On-Farm Anaerobic Digestion

Introduction

Anaerobic digestion is a naturally occurring biological process involving the decomposition of organic matter in the absence of oxygen. The process is essentially the same as composting, except that it occurs in digesters that prevent oxygen from entering the system. During the anaerobic digestion process, bacteria breakdown organic feedstock and produce a methane-rich-gas and digestate.

On-farm anaerobic digesters, within which anaerobic digestion takes place on farms, are a well established, readily available technology that has been widely adopted worldwide and is suitable to BC conditions.

On-farm anaerobic digesters come in all shapes and sizes

Technology Type

Anaerobic digestion is generally done at one of three main temperature ranges:

- *thermophylic (50°C – 60°C),*
- *mesophilic (30°C - 38°C), or*
- *psychrophylic (15°C - 25°C).*

While conversion times are shortest and benefits greatest for thermophylic digestion, so are the energy requirements, insulation needs and temperature sensitivity.

In addition to temperature differences, and due to differing physical and chemical characteristics of the feedstock, anaerobic digesters also vary greatly with regards to design and technology. While no one specific design or technology has emerged as a clear winner, different digester types include high or low volume systems, single or multi-stage digester vessels and continuous flow or batch processes.

Suitable Feedstock

While not suitable for woody feedstocks - because the lignin in wood requires very long retention times and high concentrations of other feedstocks - an anaerobic digester can digest most organic waste streams. These streams, which when appropriately mixed can double or even quadruple biogas yield, include:

- *agricultural and agri-food feedstock, such as livestock manure, food production and processing waste and crop residues,*
- *municipal feedstock, such as the organic fractions of municipal solid waste, biosolids, grass clippings and yard waste, and*
- *industrial feedstocks from biobased industries such as pharmaceuticals, cosmetics and pulp and paper.*

On-farm anaerobic digesters can utilize multiple feedstocks, including yard waste, livestock manure and food processing waste

Outputs

As previously mentioned, the two principle outputs of anaerobic digestion are biogas and digestate.

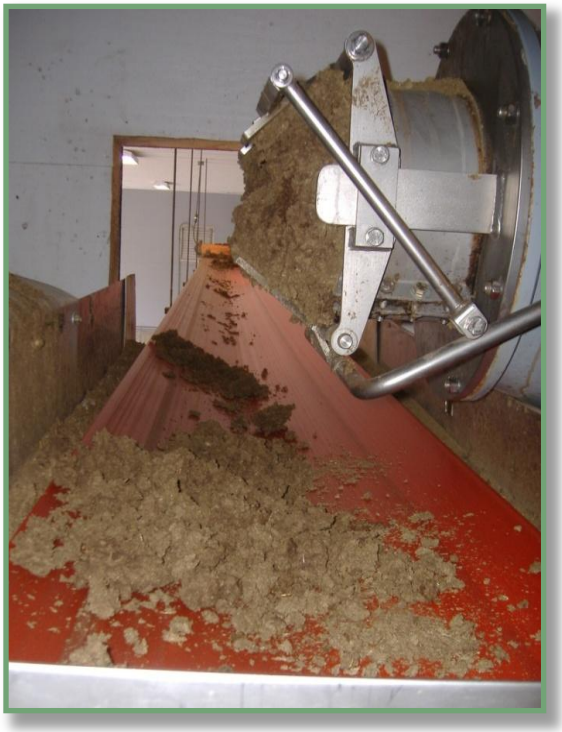
Biogas is a renewable, green, carbon neutral gas that, depending upon feedstock mix, temperature and system design consists of 55% - 75% methane, 25% - 45% carbon dioxide and other trace gases. This biogas can be fed into a boiler to produce heat, into a generator set to generate electricity, into a combined heat and power unit (co-gen) to generate both heat and electricity, or further upgraded to biomethane. Biomethane is a renewable substitute for natural gas that can be injected into the natural gas distribution network for use in transportation, heating, cooling or power generation.

Both biogas and biomethane are unlike most other biofuels as they do not compete with food, fibre or feed resources.

Digestate, which will have a mass roughly 90% - 95% of the feedstock fed into the digester, is the residue resulting from the anaerobic digestion process. This can be separated into liquid and solid digestate with technologies such as a screw press separator.

The liquid digestate can be applied directly onto land/growing crops as a fertilizer. Like manure, liquid digestate contains nutrients beneficial to plant growth. However, these nutrients are more readily available to crops than those from undigested manure.

The solid digestate can be further processed through composting or other post-treatments technologies before being used as a fertilizer/soil amendment. Alternatively, it can be used for animal bedding. This application as bedding can save the farm thousands of dollars in sawdust costs annually and has been shown to reduce somatic cell counts.



A screw press separates the solid and liquid digestate

Benefits

The most obvious and cited benefits of anaerobic digestion are that it:

- *reduces greenhouse gas emissions through methane capture,*
- *protects rural water sources through pathogen reduction in manure,*
- *produces a green renewable energy and reduces the reliance on fossil fuels,*
- *improves the fertilizer (nutrient) value of manure,*
- *stimulates rural economies,*
- *increases and diversifies agricultural revenue streams,*
- *improves animal health,*
- *increase food safety and security through better manure management,*
- *reduces odour from manure storage and spreading, and*
- *can meet waste diversion objectives by using off-farm organic materials as feedstock.*

Policies/Requirements

Currently the economic and regulatory environment within BC does not promote the adoption of on-farm anaerobic digesters. However, work is currently underway to create supportive policies and financial incentives. These policies and incentives, which have been instrumental in encouraging the adoption of AD throughout Europe and North America, are currently needed to reduce the burden of up-front capital costs and risks associated with anaerobic digester construction in BC.