# Energy 112: Ethanol

Ken Johnson

No discussion about energy sources would be complete these days without saying something about the alcohol based fuels. The bulk of these come in two general forms: ‘methanol’ . . . also known as “wood” alcohol, and ‘ethanol’ . . . also called “grain” alcohol. Those nomenclatures represent the usual raw material used as a source. They are produced by fermenting (aided by some yeast) grains, fruits, or other organic material (carbohydrate sugars) until the “mash” (mixture of water and the ground-up organics) reaches a point where it’s alcoholic content ‘kills’ the yeast spores that change the sugars into alcohol. That mash self-destructs at about the 15% alcohol level.

It should be noted that the fermentation process, to make the ethanol, not only produces the alcohol, but produces a significant amount of carbon dioxide ($CO_2$). After the mash shows signs of depleting the sugars, as shown but a lack of fermentation (no bubbles), it is filtered to remove the solid materials.

During the process, flavorings such as malt and hops can be added to provide a very important commodity . . . beer. Some breweries capture the $CO_2$ from the brewing process and inject it into the finished product to provide a precise amount of carbonation, while others discharge the fermentation $CO_2$ into the atmosphere and use commercially produced $CO_2$ for the carbonation. So, as you sit there watching the bubbles rise in your glass, realize you are releasing a Global Warming Greenhouse Gas (GWGG) . . . and if the proposed Cap and Trade legislation is passed, you will also be paying more for that beer as well as all your carbonated drinks, resulting from taxes on the producers of any carbonated beverage . . . and all bakery products which use yeast (it makes the $CO_2$ bubbles in the dough).

Returning to the fuel making process, the ethanol/water mixture is not the kind of fuel one wants to pump into an Internal Combustion Engine, so it must be further processed. This is done by a distillation process, where the ‘flat’ 15% alcohol ‘liquor’ is pumped into a kettle heated to a temperature a little bit above the alcohol’s boiling point. The vaporized alcohol is then piped from the top of the boiler and passed through a cooling coil where the vaporized ethanol is liquefied into a combustible liquid fuel (or ‘200 proof’ whiskey). At this point it becomes of interest to the Federal Government (‘revenuers’), but I don’t know to what extent.

If fruit (commonly grapes) is used as the carbohydrate, then the fermented product is wine . . . which if distilled to higher alcohol content, becomes brandy. Almost any carbohydrate has been used. The Germans toward the end of WWII were running short of petroleum and they began fermenting potatoes to make jet fuel. I once had the opportunity to examine a WWII German jet engine . . . and yes, it reeked of rotten potatoes!

Somewhere along the line, legally, a tax must be imposed on the finished product and/or a ‘denaturing’ agent must be added, to make it unfit for human consumption. It is then shipped to refineries to be blended with gasoline in various percentages, based on geographic area of use and time of year. The goal apparently is eventually all autos will be operating on 85% ethanol and 15% gasoline, but at this point I believe only 20/80 (ethanol/gasoline) is being used. Auto fuel systems must be changed to operate (poorly) on high percentages of ethanol. Presently, some newer model autos are ‘dual fuel’, meaning they will operate on two different percentages of ethanol. In some cases I believe it requires switching a valve on the fuel system or for electronic fuel injected engines, a selector switch adjusts the engine computer controlled output of the injectors.

Performing a basic reaction (combustion) analysis of ethanol/air, and comparing that to the analysis of gasoline/air combustion, it will be noted that release of $CO_2$, per unit of energy release, is about 5% less than that for gasoline/air. However, when the amount of $CO_2$ generated in the making of both fuels is considered, it turns out that the net amount for ethanol is about 5% more $CO_2$ generated overall than using gasoline. Not good for a supposedly environmentally friendly fuel. Oh well, back to the drawing board.

The story I have been attempting to convey in this series, is that all these exotic energy conversion methods are being hauled out of moth balls, dusted off, proclaimed the Savior of mankind, and fed billions of tax dollars. This has been done without the promoters ever taking the time to read or even consider the thousands of reams of data, test results, and conclusions compiled over the last century, which show these methods are just not worth the costs and appear to have only been promulgated as a means to raise taxes or just to satisfy the radical environmentalists voting block. Like the attempt to sell the idea of using ethanol as a primary source of energy.

Back in the 1960s, the Seagram Co. (whisky maker) approached one of the Research Institutes, at the engineering college where I was teaching, to do some engineering development utilizing our Internal Combustion Engine (ICE) laboratory. As we often did on this type of request, it was offered as a Senior Project to a couple of Mechanical Engineering students, which they accepted. The goal was to develop a carburetor that could operate on either gasoline or ethanol, with a simple adjustment to change fuels. The reason was, Seagram had developed a portable ‘still’ and the plan was to build a number of these that would travel around the ‘Grain Belt’ at harvest time. The purpose was to distill the farmer’s surplus grain into ethanol for use in the farmer’s tractors and trucks that would be outfitted with these carburetors. We were able to develop a carburetor with easily changeable jets

that would give satisfactory performance on the two fuels. I haven't seen how the modern 'dual fuel' engines do it, but I assume they are pretty similar. Seagram soon after dropped the project. I presumed it was primarily because of a Treasury Department concern about possible diversions of the alcohol, for sale on a black market. And it would be a nightmare trying to keep track of thousands of tanks of untaxed liquor scattered across the Midwest.

The most damaging effect, if the environmentalists are able to achieve their goal of having 75% of vehicles powered by ethanol, would be in our food supply. Just the demand for grain to supply the present level of experimentation and development has caused grain prices to skyrocket with a result of increased prices on grain fed livestock meats as well. There are already reports from undeveloped countries like Mexico, of starvation and malnutrition because the peasants can no longer afford sufficient amounts of corn, a main staple, to maintain health. I know . . . there is a country in South America who proudly states they power all their vehicles on ethanol . . . the question is, how many vehicles is that?

What's that you say? "Scientists have found an alga that is more efficient and faster growing than grain, to produce the ethanol." Sorry, I must remind you of the first Episodes of this Energy Series, namely the Energy Laws:

"Energy can neither be created nor destroyed . . . only changed from one form to another."

So where do they think that energy in the ethanol comes from? It must come from the Sun and organic material in the water that contains the algae. It is left to the interested student to estimate the number of acres of swamp and growing algae required to provide 75% of daily vehicle fuel used in the United States. It may be assumed the swamp would be in the Southeast US, for the purpose of estimated hours of available sunlight per day.

Finally, it has been reported recently that one of the prime movers since the 1970s in the promotion of ethanol (called 'gasohol' back then), as a very environmentally friendly fuel and promoted massive tax payer support in its production since then, has just done a 'mea culpa' and admitted that its benefits have been "trivial". His name is former VP Al Gore.

*The preceding is the opinion of the author and not that of ECN.*

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