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Short Communication

Effect of S-TE (solubilization by thermophilic enzyme) digestion conditions on hydrogen production from waste sludge

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ABSTRACT

S-TE (solubilization by thermophilic enzyme) digestion was always used for waste sludge solubilization and reduction with the theory of lysis enzyme secreted by thermophilic bacteria. The effects of pretreated times, pH and sludge concentrations on S-TE digestion were investigated to determine the optimum S-TE conditions on hydrogen fermentation from waste sludge. The experimental results showed that the protein, carbohydrate and SCOD (soluble chemical oxygen demand) were released after S-TE pretreatment, and the optimal conditions on sludge solubilization were 12–16 h, pH 7–9 and 4.31 g/L TSS, respectively. The optimal S-TE conditions on hydrogen yields were 8 h, pH 6 and 6.83 g/L TSS (total suspended solid), and the maximum hydrogen yields were 30.80 ml/g VSS (volatile suspended solid), 33.75 ml/g VSS and 42.90 ml H_2/g VSS, respectively. It was concluded that the optimal S-TE digestion conditions on sludge solubilization were different from that on hydrogen production.

1. Introduction

Hydrogen is an environmentally friendly clean energy alternative since its combustion by-product is only water. Biological methods for the production of hydrogen are much less energy intensive and ecologically acceptable since most organic waste materials can also be used for the purpose of hydrogen production (Azbar et al., 2009). Due to richness in proteins and carbohydrate, the sewage sludge produced from the wastewater treatment processes is becoming a potential substrate for biological hydrogen production (Xiao and Liu, 2009). In order to improve disintegration and hydrolysis of sludge flocs, several pretreatments have been used for anaerobic digestion of waste sludge. Among the different sludge pretreatment strategies proposed, thermal pretreatment at around 65 °C was described as promising to enhance the biodegradation of waste sludge as the thermophilic hydrolytic bacteria (Héry et al., 2010).

Thermophilic aerobic digestion processes are promising for sewage sludge stabilization in small and medium sized WWTPs (waste water treatment plants) due to efficient pathogen inactivation, rapid removal of volatile solids (VS), high energy consumption and simple control requirements (EPA, 1990). When thermophilic aerobic bacteria are subjected to optimal conditions for their growth, such as in the thermophilic aerobic reactor, they perform enzymatic hydrosis at expenses of other microbial cells (Foladori et al., 2010). Using the theory of lysis enzyme secreted by thermopile bacteria to hydrosis the waste sludge, it developed the S-TE (solubilization by thermophilic enzyme) technology (Song and Hu, 2006). However, at such temperature levels, in parallel to the loss of the mesophilic enzymatic activity, adapted hydrolytic enzyme activity may appear based on the growth of specific thermophilic bacteria (Héry et al., 2010). At 65 °C, 80% of the sludge biodegradable COD was solubilized in water (Fabiel, 2009). As far as we are aware, to date there are some sites applying S-TE process in Japan and other countries, this technology is supplied by Kobelco (Japan) and was also licensed to Ondeo-Degrémont (France) in 1999 (under the name Biolysis® E) (Foladori et al., 2010). Where the S-TE process was integrated, the sludge reduction was 75% compared to un-installation of the S-TE process in the same plant (Shiota et al., 2002). The solubilization of organic matters in the sludge occurs through the thermal effect and the hydrolysis caused by thermophilic aerobic bacteria. A moderate increased of 1.5-fold biogas production was observed in the sludge pretreated in the thermophilic reactor (Hasegawa et al., 2000).

There are some advantages can be achieved by using S-TE pretreatments: pathogen inactivation; great flexibility among the final options for disposal/reuse of sludge; enhancement of solid reduction; increase of biogas production. S-TE process has potential for application to sewage sludge treatment and is advantage for releasing nutrients from sludge, few S-TE are currently implemented in hydrogen production due to lack of clarity regarding

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