



Fuel Qualities Important to Combustion

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Tom Miles

T.R. Miles Technical Consultants, Inc.
Portland, Oregon
www.trmiles.com

Why is Fuel Quality Important?

- Fuel problems can be reduced or avoided.
- Fuels cause 95% of operational and maintenance problems and unscheduled outages in stoves and boilers.
- In small systems fuel problems can cause high labor costs not offset by fuel savings.



Uniform Fuel -> Reliable Operation



Hot Air Dries Wet Fuel

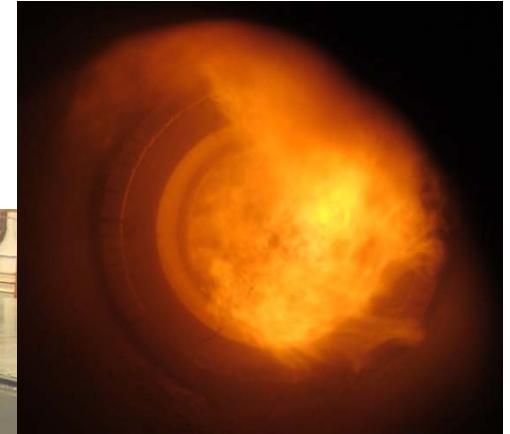


Chips Feed Well in Augers



Chips Gasify On Grate

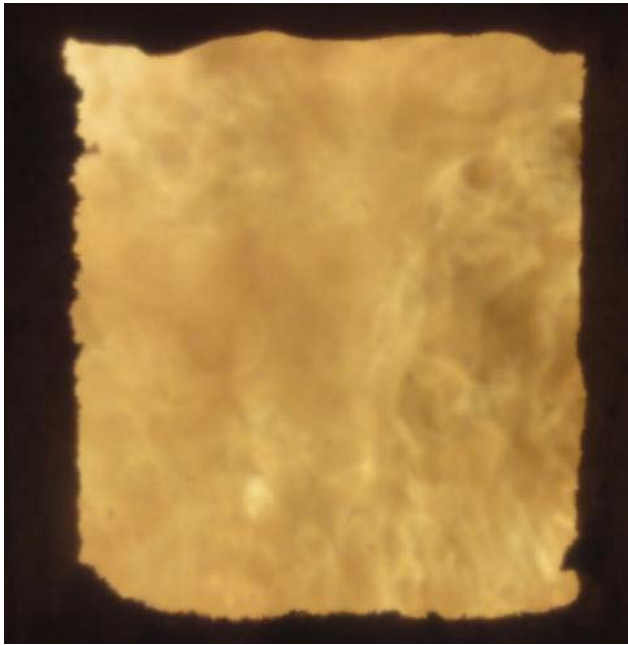
www.chiptec.com



Gas Burns in Boiler

City of Craig, AK

Good Fuel Reduces Labor and Maintenance



Quality->Control->No clinkers

Colorado State University

What is Fuel Quality?

(Messersmith)

Reliable supply (This is your first step don't skip it!)

Chips

Chipping tends to be the best except on small diameter wood.

A guide for chip size? - Think of a business card 1/8" thick, or smaller
The auger can reduce a somewhat larger chip to small enough size if you can crush it using only one hand into smaller pieces. (Use a glove, too many slivers otherwise.)

Grinding tends to be worse especially on bark.

Long stringy pieces wrap up around auger

Excessive fines create a dusty environment

Heating Value of Biomass affected by:

1. Rotted material

2. **Moisture content** (*BTU / wt. DB is about equal for most biomass*)
Roughly 9000Btu/lb DB

3. **Ash Content** (*Wood < Bark < Grass*)

Trends of mineral content in plants:

1. Perennials < Annuals (For their stems)

2. Wood < Bark





Colorado - Pine Beetle Kill Chips



Troublesome Fuel Sizes



Stringy Bark



Wet fines

Control Combustion of Wet, Fine, Dirty, Fuels To Reduce Emissions

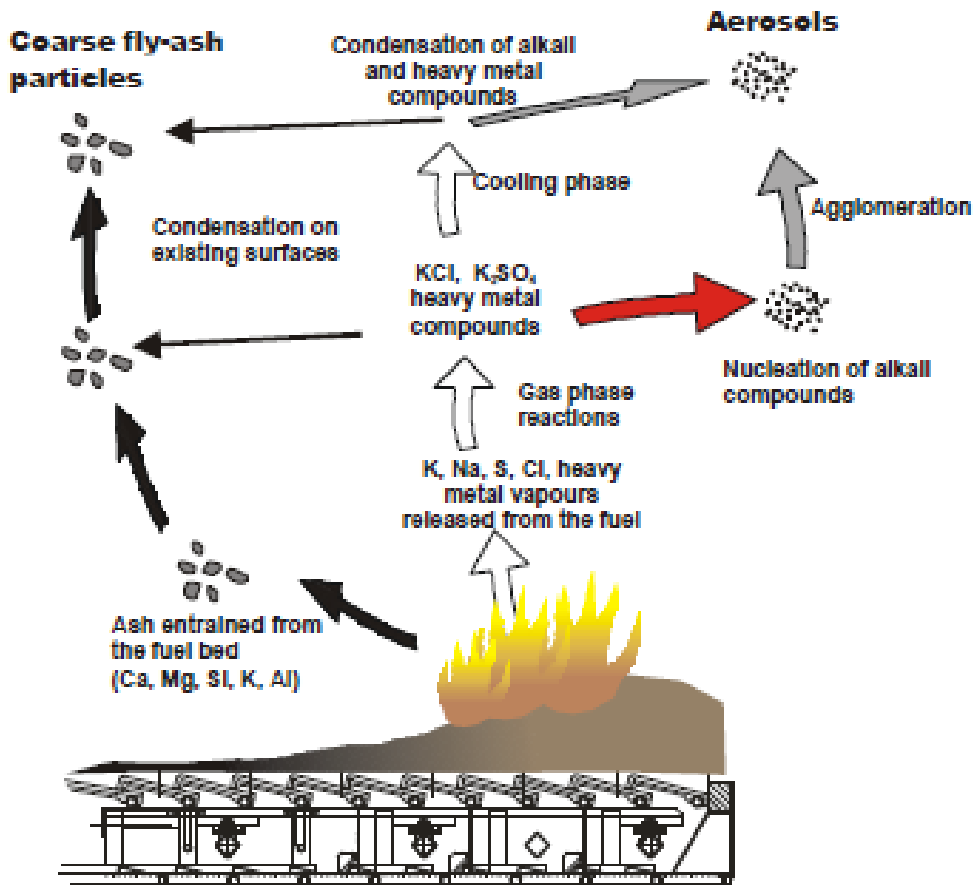


Figure 7: Aerosol formation during fixed-bed combustion of chemically untreated wood chips

Typical Boiler Fireside Problems From Fuel Ash



Victor, MT

- Ash removal problems
- Large deposits on refractory surfaces
- Deposits on refractory but not on tubes
- Spalling, slagging, viscous slag
- Accumulation around air tuyeres and refractory
- Fuel feeder blockage from slag
- Slag at hot spots from afterburning
- Blockage of gas passages
- Erosion of transitions in gas ducts

