

Potential of Using Food Wastes In Farm-based Anaerobic Digesters

Introduction

Biomass as a source of fuel is receiving increased interest among energy policy makers. Biomass resources include organic matter available on a renewable basis through natural processes or as a by-product of human activities such as agricultural crops, crop residues, wood and wood waste, and portions of the municipal solid waste stream. Because there is a large annual production throughout New York State, biomass is expected to play an increasingly important role in meeting energy needs in the new millennium. While a number of various technologies have been developed to convert different biomass resources into energy and byproducts, anaerobic digestion has proved to be an effective and promising option to manage organic wastes such as animal manure and food wastes. Accordingly, there are an increasing number of large-scale dairy operations in New York that have installed or are in the process of installing anaerobic digesters (ADs). Most digesters use dairy manure as the only feedstock, and food wastes are largely neglected as a source of biomass. Tipping fees from food manufacturers can significantly increase the profitability of ADs.

What are food wastes?

Food wastes, as organic matter derived from raw biological materials, are a category of biomass. Food wastes are generated from the following processes:

- Farm produce that does not meet supermarket specifications.
- Waste from industrial food processing establishments.
- Discarded blemished perishables and out-of-date foods at supermarkets.

- Foods prepared by service establishments that are not served to customers.
- Plate scraps from commercial and residential sources.

What is anaerobic digestion?

Under anaerobic conditions, microorganisms convert the degradable organic materials in manure and food wastes into methane (CH₄), carbon dioxide (CO₂) and other trace gases. This gas mixture is called biogas. The treated effluent from AD is stable, substantially odor-free, and still contains nutrients.

Why use food wastes in anaerobic digesters?

Animal manure and food wastes have the potential to be converted into useful bioenergy. Food wastes have high ratios of volatile solids/total solids (VS/TS) (80-90%). It is estimated that a methane yield of 0.05-0.06 m³/kg (0.80-0.96 ft³/lb) VS can be achieved through anaerobic digestion of food wastes. Methane yields about 1,000 Btu (or 252 kilocalories) of heat energy per cubic foot (0.028 m³) when burned. Considering the tremendous amount of food wastes generated on a continuous basis throughout the state, there is a high potential of utilizing food wastes for energy using AD.

From an economic perspective, food wastes, like other solid wastes, take up landfill space and require transportation to move to a final disposal destination. Landfill space is shrinking, but generation of wastes is not. Disposal of food wastes is most commonly done by either transportation to a landfill or garbage disposals connected to sewer systems. As available landfill space decreases, tipping fees as well as transportation costs increase. There are 27 landfills in New York and estimated remaining capacity is only 7 years. The National Restaurant Association states that three out of five restaurants report paying more for wastes management now than just a few years ago. They also report that tipping

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fees have more than doubled since 1982. This fact suggests that a tipping fee can become an important source of income for a farm-based AD system.

From a technical perspective, the practice of mixing food wastes with dairy manure in anaerobic digesters has shown that addition of food wastes provides some benefits, including increased biogas production and possibly a reduction of H₂S concentration in biogas. Processing food waste aerobically is expensive. Running an anaerobic digester with food waste alone runs the risk of shock loading the system and acidic conditions leading to failure. Mixing food waste with animal manure in an anaerobic digester provides buffering capacity to prevent acidic conditions and continued microbial feeding when the food waste is not available. The effluent from the digester can then be applied to cropland to recycle the nutrients.

Where do food wastes come from?

The food industry generates enormous volumes of waste while producing large amounts of food for both local and global consumption. Studies of food service operations have also identified numerous sources of food waste generation. Common sources include over-preparation of menu items; expanded menu choices which complicate food inventories; unexpected fluctuations in food sales due to unforeseen changes in weather or other factors beyond the control of food service operators; excessively large servings; and receipt of unwanted or unselected food at noncommercial establishments such as healthcare facilities. Food wastes that can be potentially explored for energy production include: residuals or by-products of food processing, such as whey, vege-

table and fruit residues and meat residuals; spoiled food and vegetable trimmings during the process of storage and handling in supermarkets; and food residuals from cafeterias in concentrated institutions such as colleges and schools. Currently very little food wastes have been used for bioenergy production through anaerobic digestion, mainly because of the difficulty of collecting and sorting, and lack of knowledge about the effects of inclusion in ADs. However, large-scale and concentrated food waste generating sources such as food processing plants and supermarkets have high potential as steady suppliers of food wastes to anaerobic digesters.

Information available for locating sources of food wastes and farm digesters

Unlike fossil fuels such as petroleum and natural gas, which can be transported easily by an established infrastructure, biomass sources, especially animal manure and food wastes, are highly site-specific. It is important to know where biomass resources are located because this information indicates where potential waste is available to be used. A research project at Cornell (see below) is using a geographical information system (GIS) to develop a geo-spatial database to identify and map the locations of major animal manure and food waste generating sources in New York State. The generating sources include: concentrated animal feeding operations (CAFOs), food processing factories, supermarkets, colleges and universities, K-12 schools, hospitals and nursing homes, major private businesses, correctional facilities, and restaurants.

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