

GEORGIA BIOENERGY CONFERENCE 2006

UGA Tifton Campus

Conference Center

Tifton, Georgia

August 2, 2006

COMBUSTION OF BIOMASS: PROBLEMS AND OPPORTUNITIES

PRESENTED BY

RAYMOND C. GANGA, P. E.

The McBurney Corporation

McBurney®



EXAMPLES OF BIOMASS FUELS

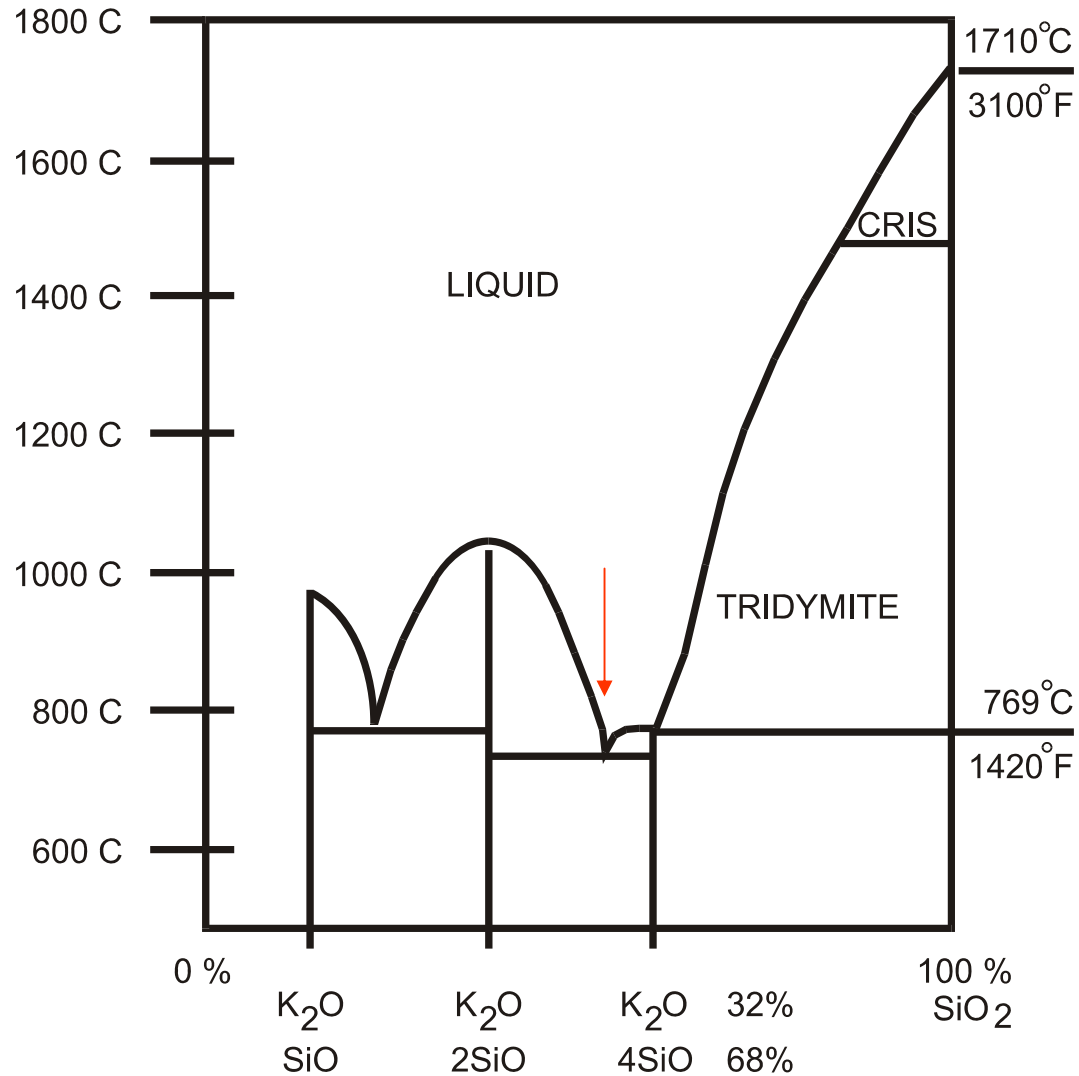
- **Bagasse**
- **Rice Hulls**
- **Straw**
- **Peanut Shells**
- **Coconut Shells**
- **Switch Grass**
- **Wood Waste**



