

| ORAL ABSTRACT RENEWABLE ENERGY & BIOLOGICAL WASTE TREATMENT | | |
|--|--|---|
| 2 | Daniah Ali Hassoon Nash | Influence of pH and Inoculum to Substrate Ratio on the Treatment of Sago Mill Effluent in Batch Anaerobic Digestion Test |
| 3 | Dwi Agustiang Ningsih | Degradation of Colour in Batik Wastewater using <i>Scirpus grossus</i> and <i>Iris pseudacorus</i> with Intermittent Exposure System |
| 4 | Gina Lova Sari | Compost Humic Acid-Like Isolates from Composting Process of Crude Oil Contaminated Soil: Properties and Feasibility to Solubilize Hydrocarbon |
| 5 | Gregory Tan Guan Yuan | Effects of Different Light Spectrums on Growth and Protein Content of <i>Chaetoceros calcitrans</i> |
| 6 | Mitsuhiko Koyama | Effect of Ca(OH) ₂ Addition on NH ₃ Recovery from Sludge during Thermophilic Composting |
| 7 | Mutsumi Sekine | Simultaneous Desulfurization and Nitrification of Anaerobic Digestion Effluent by using a Sequencing Batch Reactor |
| 8 | Nor Sakinah binti Mohd Said | Remediation of Coffee Industry Effluent through a Continuous Two-Stage Constructed Wetland System |
| 9 | Nurarina Ayuni Ghazali | Screening of Microalgae Isolated from Shrimp <i>Litopenaeus vannamei</i> Pond as Potential Bioremediator |
| 10 | Nur Atiyah binti Ramli | Optimization of Ammonia Recovery from Aquaculture Sludge by Using Composting Process |
| 11 | Nurul Farahin binti Abd. Wahab | Ammonia Tolerance in Marine Microalgae, <i>Tetraselmis tetrathele</i> Culture |
| 12 | Siti Shilatul Najwa binti Sharuddin | Phytoremediation of Total Petroleum Hydrocarbon (TPH) in crude oil sludge by <i>Scirpus grossus</i> |
| 13 | Toshimitsu Kodera | Formation of Simultaneous Denitrification and Methanogenesis Granular Sludge from Dispersed Anaerobic Digested and Denitrifying Sludges |

Influence of pH and Inoculum to Substrate Ratio on the Treatment of Sago Mill Effluent in Batch Anaerobic Digestion Test

Daniah Ali Hassoon Nash¹, Siti Rozaimah Sheikh Abdullah¹, Hassimi Abu Hassan¹, Idris Mushrifah², Ahmad Razi Othman¹

¹Department of Chemical and Process Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

²Tasik Chini Research Center, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

Corresponding author's email address: ¹danianash@yahoo.com; ²rozaimah@ukm.edu.my

Abstract

A batch anaerobic digestion test was conducted to evaluate the effects of inoculum/substrate ratios (ISRs) and pH on treatment of Sago Mill Effluent (SME). Batch reactors were used to compare the removal of containment from the effluent at different ratio of anaerobic mix culture inoculum to substrate (0.5 to 2 with OD_{600nm}) and pH (pH 4.5 to 7.5). The digestion tests were carried out at 27-32 °C Malaysia climate for 21 days and run against a control of inoculum without substrate. The stability and progress of the reaction employed experimental runs according to response surface method (RSM) to maximize the removals of the soluble chemical oxygen demand (sCOD), Ammoniacal-nitrogen (NH₄-N) and total organic carbon (TOC) by optimizing the pH and inoculum to substrate ratio. The optimization results demonstrated an obvious influence on removal at retention time at 21 days, pH 6.4 and ratio of inoculum 0.5 with removals of 57.7%, 23.8% and 21% for sCOD, NH₄-N and TOC, respectively.

Keywords--- Sago Mill Effluent, batch reactor, inoculum ratios, PH, COD

Degradation of Colour in Batik Wastewater using *Scirpus grossus* and *Iris pseudacorus* with Intermittent Exposure System

Dwi Agustiang Ningsih¹, Tangahu. B.V²

^{1,2}Department of Environmental Engineering, Faculty of Civil Environmental and Geo Engineering,
Institut Teknologi Sepuluh Nopember, Jl. Raya ITS, Surabaya 60111

