ALCOHOL...

Imagine running an engine or cooking your food using the same alcohol that you drink. It's not only possible but has been done in the past and probably is still being done in some part of the world. Ethyl Alcohol, also know as grain alcohol,ethanol, industrial alcohol, or C_2H_6O, has a heat value of 84,000 B.T.U. per gallon as compared to 135,000 B.T.U. per gallon for gasoline. Alcohol also has an octane rating of 99.

Alcohol is obtained by fermentation and distillation of various organic materials such as wood, corn, potatoes, sugar cane and sugar beets. Wood presents an interesting possiblility since it is widely available in the form of scraps and sawdust and paper products. The following table taken from Ayres and Scarlott shows the possible alcohol yields of several materials.

ALCOHOL YIELDS FROM VARIOUS MATERIALS

Material	gal./ton	gal./acre
wood	70	70
corn	84	89
potatoes	23	178
sugar cane	15	268
sugar beet	22	287

Alcohol as a fuel in this and other countries is nothing new and has been used in wartime as well as promoted as a way to help farmers by growing crops for fuel. In the 30's and 40's the opposition of the oil industry to alcohol was very strong.

..........a few months later

Some comments on the alcohol and wood gas article. Sugar from cane and beets can be fermented easily by the addition of yeast. The starch in potatoes also ferments readily if yeast is added. Corn should be sprouted first, then heated and ground before the addition of yeast, but once the right enzymes are present, ground unsproute grain will ferment yielding ethyl alcohol.

The cellulose in wood is a different story. Cellulose must be hydrolyzed to glucose -- a fermentable sugar -- and this has been done industrially using strong acid, high temperatures, and high pressure, impractical methods for home use. Long boiling of sawdust in acid will convert the cellulose to glucose, but *an acid-resistant vessel is necessary*, and the acid should be neutralized and cooled before the addition of yeast.

Once the sugar has been fermented to alcohol (and carbon dioxide and water), the alcohol must be distilled out of the solution. The alcohol concentration can be as high as 16% if special strains of yeast are used, but 12% is more common. Ethyl alcohol boils at 78 C and water at 100 C, so it's necessary to heat the fermented solution in a suitable container so that the alcohol boils off and condenses before the water comes over and dilutes it to such an extent that it will not burn.

When your still is in operation, collect everything that distills up to about 85 C. Don't distill too fast. Rapid drops are preferable to a steady gush of liquid. Be careful! Ethyl alcohol is inflammable and explosive when mixed with air.

Fermentation and distillation are simple procedures to master. But there is one fly in the ointment. As usual, it's the government. You must have a federal license to operate a legal still *even if you are producing alcohol for fuel* -- and licenses are not easy to come by. Even if you use a still to distill water, you must have a license.

After reading a number of detailed engineering articles on production of ethyl alcohol from wood, I'd say flatly that none of the commercial methods could be used at home for making a few gallons for fuel. Strong acids mean corrosion proof metals, the acids must be recovered in order to be economical and prevent pollution. High pressure means thickwalled expensive pressure equipment.

The only process that looks at all feasible is an in-efficient one. If white spruce chips are heated with 3% hydrochloric acid for 6 hours at 96F one can get about 20% yield of fermentable sugar instead of the 70% one can get in a high temperature-high pressure process. This method just might be done in a 55 gal. drum with a heavy plastic liner.

Alcohol from wood usually contains several other substances which render it unfit for human consumption unless carefully purified. However, these substances can be used for fuel also.

If I had to have alcohol for fuel, I'd use potatoes, sugar beets or Jerusql
beets or Jerusalem artichokes (10-20 tons/acre) rather than wood.

The table of alcohol yields quoted in ASE #8 gives 70 gal/ton as yield from wood. The theoretical amount is 94.1 gal/ton but none of the articles I've seen get more than 25-30 gal/ton.

Liquid hydrogen fluoride was proposed in 1933 for cellulose hydrolysis since it caused instant results at atmospheric pressure and 20-25C. It was not used commercially because there were few methods for handling hydrogen fluoride then. Today it could be done and the acid is easily recoverable since it is easily vaporized and condensed.

Lab yields of sugar from wood have been 85-90% and this method would seem to have promise. Perhaps we could solve part of our solid waste problem,converting old newspapers to alcohol.

For more information, see WOOD CHEMISTRY by Louis Wise, Reinhold Co, 1949.

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The process of making fuel alcohol is no different from making high-proof moonshine. You need a mash to ferment, a still, and a smokeless heat source.

The mash can be made from anything which contains enough sugar or starch for yeast to convert to alcohol:

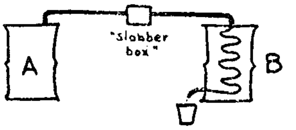
wood chips	sugar beets
fruit	refined sugar
potatoes	sugar cane
corn	corn stalks
oats	molasses
wheat	stale bread

All these come to mind as possible sugar and starch sources for the mash. You can use any one, or mix these materials in the final mash. The starchier sources, such as corn, potatoes, wood, etc., should be cooked for a few hours. The sugar sources shouldn't be heated too much. Toss everything together in a large container of warm water to make a soupy mash. Add yeast and cover with a cloth. If your temperature is around 70 F your mash should be 10% alcohol at the end of two weeks. At this point it is ready for the still.

The traditional still is made of copper throughout -- a precaution against metalic impurities in the final product (and in its consumer). A still for fuel alcohol could be put together out of old oil drums and copper tubing.

A warning! The alcohol from this set-up will NOT be fit to drink! A drink of it could kill you -- just like a drink of gasoline. If you really want to ruin your head on the same juice that runs your tractor, then read John F. Adams' *An Essay on Brewing, Vintage, and Distillation*, Doubleday, 95¢. The book has an excellent discussion on stills in general.

Heat your mash in Barrel "A" to 170 - 180 F, above the boiling point of alcohol but below that of water. Alcohol steam rises and travels through ½" tubing to condenser barrel "B", through which is a 10-foot coil of copper tubing, and which is filled with cold water. Alcohol trickles out of the end of the tube into your waiting container. The batch is finished when the trickle from the tube turns to water, and you'll see that the liquid changes



consistency quite markedly.

If you add a "slobber box" between the primary vat and the condenser, you'll get a purer product. The slobber box allows fewer volatile gases to condense and thus be removed from the distillate. But you should run everything through twice for the cleanest-burning alcohol.

The spent mash will re-ferment when yeast is added, increasing your yield by 50%. If the mash still seems sweet, you can keep on re-fermenting after each distillation, till the sugar and starch are all gone.

Questions: Does anybody out there know the legal aspects of distilling your own fuel alcohol? Will my old John Deere actually run on it? (It runs on regular gas or diesel fuel.) How about running a regular car? A Briggs & Stratton engine? A Coleman stove or lamp? I would mightily like to know the answers to these.

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