E3A: Biodiesel Applications for the Home, Farm or Ranch

Oilseed processing

In 2012, the most commonly produced oilseeds in Missouri were soybeans at 5.4 million acres planted, according to the National Agricultural Statistics Service. Missouri farmers also apportion a small number of acres to grow sunflowers. Farmers in other parts of the country produce cotton seed, peanuts, canola, safflower, flax, camelina and other crops processed for oils.

Oilseed processing methods

Two processes are used to separate oil from an oilseed: mechanical extrusion and solvent extraction.

During mechanical extrusion, the seed is mechanically pressed to separate the oil from the meal. Solvent extraction is often used in conjunction with some form of mechanical extrusion. Solvent extraction applies a solvent solution to prepressed material. Solvent bonds to oil in the prepressed material, and an oil-laden solvent solution is then separated and further processed to separate the oil from the solvent.

Mechanical extrusion typically recovers between 65 and 80 percent of the oil contained in a seed. Solvent extraction recovers over 95 percent of the oil contained in a seed. Solvent processes are generally only used in plants with daily processing capacities of more than 200 tons per day.

How much oil is produced per acre?

The amount of oil produced per acre depends on crop yield, oil content of the seed and processing efficiency. Common oilseed crops in Missouri have average yields of 350 pounds per acre.

Different oilseed crops have different levels of oil in the seed, which must be taken into account when calculating oil production per acre. These are some examples of common oilseed crops and their average respective oil contents:

- Soybeans — about 18 percent oil
- Flax, safflower, canola and camelina — 30 to 42 percent
- Mustard seeds — 25 to 30 percent

Only a portion of the oil in a raw oilseed can be extracted. To estimate the recoverable oil per acre of an oilseed crop, follow this formula:

Yield in lbs. × oil content percent × recovery rate percent = lbs of oil per acre

For example, 1 acre of soybeans yielding 2,490 pounds with 18 percent oil content processed with mechanical extraction technology with a 75 percent recovery rate would result in 336 pounds of oil (2,490 × 0.18 × 0.75 = 336).

A gallon of vegetable oil weighs approximately 7.5 pounds per gallon (this varies based on the type of vegetable oil). By dividing 336 by 7.5, you can estimate that 2,490 pounds of soybean seed will produce approximately 24 gallons of oil.

Mechanical processing technology

Oilseed processing equipment with a capacity of fewer than 50 tons per day typically uses mechanical extraction to separate oil from oilseed. Many operations use a screw press to extract oil from oilseed.

Mechanical extraction processes have two main elements; the first is seed preparation. Methods vary based on seed characteristics. For example, seed preparation for canola is often limited to seed cleaning, but other oilseeds may need to be cleaned, de-hulled, cracked, rolled or flaked. Additional equipment may be required to complete seed preparation. You should identify the oilseeds you are likely to work with to determine what equipment will be needed.

The second element is the extraction of oil from the oilseed. In a screw press operation, seed is fed into the screw press, which uses pressure to force oil contained in an oilseed through small openings in the side of the press. Meal too large to exit through the small openings is pushed out through larger openings at the end of the press. Screw presses are capable of extracting approximately 65 to 75 percent of the oil contained in an oilseed. Some mechanical presses preheat seed as it enters the press. Preheating may improve oil recovery rates to 80 percent. Alternatively, if seed is processed at low temperatures (for example, below freezing) oil recovery rates may be lower than 60 percent. Actual recovery rates will depend on press quality, press operation, seed quality, seed type and seed temperature.

Capital costs

Equipment retailers may include various accessories with the basic processing equipment. It is important to consider exactly what equipment is included when comparing offers. Some basic equipment is used for oilseed processing:

- Seed preparation equipment
- Mechanical extractor
- Power source for the extractor
- Seed storage bins
- Meal storage bins
- Pumps, filters and plumbing for oil storage
- Oil storage tanks

Equipment necessary for seed preparation will vary depending on the oilseed to be processed. For some oilseeds (e.g., canola), little seed preparation equipment is required. For others (e.g., sunflower), additional equipment is required to remove hulls. Equipment manufacturers and retailers can help you determine equipment requirements for a particular oilseed.

