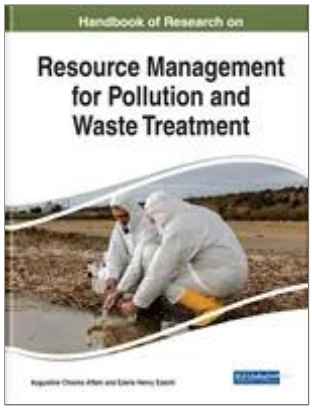

Industrial Wastewater Treatment: Recycled Paper Mill Effluent Treatment Using Modified Anaerobic Hybrid Baffled (MAHB) Bioreactor

Siti Roshayu Binti Hassan (Universiti Malaysia Kelantan, Malaysia), Mohamad Johari Abu (Universiti Malaysia Kelantan, Malaysia) and Irvan Dahlan (Universiti Sains Malaysia, Malaysia)

Source Title: Handbook of Research on Resource Management for Pollution and Waste Treatment (/book/handbook-research-resource-management-pollution/228091)

Pages: 21

DOI: 10.4018/978-1-7998-0369-0.ch014

Abstract

The development of effective and simple methods for treating wastewater is a challenging task for environmental engineers. In this chapter, a novel modified anaerobic hybridized baffled (MAHB) bioreactor, which is a combination of regular suspended-growth and fixed biofilm systems together with the modification of baffled-reactor configurations, was proven to be a modest bioreactor for wastewater treatment rather than the commercial anaerobic baffled reactor (ABR). The significant advantages of this bioreactor were its ability to nearly realize the multi-stages anaerobic theory, allowing different bacterial groups to develop under more favourable conditions, reduced sludge bed expansion, no special gas or sludge separation required, and high stability to organic and toxic shock loads. The compartmentalization of this bioreactor results in a buffering zone between the primary acidification zone and active methanogenesis zone, and provided the strong ability to resist shock loads which broaden the usage of multi-phase anaerobic technology for industrial wastewater treatment.

Chapter Preview

Top

Introduction

With the rapid change of world economic conditions and human populations, water resources are becoming progressively deficient and the quality of environment in the world is constantly becoming worse in most regions. Disposal of wastewater directly into the lands and rivers is presently one of the serious environmental problem contributors. Therefore, there is a dire need to develop reliable technologies for wastewater treatment. In general, anaerobic process has been extensively applied to treat wastewater due to its design simplicity, high treatment efficiency, low excess sludge production and low operating cost (Moawad et al., 2009; Vicentin et al., 2019). In addition, it involves biological conversions in a stepwise fashion of organic materials to various end-products including methane (CH_4) and carbon dioxide (CO_2). A well-managed anaerobic digestion system has the ability to produce maximum methane production without discharging any gases into the atmosphere (Paolini et al., 2018). There are various types of anaerobic reactors, such as up-flow anaerobic sludge blanket (UASB), expanded granular sludge bed (EGSB), strengthened circulation anaerobic reactor (SCAR), anaerobic membrane bioreactors (An MBRs), anaerobic sequential batch reactor (ASBR), anaerobic side-stream reactor (ASSR) and anaerobic baffled reactor (ABR) have been employed to process dyeing wastewater. Their results demonstrated that the treatment on the dyeing wastewater by pilot-scale