Corresponding author's email address: voijant@its.ac.id

Abstract

Wastewater produced from Batik colouring process is commonly disposed into the river or drainage system without proper treatment. By applying phytotechnology, the treatment of batik wastewater can be simple and affordable. One of phytotechnology principles is treating wastewater using plants as phytotreatment agents which absorb the pollutant contained in wastewater. Intermittent exposure system was applied to increase treatment efficiency by connecting plants and wastewater periodically through flood and drain cycle (F/D). This system increases redox condition, thus increases the treatment efficiency. Plants used in this research were *Scirpus grossus* and *Iris pseudacorus*. Both of these plants are semi aquatic and adaptable plants in polluted environment either in wet or dry condition. The aim of this research was to investigate degradation process of colour from batik wastewater using both plants by applying intermittent exposure system. The treatment efficiency was evaluated based on plants species, i.e., *Scirpus grossus* and *Iris pseudacorus* (either single plantation or combined plantation), and F/D ratio applied in intermittent exposure system variation, i.e., F/D 2:1 and F/D 1:2. Range Finding Test (RFT) was conducted during preliminary test by means of acclimatization of plants to determine the concentration (load) of industrial wastewater batik used in phytoremediation test. Phytoremediation was conducted during the 18-days in a laboratory scale by measuring colour intensity as the main parameter. The supporting parameters were temperature, pH, and the physical characteristic of the plant. The result showed that the highest removal of colour (i.e., 99% colour removal) was obtained in combined plants reactor with intermittent exposure F/D ratio of 2:1.

Keywords---**Batik wastewater, colour, phytoremediation, intermittent**

Effects of Different Light Spectrums on Growth and Protein Content of *Chaetoceros calcitrans*

Gregory Guan Yuan Tan¹, Banerjee S.¹, Khatoon H.², Shariff M.³, Yusoff F. M.¹

¹Institute of Bioscience, Universiti Putra Malaysia, 43400 Selangor, Malaysia.

²School of Fisheries and Aquaculture, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Malaysia.

³Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 Selangor, Malaysia.

Corresponding author's email address: gregtangy@gmail.com

Abstract

Microalgae have recently received much attention as a new biomass source for protein, lipid, fatty acids and natural pigments. This makes microalgae a potentially rich source of chemical products with applications in the feed, food, nutritional and pharmaceutical industries. The growth and biochemical composition of microalgae are known to be greatly influenced by light. Limited availability of natural light (e.g. sunlight) due to diurnal cycles and seasonal variations impedes the viability of their production. Artificial lights such as fluorescent lamps are commonly used as a substitute to overcome light limitations. However, some of these light sources have high energy consumption. Therefore, energy-saving alternatives such as light emitting diodes (LEDs), with specific spectrums are encouraged to be integrated into culture systems to achieve faster growths and high quality biomass at a reduced operational cost. *Chaetoceros calcitrans* is widely used as a live feed for shrimp larvae. The growth and protein content of this commercially important species cultivated under 3 different light spectrums – blue, red LED, and compact fluorescent lamp (CFL; control) were evaluated in this study. The highest specific growth rate (SGR) for *C. calcitrans* was blue and red LED treatments, which were significantly higher from the rest of the treatments ($p < 0.05$). The highest protein content was obtained in blue LED treatment ($p < 0.05$) (Table 1). These results indicate that blue and red LED promotes the growth of *C. calcitrans*. However, the protein content of the species was only higher when cultivated under blue LED.

Keywords---*Chaetoceros calcitrans*, LEDs, protein content, light source, growth

Compost Humic Acid-Like Isolates from Composting Process of Crude Oil Contaminated Soil: Properties and Feasibility to Solubilize Hydrocarbon

Gina Lova Sari^{1,2}, Dwi Agustina Wulandari¹, Yulinah Trihadiningrum¹

¹Department of Environmental Engineering, Faculty of Civil, Environmental, and Geo Engineering, Institut Teknologi Sepuluh Nopember, Kampus ITS Sukolilo, Surabaya, 60111, Indonesia.

²Faculty of Engineering, Universitas Singaperbangsa Karawang, Teluk Jambe Timur, Karawang 41361, Indonesia.

