**The Effect of Buffer on the Performance of Anaerobic Digestion – Microbial Electrolysis Cell (AD-MEC) Integrated Systems**

Anaerobic digestion (AD) process is traditionally used to produce biogas with about 60% methane (CH4) content. AD is capable of converting various organic wastes into renewable methane-based bioenergy, which may be used as a substitute of fossil fuels. Hence, AD may be a part of the solution to the economic and political problems associated with the depletion of fossil fuels. However, certain operational conditions such as volatile fatty acid (VFA) accumulation, long solids residence time (SRT), pH changes, and excess ammonia may reduce the waste conversion efficiency and energy recovery performance of conventional AD. A promising technology, anaerobic digestion and microbial electrolysis cell (MEC) integrated systems (AD-MEC) has been recently developed to overcome these issues. In an AD-MEC, microorganisms that are grown on the electrodes are also in picture and utilize organic matter while producing electrical current via application of a small voltage (0.7-1.0V). Buffers are used in AD-MEC systems to balance pH (caused by VFA accumulation) and reduce internal resistance. Increased buffer concentration decreases the resistance caused from bulk solution, resulting in accelerated electron transfer and enhanced AD-MEC performance. It has been recorded that 50 mM phosphate buffered saline (PBS) increased the methane production by about 40% compared to control in AD-MEC systems fed with sludge. However, there is still a gap in buffer usage in AD-MEC systems with cattle manure (CM). Therefore, in this thesis, the effect of different buffers such as PBS and carbonate buffer on the performance of AD-MEC systems fed with CM have been investigated for the first time. In addition to buffer, other types of performance parameters such as electrode configuration and applied voltage will be optimized for process enhancement.

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