could be achieved chemical oxygen demand (COD) removal rate around 10 – 45.8% with an organic loading rate (OLR) at 0.53–7.4 kg COD/(m^3.h) (Li et al., 2017; Qi et al., 2019; Yang et al., 2018). Among these technologies, ABR takes advantage of the baffle structure to form several separate compartments up to eight inside the reactor, where the flow regime in which is mainly plug flow. It also forms multiphase anaerobic environment, and has the fine buffer capability resistant to shock loads and adaptability to influent toxicants. It uses two-way direction (up and down) of water stream to stir anaerobic sludge to mix with wastewater make a certain microorganism community cultivated in each of its compartments. Thus, better biological population distribution will be formed to improve treatment efficiency and operation stability due to the unique structure and flow regime of the reactor. However, most ABR reactors displays large solid loss and slow start-up period (usually more than a month) due to slow-degree adaptation of anaerobic microorganisms (Hassan et al., 2013b). Successful start-up period in the shortest time is an important indicator of a successful start-up process of an anaerobic reactor. Moreover, various trophic groups may not be in balance during the start-up process and the reactor may fail. Hence, the development of the optimum start-up condition is a very crucial. During start-up, external fluctuations such as pH, temperature and hydraulic retention time (HRT) must be avoided whilst organic loading rates (OLR) must be fixed. In the initial phase of start-up, the loading rate must be in the low region of 0.1 g $CODgVSS^{-1}d^{-1}$, which corresponds to 1.2 g $CODL^{-1}d^{-1}$ for a system with biomass of 12 g VSS L^{-1} (Barber & Stuckey, 1998). Some modification on the ABR is required to treat wastewater in a very short of time. Besides that, there is a combination of both suspended and attached-growth processes in a single reactor such as hybrid anaerobic filters (HAF) like plastic media, are designed to take advantage of huge solid loss (Hassan et al., 2013a). The improvement of the structure led to the adherence of the microorganisms on the packing to form biofilms, and further increased the microbial richness and diversity (Donlan, 2002). Therefore, in this chapter, a modify ABR reactor with a combination of regular suspended growth and fixed biofilm systems, together with the modification of baffled-reactor configurations was developed to treat effluent from local recycled paper mill industry.

Key Terms in this Chapter

Acclimate (/dictionary/acclimate/307): Respond physiologically or behaviourally to a change in an environmental factor under controlled conditions.

Suspended (/dictionary/suspended/79902): Wastewater treatment processes in which the microorganisms and bacteria treating the wastes are suspended in the wastewater being treated.

Washout (/dictionary/washout/79903): The sudden erosion of soft soil or other support surfaces by a gush of water, usually occurring during a heavy downpour of rain (a flash flood) or other stream flooding.

Attached Growth (/dictionary/attached-growth/79899): Wastewater treatment processes in which the microorganisms and bacteria treating the wastes are attached to the media in the reactor.

Methanogenesis (/dictionary/methanogenesis/79900): The production of methane by bacteria or other living organisms.

Acetogenesis (/dictionary/acetogenesis/79898): A process through which acetate is produced from CO 2 and an electron source (e.g., H 2 , CO, formate, etc.) by anaerobic bacteria via the reductive acetyl-CoA or Wood-Ljungdahl pathway.

Seeding (/dictionary/seeding/79901): To spread a defined amount (volume or cell number) of a cell suspension into a new flask or onto a plate, etc.

Complete Chapter List

Chapter 1 **$37.50**

Waste Tyre Rubber Application in Semi-Rigid and Flexible Pavement (/chapter/waste-tyre-rubber-application-in-semi-rigid-and-flexible-pavement/242008) (pages 1-21)

Euniza Jusli, Hasanan Md. Nor, Ramadhansyah Putra Jaya, Zaiton Haron, Mastura Bujang, Wan Nur Aifa Wan Azahar

Sample PDF (/viewtitlesample.aspx?id=242008&ptid=228091&t=Waste Tyre Rubber Application in Semi-Rigid and Flexible Pavement&isxn=9781799803690)

Chapter 2 **$37.50**

Utilization of Waste Cooking Oil (WCO) in Hot Mix Asphalt (HMA) (/chapter/utilization-of-waste-cooking-oil-wco-in-hot-mix-asphalt-hma/242009) (pages 22-46)

Mastura Bujang, Wan Nur Aifa Wan Azahar, Euniza Jusli

Sample PDF (/viewtitlesample.aspx?id=242009&ptid=228091&t=Utilization of Waste Cooking Oil (WCO) in Hot Mix Asphalt (HMA)&isxn=9781799803690)

Chapter 3 **$37.50**

Recent Advances in Waste Cooking Oil Management and Applications for Sustainable Environment (/chapter/recent-advances-in-waste-cooking-oil-management-and-applications-for-sustainable-environment/242010) (pages 47-63)

Ching Thian Tye

Sample PDF (/viewtitlesample.aspx?id=242010&ptid=228091&t=Recent Advances in Waste Cooking Oil Management and Applications for Sustainable Environment&isxn=9781799803690)

