

ETHANOL AS A FUEL SOURCE

What is Ethanol?



Ethanol which is often referred to as ethyl alcohol, pure alcohol, or even drinking alcohol, is a volatile, flammable, colorless liquid which can be used as an alcoholic beverage (moonshine), but more importantly as a biofuel alternative to gasoline. Ethanol is very easily manufactured and processed, using a technique that is similar to producing alcohol. This process can produce a large amount of fuel in a relatively short period of time. Because ethanol is made from common farmer's crops such as corn and sugar cane, it is a very renewable resource [1]. In other words, it is no longer necessary to go digging around in hope of finding oil, but instead one can continue producing more crops for food and also use those same crops for fuel. As a matter of fact, "Congress Congress mandated the use of biofuels such as ethanol as a way of reducing oil imports and providing increased support to the agricultural sector" [2]. But there are many down sides to ethanol as a fuel source. The amount of energy that is actually able to be used from the food crops is little compared to the energy that is used to make these crops. Also, there is simply not enough land for these food crops to feed people and supply the fuel for their cars. Plus, people using ethanol for their vehicles in cold weather climates might have problems getting their cars started because of the poor ability igniting the fuel.

How Ethanol is Made:

Ethanol as a fuel source is produced in very much the same way that beer or alcohol is made. This is a fairly simple process, in which a cellulosic material is broken down and mixed with water and yeast, fermented and distilled, and then mixed with a certain amount of gasoline to produce a biofuel that can be used to power an automobile. Naturally, this process is a bit more complex than its Lehman term counterpart

would lead you to believe, but the basic process is familiar and will be described in detail below the following image of an ethanol fuel plant.

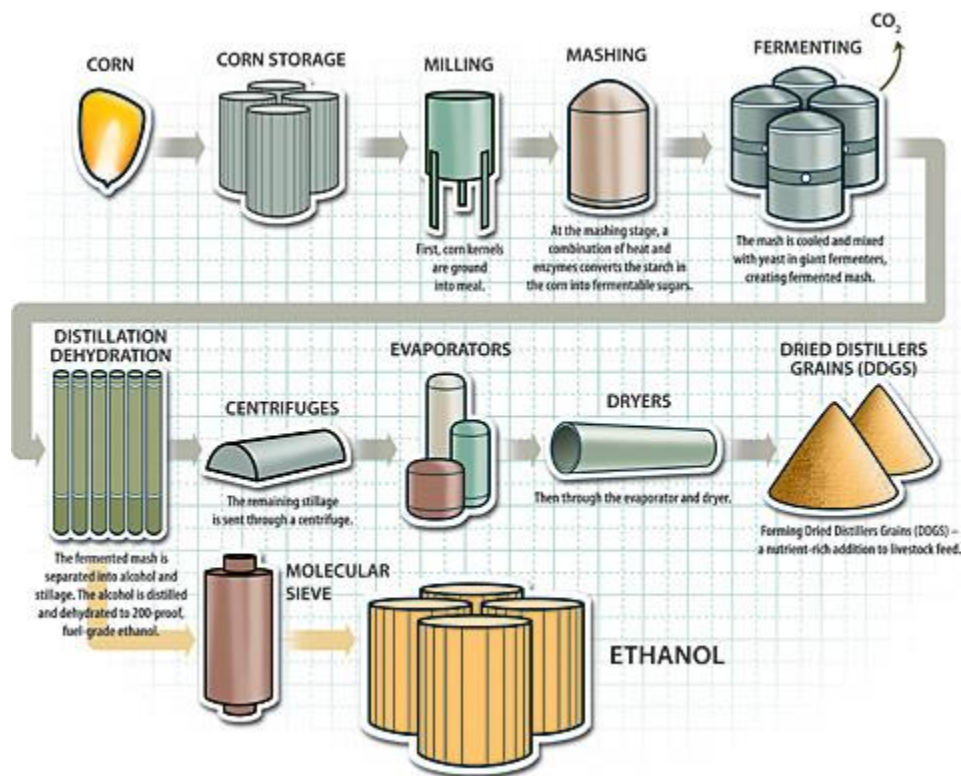


When most people hear the term ethanol, their natural instinct is to think of a fuel produced by corn. This is because in the United States, corn is the main source for ethanol, and in recent years a strong push has been made to divert a majority of the nation's corn supply to the ethanol producing industry. So much in fact that in 2007, ethanol production consumed over 20 percent of the nation's total corn supply which is equivalent to about 3.0 billion bushels, and this amount yielded a record 6.5 billion gallons of fuel [3]. This is nearly double the amount of ethanol produced just three years prior. While corn is leading the charge in the production of ethanol, it is not the only possible source. Any starch or sugar based feedstock, generally referred to as cellulosic material, can be converted to a fuel. In addition to corn, this can include barely, switchgrass, wood chips, sugar beets, and sugar cane. Brazil, which is one of the world's major ethanol producing countries, uses sugar cane as their main source for fuel.

