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A Platform for Sludge Management and Biomethanation that Uses Immobilised Bacteria and Sodium Thiosulphate to Promote Their Disintegration

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Abstract

The goal of the current study was to better understand lucrative biomethanation using sludge that had undergone sodium thiosulphate-induced immobilised protease secreting bacterial disintegration (STS-IPBD). At a dosage of 0.08 g/g SS, STS disperses the flocs and aids in the subsequent bacterial breakdown. Bacterial immobilisation boosts cell hydrolytic activity for efficient sludge liquefaction. When compared to immobilised protease secreting bacterial disintegration, STS-IPBD achieved a greater liquefaction of 22%. (IPBD alone). When compared to suspended free cells, immobilised cells had a maximal specific growth rate (max) of 0.320 h1 according to the kinetic parameters of the Line Weaver Burk plot analysis, demonstrating the advantage of immobilisation. Bacterial floc dispersion and immobilisation play a significant role in biomethanation since methane generation (0.32 gCOD/g COD) was quite high.

Keywords: Bacterial disintegration; Sludge; Sodium thiosulphate

Introduction

In 2035, the projected rise in the world's energy consumption is 53%. The two most pressing emerging issues on the planet today—energy security and ecological sustainability—can only be addressed by utilising a variety of green fuels and energy sources. Anaerobic digestion (AD) of waste activated sludge biomass (WAS) is seen as a potential approach to address these problems in this perspective. Due to its high organic content, WAS can be used as a viable renewable energy source. This is because it can be turned into biogas that is rich in clean energy and contains 65% methane and can be used to produce heat or electricity or biofuel. The complicated nature and resistant components of the AD process, however, limit the biodegradable potential (hydrolysis) [1, 2].

Due to the presence of hazardous substances and metal ions, it has been determined that the period that injected microorganisms have been present in the medium during biological sludge disintegration is ineffective. Immobilization of bacteria is important in the biological degradation of WAS because it helps to prolong the survival time of injected germs [3]. In order to increase the strength of the immobilised microorganisms and improve their ability to dissolve organic compounds in sludge, certain bacteria can be chosen and immobilised in the carrier through immobilisation. Additionally, immobilised cells can be used multiple times without significantly losing their ability to function and secrete enzymes. Therefore, immobilising bacterial cells is a useful and profitable strategy [4, 5].

Utilizing sodium thiosulphate to disperse flocs

Sludge from a waste water treatment facility in Kerala was collected for the current study. The sludge was described as having a pH of 6.8, a total chemical oxygen demand of 10,100 mg/L, a soluble chemical oxygen demand of 110 mg/L, 7,000 mg/L of suspended solids, and 12,000 mg/L of total solids [6,7]. The bacteria utilised in the disintegration process were isolated, tested for hydrolytic enzymes including protease, and identified as Bacillus cereus in the prior work. In this study, the floc matrix was distributed through a cation binding agent and a metal chelator, sodium thiosulphate, in order to expand the surface area and improve the sludge liquefying capacity of bacterial disintegration (STS). On the basis of changes in EPS (extracellular polymeric substance), the floc dispersion capacity of STS was assessed [8].

In WAS a coating of extracellular polymeric substances (EPS) forms around the sludge biomass and clings to one another to produce flocs. The floc is kept rigid by this layer, which also strengthens it mechanically. The surface area for the subsequent bacterial breakdown can be increased since the removal of the EPS disperses the flocs. For floc dispersion, various techniques are used. The chemical approaches make use of substances like dioctyl sodium sulfosuccinate (DOSS), a surfactant, an alkali (potassium hydroxide), and an acid (citric acid). The goal of the proposed effort is to increase the production of methane while facilitating the surface area for bacterial breakdown [9].

Conclusion

Evaluation was done on how floc dispersion affected the immobilised protease-secreting bacteria's ability to dissolve sludge. At a disintegration time of 36 hours, the sludge biomass is effectively broken down by the STS-IPBD and IPBD processes. The effectiveness of floc dispersion, which enhances the surface area for the ensuing bacterial disintegration, was revealed by the increased liquefaction (22%) and SS reduction (19.1%) that was seen in STS-IPBD [10].

Potential Conflicts of Interest

No conflict or competing interests in the publication of this paper.

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