Chapter 4 **$37.50**

Sustainable Technologies for Solid Waste Monitoring and Treatment (/chapter/sustainable-technologies-for-solid-waste-monitoring-and-treatment/242011) (pages 64-87)

Kafayat Olafunke Adeyemi, Urbans Benywanira

Sample PDF (/viewtitlesample.aspx?id=242011&ptid=228091&t=Sustainable Technologies for Solid Waste Monitoring and Treatment&isxn=9781799803690)

Chapter 5 **$37.50**

Recent Advances in Fluidized Bed Gasification of Oil Palm Empty Fruit Bunches (/chapter/recent-advances-in-fluidized-bed-gasification-of-oil-palm-empty-fruit-bunches/242012) (pages 88-105)

Bemgba Bevan Nyakuma, Olagoke Oladokun

Sample PDF (/viewtitlesample.aspx?id=242012&ptid=228091&t=Recent Advances in Fluidized Bed Gasification of Oil Palm Empty Fruit Bunches&isxn=9781799803690)

Chapter 6 **$37.50**

“Microplastics”: The Next Threat to Mankind? (/chapter/microplastics/242013) (pages 106-122)

Asha Embrandiri, Shlrene Quaik, Madu Ijanu Emmanuel, Mariyam Rahma, Parveen Fatemeh Rupani, Mohd Hafiz Jamaludin, Mohd Azrul Naim

Sample PDF (/viewtitlesample.aspx?id=242013&ptid=228091&t=“Microplastics”: The Next Threat to Mankind?&isxn=9781799803690)

Chapter 7 **$37.50**

Fundamental Theories and Kinetic Models for the Pyrolysis of Lignocellulosic Biomass Wastes (/chapter/fundamental-theories-and-kinetic-models-for-the-pyrolysis-of-lignocellulosic-biomass-wastes/242014) (pages 123-151)

Olagoke Oladokun, Bemgba Bevan Nyakuma, Arshad Ahmad

Sample PDF (/viewtitlesample.aspx?id=242014&ptid=228091&t=Fundamental Theories and Kinetic Models for the Pyrolysis of Lignocellulosic Biomass Wastes&isxn=9781799803690)

Chapter 8 **$37.50**

Emerging Contaminants in Landfill Leachate and Their Treatment Methods (/chapter/emerging-contaminants-in-landfill-leachate-and-their-treatment-methods/242015) (pages 152-175)

Pradeep Kumar Singa, Jun-Wei Lim, Mohamed Hasnain Isa, Yeek-Chia Ho

Sample PDF (/viewtitlesample.aspx?id=242015&ptid=228091&t=Emerging Contaminants in Landfill Leachate and Their Treatment Methods&isxn=9781799803690)

Chapter 9 **$37.50**

Application of Graded Limestone as Roughing Filter Media for the Treatment of Leachate (/chapter/application-of-graded-limestone-as-roughing-filter-media-for-the-treatment-of-leachate/242016) (pages 176-219)

Augustine Chioma Affam, Ezerie Henry Ezechi

Sample PDF (/viewtitlesample.aspx?id=242016&ptid=228091&t=Application of Graded Limestone as Roughing Filter Media for the Treatment of Leachate&isxn=9781799803690)

Chapter 10 **$37.50**

Review on Microbial Analysis Tools in POME treatment (/chapter/review-on-microbial-analysis-tools-in-pome-treatment/242017) (pages 220-240)

Mohamad Mokhtar Ibrahim, Zulkifly Jemaat, Abdurahman Hamid Nour

Sample PDF (/viewtitlesample.aspx?id=242017&ptid=228091&t=Review on Microbial Analysis Tools in POME treatment&isxn=9781799803690)

Chapter 11 **$37.50**

Waste-Activated Sludge Treatment Processes (/chapter/waste-activated-sludge-treatment-processes/242018) (pages 241-263)

Chin Heng Gan, Siew Hoong Shuit

Sample PDF (/viewtitlesample.aspx?id=242018&ptid=228091&t=Waste-Activated Sludge Treatment Processes&isxn=9781799803690)

