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Enhanced phosphorus release by low pH anaerobic digestion process

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Lab scale anaerobic digesters were deployed to enhance in-reactor P solubility in a semi-continuous AD process at low pH conditions. The experiment was setup for five pH ranges of 7, 6.5, 6.0, 5.5 and 5.0 by applying a sludge retention time of 48 days (HRT 12 days) at each pH condition. The pH was controlled and maintained automatically using PLC interface. Significant increase in soluble P (84% of total P) was observed between pH 5-5.5 and 50-62% of total P was released between pH 6-6.5; whereas, control reactor (pH 7) showed a 43% release of total P. While methane yield was decreased at low pH but it did not affect the methane production rate but the extent of conversion of the residual organic matter into biogas. Methane loss at pH 6.5, 6, 5.5 and 5 was 20, 28, 29 and 38% respectively. Figure 1 shows the methane yield and concentration of soluble P at each pH compared to control. COD removal and VS removal were also affected in the same manner as methane yield at low pH. Total VFA and SCOD were respectively increased from 40 to 850 mg L^{-1} and 600 mg L^{-1} to 2700 mg L^{-1} from pH 7-5. This increase in the concentration of soluble organics is addressed due to an imbalance in the equilibrium between acidogenesis and methanogenesis where production of intermediate products (butyric and propionic acids) was higher than their conversion into acetate. A post AD analysis of digested sludges at different pH conditions was also carried out via biochemical methane potential (BMP) test. BMP of low pH sludges have shown higher methane production than control. Low pH is suggested to be a suitable option which can reduce overhauling frequency, reactor shutdown and acid flushing to reduce precipitants.

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Economizing bioethanol production process through value-added utilization of lignin residue

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Recently, energy crisis has become a main issue as the global energy demand is increasing while the crude oil reserves are depleting as the time passes. Therefore it is necessary to find alternative and renewable energy sources. Biofuels are very promising renewable energy source. Bioethanol is a biofuel which is mostly used as an automobile fuel. During the production of bioethanol, large amount of lignin is produced as a by-product. Lignin has a great potential to produce valuable products to increase the overall revenue. In this research, lignin has been utilized for methanol production and power generation through gasification process or for producing activated carbon, methanol and power through pyrolysis process. Both processes were simulated using Aspen Plus software. Lignin gasification process converted about 51% of lignin into methanol. On the other hand, lignin pyrolysis process converted about 9% of lignin into methanol and 20.5% into activated carbon. Heat integration of both processes resulted into producing surplus of steam which was utilized to meet some of the processes utility requirements along with power generation using steam turbines. Economic analysis of two processes showed that capital investment and payback period of lignin pyrolysis process was significantly higher. Therefore, lignin gasification process was considered to be more economically feasible.

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