

ENVIRONMENT

Title: On-Site Biomethanol Production from Swine Waste Digester Methane **NPB# 05-131**

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Scientific Abstract:

Sizeable amounts of methane can be produced on site by digestion of livestock waste. However its utilization is limited by cost justification for on-site electricity generation and challenges with the transportation of animal waste and/or methane to centralized facilities. It would thus be advantageous to convert methane into a liquid fuel such as methanol on-site so it can be easily transported using the existing petroleum pipelines and distribution systems. The objective of this research was to develop a low temperature on-farm alternative to Fisher Tropsch for direct conversion of methane to methanol. Studies were conducted to evaluate the performance of a photocatalytic process utilizing ultra violet light. Compressed methane:air gas mixtures of 100:0, 80:20 and 70:30 were sparged through water at 90°C and the effect of water vapor content in the feed gas studied by varying the flow rate from 35 – 45 ml/min during sparging. Moist feed gas at atmospheric pressure was fed to the photocatalytic reaction chamber, with a UV or UV-Vis light assembly, maintained at 100°C. An ice-cooled condenser at the downstream end was used to collect the methanol. The effect of hydrogen peroxide as free radical generator on conversion efficiency was investigated by adding 0 -1 ml/L H₂O₂ to the sparging water. Methane to methanol conversion in the presence of a catalyst (tungsten oxide (WO₃) in the photocatalytic reactor was also studied. Gas samples for chromatographic analyses were collected at intervals of 60 minutes to quantify methane, hydrogen, carbon monoxide, carbon dioxide and nitrogen. H₂, CO, and CO₂ were not detected during analyses. Methane conversions ranging primarily between 40-60% were obtained. Volumes of condensate collected at the end of each 3 hour run were measured and found to be less than 0.5 ml in most cases. It has been reported that for a direct process to be economically competitive with the conventional indirect process, 80% selectivity of methanol with a methane conversion of 10% is required. The results of this study indicate good conversion however further research is needed to determine selectivity for methanol. Hence, condensate composition needs be analyzed and the optimum gas ratio, flow rate, light source, and radical/catalyst combination determined.

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