Chapter 12 **$37.50**

Biological Nutrient Removal by Suspended Growth Systems (/chapter/biological-nutrient-removal-by-suspended-growth-systems/242019) (pages 264-293)

Ezerie Henry Ezechi, Augustine Chioma Affam, Khalida Muda

Sample PDF (/viewtitlesample.aspx?id=242019&ptid=228091&t=Biological Nutrient Removal by Suspended Growth Systems&isxn=9781799803690)

Chapter 13 **$37.50**

Bioremediation: A Logical Approach for the Efficient Management of Textile Dye Effluents (/chapter/bioremediation/242020) (pages 294-317)

Sneha Unnikrishnan, Nagamani Bora, Karthikeyan Ramalingam

Sample PDF (/viewtitlesample.aspx?id=242020&ptid=228091&t=Bioremediation: A Logical Approach for the Efficient Management of Textile Dye Effluents&isxn=9781799803690)

Chapter 14 **$37.50**

Industrial Wastewater Treatment: Recycled Paper Mill Effluent Treatment Using Modified Anaerobic Hybrid Baffled (MAHB) Bioreactor (/chapter/industrial-wastewater-treatment/242021) (pages 318-338)

Siti Roshayu Binti Hassan, Mohamad Johari Abu, Irvan Dahlan

Sample PDF (/viewtitlesample.aspx?id=242021&ptid=228091&t=Industrial Wastewater Treatment: Recycled Paper Mill Effluent Treatment Using Modified Anaerobic Hybrid Baffled (MAHB) Bioreactor&isxn=9781799803690)

Chapter 15 **$37.50**

Reverse Osmosis Membrane Desalination Technology and Process: Case Study on Small-Scale Brackish City Polluted Water Treatment (/chapter/reverse-osmosis-membrane-desalination-technology-and-process/242022) (pages 339-372)

Man Djun Lee, Pui San Lee

Sample PDF (/viewtitlesample.aspx?id=242022&ptid=228091&t=Reverse Osmosis Membrane Desalination Technology and Process: Case Study on Small-Scale Brackish City Polluted Water Treatment&isxn=9781799803690)

Chapter 16 **$37.50**

Classical Fenton and Sequencing Batch Reactor Treatment of Pesticide Wastewater (/chapter/classical-fenton-and-sequencing-batch-reactor-treatment-of-pesticide-wastewater/242023) (pages 373-403)

Augustine Chioma Affam, Ezerie Henry Ezechi, Malay Chaudhuri

Sample PDF (/viewtitlesample.aspx?id=242023&ptid=228091&t=Classical Fenton and Sequencing Batch Reactor Treatment of Pesticide Wastewater&isxn=9781799803690)

Chapter 17 **$37.50**

Principles of Electrocoagulation and Application in Wastewater Treatment (/chapter/principles-of-electrocoagulation-and-application-in-wastewater-treatment/242024) (pages 404-431)

Ezerie Henry Ezechi, Augustine Chioma Affam, Khalida Muda

Sample PDF (/viewtitlesample.aspx?id=242024&ptid=228091&t=Principles of Electrocoagulation and Application in Wastewater Treatment&isxn=9781799803690)

Chapter 18 **$37.50**

Coagulation-Flocculation Technology in Water and Wastewater Treatment (/chapter/coagulation-flocculation-technology-in-water-and-wastewater-treatment/242025) (pages 432-457)

Yeek-Chia Ho, Siong-Chin Chua, Fai-Kait Chong

Sample PDF (/viewtitlesample.aspx?id=242025&ptid=228091&t=Coagulation-Flocculation Technology in Water and Wastewater Treatment&isxn=9781799803690)

Chapter 19 **$37.50**

Adsorption of Dyes in Aqueous Medium Using RHA and CFA: Effect of Preparation Methods and Process Optimization (/chapter/adsorption-of-dyes-in-aqueous-medium-using-rha-and-cfa/242026) (pages 458-475)

Irvan Dahlan, Sariyah Mahdzir

Sample PDF (/viewtitlesample.aspx?id=242026&ptid=228091&t=Adsorption of Dyes in Aqueous Medium Using RHA and CFA: Effect of Preparation Methods and Process Optimization&isxn=9781799803690)

