
Viewpoint

Vegetable oil fuel

This article by David Bartholomew was prepared during the middle of February. Bartholomew, a regular contributor to *JAOCS*, is manager of the oilseeds division for Merrill, Lynch, Pierce, Fenner & Smith at the Chicago Board of Trade. In this article, Bartholomew discusses the future role of renewable agricultural resources in providing fuel, noting that it was only during this century that U.S. farmers began to use petroleum as a fuel for tractors as opposed to forage crop as fuel for work animals. Now farmers may again turn to crops as fuel for agricultural production.

Attention is rapidly shifting toward technological development of the use of various vegetable oils as an alternative fuel source. This follows closely on the heels of rapid advances being made in the use of grains and other substances for manufacture of alcohol as a gasoline substitute. Alcohol is readily adaptable for use in gasoline engines. In fact, it is used exclusively in many racing automobiles, and has been for years. But it is not practical in diesel engines. And, in recent years, there has been a solid shift toward diesel in farm tractors and other engines used on farm self-propelled equipment. A recent estimate is that 90% of farm motive power is supplied by diesel equipment.

Vegetable oil is the favored substitute for diesel fuel. Primary experimentation has been done on sunflower oil, soybean oil and rapeseed oil as these are the ones most readily available in the countries pioneering this effort. Some work has been done on other fats and oils, and apparently any of them could be used. Of course, the properties of each are variable for this use, just as they are for any other application, edible or inedible.

Results are mixed, as might be expected. Some have been very encouraging, and some have been clearly negative. There are two basic reasons. One is the variability of diesel engines among various manufacturers. The other is that early work was done with edible or potentially edible forms of these oils. Now it is being recognized that when vegetable oil is to be used as a fuel, it is not necessary to maintain it in an edible form. Consequently, various experiments are now being conducted to determine what additives can be used, of an inedible nature, to overcome the negative aspects.

There is no doubt that the right combination of modifications can be found which will make vegetable oils practical as a substitute for diesel fuel. (Some of these initial problems were reported in the November 1980 issue of the *Journal of the American Oil Chemists' Society*, and numerous other publications).

The most advanced work has been done in South Africa, with concentration on sunflower oil, which is a primary crop there. The reason is largely political, and it relates to the difficulty in obtaining petroleum at reasonable prices.

Brazil also is working aggressively on the subject. Even though at present the economics do not seem to favor the substitution, it is assumed that they soon will be favorable,

and it takes time to make a satisfactory shift. Research is progressing by Scania and Mercedes, which manufacture most trucks and buses in Brazil. Others who manufacture diesel engines for agriculture, industry and transportation are equally involved.

The Brazilian government is firmly dedicated to the concept of reducing dependence on petroleum imports, which constitute approximately 85% of total use in that country. Not to be overlooked is the fact that some foreign exchange is lost when converting cruzeiros to dollars, both when petroleum is imported and when vegetable oil (mostly soybean oil) is exported.

In 1980, Brazil exported 700,000 tons of soybean oil. Soon, no soybean oil will be exported. It may be just a matter of a few months before the technology of its use in diesel engines will be sufficiently advanced. Maybe it will still be 1981 when that happens. The recently announced target was to have 6% substitution in 1981, and 16% substitution in 1982. That represents 960,000 metric tons and 2.56 million metric tons, respectively. At the moment, it looks like there is some delay in that timetable, but it will most likely be implemented shortly.

To illustrate the collaboration of industry and the government of Brazil in the program to utilize vegetable oil in diesel fuel, we quote herewith a direct translation from a leading Brazilian newspaper, *O Estado de Sao Paulo*, dated January 28, 1981:

Alternative Fuels: Caterpillar Is Ready for Whatever Option

In the battle for the winning of a substitute for diesel fuel, Caterpillar has two basic pre-occupations: to cooperate with the Brazilian government in their search for a solution and to be ready to react in the method most rapid and economical to the thousands of users of machines of their manufacture in Brazil. Working in a system of total priority, the technical center of Caterpillar in the U.S. and Caterpillar Brazil is initiating an extensive program of research and tests in order to know the reaction of its machinery utilizing a fuel that would not be diesel. The tests are continuing but the conclusions until now are totally favorable. The machines Caterpillar builds in Brazil are maintaining their total power with a mixture of 10% vegetable oil. This was obtained without any alterations or adjustments to the motor. And further an advantage to the Caterpillar motors is in the pre-combustion chamber. The tests of the research continue with the machines operating at the present time with mixtures of 30% vegetable oils. As of now, it

has not been necessary to make any modifications (to the motors). And further, other tests are being made with other fuels and with motors of direct injection used on some imported machinery. More important than the technological victory of one company, this announcement assures the tranquility and security for those who are already owners and for those who plan to purchase machinery built by Caterpillar. This is because whatever changes will be made, we are ready. And above all, it represents a confidence to a people that will benefit by the progress that Caterpillar machinery is helping to build this country.

Work on this subject in the U.S. is also advancing. As reported in *JAOCs*, the major farm implement manufacturers are working on it. Also involved are numerous governmental institutions and private individuals. Farmers themselves are getting excited about the prospect. For many years they have resented the fact that they have to sell their soybeans or other oilseeds to crushing plants, at prices they consider too low, and then turn around and buy the oilseed meals from crushers for livestock feeding, at prices they consider too high. They are currently fascinated with the prospect of having their own oilseeds and receiving oil for fuel and meal for feed. Such an enterprise may never become significant in the total market structure—but it might.

