Panel 4: Updates in Biochar and Activated Carbon

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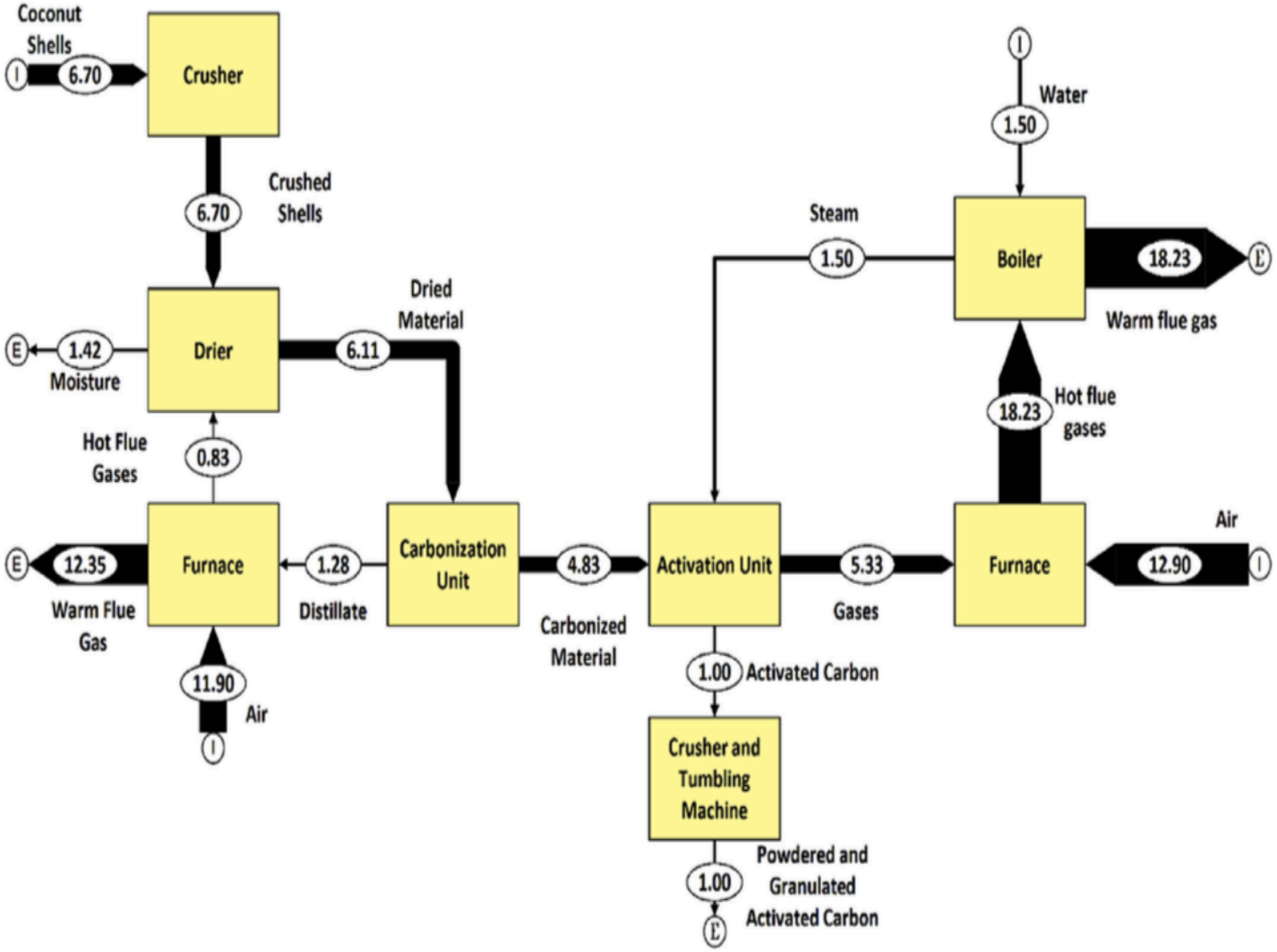
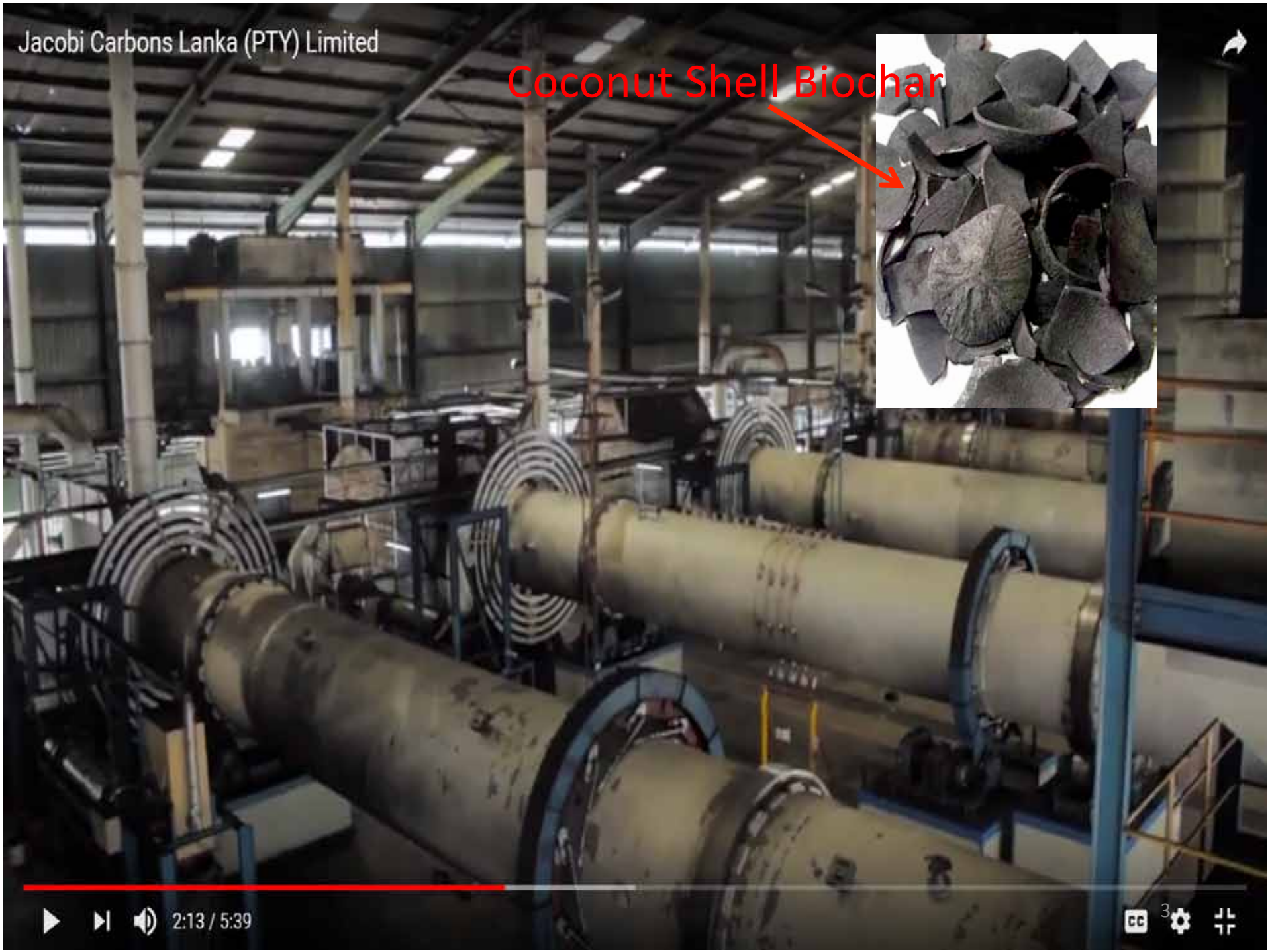
Physical (Steam) Activation Of Biochar