Chapter 20 **$37.50**

Application of Soil Washing Treatment Method for the Remediation of Petroleum Polluted Soil (/chapter/application-of-soil-washing-treatment-method-for-the-remediation-of-petroleum-polluted-soil/242027) (pages 476-501)

Abdullahi Evuti Mohammed, Kamoru Adio Salam, Silas Shamaye Samuel

Sample PDF (/viewtitlesample.aspx?id=242027&ptid=228091&t=Application of Soil Washing Treatment Method for the Remediation of Petroleum Polluted Soil&isxn=9781799803690)

Chapter 21 **$37.50**

Membrane Technology for Treatment of Pharmaceutical Wastewaters: A Novel Approach (/chapter/membrane-technology-for-treatment-of-pharmaceutical-wastewaters/242028) (pages 502-530)

Saritha Vara, Madhavi Konni, Manoj Kumar Karnena

Sample PDF (/viewtitlesample.aspx?id=242028&ptid=228091&t=Membrane Technology for Treatment of Pharmaceutical Wastewaters: A Novel Approach&isxn=9781799803690)

Chapter 22 **$37.50**

Waste Management Practice in Malaysia and Future Challenges (/chapter/waste-management-practice-in-malaysia-and-future-challenges/242029) (pages 531-549)

Huang Shen Chua, Mohammed J. K. Bashir

Sample PDF (/viewtitlesample.aspx?id=242029&ptid=228091&t=Waste Management Practice in Malaysia and Future Challenges&isxn=9781799803690)

Chapter 23 **$37.50**

Agricultural Runoff and Treatment Methods (/chapter/agricultural-runoff-and-treatment-methods/242030) (pages 550-575)

Yeek-Chia Ho, Boon-Chin Lim, Jun-Wei Lim

Sample PDF (/viewtitlesample.aspx?id=242030&ptid=228091&t=Agricultural Runoff and Treatment Methods&isxn=9781799803690)

Chapter 24 **$37.50**

Synergy Between Air Quality, Various Urban Forms, and Land Surface Temperature: A Case Study of Kolkata Metropolitan Area (/chapter/synergy-between-air-quality-various-urban-forms-and-land-surface-temperature/242031) (pages 576-609)

Abira Dutta Roy, Munni Debnath Parial, Kasturi Mukherjee

Sample PDF (/viewtitlesample.aspx?id=242031&ptid=228091&t=Synergy Between Air Quality, Various Urban Forms, and Land Surface Temperature: A Case Study of Kolkata Metropolitan Area&isxn=9781799803690)

Chapter 25 **$37.50**

Real-Time Construction Waste Reduction Using Unmanned Aerial Vehicle (/chapter/real-time-construction-waste-reduction-using-unmanned-aerial-vehicle/242032) (pages 610-625)

Wallace Imoudu Enegbuma, Jibril Adewale Bamgbade, Cosmas Pang Han Ming, Chukwuka Christian Ohueri, Bruno Lot Tanko, Edo Oga Ojoko, Yakubu Aminu Dodo, Sa'id Kori

Sample PDF (/viewtitlesample.aspx?id=242032&ptid=228091&t=Real-Time Construction Waste Reduction Using Unmanned Aerial Vehicle&isxn=9781799803690)

Chapter 26 **$37.50**

Anaerobic Digestion (AD) of Organic Waste Is a Sustainable Waste Management Facility (/chapter/anaerobic-digestion-ad-of-organic-waste-is-a-sustainable-waste-management-facility/242033) (pages 626-650)

Asim Yaqub, Kamal Hussain, Kinza Irshad, Iftikhar Zeb, Rashid Nazir, Muhammad Bilal, Huma Ajab

Sample PDF (/viewtitlesample.aspx?id=242033&ptid=228091&t=Anaerobic Digestion (AD) of Organic Waste Is a Sustainable Waste Management Facility&isxn=9781799803690)

About the Contributors — View Full PDF (/pdf.aspx?tid=242035&ptid=228091&ctid=17&t=About the Contributors&isxn=9781799803690)

Index — View Full PDF (/pdf.aspx?tid=242036&ptid=228091&ctid=17&t=Index&isxn=9781799803690)