Symposium

Papers from the symposium on
Vegetable Oils as Diesel Fuels
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Vegetable Oils as Diesel Fuels: Overview

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Vegetable oils apparently have good potential as alternative fuels for maintaining crop production during periods of fuel shortages. Among the advantages of vegetable oils as fuel are: their physical nature as liquids and, hence, their portability; their heat content (88% of diesel oil); their ready availability and the fact that they are renewable resources. In reality, vegetable oil fuels used in US farm tractors introduce a number of problems, the origins of which can be traced back to their high viscosity, low volatility, and the reactivity of the unsaturated hydrocarbon chains.

In short-term engine performance tests of less than 10 hr duration, the vegetable oils perform quite well. The problems show up only after the engine has been operating on the vegetable oil for longer periods of time and are far more pronounced in direct-injection engines than in the less efficient engines having precombustion chambers (indirect injection). The problems include:

—coking and trumpet formation on the injectors to such an extent that fuel atomization does not occur properly or is even prevented as a result of plugged orifices;
—carbon deposits;
—oil ring sticking; and
—thickening and gelling of the lubricating oil as a result of contamination with vegetable oil.

In addition to the question of technical feasibility, the following symposium and poster session papers address questions of on-farm production, economic feasibility, oil availability, land availability, energy efficiency and vegetable oil modification.

On-farm recovery of oil from sunflower seed appears feasible (Backer, Jacobsen and Olson), and this probably is true also for other oilseeds of high oil content. The economics of on-farm recovery of sunflower oil are not favorable at the moment, but the energy output/input ratio for this oil is very favorable (Helgeson and Schaffner). Use of a 25/75 blend of sunflower oil in diesel oil in a standard 200-hr screening procedure indicated that long-term use of such a mixture would not be feasible in a direct-injection engine (Ziejewski and Kaufman). With a different type of direct-injection engine, the same test procedure indicated that a 33/67 but not a 50/50 blend of soybean oil in diesel might be tolerated for emergency use (Adams, Peters, Rand, Schroer and Ziemke). The differences in engines but probably not in the vegetable oils might account for apparent discrepancies between these two results.

A third oilseed, winter rape (*Brassica napus L.*), when blended in the proportion 30/70 in diesel oil, was used to power an indirect-injection engine for 850 hr with no adverse effects noted (Peterson, Auld and Korus). On-farm recovery was demonstrated also for this oilseed. Either high- or low-erucic rapeseed oils can be recovered satisfactorily in a screwpress, and the oils show little difference in performance between small or large engines in short-term tests, but there is a major problem with viscosity, particularly in cold weather (Strayer, Blake and Craig).

Cottonseed and sunflower oils need to be at least degummed for fuel use, as shown in short-term performance tests with an engine having a precombustion chamber, but even at that state of refinement, they are unsuitable for runs of more than 40 hr when used as the straight, unblended fuel (Engler, Johnson, LePori and Yarbrough).

Although vegetable oils apparently can be tolerated in direct-injection engines only as dilute blends in diesel oil, there is accumulating evidence worldwide that the simple esters can function as a diesel fuel by themselves because of improved viscosity and volatility properties compared to the triglyceride. Ethyl esters of monounsaturated or short-chain fatty acids should make good alternative fuels as demonstrated in short-term tests with a single-cylinder, direct-injection engine (Klopfenstein and Walker). Most of the ester fuels tested had higher thermal efficiencies than did No. 2 diesel fuel. An intriguing concept is the conversion of used frying oil to simple esters (Nye, Williamson, Deshpande, Schroder, Snively, Yurkewich and French).