Iowa Science Teachers Journal

Volume 16 | Number 3 Article 5

1979

Corn to Alcohol

A. C. Haman
University of Northern Iowa

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A.C. Haman
Department of Biology
University of Northern Iowa
Cedar Falls, IA 50613

The combination of critical fuel shortages and zooming oil prices have lead to the possibility of converting corn to an alcohol fuel, a process that has been known for some time.

The benefits offered by an alcohol-fuel industry are substantial, among a few are: the fuel source is renewable each year; domestic alcohol fuel reduces dependence on oil imports; and fuel alcohol burns clean reducing pollution. The economic impact to the state economy is obvious.

A bushel of corn can produce about 2.6 gallons of alcohol and form 17-18 pounds of high-protein feed for livestock. Produced in small, on-farm plants some farmers have become self-sufficient in their energy needs and in the production of high-protein feeds.

By June 1979, Iowa motorists using gasohol, a alcohol-gas mixture, have purchased more than 28 million gallons of gasohol. Some pioneering farmers have shown that corn alcohol in the 165-180 proof range can be used as a complete fuel replacing gasoline. Gasohol, as sold in Iowa, contains 90% gas and 10% alcohol. Brazilians have shown that a blend of 80% alcohol and 20% vegetable oil works efficiently in diesel trucks and tractors.

The basic technology for obtaining alcohol from plant life goes back thousands of years. With some modern improvements, the process has become more efficient. The following is a simplified set of steps for use in small alcohol plants:

1. Grind or mill the kernels into fairly uniform "fine" sizes. (A 3/16th hammermill screen will do the job.)
2. Make a slurry (mash) by adding about 16 gallons of water per bushel of corn.
3. Adjust the pH level of the mash to a 6.0-7.0 range, using acids and alkalis to reach the balance needed.
4. Add an enzyme, Alpha Amylase, and cook the mash at a boil for 30 minutes, with constant agitation. This step converts the starches to gelatin.
5. Cool the slurry to 85-90 degrees, thin the mash by adding 16-18 gallons of water per bushel (which also helps the cooling).
6. Adjust the pH level down to a 4.0-4.5 range, add a second enzyme, Gluco-Amylase, and inoculate with a yeast culture (brewer's yeast) on a basis of 2-4 oz. per bushel of corn.
7. Allow to ferment for 60-70 hours at 85-90 degrees, with agitation. This step produces ethanol (grain alcohol) from the fermentable sugars.

8. Screen out the distiller's grain, leaving the "beer" (alcohol and water) for the final step.
9. The beer is run through an upright distillation column at near-boiling temperatures. Since alcohol vaporizes at 173 degrees, the vapor rises and leaves the column, goes into a cooling tank where it becomes liquid. (Low-proof alcohol should be run through the distillation column a second time to reduce its water content.)
10. Denature the alcohol (under federal direction), and feed the residue as a high-protein supplement.

Many opportunities for more efficient conversion methods are possible and afford many opportunities for study in biology, physics, chemistry and engineering design, particularly in the production of small volume on-farm plants. Grants are available for such studies.

For further technical and legal details write for the free booklet *Corn Alcohol . . . Farm Fuel!* printed by the Iowa Corn Promotion Board, 402 West Towers, 1200 35th Street, West Des Moines, Iowa 50265. The booklet also contains a source of grants for improving efficiency in the production of corn alcohol.

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Preserving Snowflakes

One of the best responses to articles we have published has been *Snowflakes You Can Keep*, Vol. 14(3):24, 1977. An inexpensive kit using the same techniques can now be obtained from Ward's Natural Science Establishment, P.O. Box 1712, Rochester, New York 14603. The cost of the kit is $5.50. Also available is a photoslide set with text describing and explaining different types of snowflakes.