Problems With Biomass

- **High Moisture**
 - Low combustion efficiency
- **Fibrous**
 - Hard to Process
- **High Silica and Alkalis**
 - Silica present as part of the structure (usually amorphous) or as tramp dirt (usually crystalline)
 - Can Lead to Slag Formation in the Presence of Alkalis (see phase diagram)
 - Fouling of Tubes
 - Potential to Produce Carcinogens in The Ash
- **Low Bulk Density**
 - High volume of storage required
 - Limited range for fuel supplies because of high volume transport

Phase Diagram for K_2O-SiO_2



New Wine In Old Bottles

The problems of biomass are being solved through cost effective improvements in older technologies. Some of the keys to high efficiency and low emissions in these systems include:

- Better seals for less air leakage
- Increased use of membrane wall furnace design
- Larger grate sizes and furnace volumes for lower heat release rates, more retention time and lower furnace exit gas temperatures (FEGT)
- Improved feeders for better fuel distribution over a grate
- Better burner designs for suspension firing
- Improved air distribution systems
- Increased use of staged combustion
- Better over fire air systems
- Sectionalized under grate areas
- Flue Gas Recirculation
- Improved Fuel Processing Systems
- Newer types of hammermills and hogs, etc.
- Increased use of modeling before final design

Old Technologies Solving Tomorrows Problems

Stokers

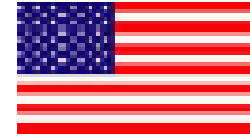
- Mass Burn – Common in European applications. They are suitable for waste combustion. Because of the passive grate it helps minimize unburned carbon carryover at the cost of having a large footprint to control heat release rate on the grate.
- Spreader Stoker – More common in The United States. More responsive to load changes than mass burn units and having a smaller grate area per unit of heat introduced into the furnace. Spreader stokers can have fixed grates or moving grates for continuous ash discharge. Improvement in seals for moving grates has reduced the amount of tramp air entering a furnace and minimized unburned carbon losses.
- Underfeed stokers – rarely used any more except for very small units where low cost is paramount.

Suspension Firing

Similar to pulverized coal these burners consume fine and dry biomass materials. Typically because of the higher quantities of volatiles in biomass the grind sizes do not have to be as fine as with PC coal. Significant work has been done on refining the optimum grind size for combustion and hammermills (and other size reducing equipment) have been improved to be able to more consistently obtain the proper size distribution.

SIERRA-PACIFIC – ABERDEEN, WA

- **Boiler Capacity:**
72.5 T/hr, (160,000 pph)
- **Steam Pressure:**
86.2 Bar, (1250 psig)
- **Steam temperature: 537°C, (900°F)**
- **Fuels: Wood, Natural Gas**
- **Detroit Stoker Vibrograte**
- **Emissions Controls:**
 - Multicyclone Collector
 - Electrostatic Precipitator
 - SNCR
- **McB Scope: EPC**
- **Electrical Generation: 16 MW**
- **Project Schedule: 18 mos.**
- **Commercial Operation: March 2003**



AT BIOWPOWER- PICHIT, THAILAND

- **Boiler Capacity:**

90.7 T/hr (200,000 lb/hr)

- **Steam Pressure:**

65.5 Bar (950 psig)

- **Steam Temperature:**

482°C (900°F)

- **Fuels:**

Rice Husks, No. 2 Oil

- **Emissions Controls:**

- Staged Combustion, Overfire Air

- Mechanical Collector

- Electrostatic Precipitator

- **McB Scope: Boiler Island Design,
Combustion System Supply**

- **Project Schedule: 24 mos.**

- **Commercial Operation:**

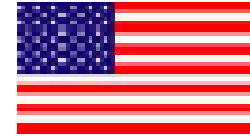
December 2005



US SUGAR – CLEWISTON, FL

- **Boiler Capacity:**

226.5 T/hr, 41.4 Bar, 399°C,
(500,000 lb/hr, 600 psig, 750°F)



- **Fuels:**

Bagasse & No. 2 Oil

- **Emissions Controls:**

- Wet Scrubbers

- SNCR System for NOx

- Electrostatic Precipitator

- **McB Scope: EPC**

- **Project Schedule: 16 mos.**

- **Commercial Operation:**

March 2005



SARA LEE – SUFFOLK, VA

- **Boiler Capacity: 13.3T/hr (29,325 lb/hr)**
- **Steam Pressure: 18 Bar (265 psig)**
- **Steam Temperature: Saturated**
- **Fuel: Coffee Grounds**
- **Detroit Stoker Vibragrate**
- **McBurney Scope – EPC**
- **Emissions Controls:**
 - **Multicyclone Collector**
 - **Electrostatic Precipitator**
- **Project Schedule:**
 - 16 months**
 - (two phases combined)**
- **Commercial Operation: October 2003**

