**Conversion of CO2 to Carbolylic acids in a system of of zero-valent metal and anaerobic granular sludge at mild conditions**

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**ABSTRACT**

Global climate change is a worldwide concern that requires the dramatic reduction of greenhouse gases. Therefore, innovation in sustainable technologies for CO2 utilization to other high-value products is an emerging and rising field. A new approach for CO2 utilization (as a sole carbon source) to acetic acid and other carboxylic acids under ambient conditions using zero-valent iron and anaerobic granular sludge was investigated by methanogens inhibition and homoactetogenesis enrichment. It was recently found that Zero-valent metals such as Iron and Magnesium, when are anaerobically oxidized at the presence of bicarbonate, generate H2 at a relatively high rate. Then the H2 can be utilized along with CO2 by homoacetogens in the anaerobic granular sludge to produce acetic acid or other carboxylic acids. However, methanogens in anaerobic sludge act antagonistically with homoacetogens. One objective of this study was to examine strategies to inhibit methanogens and enrich homoacetogens. Based on this, several strategies were investigated, such as the exposure of (a) anaerobic granular sludge to low pH, (b) the short exposure of anaerobic granular sludge to heat, (c) addition of bromoethanesulfonate (BES) under various concentrations and (d) exposure of anaerobic granular sludge to salinity 30–90 g NaCl/L. The findings of the current study showed that 2,200 mg/L (after 12 days) can be produced using anaerobic granular sludge, ZVI and BES. In contrast, the anaerobic sludge exposure to heat can generate around 1,300 mg/L after 12 days. The anaerobic granular sludge exposure to ZVI and 30 g NaCl/L generated 848 mg/L of carboxylic acids after 12 days, and around 30 % of the headspace consisted of CH4. The microbial profile under various conditions was examined using sequencing techniques. When Fe and Mg were used, the dominant crystalline product on the outer surface was FeCO3 and MgCO3.3H2O, respectively. Likely, carbonate formation on the zero-valent metal outer surface has reduced the amount of H2 release from zero-valent metal, shielding the substrate for methanogens. Strategies to counteract the formation of carbonate salt and to increase the generation of carboxylic acids were examined.

**KEYWORDS: CO2 utilization,** hydrogen generation, homoacetogens, Zero-valent metal