Once the fuel source, in this case corn, has been selected, the fermentation process can begin. Once the corn has been unloaded and placed in a storage silo, the first step of the process is to mill the corn into a fine grain-like powder. There are two fundamental ways to do this: wet and dry milling. The major difference of the two is the initial handling of the grain. Dry milling is the most common process found in the United States, so this is the process that will be covered in detail. Once the corn has been ground into fine flour, it is mixed with water and enzymes to form a slurry. The water creates a soupy mash, and the enzymes convert the starch found in corn to a simple sugar, dextrose [4]. Ammonia is often added at this step to control pH levels, and the mash is heated to a very high temperature to reduce bacteria levels, and then rapidly cooled in order to provide the best environment for the yeast. The job of the yeast is to convert the sugars found in the mash to ethanol, which produces a carbon dioxide byproduct.

This stage in the process is referred to as fermentation, and typically lasts for 40 to 50 hours. The yeast and mash are kept at a fairly cool constant temperature and agitated to ensure the best possible conditions for the yeast to do its job. The more lucrative the environment for the yeast is, the more sugars will be converted to

fuel with the least amount of waste. Once the slurry has been ferment, it is now generally referred to as "beer" [5]. After the allotted time has passed, the beer is transfer to distillation columns. At this point, the ethanol is separated from the remaining solids. The ethanol is concentrated to roughly 190 proof, which is extremely alcoholic. For comparison, it is illegal to buy alcohol in Pennsylvania that is higher than 151 proof. There is still a bit of water remaining in the ethanol at this point, so it is then dehydrated in a molecular sieve system to remove this last 5%, increasing the alcohol level to 200 proof. While it wouldn't be recommended, the ethanol at this point is technically an extremely potent potable. In order to make it undrinkable, it is denatured with pure gasoline by about 5%. This also has the advantage of excluding ethanol from the beverage alcohol tax [4].



The ethanol is then stored until it can be shipped to a gasoline terminal or retailer. At that point the ethanol is blended with gasoline to produce different types of fuel. E-10 is the most common form of ethanol blend found in the U.S. E-10 designates 10% ethanol and 90% unleaded gasoline. Every car produced in the last 20 years is capable of running on E-10 without modification, and 50% of the nation's gasoline contains ethanol, most commonly in the form of E-10. In some states it is possible to purchase ethanol blends greater than 10%. The most common form is E-85, but many mid-range blends also exist. Only vehicles designed to run on ethanol, commonly known as flex fuel vehicles, should be fueled by blends higher than E-10. The variety of blends between E-10 and E-85 are designed to provide flex fuel vehicle owners with many options, and some tests have shown that non-flex fuel vehicles can run on blends as high as 20% with positive results. E-85 is of course 85% ethanol and 15% unleaded gasoline. This is the highest blend flex fuel vehicles are capable of

running on, and is becoming very popular as an alternate source for fuel. There are around 7 million flex fuel vehicles on the road today, and in the upwards of 2,000 flex fuel filling stations across the U.S. [3].

While the previous information describes the total process of converting corn into usable fuel, there is still more work that needs to be done back at the ethanol plant. All of the wastes produced during the production of ethanol can be processed and recycled, further reducing the impact of ethanol on the environment. The solid wastes that were formed during the distillation process are sent through a centrifuge that separates the grain and a watery silage that contains about 5% solids [3]. This silage can be recycled back to the slurry tanks, thereby reducing the amount of water needed for that step of the process. The remaining grains are sent through dryers to produce a product called dried distillers grains (DGGs) which is a very high quality, rich in nutrient feed that is sold to farmers to feed their livestock [5]. Finally, the carbon dioxide that is given off during the fermentation process is collected and sold to carbonate soft drinks and can also be used in the production of dry ice.

Source : <http://me1065.wikidot.com/ethanol-as-a-fuel-source>