Bioaugmentation of Anaerobic Digesters with Micro-aerobic Cultures for Increased Biomethane Production and Process Stability

Proper methane production is required for stabilization of municipal, industrial and agricultural wastes via anaerobic digestion. Anaerobic digesters are used to treat wastes and produce renewable energy. In the process, select microorganisms are contacted with the waste and convert it to biogas that contains methane. The methane can be used as a renewable fuel. Anaerobic digestion is a multistep process with different microbial communities working in syntrophy. If the syntrophy is disrupted by organic overload or other changes, then the entire process may slow or stop, causing costly delays at industrial and municipal treatment plants. Most notably, efficient metabolism of hydrogen (H_2) and propionic acid is required. One potential method to improve anaerobic digestion is bioaugmentation, the addition of specific, active microbes to enhance performance. Oxygen (O_2) toxicity tolerance of anaerobic cultures used for bioaugmentation is of particular importance. Methanogenic cultures that are resistant to O_2 toxicity may be better choices as bioaugmentation cultures since they may be more easily freeze-dried, stored and transported in an air atmosphere. We have developed methanogenic and fermentative cultures that can function in the presence of limited oxygen. These cultures are more aero-tolerant and can withstand handling (e.g., thickening, drying, storage) in an air environment better than strictly anaerobic cultures. In addition, we have found that micro-aerobic, methanogenic and fermentative cultures have special properties, including increased culture diversity and novel and/or rare organisms, that cause these micro-aerobic cultures to be better choices for bioaugmentation of anaerobic digesters than strictly anaerobic cultures. In addition, some of our micro-aerobic cultures demonstrate higher maximum specific methane production rates than strictly anaerobic cultures. We have found that some limited air or oxygen is beneficial to the methanogenic process. These micro-aerobic, methanogenic or fermenatative cultures have applications for addition to industrial digesters to increase methane production and process stability.