Are We Missing the Boat on US Export Wood for Fuel?

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June 2013

INTRODUCTION

The US and Canada now ship more than 3 million tons of wood pellets per year to Europe. There is an old saying in solid fuel preparation – *do only as much as the application requires*. So why take all the effort to make a pellet? The reasons are that they are a standard commodity, are low in moisture, have good flow properties, and are higher in bulk density than raw wood. But they also can be costly, are prone to dusting and crushing, and generate carbon monoxide (CO) while in storage.

The EU has set a goal of 20% renewable energy by the year 2020. According to Biomass Magazine, the current US and Canadian pellet exports total 2 million tons. At an assumed market price of $150/ton, this represents $300 million in annual pellet revenue. Total worldwide pellet consumption is in the range of 14 million tons per year. The most conservative projections (Poyry's second edition of the Global Pellet Multi-Client study) predict an increase in European wood pellet use from 10.8 million tons to 23.8 million tons between 2010 and 2020. Projections show the southeastern US as the potential source for over 6 million tons by 2020 – a 4.5 million ton increase over current levels.

Are pellets the only way to slake the European thirst for biomass, or are there superior, lower cost, greener fuels available with smaller carbon footprints? One that has potential is DMC Fuel™ (dry micro chip fuel). This is created by a new generation of in-forest chippers[1] which produce a nominal ¼" long by 1/16" thick chip. When dried, micro chip fuel has all of the positive properties desired for combustion: low moisture, good handling, near zero dust, little breakage when handling, and based on preliminary tests, no detectable CO generation in storage. Fuel can be stored in simple, lower-cost, roofed buildings instead of traditional silos. Capital cost and electricity are reduced within the grinding and pelletization process, thereby reducing delivered price at European ports.

COMPARING PELLETS AND DRY MICRO CHIP FUEL

"Engineered Fuels"[2] are those that undergo one or more beneficiation steps. For biomass, this would start with the base fuel of whole tree chips or hog fuel. Beneficiation steps include size reduction, drying, pelleting, briquetting and torrefaction. Each step has its own costs and benefits. This paper focuses on DMC Fuel™ (dry micro chip fuel) and its comparison to pellets.

Micro chip fuel is a new biomass product aimed primarily at the industrial export market, and secondarily at the national market for residential and commercial wood heating. It is trademarked by TMTS Associates, Inc, an engineering consulting firm focusing on biomass projects.

Figure 1 shows both micro chip fuel (at left) and conventional wood pellets (at right). Conventional pellets are about 3/8" diameter x ½" long. Dry micro chip fuel's smaller size makes drying much easier and faster (as compared with the old standard 2"x2"x1/4" whole tree chips, or 2" hog fuel), getting the job done with shorter dryer residence time and smaller dryer shells.

Figure 1, DMC Fuel™ and Conventional Wood Pellets

Tables 1 and 2 list the pros and cons of wood pellets and dry micro chip fuels while Figure 3 shows comparative flow sheets.

Table 1, Pellet Pros and Cons

Pros	**Cons**
Well-established commodity	Dusting and crushing in transport and handling
High bulk density	Loss of integrity upon wetting; protection from weather required
Low moisture content	The need for hammer milling/grinding to less than 1/16" particle size before pelletizing
	High energy and maintenance pelletizing step
	High cost and power consumption in manufacture
	Need for pellet coolers
	Carbon monoxide generated in storage (Reference 2: CO levels have been found that are many times the NIOSH IDLH (Immediately Dangerous to Life and Health) level of 1,200 ppm, with CO concentrations of 1,460 to 14,600 ppm in cargo holds for ocean shipped pellets)[3]

Table 2, Micro Chip Fuel Pros and Cons

Pros	**Cons**
Lower capital costs	Lower bulk density
Lower power, labor and maintenance cost	Higher ocean transport cost
Lower cost per ton	
Greener fuel due lower power per ton in manufacture	
No grinder/hammermill	
No pellet mill	
No pellet cooler	
Smaller dryer shell	

The properties of micro chip fuel vary little with type of wood, with the exception of slightly higher heat content and volatile fraction for softwoods as compared to hardwoods, as would also be the case with pellets.

Micro chip fuel ash content will vary with feed stock, and, if sand and fines are excessive, screening to remove sand and fines can be done as part of the production process after drying, and any resultant fines can be used as dryer fuel as an additional benefit.