One of the largest capital expenditures for a small-scale oilseed processor is the mechanical extraction press. These presses may be sold with or without a power source. Small-scale oilseed processing equipment is often sold without seed storage bins, meal collection bins and oil storage tanks. Some buyers may use bins and tanks they already own to reduce capital costs. However, some retailers offer complete systems that include a press, tanks, bins and a power source. There are also costs associated with installation, delivery and setup. The size and weight of presses, bins and tanks can dramatically increase shipping costs, but you can buy bins and tanks from a local supplier to reduce these costs. Oil needs to be stored and filtered, so pipes, valves, tanks, pumps and filters may be necessary.

Most oilseed processing equipment is powered by electricity. Installation may require modifying or upgrading current electrical systems to accommodate the new equipment.

Operating costs

Operating costs vary greatly among different sizes and brands of processing equipment. Some presses are designed to operate without direct supervision. When direct supervision is not required, a press can be operated for hours without substantial labor requirements. Other presses require approximately five minutes of labor per hour of operation for monitoring and other purposes. Although this may seem like a small amount of time, it requires the operator to remain relatively close to the press during its operation.

Another consideration is the output per unit of labor input. For example, a two-ton press requires essentially the same labor as a five-ton press. This means that on a per-ton basis, labor costs for the two-ton press would be 250 percent higher than for the five-ton press.

Processor capacity

Commercially available mechanical processors have daily processing capacities ranging from less than one ton to more than 50 tons. The capacity of the processor and the hours of operation determine the amount of seed that can be processed. Commercial plants often operate 24 hours a day for over 300 days a year, but smaller processors may operate for less than 12 hours per day and only a few months each year.

Table 1 shows estimated annual processing volumes for three processors with different capacities, assuming each is operated 24 hours a day for 320 days a year. These tables also estimate the quantities produced by each processor.

Table 2 presents estimated processing volumes for the

Table 1: Estimated annual plant output

Processor daily capacity	2 tons	5 tons	30 tons
Oil content of feedstock	35%	35%	35%
Oil recovery rate	75%	75%	75%
Annual seed requirement (short tons)	640	1,600	9,600
Annual oil production (gallons)	44,800	112,000	672,000
Annual meal production (short tons)	427	1,068	6,408

same three processors under the assumption that each is operated 12 hours per day for 120 days each year.

Table 2: Estimated annual plant output

Processor daily capacity	2 tons	5 tons	30 tons
Oil content of feedstock	35%	35%	35%
Oil recovery rate	75%	75%	75%
Annual seed requirement (short tons)	120	300	1,800
Annual oil production (gallons)	8,400	21,000	126,000
Annual meal production (short tons)	80	200	1,202

Availability of feedstock

Small-scale oilseed processing operations face constant concern over the required volume of feedstock. Farm-based processors may be able to produce all or a significant portion of their feedstock requirements. Larger processing facilities will need to purchase most or all of their feedstock from other sources. Estimating on-farm oilseed production and the commercial availability of oilseed in the region are integral to the planning process.

Product markets

Oilseed processing produces two products: oil and meal. Oilseed meal is generally used as a feed product for livestock. The oil has a variety of uses, including human consumption, biodiesel, bio-lubricants, cosmetics and many other applications.

Meal comprises more than 60 percent of the seed processed. Identifying markets or uses for the meal before processing feedstock may prevent storage and disposal problems. The characteristics of an oilseed meal are determined by the oilseed processed and the oil content of the meal. Available markets will differ for each specific meal product, and establishing local markets for meal and seed will reduce transportation costs. Information about wholesale food manufacturing standards and other related issues is available from the Missouri Department of Health and Human Services at *http://halth.mo.gov/safety/foodsafety/pdf/Processor_Brochure.pdf.*

Notes

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