obtained at 244.3 ng/μl

2. Calculation DNA copy using the following equation (1):

$$\text{DNA copy} = \frac{(6.02 \times 10^{23}\ \text{copy/mole}) \times \text{DNA amount (g)}}{\text{DNA length (bp)} \times 660\ \text{(g/mol/bp)}} \qquad (1)$$

Result was obtained at

$$\text{DNA copy} = \frac{(6.02 \times 10^{23}\ \text{copy/mole}) \times 244.3 \times 10^{-9}\ \text{(g)}}{4{,}500\ \text{(bp)} \times 660\ \text{(g/mol/bp)}}$$

$$= 4.9 \times 10^{10}\ \text{copy/ μl}$$

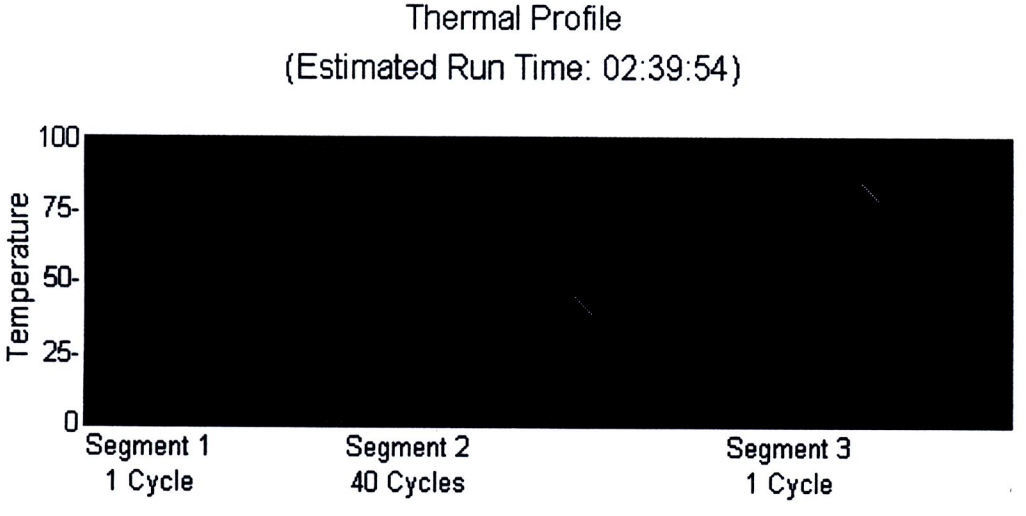
3. Serial dilution of EUB DNA

Dilution No.	Preparation				DNA amount (Copy / 2 μl)
	Template	DNA (μl)	H_2O (μl)	Total volume (μl)	
D1	D0	5	45	50	9.8×10^9
D2	D1	10	90	100	9.8×10^8
D3	D2	10	90	100	9.8×10^7
D4	D3	10	90	100	9.8×10^6
D5	D4	10	90	100	9.8×10^5
D6	D5	10	90	100	9.8×10^4
D7	D6	10	90	100	9.8×10^3
D8	D7	10	90	100	9.8×10^2

4. KAPA SYBR® Fast qPCR Kit was used for real-time reactions (KAPA, Brazil). The qPCR assay was performed using a fluorescence-detecting thermocycler (Stratagene Mx3005P). Sample was prepared using the following ratio:

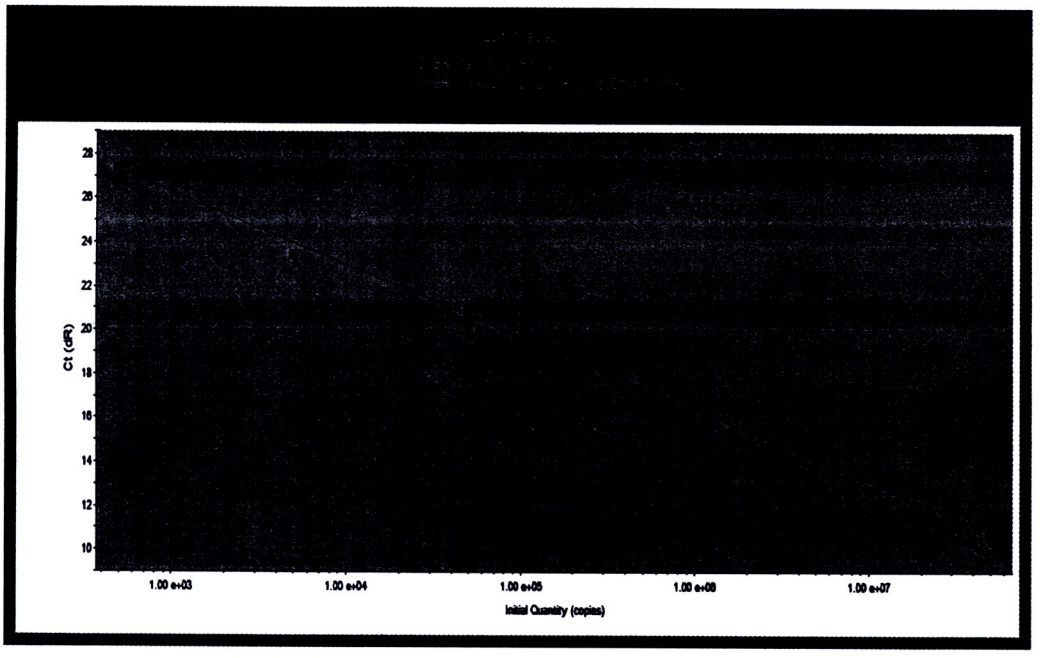
KAPA Master MIX	10	µl
Forward primer (8F)	0.4	µl
Reverse primer (1492R)	0.4	µl
qPCR water	7.2	µl
Template DNA	2	µl
Total volume	**20**	µl

5. Thermal profile of Standard curve generation was shown in figure below:



6. Results of EUB standard curve generation

	Linear rang (copy/2 µl)	Slope	R^2 of slope	Source strain
EUB	$9.8 \times 10^7 - 9.8 \times 10^2$	-3.286	0.996	ES1



2. Standard curve generation of archaea (ARC)

1. Measurement initial DNA concentration of standard ARC (*Methanosaeta* sp. clone no. POME_ARC54) by using Nano drop machine at 260 nm. Initial ARC DNA concentration was obtained at 38.9 ng/µl

2. Calculation DNA copy using the following equation (1). Result was obtained at

$$\text{DNA copy} = \frac{(6.02 \times 10^{23}\ \text{copy/mole}) \times 38.9 \times 10^{-9}\ (\text{g})}{4{,}500\ (\text{bp}) \times 660\ (\text{g/mol/bp})}$$

$$= 7.8 \times 10^{9}\ \text{copy/ µl}$$

3. Serial dilution of EUB DNA

Dilution No.	Preparation				DNA amount (Copy / 2 µl)
	Template	DNA (µl)	H_2O (µl)	Total volume (µl)	
D1	D0	5	45	50	1.58×10^9
D2	D1	10	90	100	1.58×10^8
D3	D2	10	90	100	1.58×10^7
D4	D3	10	90	100	1.58×10^6
D5	D4	10	90	100	1.58×10^5
D6	D5	10	90	100	1.58×10^4
D7	D6	10	90	100	1.58×10^3
D8	D7	10	90	100	1.58×10^2

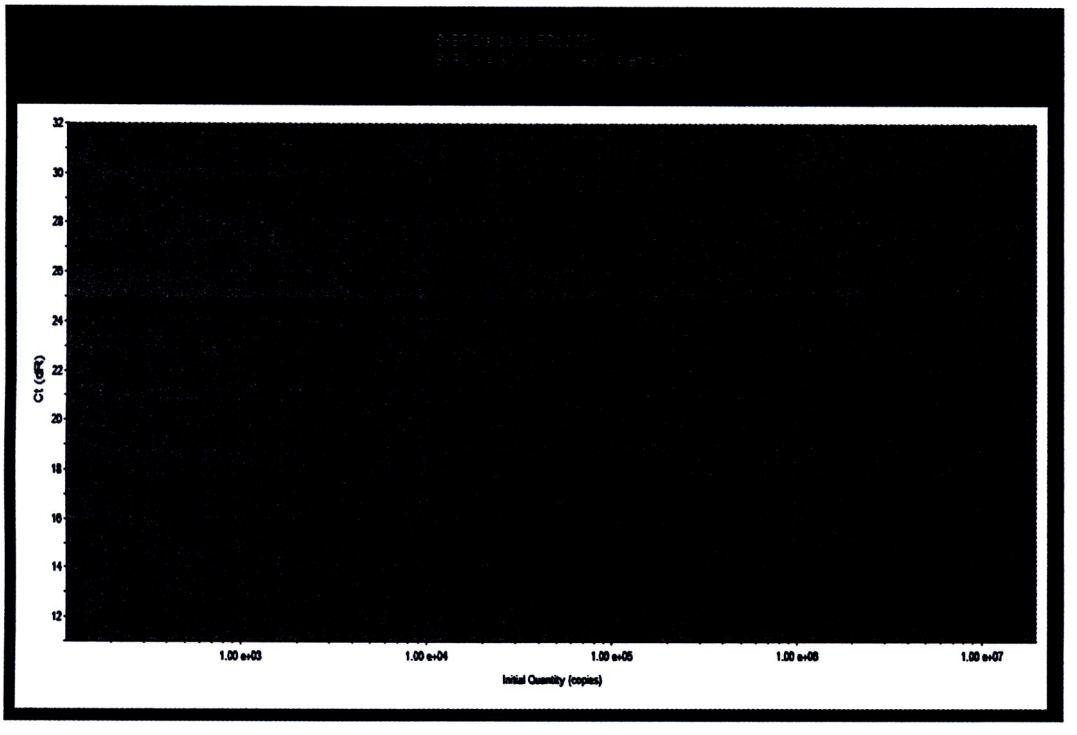
4. KAPA SYBR® Fast qPCR Kit was used for real-time reactions (KAPA, Brazil). The qPCR assay was performed using a fluorescence-detecting thermocycler (Stratagene Mx3005P). Sample was prepared using the following ratio:

KAPA Master MIX	10	µl
Forward primer (A1F)	0.4	µl
Reverse primer (1492R)	0.4	µl
qPCR water	7.2	µl
Template DNA	2	µl
Total volume	**20**	µl

5. Thermal profile of Standard curve generation was similar to EUB

6. Results of ARC standard curve generation

	Linear rang (copy/2 μl)	Slope	R^2 of slope	Source strain
ARC	$1.58 \times 10^7 - 1.58 \times 10^2$	-3.709	0.991	ARC54



3. Quantitative real-time PCR study of microbial population in AHR of POME

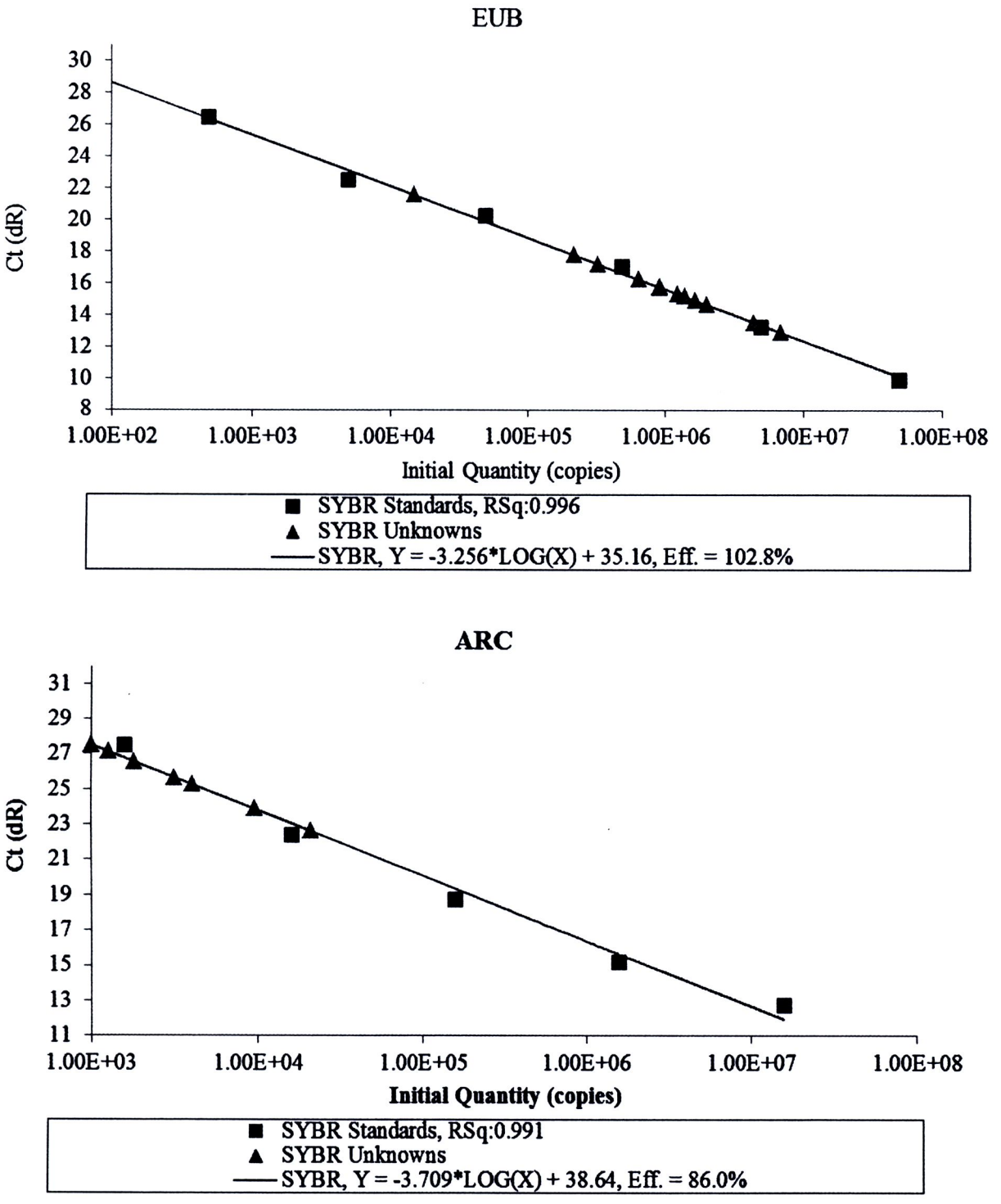


Figure B. Eubacterial (EUB) and archaeal (ARC) populations' analysis by qPCR

Gas composition

Methane in gas was analyzed by GC (Shimadzu, Class-GC 9A) using the following parameters:

Column ID and length:	Porapak-N-80/100, 1/8 inch
Detector:	TCD
Current bridge:	100 mA
Carrier gas:	Helium
Column temperature:	70°C
Detector temperature:	120°C
Injection temperature:	120°C

Biogas was collected by syringe (gas type) 250 µl from U-tube. Gas was injected to GC and then gas composition was reported by integrator of Shimadzu model C-R3A

VFA concentration

VFA in sample was analyzed by GC (Shimadzu, Class-GC 14B) using the following parameters:

Column:	Carbo-pack B-DA/4%carbowax 20M
Detector:	FID
Carrier gas:	Nitrogen
Column temperature:	170°C
Injection temperature:	200°C

VFA in samples was prepared by centrifuging at 10,000 rpm for 10 min to remove the suspended solid. The supernatants were acidified by oxalic acid 0.2 N of 200 µl to convert the VFA into the free acid form. Then the sample was ready for VFA examination with the same method as methane gas analysis. Concentrations of ethanol, acetic acid, butyric acid and propionic acid were reported by integrator of Shimadzu model C-R3A

Alkalinity and Total volatile acid

Alkalinity effluent was determined by titration with 0.05 N H_2SO_4 to the end-point when pH changes to 4.0. Volume of sample and H_2SO_4 were calculated to alkalinity value. The sample with pH 4.0 was then continuously titrated with 0.05 N NaOH to the end-point when pH changes to 7.0. Final volume of NaOH was calculated the TVA value (Kalayanee, 2000).

