Cellulose to Fuel

We held a Growing Corn and Soybeans for Fuel workshop this week. The good farmers from Gage County thrilled in the opportunity to tell me how good a presentation my son John delivered compared to my meager efforts. They were right in one respect. John's presentation was excellent. I thought I would share some of the highlights.

Cellulosic ethanol is one form of liquid fuel. Cellulose (corn stalks, switchgrass, rice hulls, wood chips wheat straw) is first harvested transported, ground then fractionated into its constituent parts of cellulose, hemicellulose, and lignin. The cellulose and hemicellulose are then pretreated with either strong or dilute acid to break down the cellulose into sugars, sugars are then fermented into ethanol. New research is taking place to replace the acid pretreatment with a microbial breakdown of cellulose into sugars. Although some cultures currently exist commercial scale is currently not available. There are other approaches which we have the technology to do, but still need technological adaptations to do cheaply and efficiently.

Thermal decomposition of cellulose to bio-oil or bio-crude is another route from cellulose to fuel. The plant materials are ground then exposed to super heat and pressure. The resulting bio-oil or bio-crude can then be refined into green gasoline or green diesel.

Gasification of biomass creates a synthetic natural gas made of hydrogen and carbon monoxide which can be burned, or transformed into a liquid fuel through a process named after the scientists that discovered it Fischer Tropsch. The finely ground biomass material is burned in high temperature low oxygen environment resulting in the liberation of flammable gases.

Farm producers who grow the biomass which will be used in bio-refineries will have to provide a high quality product. Biomass first and foremost must be dry, in order for the grinder to process the material the biomass bale must be near 90% dry matter. Secondly the biomass needs to be free of soil contamination. Soil and other foreign material are negative to the commercial process. Research has been done on harvesting directly from the combine, yet these systems are not easily available today. Harvest techniques will improve. Storage of biomass will most likely take place on the farm. Sheds, tamps, or at the least net wraps would be required for storage. Type of bale, round or square is yet to be determined. Some companies have expressed interest in only round bales while others like the square for ease of handling.

Switchgrass yields in the Southeast Nebraska range from 2-5 tons per acre under relatively low management. Switchgrass will most likely not take over corn/soybean acres as income from switchgrass will not likely keep pace with per acre income from corn or soybeans. Yet grown on acres of more marginal land, switchgrass could work well as a alternative crop. Mass production might take less acres than corn stover of which only the cobs or 20% of stalks could be harvested in a cor/soybean rotation in our area to protect soil organic matter levels.

There is more than one option for production of tomorrow's renewable fuels. Time and technology will lead us to future sustainable developments.

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