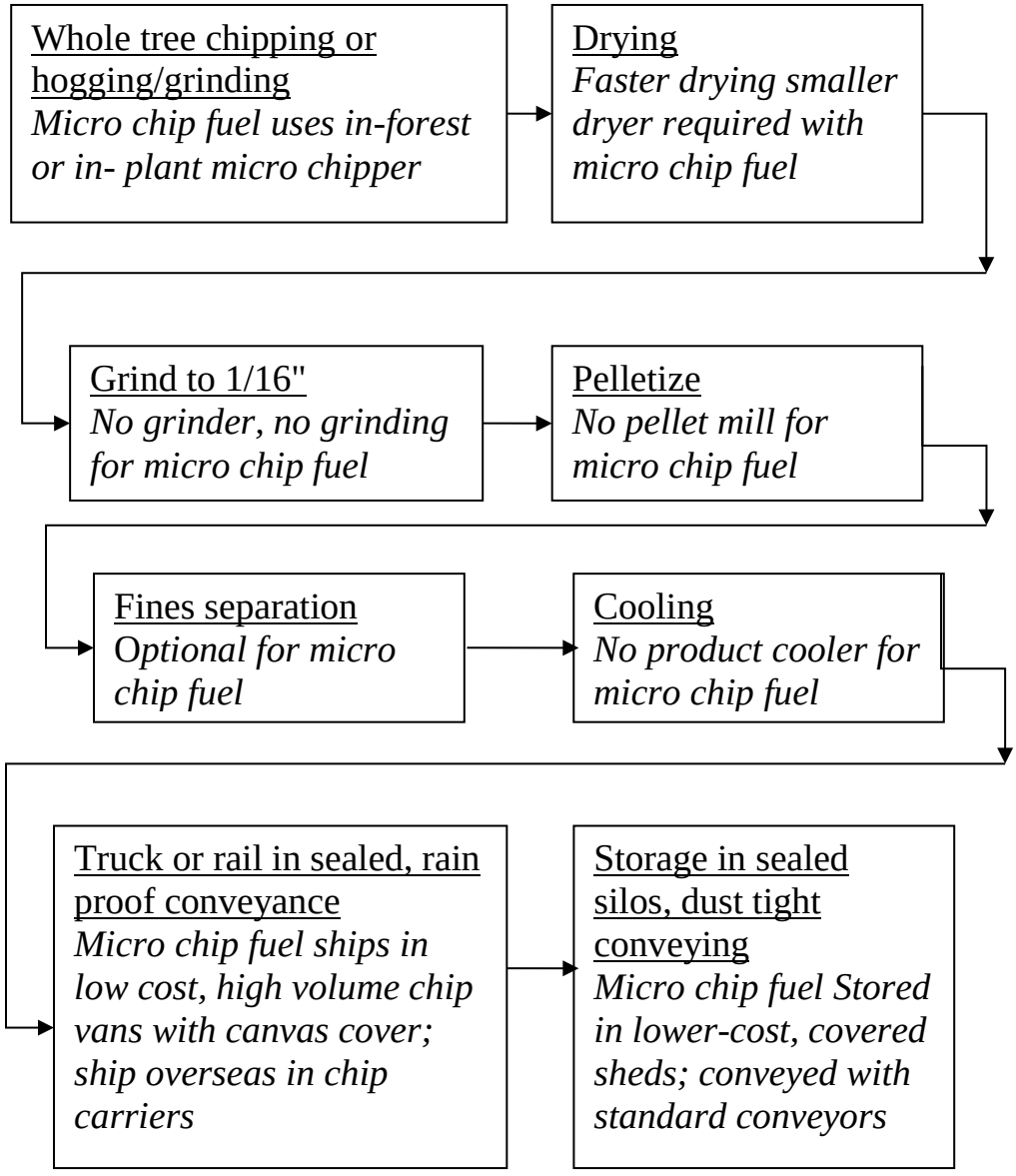
Pellet bulk density is in the range of 45 lb/cu ft (720 kg/m3), while micro chip fuel is about 15 lb/cu ft (240 kg/m3). Cost for truck shipping differs little in practice between the two fuels, as both can make a full truckload weight, and a standard 48' chip van can transport a full truckload (20 short tons plus) of micro chip fuel.

An additional advantage of micro chip fuel is the potential outsourcing of the drying step to existing tolling facilities to enable low risk, fast startup of production and bypass the need to expend capital and time on equipment, permitting and construction.

Capital and Operating Cost

Elimination of equipment from the flow sheets (e.g., hammermill, multiple pellet mills, pellet cooler, interconnecting conveyors, etc.) cuts capital cost of equipment 57%. Total savings for power, maintenance, labor, reduced amortized cost of capital is in the range of $30-$35/ton. Estimates of the premium for transatlantic shipping of lower bulk density product via chip carriers suggest an added cost of $15/ton, resulting in a net savings on dry micro chip fuel delivered to the EU of about $15-$20/ton when compared to wood pellets.

Figure 3, Flow Sheet for Pellets and *Differences for Micro Chip Fuel*



PRODUCT REGULATION AND SPECIFICATIONS

In addition to grading by industry standards for industrial (higher ash) and residential (lower ash) markets, multiple parameters are tested on wood pellets:

- fines content, bulk density, diameter, length
- heating value, chloride, moisture content,
- pellet durability index
- ash content

Comparatively, micro chip fuel requires only moisture content, particle size range, ash content and heating value tests. Table 3 shows general specifications for micro chip fuel:

Table 3, DMC Fuel Specifications

Parameter	**Value**	**Comment**
Size	Nominal top size 1/4"	This can be fine-tuned for end use
Moisture content	10%	8-12% typical, wet basis
Heating value	+/-7650 Btu/lb (18 kJ/kg)	Varies with hardwood (less), softwood (more)
Bulk density	15 lb/ft^3 (240 kg/m^3)	Approximate
Ash	0.5% to 2%	Varies with source; can be reduced by screening

A major issue for export is moisture content. Wet wood is generally banned from shipment due to the potential for transporting parasites, such as PWN (pine wood nematode). PWN treatment per the "56/30" rule requires a core temperature of at least 56°C for 30 minutes for wood chips. Hence, the drying step is mandated for overseas shipment.

While wood chips tend to pack in storage, leading to arching and bridging in storage and handling systems, dry wood is freer flowing, and is stronger and less prone to jams and hang-ups.

SUMMARY

While pellets are the current logical choice for export of biomass for industrial/utility use in Europe and Scandinavia, dry micro chip fuel has potential for lowering costs and reducing the carbon footprint associated with biomass fuel.

References:

1. Example micro chipper manufacturers: Peterson: http://tinyurl.com/ChipPeterson Vermeer: http://tinyurl.com/ChipVermeer
2. McGowan, Thomas F., Sizing, Drying, Torrefaction and Pelletization, IT3, Jacksonville, FL, May 11, 2011
3. Urban Svedberg, Jerker Samuelsson, Staffan Melin, Ann. Occup. Hyg., Vol. 52, No. 4, pp. 259–266, 2008, Hazardous Off-Gassing of Carbon Monoxide and Oxygen Depletion during Ocean Transportation of Wood