At this point, it should be noted that most experimental work done so far indicates that the most practical approach is not a 100% substitution of vegetable oil for diesel fuel, but rather a 20% vegetable oil/80% diesel fuel blend. (Some short-term experiments have been successful at a 50/50 ratio). So from an economic point of view, it is not a matter of total substitution, which could in some years be a very vulnerable situation. Rather, it is a situation of varying blends depending on the economics of supply and prices in any particular season.

What does this mean in terms of substitution in the U.S.? If a blend of 20/80 is considered, and if half of the 20% vegetable oil is from sunflower oil, then it would absorb just exactly the amount of sunflower seed produced in the U.S. in 1979. The balance could come from soybean oil and other oils without seriously affecting total supply and demand. There will be increased availability of corn oil from the rapidly growing production of alcohol for fuel and from fructose sugar. It is projected that in 1981 this could grow by 117,000 MT and could be increasing by two or three times that amount soon thereafter. Or, on the other hand, the entire 20% could come from sunflower seed, if production of that doubles as seems likely in the near future.

Use of Food for Fuel?

It can be expected that there will be increasing public debate about the use of an edible product for fuel use. This was mentioned by several sources quoted in the aforementioned *JAOCs* articles. At one time, it was a concern of this author also. But there are several factors which must be mentioned in this regard, to keep things in their proper historical perspective.

From the beginning of time, man has used the productivity of agriculture as a source of fuel for the provision of motive power for on-farm and off-farm use. It has been only since the 1930s that the U.S. shifted from horses and

mules to the use of petroleum-powered implements and vehicles that did not use food for fuel. That's a very short blip in the time-line of man's existence on earth. In fact, many parts of the world even today still depend on animal power instead of mechanical power. Some countries which made the shift in just the past 10 or 20 years, largely at the recommendation of AID representatives from the U.S., are now going back to animal power due to OPEC price escalation of petroleum.

Seen in this light, it should be said that petroleum is the "alternative" fuel, instead of vegetable oil and alcohol as being alternatives. The U.S. made the shift just about 50 years ago when the government adopted a cheap petroleum policy as a stimulant to mechanization and industrialization. Any person who honestly appraised the long-term results of that policy knew it could not last forever, but those in charge left the reconciliation of that problem to some future generation in order to reap the short-term benefits.

We are now that future generation! It must be seen that some form of renewable energy sources must begin to take the place of the nonrenewable sources. That is in reality what is behind the OPEC price escalation of the past eight years, and the probable advances in the future. For some of those countries, there will be nothing but sand to sell for export when the petroleum is gone, and there is no market for sand. Eventually coal and uranium will be gone also, as they likewise are nonrenewable.

There have been some people in the past who realized all this, but their logic was lost in the scramble toward a cheap petroleum policy. One of the earliest such seers was quoted in the May 12, 1907, edition of the *Chicago Tribune*, though his name has been forgotten:

Increasing attention lately has been given to the possibilities of obtaining power from alcohol by means of the internal combustion engine.

From many points of view the advantages of alcohol over petroleum spirit, which hitherto has been in chief demand, are clear and pronounced. Of course, foremost among these is its comparative freedom from combustible vapors at ordinary temperatures, and its great cleanliness.

... In looking to agriculture for future sources of power, it is to be remembered that the soil would constantly be in position to provide fresh stores of raw material, the oxygen, hydrogen, and carbon of the alcohol being mainly derived from the atmosphere, while the ashes and mineral products would return to fertilize the ground.

That was when the automobile industry was in its infancy and farm tractors were still to be developed.

Some Facts and Figures

In 1919, the U.S. reached a peak in numbers of horses and mules on farms, at 26 million! This does not include the millions used in non-farm transportation.

Harvested corn acreage for all purposes peaked in 1917 at 111 million acres. It stayed at 100 million or more for the next 15 years, even though horse and mule population was rapidly declining, and hit 111 million acres again in 1932. This was a major cause of the economic depression of the early 1930s, because alternative markets were not

developing rapidly enough for so much corn.

In 1919, the agricultural acreage devoted to the production of feed for horses and mules in the U.S. reached a peak of 81 million acres! That was 22% of the harvested crop land. We should not be so offended if once again a sizeable percentage of our farm land were devoted to the production of raw materials for the manufacture of fuel, even though it is not to feed horses and mules.

There were 45 million acres of oats harvested for grain in 1921. Now there are just 9 million.

Soybean planted acreage was first reported in 1924 and it was less than two million acres. Now there are 70 million.

Cotton harvested acreage in 1925 was 44 million acres, and it was all picked by hand. Now there are 13 million acres.

There were 90 million bushels of corn and 150 million bushels of barley converted to beverage alcohol in 1980. This is a non-food use of grain. No one seems to challenge this as being an unethical use of food grains.

Conclusion

In the long-term outlook, many sources probably will be developed for the production of fuels from non-food but

renewable sources, diminishing the use of food grains. Some of this technology is developing even now, such as use of city garbage, corn stalks, grain straw and wood chips. Moreover, a major pollution problem will be overcome by converting all kinds of wastes into fuel. Large livestock operations are converting manure into methane gas; the residue is an acceptable feed ingredient of 30% protein.

In addition, tropical areas of the world are ideally suited to expanded production of palm and coconut oil, plus sugar cane and manioc, which are excellent fuel sources. For many generations, these areas have been formidable economic drags on the world balance of trade. Now they can be developed agriculturally and economically to become important contributors to the world economy.

The decade of the 80s will see many exciting achievements in the factors cited in this article. The short-term market will have many adjustments to make. It will not be simple. The many complex relationships will cause periods of dislocation in supply, demand and price. Historic values and relationships will be discarded and new ones developed, with severe strains at times. But the ultimate resolution of these developments will be healthy for the economy as a whole, and for those segments which are flexible enough to make the necessary adjustments.

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