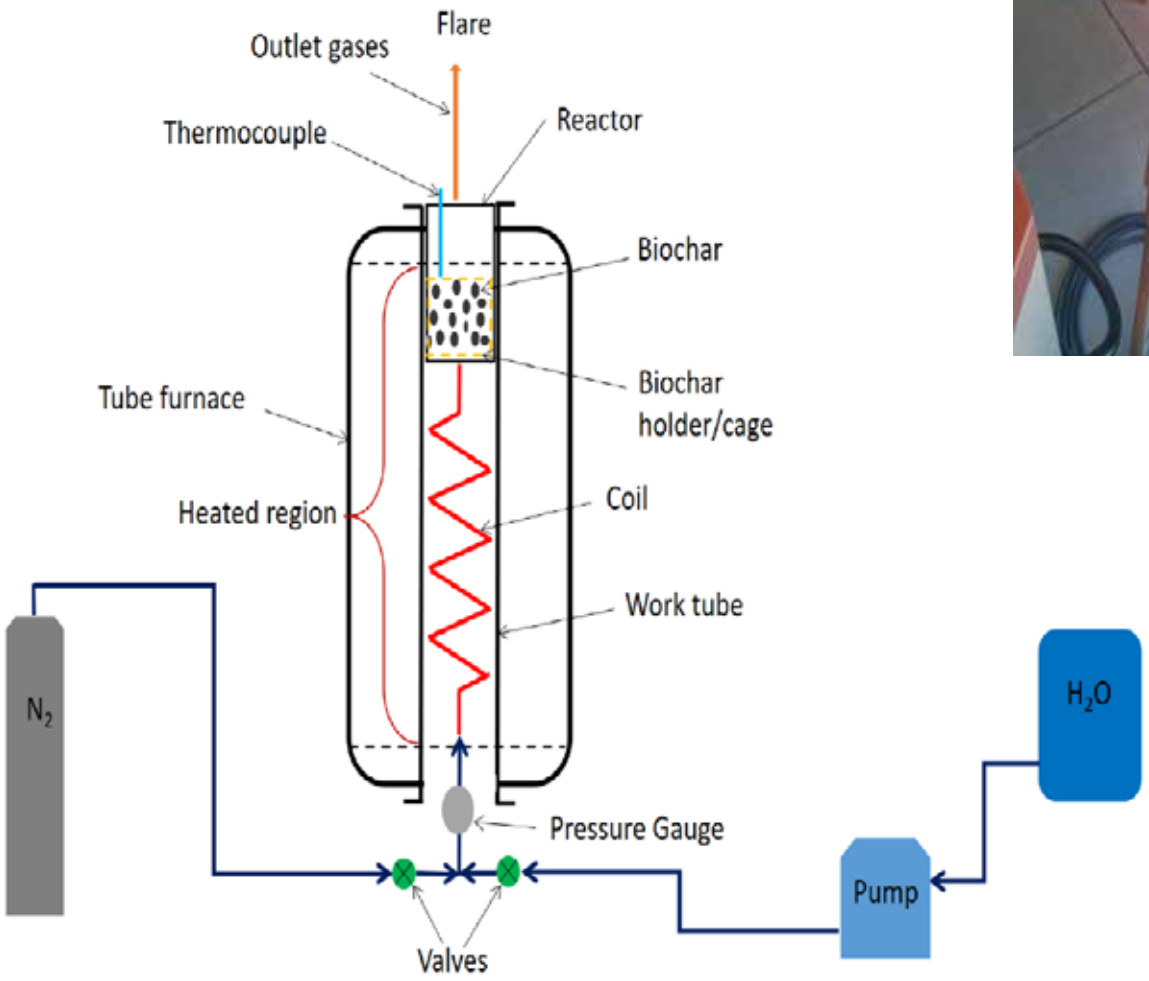

Jacobi Carbons Lanka (PTY) Limited
Coconut Shell Biochar
2:13 / 5:39

Scalable Production Of Activated Carbon

- Feedstock: biochar from Phoenix Energy
- No use of Nitrogen to heat up biochar
- No use of chemicals to pre/post wash biochar or activated carbon
- Approximates industrial process

