Whole Canola as an Energy Source

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The combined effects of heat and drought had a negative impact on the quality of Ontario's canola crop in 2005. Samples contained higher quantities of heat damaged seeds than the crushers were willing to accept. The infrastructure was not in place to take most of Ontario's canola production from 2005 (about 50,000Mt) to produce biodiesel or other industrial products. Even if that infrastructure was in place, the fate of the meal left over after oil extraction would have to be determined.

We wondered if canola seeds could be used directly as an energy source. Using the whole seed would sidestep the need for infrastructure to produce biodiesel that we did not have, and finding a use for the meal that the marketplace may not want.

We discovered that the energy content of whole canola seed ranged between 27.6 and 29.2 MJ/kg (megajoules per kilogram) on a dry weight basis. By way of comparison, a value 18 MJ/kg is often stated as the energy content of dry wood; 16 and18 MJ/kg for dry corn and wheat respectively; 37 and 41 MJ/ℓ for #2 light fuel oil and #6 heavy fuel oil (Bunker C) respectively; 37 MJ/m^3 for natural gas and 3.6MJ/kWh (kilowatt hour) for electricity.

Green and brown seed content are factors which can downgrade canola. Green seed results from immature seeds being harvested. Brown seeds are seeds that were aborted by the plant under stress. This was the problem with Ontario's 2005 canola crop. These downgrading factors did not influence the energy content of the canola samples we evaluated.

Moisture is also a consideration of energy output. There were no surprises in that the calorific output of combustion decreased linearly with the increase in moisture at close to a 1:1 ratio. This means that users of whole canola as an energy source need only to reduce the expected energy output according to the moisture: 10% moisture means 10% less energy as compared to bone-dry seed.

The oil contained in the seed is a significant contributor to the total energy content. We found that the energy content of the seed increased between 0.13-0.22MJ/kg for each percentage increase in oil content. Although this relationship is statistically significant, it is not practically important because differences in oil content that are normally encountered, and the resulting variation in the energy content, are not large. Seed size also did not affect the energy content of whole canola seed.

Whole canola was ashed in a muffle furnace at 500°C and the ash analyzed for 11 heavy metals, nutrient content, electrical conductivity (salts) and pH. The ash would be suitable for raising soil pH (ash pH 9.9) and contains enough potassium and phosphorus to be

considered as a source of these nutrients. Levels of metals were well within guidelines for use on agricultural land.

Five tonnes of canola were shipped to the CANMET Energy Technology Centre, Natural Resources Canada, for evaluation in a 1MW (megawatt) industrial grate furnace. The seed was #2 canola (not off grade) and evaluated to contain 28.43MJ/kg (dry weight). An auger was used to feed the canola into the furnace. The temperature in the furnace averaged over 950°C, which was achieved quickly and had little variation. Without any emission control devices, the stack emissions were within MOE guidelines with the exception of particulate matter, which were marginally over the guideline. Technology to remove particulates from the stack emissions is readily available.

This project allows a cost comparison between various energy sources to be made. The following table helps to put some of these values into perspective:

Energy source	**Example Price**	**$/MJ**	**Canola[1] price (delivered) per tonne to have equivalent cost per megajoule (MJ)**
#2 Heating Oil[2]	$0.8732/ℓ	$0.0236	$600
Corn[1]	$300/tonne	$0.0206	$525
Electricity[3]	$0.119/kWh	$0.0331	$841
Natural Gas[4]	$0.39/m^3	$0.0105	$268

[1] 10% moisture- Corn 14.5MJ/kg, Canola 25.5MJ/kg
[2] price delivered, less GST
[3] price per kWh above 750kWh base, includes delivery, regulatory and debt retirement charges, less GST
[4] price includes transportation, storage and delivery, less GST

When the price of canola falls below the price in the 4th column of this table, it is a less expensive source of energy relative to the example prices given. It is unlikely that #2 canola at current prices would be used as an energy source to compete with #2 heating oil or natural gas; however, off grade canola is deeply discounted and may be an attractive source of energy. The moving grate furnace technology used in the CANMET facility is readily available and is adaptable to a variety of feedstocks.

We conclude that off grade whole canola seed is energy dense and easily utilized as an economically viable energy source.