Energy Opportunities
Anaerobic Digestion: Meat Processing

Meat processing by-products can be an energy source. An anaerobic digester will partially convert meat processing by-products to energy in the form of biogas which contains methane (CH_4).

Multiple sources of meat processing by-products were collected in Alberta and analyzed to determine their potential energy production. The average potential energy used (see referenced map) was from samples analyzed and values from literature. A description of each source, the methane yield and energy production specific to these sources are in Table 1.

For both cattle and swine processing samples were collected from the eviscerating area and from waste collected during the splitting and cutting of the carcasses. The values used for poultry include samples collected from the bleeding, defeathering, and evisceration processes. The general slaughter data includes waste from the entire plant including manure, blood, offal, and fat.

Table 1. Potential energy from meat processing by-products

Source	Description	Total Solids (%)	Volatile Solids (%)	Accumulated CH_4 (NL/kg VS)	Energy ($MJ/T_{feedstock}$)
Cattle [a, b]	Rumen Content	15	63	325	1212
Cattle [b]	Intestines & Fat	78	100	860	21734
Swine [a, b, c]	Stomach & Content	14	64	241	759
Swine [a]	Intestines & Fat	44	74	396	4178
Poultry [a, d]	Feathers, Blood, & Offal	28	94	500	4273
General [a, b]	Blood, offal, fat, manure	48	80	311	3869

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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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