

# Biochar Equipment Design and Operations – Scaling – Automation – Associated Economics

The growing biochar markets is dependent on cost effective production of materials. This presentation will show technical learnings relative to biochar production from an exothermic carbon optimized gasification approach. Specific areas covered will include automated feeding in high temperature dirty environments; metal alloy choices and gasket choices for high temperature reliability; cost of production relative to productivity curves; econometrics associated with energy as a co-product.

**Jonah Levine**

[jonah@biocharsolutions.com](mailto:jonah@biocharsolutions.com)

Biochar Solutions LLC

[www.biocharsolutions.com](http://www.biocharsolutions.com)



- Biochar Solutions Inc. [www.biocharsolutions.com](http://www.biocharsolutions.com)
- Stand alone production unit
- Continuous basis operations
- 2 cubic yard/hr. feedstock in (500 lbs./hr. wood chip)
- Output of 60-120 lbs./hr. char and 2 MMBTU/hr. hot raw gas
- Run by exothermic reaction

- Less than 15 minute residence time, as brief as 1 minute
- Woodchip feedstock at or below 20% moisture
- HHT of 700 deg C
- Screened --- a client design request specification
- 100-400 m<sup>2</sup>/g BET -> 6-10 g/100g Butane
- >70% fixed carbon as high as 90%

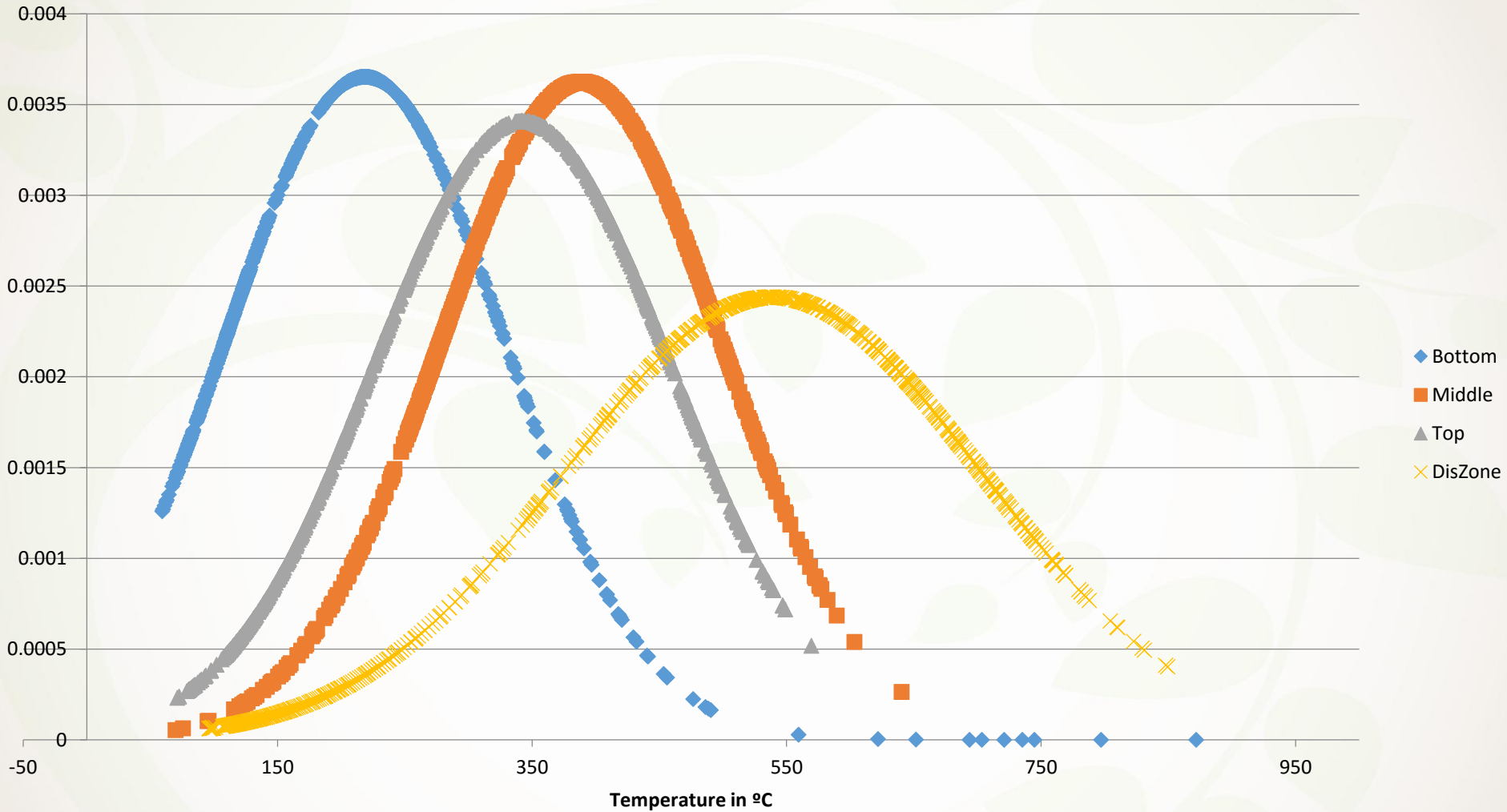




Machine premodification		
Average	94.98	LBS/hr -- no volume listed
Best	121.28	LBS/hr -- no volume listed
Worst	66.15	LBS/hr -- no volume listed



