3P-173 Effect of hydrothermal pretreatment on solubilization and subsequent volatile fatty acids fermentation of waste activated sludge

○Wei Cai, Weiwei Huang, Danni Li, Junjun Li, Zhongfang Lei, Zhenya Zhang
(Grad. Sch. Life Env. Sci., Univ. Tsukuba)
zhang.zhenya.fu@u.tsukuba.ac.jp

Hydrothermal (HT) technology has been proven to be a promising approach to enhance sludge solubilization and thus accelerate the hydrolysis step during anaerobic digestion. Volatile fatty acids (VFAs) as the dominant intermediate product of anaerobic digestion are also expected to be increased after waste activated sludge (WAS) being pretreated by HT. In this study, HT pretreatment from 100 ℃ to 275 ℃ with holding time of 0 min was employed to pretreat WAS. After HT pretreatment at different temperatures, mesophilic VFAs fermentation assessment was carried out on the HT pretreated WAS.
During HT pretreatment, sludge solubilization was improved with the increase in HT temperature. HT pretreatment at 175 ℃ to 200 ℃ was found to be the most suitable condition for protein and carbohydrate dissolution. Higher temperatures resulted in decreased soluble proteins and carbohydrates possibly via non-enzymatic browning process. In addition, partial organics were detected to be lost as CO2 and CH4 under higher temperature conditions.
During the subsequent VFAs fermentation, the highest VFA yield (483.0 mg COD/g-VSS) was obtained from the HT pretreated WAS at 175 ℃, about 2.2-fold of the raw WAS (216.6 mg COD/g-VSS). Meanwhile, probably due to the high soluble proteins produced, the proportions of HBu and HVr exceeded HPr, about 27.7% and 19.9%, respectively. The products generated during HT pretreatment might inhibit the activities of anaerobic microorganisms when HT temperature higher than 200 ℃.

Effect of hydrothermal pretreatment on solubilization and subsequent volatile fatty acids fermentation of waste activated sludge

○Wei Cai, Weiwei Huang, Danni Li, Junjun Li, Zhongfang Lei, Zhenya Zhang
(Grad. Sch. Life Env. Sci., Univ. Tsukuba)

Key words Waste activated sludge, Hydrothermal pretreatment, Solubilization, Volatile fatty acids

3P-174 弱アルカリ環境におけるバイオガスの生物的脱硫法の研究

○程 燕飛[1], 張 振亜[1], 林 聡[2]
([1]筑波大院・生命環境, [2]中国農業大院・農業生物環境)
zhang.zhenya.fu@u.tsukuba.ac.jp

【背景と目的】バイオマスや有機廃棄物からは、嫌気性発酵によってクリーンなエネルギーを生産することができる。しかしながら生産されたバイオガス中に硫化水素ガスが含まれるため、メタンガスの利用に様々な弊害をもたらす。そのため、有効なバイオガスの脱硫法の研究開発は急務となっている。メタンガスから硫化水素を除去する方法は多種あるが、なかでも微生物を利用する方法はコスト安く、操作簡単など利点があると言われている。本研究では、汚水処理場の水に優勢な群落を形成する微生物を特定し、その特性を明らかにするとともに、その微生物を用いて、メタンガス中から硫化水素を除去するシステムを設計し、最適な条件を求めることを目的とした。
【方法】実験室で、硫化物を利用できる微生物を特定し、その特性を求め、メタンガス中から硫化水素を除去するシステムを設計する。バイオガスプラントにおいて、その微生物を応用して、実際の脱硫を行い、最適条件を求める。
【結果と考察】汚水処理場の汚泥には硫化物を利用できる微生物が特定した。炭酸水素ナトリウムと塩化アンモニウムを添加した場合、その微生物の優先な群落の形成が観察された。10日間の培養で最も高い微生物濃度に達成した。これらの結果を用いて、硫化水素除去のシステムを設計した。その脱硫運転の最適条件を求めた。DOが0.8~1.2mg / L、pHが7.8~8.5、リアクタの滞留時間が30分という最適運転条件が確立された。

Biological hydrogen sulfide removal from biogas under weak alkaline condition

○Yanfei Cheng[1], Zhenya Zhang[1], Cong Lin[2]
([1]Grad. Sch. Life Environ. Sci., Univ. Tsukuba, [2]Grad. Sch. Agric. Bio-Environ. , China Agric. Univ.)