TCOD and SCOD

Filtrated and infiltrated samples were analyzed SCOD and TCOD, respectively. A fixed volume is added to a sample of the solution being analyzed as potassium permanganate ($KMnO_4$). After a refluxing digestion step, the initial concentration of organic substances in the sample is using spectrophotometric determination of the oxidant still remaining in the sample.

Total solid, Suspended solid and Volatile suspended solid

Total solid was determined both influent and effluent POME by placing the sample in the 105°C oven for 24 h. Let cool to room temperature in a desiccators. Weigh the solid and record. This is the total solid in influence and effluence. For suspended solid, mixed sample is filtered and dried at 105° C represents the amount of solids suspended in the sample solution. The amount of suspended solids in a water sample may be used as a general indicator of the overall quality of the sample. Suspended solids analyses are important in the control of biological and physical wastewater treatment processes and for assessing compliance with discharge regulations. The residue remaining after drying at 103° C is weighed and placed in a muffle furnace at 550° C. The weight loss from ignition determines "volatile suspended solids". These parameters will were analyze twice times per week.

Oil and Grease

Oil and grease represents a group of substances which have similar physical characteristics defined by their common solubility in an organic extracting solvent. It is essential that this extraction solvent be standardized for each method, because it partially defines the parameters that will be measured in the oil and grease analysis. This study analyzes oil and grease by hexane extraction method.