# Reactor Temperature Distribution



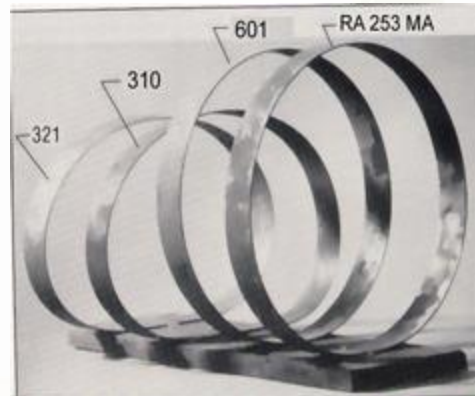
# Automation through feedstock loading control



# High temp materials reporting

Property	Units	3M™ Nextel™ 312	Nextel 440
Use Temperature*	°F °C	2200 1204	2500 1371
Filament			

- Oxidation resistance to 2000° F (1093° C)
- Good resistance to sulfidation
- Superior strength at elevated temperatures
- Good resistance to high temperature abrasion





# Beta scale photo



LBS/hr assumes each barrel is 62 lbs dry weight	average	2.07	bbl/hr	129.11	lbs/hr
LBS/hr assumes each barrel is 62 lbs dry weight	highest	3.27	bbl/hr	204.55	lbs/hr
LBS/hr assumes each barrel is 62 lbs dry weight	Lowest	1.39	bbl/hr	86.96	lbs/hr

# Beta Double Unit Initial Data

Biochar Doule Unit Production table										
Date	Start Time	End Time	down time	Total time	BBL Produced	BBL/hr	Feedstock Comments	other Comments		
12/16/2015	9am	2:30pm	0	5.5	18	3.27	3 inch minus dry			
12/17/2015	7:30am	2:30pm	2.25	4.75	10	2.11	20 MC mill chip			
12/18/2015	820am	2:45pm	1	5.5	15	2.73	20% MC mill chip			
12/21/2015	745am	243pm	0	7	13	1.86	Mill chip not dried			
12/22/2015	810am	310pm	0	7	17	2.43	Mill chip air dry			
12/23/2015	726am	318pm	0	7.5	16	2.13	1/2 mill chip and 1/2 ground pallets			
12/29/2015	800am	315pm	0	7.25	9	1.24	ground pallets, lots of dust			
12/30/2015	810am	316pm	0.75	6.25	13	2.08	used ground pallets not screened			
12/31/2015	745am	321pm	0	7.5	16	2.13	ground pallets screened			
1/5/2016	700am	315pm	0.75	7.5	12	1.60	used pallet - screened fine			
1/4/2016	800am	230pm	1.75	5.75	8	1.39				
1/6/2016	730am	300pm	2	5.5	10	1.82				
	LBS/hr assumes each barrel is 62 lbs dry weight						2.07	bbl/hr	129.11	lbs/hr
	LBS/hr assumes each barrel is 62 lbs dry weight						3.27	bbl/hr	204.55	lbs/hr
	LBS/hr assumes each barrel is 62 lbs dry weight						1.39	bbl/hr	86.96	lbs/hr

# Double Unit Current Photo 6-2016



# Cost of production old and new based on scale- the pricing is listed an example only – cost and production have multiple dependent (co-dependent) variables

Costs	# of Units	Cost per Unit	Total	Comments
Labor	1	\$ 20.00	\$ 20.00	\$/hr labor
Feedstock	0.3	\$ 25.00	\$ 7.50	ton/hr feedstock
Electric	20	\$ 0.20	\$ 4.00	\$/hr electric
Pallets	0.25	\$ 6.00	\$ 1.50	\$/hr pallets
Packing	0.5	\$ 10.00	\$ 5.00	\$/hr bulk bagging-bags
Simple Amortization	7 yrs- double shifted	\$ 250,000.00	\$ 8.93	\$/hr amortization
Hourly Costing Single Unit			\$ 46.93	
Single unit productivity rate			75	lbs/hr
\$/lbs cost			\$ 0.63	Cost
List Price Wholesale			\$ 0.89	
\$/yd average			\$ 201.12	
Labor	1	\$ 20.00	\$ 20.00	\$/hr labor
Feedstock	0.6	\$ 25.00	\$ 15.00	ton/hr feedstock
Electric	25	\$ 0.20	\$ 5.00	\$/hr electric
Pallets	0.4375	\$ 6.00	\$ 2.63	\$/hr pallets
Packing	0.75	\$ 10.00	\$ 7.50	\$/hr bulk bagging-bags
Simple Amortization	7 yrs- double shifted	\$ 350,000.00	\$ 12.50	\$/hr amortization
Hourly Costing Single Unit			\$ 62.63	
double unit productivity rate			150	lbs/hr
\$/lbs cost			\$ 0.42	Cost
List Price Wholesale			\$ 0.60	
\$/yd average			\$ 134.20	



# Conclusion and contacts

Thank you

Jonah Levine

[Jonah.bec@gmail.com](mailto:Jonah.bec@gmail.com)

[www.biocharsolutions.com](http://www.biocharsolutions.com)

303.621.5491