Corresponding author's email address: ginalovasari@gmail.com

Abstract

Biodecomposition of organic solid waste during composting process produces compost humic acid-like (cHAL), which is classified as biobased surfactant. The present study aimed to characterize the properties of cHAL substance which was formed during the composting process of crude oil contaminated soil, i.e the declining of surface tension (Δ ST) and emulsification activity (EA), and evaluate the ability to solubilize hydrocarbons. Crude oil contaminated soil from a public oilfield in Wonocolo Sub-district, Bojonegoro, Indonesia, was composted in aerobic condition with varied biodegradable waste in separate reactors. The biodegradable waste materials are yard waste and rumen residue from a slaughter house. The cHAL compounds were isolated from composting products from yard waste (Y₁₀₀), rumen residue (R₁₀₀), control of contaminated soil (S₁₀₀), and mixed of contaminated soil and biodegradable waste (S₅₀YR₅₀). The cHAL isolate samples were collected on days 0, 20, 40 and 60, and compared with Tween 80 in 0.00; 0.50; 1.00; 1.50; 2.00; 2.50; and 3.00% concentrations. The results showed that Δ ST values of cHAL isolates ranged from 6.65 to 21.50 mN/m. The EA of cHAL isolates were in the range of 7.35–38.01%. The cHAL isolates were capable to solubilize 99 to 10,710 μ g/g hydrocarbons. The cHAL isolates from R100 and S50YR50 are potential as surface tension reducer and hydrocarbon emulsifier. Values of these parameters of the isolates were close to 0.50% Tween 80, and the abilities to solubilize hydrocarbon were comparable to 1.00% Tween 80.

Keywords--- Bio-based surfactant, compost humic like substance (cHAL), emulsification activity, surface tension, hydrocarbon solubilization capacity

Effect of Ca (OH)₂ Addition on NH₃ Recovery from Sludge during Thermophilic Composting

Mitsuhiko Koyama¹, Norio Nagao², Fadhil Syukri², Abdullah Abd Rahim², Mohd Salleh Kamarudin², Tatsuki Toda³, Kiyohiko Nakasaki³

¹School of Environment and Society, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo 152-8550, Japan.

²Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia.

³Faculty of Science and Engineering, Soka University, 1-236 Tangi-machi, Hachioji, Tokyo 192-8577, Japan.

Corresponding author's email address: koyama.m.ad@m.titech.ac.jp

Abstract

Development of aerobic fermentation (i.e. thermophilic composting) for maximizing ammonia gas recovery would enable the production of a nitrogen source which is free from pathogen/heavy metal, for the cultivation of high-value microalgae. In order to enhance the evaporation of ammonium ion in the compost as ammonia gas, we used Ca(OH)₂ as alkaline agent and examined the effect of the dosing timing and pH on the ammonia gas recovery and the organic matter degradability of dewatered sludge during thermophilic composting. The sludge was mixed with the bulking agent (sawdust) and the seeding material with the dry weight ratio of 5:14:1 and aerobically composted at 60°C for 10 days. Addition of Ca(OH)₂ greatly enhanced the ammonia gas emission by evaporating ammonium ion remained in the compost. Dosing timing did not influence the microbial activity, thus early dosing was suggested to be feasible for quick recovery of ammonia gas and application to fed-batch system. Among three pH conditions of 10, 11 and 12, the conditions of pH 11 or higher produced more ammonia gas as compared with that of pH 10. To conclude, early dosing with pH 11 condition seemed to be the best option in terms of high ammonia recovery and moderate Ca(OH)₂ cost.

Keywords--- **Composting, ammonia recovery, alkaline agent**

Simultaneous Desulfurization and Nitrification of Anaerobic Digestion Effluent by using a Sequencing Batch Reactor

Mutsumi Sekine¹, Kodera, T.¹, Kishi, M.², Akizuki, S.² and Toda, T.¹

¹Graduate School of Engineering, Soka University, 1-236 Tangi-machi, Hachioji, Tokyo, Japan

²Faculty of Science and Engineering, Soka University, 1-236 Tangi-machi, Hachioji, Tokyo, Japan

