Bio-electrolytic sensor for rapid monitoring of volatile fatty acids in anaerobic digestion process - DTU Orbit (14/08/2019)

Bio-electrolytic sensor for rapid monitoring of volatile fatty acids in anaerobic digestion process
This study presents an innovative biosensor that was developed on the basis of a microbial electrolysis cell for fast and reliable measurement of volatile fatty acids (VFA) during anaerobic digestion (AD) process. The bio-electrolytic sensor was first tested with synthetic wastewater containing varying concentrations of VFA. A linear correlation ($R^2 = 0.99$) between current densities ($0.03 \pm 0.01$ to $2.43 \pm 0.12 \text{ A/m}^2$) and VFA concentrations ($5–100 \text{ mM}$) was found. The sensor performance was then investigated under different affecting parameters such as the external voltage, VFA composition ratio, and ionic strength. Linear relationship between the current density and VFA concentrations was always observed. Furthermore, the bio-electrolytic sensor proved ability to handle interruptions such as the presence of complex organic matter, anode exposure to oxygen and low pH. Finally, the sensor was applied to monitor VFA concentrations in a lab-scale AD reactor for a month. The VFA measurements from the sensor correlated well with those from GC analysis which proved the accuracy of the system. Since hydrogen was produced in the cathode as byproduct during monitoring, the system could be energy self-sufficient. Considering the high accuracy, short response time, long-term stability and additional benefit of H$_2$ production, this bio-electrolytic sensor could be a simple and cost-effective method for VFA monitoring during AD and other anaerobic processes.