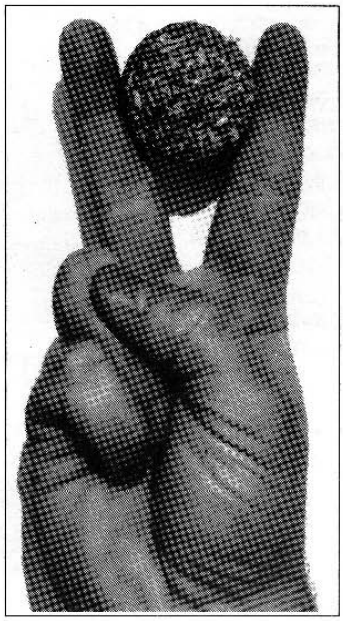
Briquettes of Grass

"Green Coal" from the Prairie

by Roger Samson

Industrial crop diversification is one of the most promising strategies for reviving agriculture's flagging fortunes. Application on a large scale includes the use of perennial prairie grasses for the production of cellulosic ethanol as a transportation fuel and in direct combustion for space and processing heat. An efficient method to compact prairie grasses may be the missing link in the development of economical non-wood combustion systems for rural energy supply.



Southern Ontario and much of the Prairie provinces are major agricultural regions with something in common: both have no presently available renewable energy option. These two areas have few forest residues for wood chip production and little hydro-electric power production. The only large scale renewable energy option for these areas is conversion of C4 grasses and agricultural residues, such as straw, into usable energy forms. Briquetting, or densification, of this type of material could be the bridge in the development of efficient and economical use of this material to supply local energy needs.

Previous attempts to convert big bales of material, such as straw, into energy have been mostly uneconomical because of a low combustion efficiency and high capital costs associated with the large facilities required for the direct conversion of big baled material. One of the big problems with straw is that it has a high ash content. When burned at a high temperature on large conventional combustion equipment beds, the ash in the straw fuses and plugs up the system. To prevent this from happening, the straw is burned at a lower temperature which results in inefficient combustion. New developments in combustion of woody biomass (described in the articles of this issue of Sustainable Farming) have conversion efficiencies of approximately 70-75% and do not have similar bed designs.

Enter Briquetting

Briquetting may enable these state of the art wood combustion systems to be used for combustion of densified agricultural materials. Briquetting enables a substantial volume reduction so that briquetted material ends up with approximately two-thirds of the energy content of coal on a volume basis. It is a much less expensive operation than pelleting because it requires approximately 70% less energy to process material and operating costs are substantially lower (primarily because pellet mills use dies which have a short life span and are expensive to replace).

In the case of briquetted material, densification is done under great pressure through one hole (rather than at a lower pressure through hundreds of holes as in the case of a pelleting). Briquetting can take the form of either solid logs to replace firewood or be sliced into 4 cm lengths in the shape of a hockey puck.

Under the high pressure necessary for briquetting, the natural resins in the plant material act as a "glue" to keep the material held together in its cylindrical shape. The technology has been used commercially since the mid-1980's in the United States, mainly for the densification of wood residues from the forest products industry. However recent work by Ed Wooley of the Iowa Department of Natural Resources, in conjunction with Andy Lee of BMSI (Briquetting Manufacturing Services Inc. of Richfield, Minnesota) have shown that the technology can be successfully applied to briquetting C4 grasses such as switchgrass.

Competitive

The material is much denser and dryer than wood, which should enhance its combustion potential. As this material is denser and contains less water than wood, the combustion efficiency should be over 70% efficiency. While some skepticism may be expressed about consistently obtaining this efficiency level, it should be recognized that pellet stoves are already achieving efficiency levels of 80% with materials that are less dense than briquetted grasses.