Corresponding author's email address: mu_sekine@soka.gr.jp

Abstract

Anaerobic digestion (AD) is an economical and environmentally friendly biological treatment method of organic wastes with biogas generation. For further widespread of the AD, it is required to reduce environmental loads and costs for post-treatments such as desulfurization for biogas utilization and nitrification-denitrification for nitrogen removal from effluent (ADE). Sulfide of biogas and ammonium of ADE may be simultaneously treated by developing a consortium of sulfur-oxidizing bacteria and nitrifying bacteria, which have similar optimum growth conditions. However, sulfide is a strong inhibitor to nitrifying bacteria. Therefore, nitrification efficiency of the bacteria consortium may decrease with the supply of biogas containing a high concentration of sulfide. On the other hand, microbes are known to acclimate to inhibitors. A sequencing batch reactor (SBR), which has high sludge retention time (SRT), may effectively acclimatize microbes by long-term exposure to sulfide. Therefore, the objective of this study was to develop the bacteria consortium by using SBR. SBR was daily operated at 23.5 h of feeding and reaction, 0.25 h settling, and 0.25 h drawing periods. The filtrated ADE was supplied as a substrate with NaHS solution, and sulfide loading rate (SLR) was increased stepwise from 0 to 32, 64, 128, and 258 mg L⁻¹ d⁻¹. With SLR of less than or equal to 128 mg-S L⁻¹ d⁻¹, stable desulfurization and nitrification were achieved simultaneously at 100% efficiencies. With SLR of 258 mg-S L⁻¹ d⁻¹, NH₄⁺ removal efficiency decreased to 47%, and the removed NH₄⁺ was almost converted to NO₂⁻ due to sulfide inhibition, especially on the nitrite-oxidation process. From results of batch bioassays, the sulfide tolerance (50% inhibitory sulfide concentration, IC₅₀) of microbes at 128 mg-S L⁻¹ d⁻¹ of SLR was 4 times higher than at 0 mg-S L⁻¹ d⁻¹ of SLR at the beginning of the experiment, indicating that the bacteria consortium was adapted to the sulfide by high SRT in SBR.

Keywords--- Anaerobic digestion (AD), Simultaneous desulfurization-nitrification, sulfide inhibition, sulfide acclimatization, sequencing batch reactor (SBR)

Remediation of Coffee Industry Effluent through a Continuous Two-Stage Constructed Wetland System

Nor Sakinah Mohd Said, Sheikh Abdullah S.R., Ismail N.I., Abu Hasan H. & Othman A.R.
Department of Chemical and Process Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

Corresponding author's email address: norsakinahsaid95@gmail.com

Abstract

Coffee industry is one of the industries that keeps rising nationally and globally. Coffee processing produces large volume of wastewater especially when wet method is used to process the coffee beans. Effluent from coffee industry is acidic, has high value of BOD, COD and organic substances. Coffee effluents used in this study has pH of 4.4 with total suspended solid as 399.3 mg/L, color as 193000 ADMI, meanwhile COD and BOD with concentration of 12966.7 and 1717.5 mg/L respectively. Hence, this study was conducted to determine the phytoremediation performance of a continuous two-stage constructed wetland system using tropical plants that easily found in Malaysia (*Phragmites karka* and *Eichhornia crassipes*) to reduce contaminants in real coffee industry effluent in a single treatment. The system was fed continuously with coffee industry effluent at volumetric flowrate of $1.71 \times 10^{-4} \text{ m}^3/\text{h}$ to keep the hydraulic retention time at 3 days for *Phragmites karka* and 4 days for *Eichhornia crassipes*. From the results, the two-stage plant system was capable to remove on average 92% suspended solids, 76% colour, 64% BOD₅ and 38% COD giving evidence that phytotechnology can be used to treat coffee industry effluent.

Keywords--- Phytoremediation, *Phragmites karka*, *Eichhornia crassipes*, constructed wetland, coffee industry effluent

Screening of Microalgae Isolated from Shrimp *Litopenaeus Vannamei* Pond as Potential Bioremediator.

Nurarina Ayuni Ghazali¹, I. Natrah^{1,2,3}, Fatimah Md. Yusoff^{1,2,3}, Murni Karim^{1,3}, Chong Chou Min^{1,3}, Norio Nagao^{1,3}

¹Laboratory of Marine Biotechnology, Institute Bioscience, Universiti Putra Malaysia, 43400 UPM, Selangor

²Laboratory of Sustainable Aquaculture, International Institute of Aquaculture and Aquatic Sciences, Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor

³Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM, Serdang Selangor

Corresponding author's email address: natrah@upm.edu.my

Abstract

Aquaculture is among the fastest growing industry due to significant demand for seafood supply throughout the world. The industry development also raise concerns on the increasing level of organic waste and toxic compounds that can affect the aquaculture productivity and degrade environment. Excessive nitrogenous compounds (ammonium, nitrite and nitrate) due to high feed loads and high stocking density can affect animal growth and decrease its survivality. Microalgae have received increasing attentions as an alternative treatment in maintaining good water quality for culture organisms. In this study, various microalgae species isolated from the shrimp *Litopenaeus vannamei* culture ponds were tested for bioremediation potential in removing total ammonia nitrogen (TAN). All microalgae species reduced TAN level significantly ($p < 0.05$) with more than 50% removal within 4 days of culture. This study showed that phycoremediation could be used to provide an effective and environmentally acceptable option for a more sustainable aquaculture industry.

