Energy Opportunities Anaerobic Digestion: Alberta Processing Co-Products

Processing co or by-products can be an energy source. An anaerobic digester will partially convert the co-products into energy in the form of biogas which contains methane (CH_4).

Processing investigated for this study included sugar beets, ethanol, potatoes, oilseeds and breweries. Samples were randomly collected from 10 to 20 different locations within the co-product flow to the storage facility or from the storage facility. The random samples were then mixed thoroughly and a final sample collected for analysis. All co-products were sampled within Alberta processing facilities and the range of characteristics, potential CH_4 and energy production is shown in Table 1.

Table 1. Potential energy from processing co-product sources

Source	Description	Total Solids (%)	Volatile Solids (%)	Accumulated CH_4 (NL/kg VS)	Energy ($MJ/T_{feedstock}$)
Sugar Beets	Pulp [d]	93	91	341	9300
	Molasses	80	74	359	6886
Ethanol	Whole Stillage	10	96	352	1095
	Thin Stillage	9	94	378	1036
	Wet Cake	7	97	376	3191
Potatoes	Pulp & Peel [e]	12	93	335	1229
	Chips	99	96	516	15824
Oilseeds	Canola Meal [a, b]	90	88	380	9745
Brewery	Spent Grain [c, f]	20	91	426	2581

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Background for Methane Yields

Volatile Solids (VS) analysis determines the total amount of organic matter (OM) in a feedstock. It is a definitive measure of OM on a mass basis. Feedstocks containing more than 60 or 70% VS on a dry matter basis are good candidates for anaerobic digestion. The non-volatile solids, or ash content, of a feedstock takes up valuable digester volume and will not contribute to biogas production (Hamilton, 2012).

The methane yield is determined by taking a sample of feedstock, seeding it with anaerobic microorganisms, mixing with a nutrient medium, and incubating it. The volume of CH_4 produced during the incubation period is measured and interpreted as specific methane yield or the volume of CH_4 produced per mass of VS added (Hamilton, 2012). The methane yield is reported as normalized litres per kilogram VS added (NL/kg VS).

To convert from methane yield to Energy (Vik, 2003):

- Convert the VS (%TS) to kg of VS/T of feedstock
- Use VS (kg) to convert methane yield from NL/kg VS to m^3/T of feedstock
- Apply a 90% efficiency rate to represent commercial operations
- Use the lower heating value for CH_4, 36 MJ/m^3, to determine MJ/T of feedstock
- To determine the potential MW the overall supply of the feedstock available must be determined. This is the power output from the feedstock that went into the digester.

NOTE: The energy potential displayed on the map is the pure energy calculated above. The CH_4 can be used by a combined heat and power (CHP) unit to transfer the pure energy into electrical output and heat. On average, units produce 40% electricity (Clarke Energy, 2013).

A CHP unit is typically a reciprocating gas engine that uses the gas, CH_4, to drive a crank shaft. The crank shaft turns an alternator to produce electricity. Heat is released during the gas combustion process (Clarke Energy, 2013). This heat can be recovered during cogeneration in order to maximize the heating value of the system.

References

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