PSYCHROPHYLIC ANAEROBIC DIGESTION OF WASTEWATER POND ALGAE

R.J. Craggs and J. Maier
National Institute of Water and Atmospheric Research Ltd (NIWA), P. O. Box 11-115, Hamilton, 3200.
(E-mail: r.craggs@niwa.co.nz)

ABSTRACT

This paper presents the results of experiments on psychrophilic anaerobic digestion of algal biomass harvested from wastewater treatment HRAP and the influence of organic loading rate and ammonia concentration on digestion efficiency. Harvested algal biomass has a low solids content (typically ~2%) but could be easily concentrated to 4% solids using a geotextile filter cloth, or 8% solids using a centrifuge, however, it is not a well-known anaerobic digestion feedstock particularly when digested at ambient psychrophilic temperatures (~20^{o}C) in Covered Digester Ponds. Experiments were conducted to compare algal digestion efficiency at three different loading rates (2.3, 4.6 and 9.2 g VS/L/d) that correspond to loading a digester with algal biomass at 2, 4 and 8% solids content respectively. Triplicate laboratory-scale (20 L) digesters that mimic the operation of in-ground Covered Digester Ponds (solids sedimentation, passive mixing, no heating) were operated with weekly addition of algal biomass over an experimental duration of 61 days (8 additions in total). Relative methane production (100, 64 and 22%) and the ratio of methane to CO_2 in the biogas (3.2, 1.5 and 0.4) declined with increasing organic loading rate of the digesters (2.3, 4.6 and 9.2 gVS/L/d respectively) indicating that digestion was inhibited at the organic loading rates associated with higher solids content. A second group of experiments investigated the influence of the ammonia concentration (1 - 6 g/L) that could result from anaerobic digestion of algae when loaded into the digester at particular solids content. Triplicate laboratory-scale (2 L) digesters that mimic the operation of in-ground Covered Digester Ponds were operated with a single initial addition of algal biomass over an experimental duration of more than 30 days. Relative methane production (100, 80, 26 and 23%) declined with increasing ammonia concentration in the digesters (1, 2, 4 and 6 g/L respectively) showing that some ammonia inhibition occurred even in the digesters with a 2 g/L ammonia concentration. These experiments indicate that unconcentrated harvested algal biomass can be effectively digested as toxic ammonia concentrations are avoided.

KEYWORDS

Wastewater, Anaerobic Digestion, Ammonia Inhibition, HRAP, Algae, Organic Loading