Keywords--- Microalgae, bioremediator, aquaculture

Optimization of Ammonia Recovery from Aquaculture Sludge by Using Composting Process

Nur Atiyah Ramli, Muhammad Fadhil Syukri Ismail, Mohd Salleh Kamarudin, Murni Marlina Karim

Department of Aquaculture, Faculty of Agriculture, University Putra Malaysia,
43400 UPM Serdang Selangor, Malaysia.

Corresponding author's email address: fadhil@upm.edu.my

Abstract

Sludge formation and accumulation is common in several culture methods that been practiced in aquaculture which is need to be safely disposed frequently in order to keep the environment. Ammonia is one of the ultimate product produced under ideal conditions of anaerobic digestion, natural process carried out by facultative and obligatory anaerobic bacteria. Composting process of the sludge will enhance the recovery of ammonia gases. Temperature are on the factors that influence the digestibility of the sludge and biogas production. While bulking agent such as sawdust of oil palm empty bunch, rubber stalk, and kenaf trunk can be used to promote composting process by reducing anaerobic digestion spots. The objectives of this study are to investigate the effect of composting temperature on ammonia recovery from aquaculture sludge and to study the optimization of ammonia emission by using different types of bulking agent. In experiment 1, 20kg of homogenous anaerobic sludge per reactor will be composted by using 200L PVC reactor under 50°C, 60°C and 70°C of temperature for 10 days. Sampling will be done at day 0, 1, 2, 3, 5, 7 and 10. The sludge mixture will be mixed once per day as the process progressed. In experiment 2, 21kg of sawdust of oil palm empty bunch, rubber stalk, and kenaf trunk per reactor will be mixed with anaerobic sludge for the composting experiment on the optimization of NH₃ emission. The emission of ammonia frequently occurs during the thermophilic stage of composting. At low initial C/N ratios, ammonia emissions from anaerobic sludge tend to be high. Loses of ammonia could be controlled during composting to enhance the agronomic value of the compost and reduce atmospheric pollution. Moisture contents were maintained at the optimum range (40-60%), pH value at 70°C might slightly lower than other temperature conditions. Rate of increase in emission of nitrogen from 50°C to 60°C might slightly higher than emission of carbon. 70°C results might indicate the microbial growth is severely inhibited. In all temperature conditions, substantial amount of NH₃ remained in the compost.

Keywords--- **Anaerobic digestion, composting, digestibility, bulking agent, optimization**

Ammonia Tolerance in Marine Microalgae, *Tetraselmis tetrathele* Culture

Nurul Farahin Abd. Wahab¹, Norio Nagao¹, Fatimah Md Yusoff^{1,2}, Natrah Ikhsan^{1,2}, Tomoyo Katayama³, Tatsuki Toda⁴

¹Laboratory of Marine Biotechnology, Institute of Bioscience, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

²Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

³Department of Aquatic Bioscience, University of Tokyo, Japan. ⁴Department of Environmental Engineering for Symbiosis, Faculty of Engineering, Soka University, Tokyo, Japan.

Corresponding author's email address:

Abstract

The main form of nitrogen in wastewater is ammonium that can be used as nitrogen sources in microalgae production. However, at certain levels, it become inhibitory to the cell growth. Batch experiment at laboratory scale was performed to evaluate the effects of total ammonia nitrogen ($\text{NH}_3 + \text{NH}_4^+$) on growth rate, photosynthetic efficiency (F_v/F_m) and pigment contents (chlorophyll *a*, lutein, neoxanthin and β -carotene) in *Tetraselmis tetrathele*. The experiments were performed at different concentration of total ammonia nitrogen for six days under $300\mu\text{mol photon m}^{-2} \text{ s}^{-1}$. No apparent enhancement of photosynthetic efficiency (F_v/F_m) was observed in the high level of ammonia nitrogen condition for *T. tetrathele* within 24 hours. However, after 24 hours, F_v/F_m of *T. tetrathele* was found to increase significantly even though in the high concentration of total ammonia nitrogen. Meanwhile, the ammonia concentration also decreased which showed that this species used ammonia as their nitrogen sources to grow. After two days, the chlorophyll *a* and neoxanthin contents increased whereas β -carotene and lutein production decreased. These results suggested that *T. tetrathele* can adapt in high concentration of total ammonia nitrogen within 24 hours and can be a potential microalgae for wastewater treatment use.

