Fuel characteristics of processed, high-fiber cane

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Sugarcane bagasse, the fibrous byproduct of raw sugar production, is commonly used as boiler fuel to generate steam and electricity, and provide power and process heat in the sugar factory. Alternative uses for sugarcane fiber (e.g. medium density fiberboard (MDF) production) have been identified in the sugar industry and the use of cane varieties selected for fiber production, rather than sugar production, is being evaluated. Alternative harvesting, processing, and resource allocation strategies are under consideration as part of this shift toward expanded fiber production and utilization. For example, forage harvesters and billet cane harvesters are possible alternatives to push rake harvesting methods typically practiced in Hawaii. Cane processed to produce primarily fuel or MDF rather than sugar would likely be subjected to a subset of the unit operations typically found in a sugar factory. Bagasse diverted from use as a fuel to a satisfy other fiber demands could be replaced with alternative biomass or fossil fuels. Cofiring of biomass and coal to satisfy power and process heat requirements is also under consideration

A study was conducted to identify a reduced set of unit operations that produce a processed, biomass fuel which can be effectively co-fired with coal. A sugarcane variety (B52298, originating from the island of Barbados) was selected for its architecture and fiber production. Test plots were grown, hand harvested, and processed on the Hawaiian Commercial & Sugar, Co. (HC&S) plantation on Maui. Fuel chemistry, bulk density and moisture content of the final products from four candidate processes were determined. Combustion characteristics of these four fuel lots, commercial bagasse, and coal used in the HC&S boilers, were evaluated individually and as blends at the Combustion Research Facility of Sandia National Laboratories [1]. This paper reports the results of the fuel processing portion of the study.

Roughly one fourth of the cane harvested from test plots was stripped of all leaf material. The remainder was maintained as whole cane including all leaf material. The stripped cane and whole cane lots were separately passed through a forage harvester. Further processing used a three-roll, Cuba mill according to the treatment matrix shown in Table 1. The grooved-surface, Cuba mill rolls measured 30.5 cm in diameter and 30.5 cm in width. Multiple passes through the Cuba mill were required to attain a moisture content (~50% wet basis) typically obtained by a single pass through a single mill in a sugar factory.

Table 1. Summary of treatment processes for cane variety B52298 fuel lots.

Treatment Name[*]	Initial Material	Forage Chopped	Initial Cuba Milling (4 passes)	Leaching	Second Cuba Milling (4 passes)
WC-U	whole cane	x			
WC-M	whole cane	x	x		
WC-MLM	whole cane	x	x	x	x
SC-MLM	stripped cane	x	x	x	x

* WC – whole cane
SC – stripped cane
U – unprocessed
M – milled four times through the Cuba mill
L – leached using tap water at a 10:1 weight ratio (nominal) of water to fiber.

Removal of potassium and chlorine is particularly important in reducing a fuel's tendency to foul heat exchange surfaces or create slag in a boiler. Distributions of K^+ and Cl^- in the liquid streams generated during the fuel processing trials are shown in Figures 1 and 2. In the whole cane treatment, the initial four pressings (to ~50% moisture) removed 65% and 72% of the total K^+ and Cl^-, respectively,. In comparison, 76% and 82% of the total K^+ and Cl^-, respectively, were removed from the initial milling in the stripped cane treatment.

In addition to these results, fuel compositions and physical properties, mass and element balances, and detailed equilibrium calculations for each of the fuel treatments will be reported.

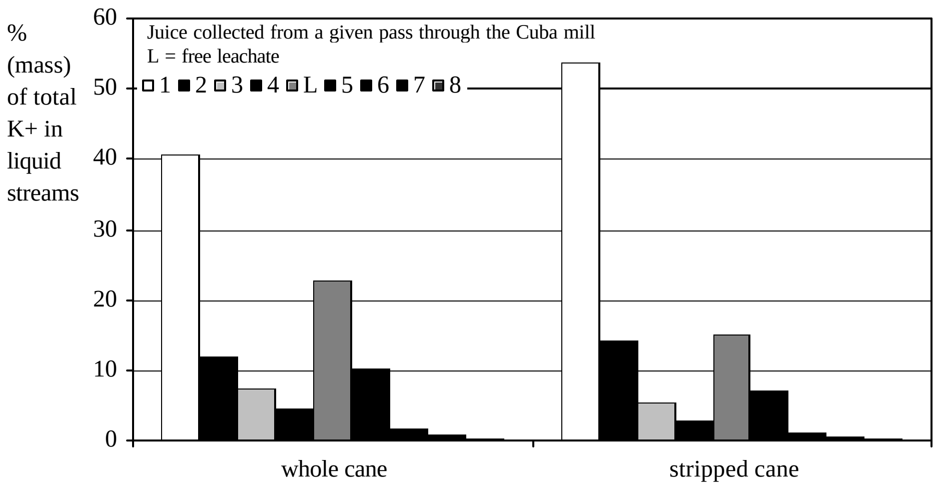

Figure 1. Distribution of potassium measured in expressed liquids and free leachate as a percentage of the total potassium recovered from whole cane and stripped cane treatments.

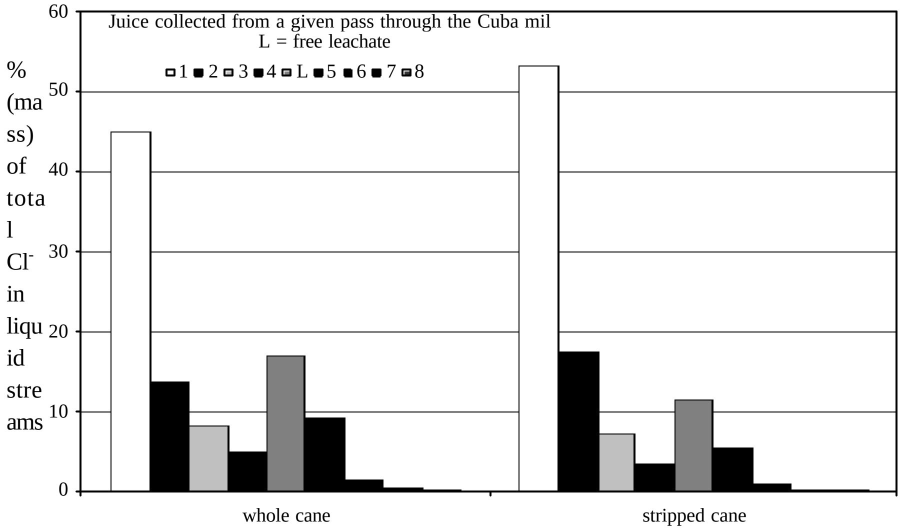

Figure 2. Distribution of chloride measured in expressed liquids and free leachate as a percentage of the total chloride recovered from whole cane and stripped cane treatments.

[1] Wu B, Blevins L, Jakeway L, Jenkins B, Turn S, and Baxter L. Closed-loop biomass/coal cofiring project at Hawaii Commercial and Sugar. Abstracts of the Fifth Biomass Conference of the Americas