Anaerobic Digestion for Efficient Biogas Production from Organic Wastes by Integration with Thermal Gasification

Gang LUO, Ph.D
Department of Environmental Science and Engineering, Fudan University, China

Abstract

Although biomass can be biologically converted to biofuels, a significant portion is difficult to be biodegraded due to the refractory characteristics. Thermal gasification is an alternative method to convert biomass to syngas, which consists of CO, CO_2, and H_2. We aimed to integrate thermochemical and biological approaches for efficient biomethanation of organic wastes. A novel technology for simultaneous sewage sludge and syngas biomethanation in anaerobic reactors was presented. Batch experiments showed CO was inhibitory to methanogens, but not to bacteria, at CO partial pressure between 0.25 and 1 atm by digested sewage sludge as inoculum. During anaerobic digestion of sewage sludge supplemented with CO added through a hollow fiber membrane (HFM) module in continuous stirred-tank reactors (CSTR), CO did not inhibit the process even at a pressure as high as 1.58 atm inside the HFM, due to the low dissolved CO concentration in the liquid. Complete consumption of CO was achieved with CO gas retention time of 0.2 d. In addition, anaerobic granular sludge (AGS) was also proposed to achieve simultaneous biomethanation of wastewater and CO. Batch experiments showed that AGS tolerated CO partial pressure as high as 0.5 atm without affecting its ability for synthetic wastewater degradation after accumulation. Continuous experiments by upflow anaerobic sludge blanket (UASB) reactors showed AGS could efficiently convert synthetic wastewater and CO into methane by applying gas-recirculation to increase gas-liquid mass transfer. The addition of CO to UASB reactor enhanced the hydrogenotrophic CO-oxidizing pathway, and also changed the microbial community compositions of the AGS.

Key Words

Anaerobic digestion, syngas, sewage sludge, anaerobic granular sludge, biomethantion