Keywords--- Nitrogen sources, ammonia tolerance, *Tetraselmis tetrathele*, photosynthetic efficiency (F_v/F_m)

Phytoremediation of Total Petroleum Hydrocarbon (TPH) in crude oil sludge by *Scirpus grossus*

Siti Shilatul Najwa Sharuddin,¹ Sheikh Abdullah S.R.^{1,2}, Abu Hasan H.^{1,2} & Othman A.R.^{1,2}

¹Research Centre for Sustainability Process Technology, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

²Chemical Engineering Program Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

Corresponding author's email address: sitishilatulnajwa@gmail.com

Abstract

Phytoremediation using the perennial plant *Scirpus grossus* was suggested as an environmental friendly and economical method for treating contaminated soil with petroleum hydrocarbon. The main objective of the current study was to evaluate the performances of *S. grossus* towards the removal of Total Petroleum Hydrocarbon (TPH) as an indicator for hydrocarbon contaminant in crude oil sludge. In this study, a batch system was adapted for the phytoremediation of real crude oil sludge using *S. grossus*. The study was conducted using crates under conditions similar to the natural environment at the temperature of 30° C throughout a 28-day exposure. Nine plants of two-month old with uniform size, which were propagated in the greenhouse, were transferred to each crate of 100% crude oil sludge for the treatment study. The removal of TPH after 28 days of exposure was recorded as 59.1%, 16.5% and 3.7% for days 14, 21 and 28 respectively with all plants survived until the end of exposure. The extraction of TPH in stem and root of *S. grossus* was also analyzed and the maximum TPH was 10.82 mg/g in stem samples with decreasing value of plant biomass as the treatment continue to 28 days. As a conclusion, *S. grossus* could be a promising solution for the phytoremediation of contaminated crude oil sludge.

Keyword---Phytoremediation, TPH, *Scirpus Grossus*, crude oil sludge

Formation of Simultaneous Denitrification and Methanogenesis Granular Sludge from Dispersed Anaerobic Digested and Denitrifying Sludges

Toshimitsu Kodera¹, Akizuki S.², Watanabe K.¹, Kurosawa N.¹ and Toda T.¹

¹Graduate School of Engineering, Soka University, 1-236 Tangi-machi, Hachioji, Tokyo, 192-8577, Japan.

²Faculty of Science and Engineering, Soka University, 1-236 Tangi-machi, Hachioji, Tokyo, 192-8577, Japan.

Corresponding author's email address: toshikodera@soka.gr.jp

Abstract

Anaerobic digestion in upflow anaerobic sludge blanket (UASB) reactor could retain biomass as aggregates called granular sludge and has high treatment capability of organic wastewater with bioenergy production. Recently, simultaneous denitrification and methanogenesis (SDM) granular process has been proposed for the efficient treatment of nitrogen and organic rich wastewater. Generally, SDM granules are formed by acclimatizing the priority formed conventional methanogenic granules to nitrate. However, in the conventional method, nitrate is being released during the formation of methanogenic granules, and it requires long period for the formation of SDM granules. To improve upon this, SDM granules were formed from dispersed anaerobic digested and denitrifying sludges while acclimatizing to nitrate. However, the nitrate in the substrate is known to inhibit methanogenesis which might lead to process instability. On the other hand, the presence of inhibitors/toxicants are known to promote the secretion of extracellular polymeric substances (EPS) which adheres microbes. Therefore, the nitrate might accelerate the granulation. The present study was conducted to investigate the effects of nitrate on granulation and treatment performance in SDM process. Experiments to form granules in SDM process and conventional methanogenic process were conducted. High chemical oxygen demand (COD) and nitrate removal efficiencies over 90% were achieved after 15 days in SDM reactor. Granulation occurred relatively earlier in SDM reactor compare to methanogenic reactor (57 and 75 days, respectively). When granulation occurred in SDM reactor, the EPS, particularly bound EPS, were remarkably higher compared to that of methanogenic reactor. The higher EPS production was probably caused by protection mechanism of methanogens against nitrate as well as increased abundance of EPS producing denitrifiers *Thauera aminoaromatica*. Therefore, this study revealed that the presence of nitrate in the substrate promotes granulation in SDM process by increasing EPS production.

Keywords--- Methanogenesis, denitrification, granulation, extracellular polymer substances (EPS), upflow anaerobic sludge blanket (UASB) reactor