Grass briquettes for energy use, therefore, present an interesting prospect with estimated production costs running between $40-60/tonne. If C4 grasses can be produced for $30 per tonne in prairie regions,

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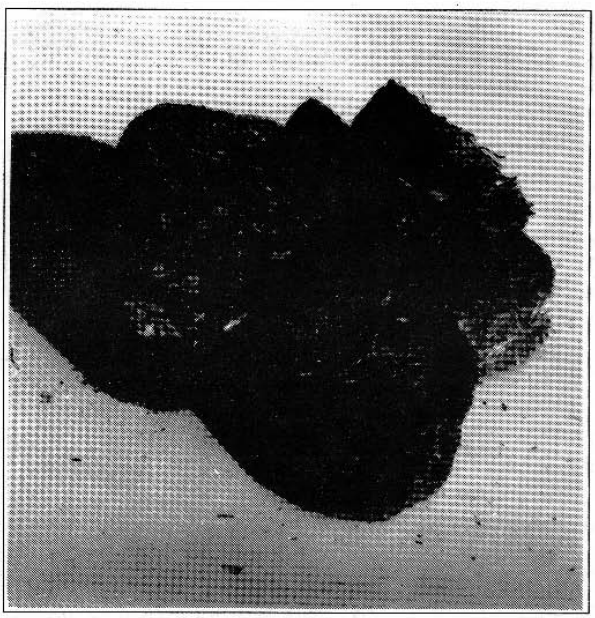
Advantages of Briquetting Grasses

- no binding agents required
- reduces storage space
- need for drying is reduced or eliminated (material is briquetted at moisture contents below 15% which should be obtainable from standing material in the field)
- combustion efficiency is superior (material contains little water and the combustion units are much smaller than conventional straw burners)
- reduces transportation costs because of densification and decentralized energy production

Disadvantages of Briquetting Grasses

- capital cost of briquetting equipment is (presently) relatively high (approximately $ 400,000 for a unit to briquette 10 t/hr, or $ 200,000 for equipment to briquette 2.5 t/hr.)



Switchgrass has been densified into "hockey puck" briquettes during technology development studies by the Iowa Department of Natural Resources. The hockey puck shape enables both efficient densification for transport and handling, as well as flowability from storage containers.

or $40/tonne in other regions, briquetted for between $10-20/tonne and converted at >70% efficiency level in modified wood burning appliances, it could become a very competitive energy source.

Grasses could compete directly with coal and oil in rural areas. On a per tonne basis, grasses contain approximately one-third less energy than coal which, in rural areas, sells for about $80/tonne. It could be a very competitive energy source for all areas which have no renewable energy options and high conventional energy supply costs. Combine this with the desperate state of the farm economy and the impact could be revolutionary with farmers supplying the energy to rural industries, schools and homes.

What is now required is to prove in an automated, high volume system that this renewable energy industry is competitive with coal and oil in rural areas. This combination of necessary technologies to produce a proven large scale energy supply system has not yet been accomplished. Tests by the Iowa Department of Natural Resources using switchgrass as a commercial energy source for a rural industry are expected to be initiated this summer.

It is an exciting idea to think that a low cost, clean, indigenous, decentralized and renewable energy supply could come from prairie grasses. Considering that there are over 1 billion hectares of grassland in the world it could be a global energy solution.

The Strategy

Agriculture has always been good at producing, and consumers have never had a problem consuming. The weak link, especially for new products, has usually been how to get the 'little piggy to market.' Thus, to create a market for energy crops, there needs to be a strategy:

Identify the source
Use the world's most resource efficient plants, the C4 perennial grasses as the feedstock (these are grasses, such as switchgrass, that will yield more low cost dry matter per hectare than any other land use application).

Establish the process
Wait till the end of the season to harvest the material (to lower N and K content of the material), then chop the material up into 1 cm lengths and briquette it.

Develop utilization
Burn the grass firelogs in modified wood burning appliances, as well as using chopped-up logs, or "hockey puck" briquettes, as the material to be burned in efficient gasification systems (currently used for automated wood chip combustion).