Key words weak alkaline condition, biogas, Biological hydrogen sulfide removal

3P-175 Volatile fatty acids (VFAs) accumulation from waste activate sludge under alkaline anaerobic fermentation

○Junjun Li, Wei Cai, Danni Li, Zhongfang Lei, Zhenya Zhang
(Grad. Sch. Life Environ. Sci., Univ. Tsukuba)
zhang.zhenya.fu@u.tsukuba.ac.jp

Volatile fatty acids (VFAs) are very important intermediate products from anaerobic digestion, which can be used as a readily biodegradable carbon source for biological nutrients removal, especially for phosphorus removal. In addition, previous works point out that the ratio of HPr/ HAc can influence the effect of biological phosphorus removal. It was reported that VFAs yield from waste active sludge and its compositions were significantly affected under alkaline condition. The objective of this study is to investigate the VFAs yield and its compositions during mesophilic (35℃) alkaline anaerobic fermentation.
Seven 500ml glass reactors loaded with 300ml WAS were used for VFAs production from anaerobic fermentation. The initial pH values were respectively adjusted to 12, 11, 10, 9, 8, 7 by using 3M NaOH or 3M HCl solutions. After sludge dosage and pH adjustment, the headspace of the reactor was flushed by nitrogen gas for 2 min, and then sealed and placed in a temperature-controlled water bath (35℃). Sampling from the reactors was performed once every two day. Biogas production and its components, VFAs and its composition, pH, proteins, polysaccharides, ammonia, total solids, total volatile solids, and ATP were measured accordingly.
The largest amount of total VFAs was achieved at initial pH10 and pH11 after anaerobic fermentation for 144h, about 125mg C/g-VS. Moreover, anaerobic fermentation at initial pH9 produced VFAs with the highest HPr/HAc ratio, 43.59% in comparison to 20.35%, 15.43%, and 15.74% obtained at initial pH10, pH11, and pH12, respectively.

Volatile fatty acids (VFAs) accumulation from waste activate sludge under alkaline anaerobic fermentation

○Junjun Li, Wei Cai, Danni Li, Zhongfang Lei, Zhenya Zhang
(Grad. Sch. Life Environ. Sci., Univ. Tsukuba)

Key words activated sludge, volatile fatty acids, alkaline, fermentation

3P-176 Removal of ammonia from ammonium-rich wastewater by zeolite adsorption

○Chunzi Feng, Yanfei Cheng, Zhenya Zhang
(Grad. Sch. Life Environ. Sci., Univ. Tsukuba)
zhang.zhenya.fu@u.tsukuba.ac.jp

Ammonia has attracted increasing attention in recent years, due to its negative impacts on water quality and inhibitory effects on methane fermentation when the concentration of ammonium-nitrogen (NH4+-N) reached 3000 mg/L in the bioreactor. Many methods including air striping at high pH value, chemical precipitation and adsorption have been adopted to remove ammonia from wastewater or avoid its inhibitory effect on methane fermentation. Among these methods, adsorption has recently attracted great research interest because of its easy operation, high efficiency and low cost. Nowadays, zeolite has demonstrated to be a more efficient adsorbent for removing ammonia from wastewater or fermentation liquor, compared to other natural clay minerals. The objective of this study is to determine the optimum conditions for removal of ammonia from synthetic solution by investigating the effects of temperature (25 and 35℃), initial pH (5-9) and initial ammonia concentration (500-2000 mg/L) at fixed zeolite dosage of 10.0 g/L.
The results showed that the highest ammonia adsorption capacity (4.12 mg/g and 5.85 mg/g) was obtained at pH 7, when the temperature was 25℃ and 35℃, respectively. Further increasing the pH level to pH 8 and pH 9 resulted in a decrease in ammonia adsorption capacity. In addition, the ammonia adsorption capacity increased with the increase in initial ammonia concentration, which reached the maximum value (10.35 mg/g) at initial NH4+-N concentration of 2000 mg/L.

Removal of ammonia from ammonium-rich wastewater by zeolite adsorption

○Chunzi Feng, Yanfei Cheng, Zhenya Zhang
(Grad. Sch. Life Environ. Sci., Univ. Tsukuba)

Key words Zeolite, Ammonia removal, Ammonium-rich wastewater, Adsorption