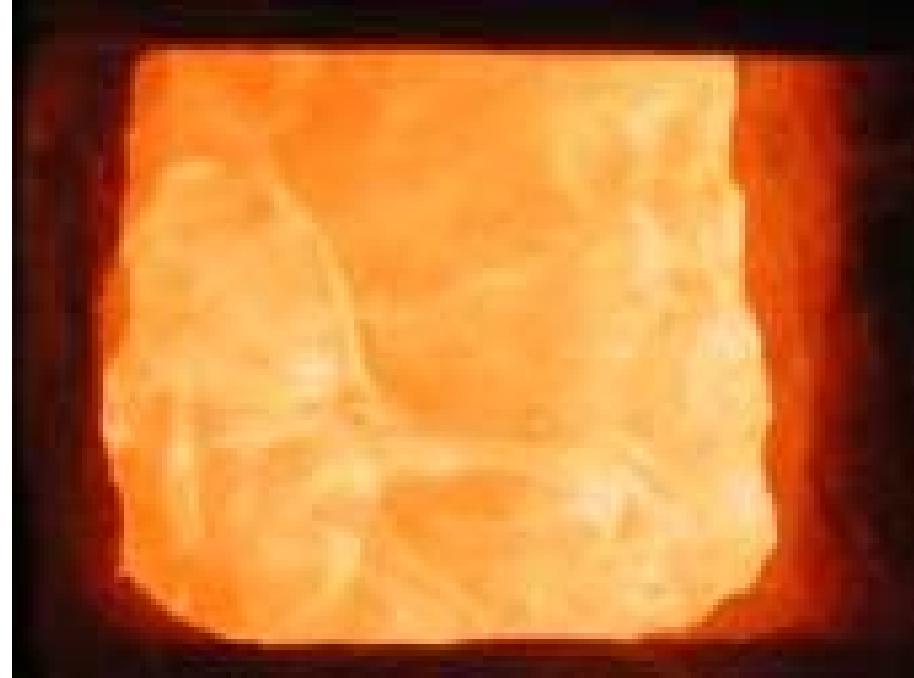
Staged Gasification-Combustion By Pile Burning Can Control Wet Chunky Fuels



Good Overfire Air Control is Important for Burning Wet Wood



Too Much Underfire, No
Overfire, High CO, Poor
Combustion



Good Air Control, Low CO,
Stable on Very Wet Fuel



Balance Combustion Air Or Fine Fuel Can Lift Off Grate

Modular Chip and Pellet Boilers Control Emissions Through Staged Combustion



John Day, OR

www.viessmann.com



Secondary Chamber Burns Gas
Heat Exchanged to Water – Flue Gas Recycled

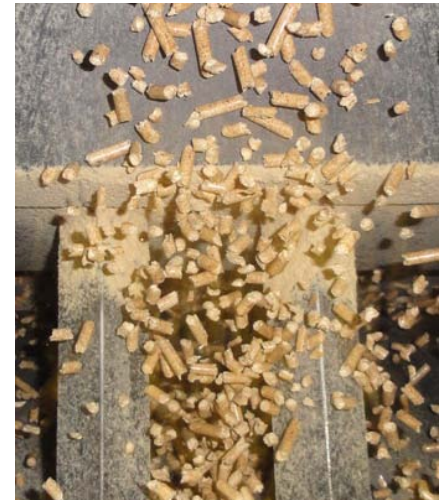


Moving Grate Primary Chamber
Gasifies Pellets or Chips



Fine Dry, Dense, Pellets Afford Good Air-Fuel Control

Good Combustion Control With Dense, Dry Pellets



Delta Junction, AK

Good Combustion, Low Emissions With Dense, Dry Bricks From Cardboard and Pallets



OMNI Enterprises, AK

Good Combustion, Low Emissions With Dense, Dry Bricks



Some Consequences of Poor Fuel Quality

	SIZE	MOISTURE	ASH
HEATING VALUE		REDUCED	REDUCED
GRATE	ENTRAINED	ENTRAINED	CLINKER
BOILER TUBES			FOULING
COMBUSTION AIR	INCREASED	INCREASED	CONTROL
EMISSIONS	INCREASED	CO, PIC, PM	PM
OPERATION	DUST	EFFICIENCY	STOPPED
	EQUIPMENT FAILURE		EQUIPMENT FAILURE
LABOR	INCREASED	INCREASED	INCREASED

FUEL QUALITY RECOMENDATIONS

- Size fuel with chippers, hammermills and screens
- Know the best moisture content for the boiler
- Blend fuels for uniform density.
- Screen or separate ash, dirt and foreign matter from fuels. Avoid leaves and needles from annual growth.



www.info.bioenergylists.org

TR Miles Technical Consultants, Inc.

1470 SW Woodward Way

Portland, OR 97225

tmiles@trmiles.com

www.trmiles.com

503-292-0107

503-780-8185 mobile

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