http://www.phoenixenergy.net/powerplan

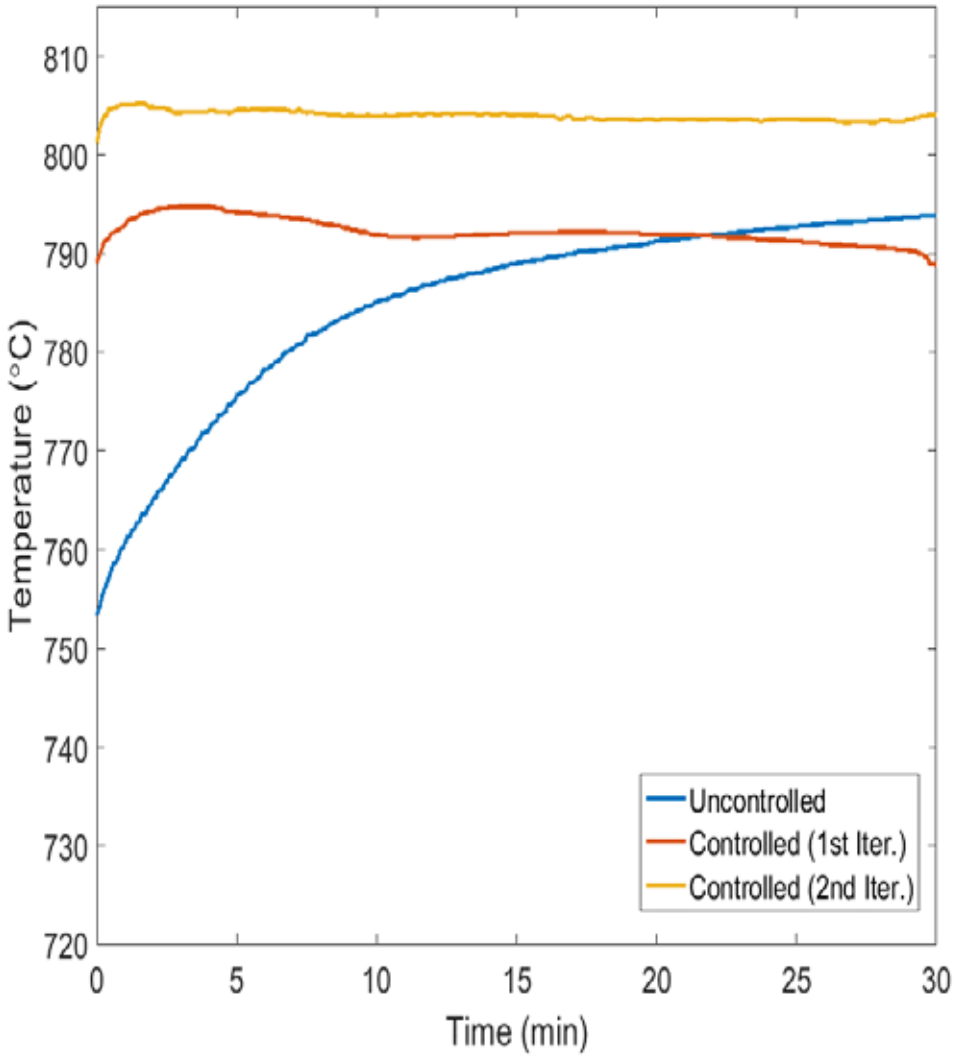
Experimental Setup



Physical (Steam) Activation Parameters

- Temperature
  - Explore range 750 – 900 °C, Most commonly 800 °C
- Time
  - 30 – 75 mins
  - Target mass losses ~50 %
- Water/steam flow rate
  - ~ 1 ml/min – 8 ml/min (laboratory scale)
- Particle size
  - Sub-mm to mm range: 0.6 – 2.36 mm (sieves #8 -#30), based on sizes used by some online vendors such as EniroSupply & Service, Inc., and IndoGerman Carbons Ltd.
- Activation of batches of 20 grams

Iterative learning control for reactor temp.



Characterization Of Activated Carbons

- Surface area
- Porosity Analysis
- SEM Images
- pH
- Fourier Transform Infra Red (FTIR) spectroscopy
- X-ray spectroscopy
- Ultimate/proximate analysis

Ultimate and Proximate Analyses

Peach Pits

Biochar

Results as Received

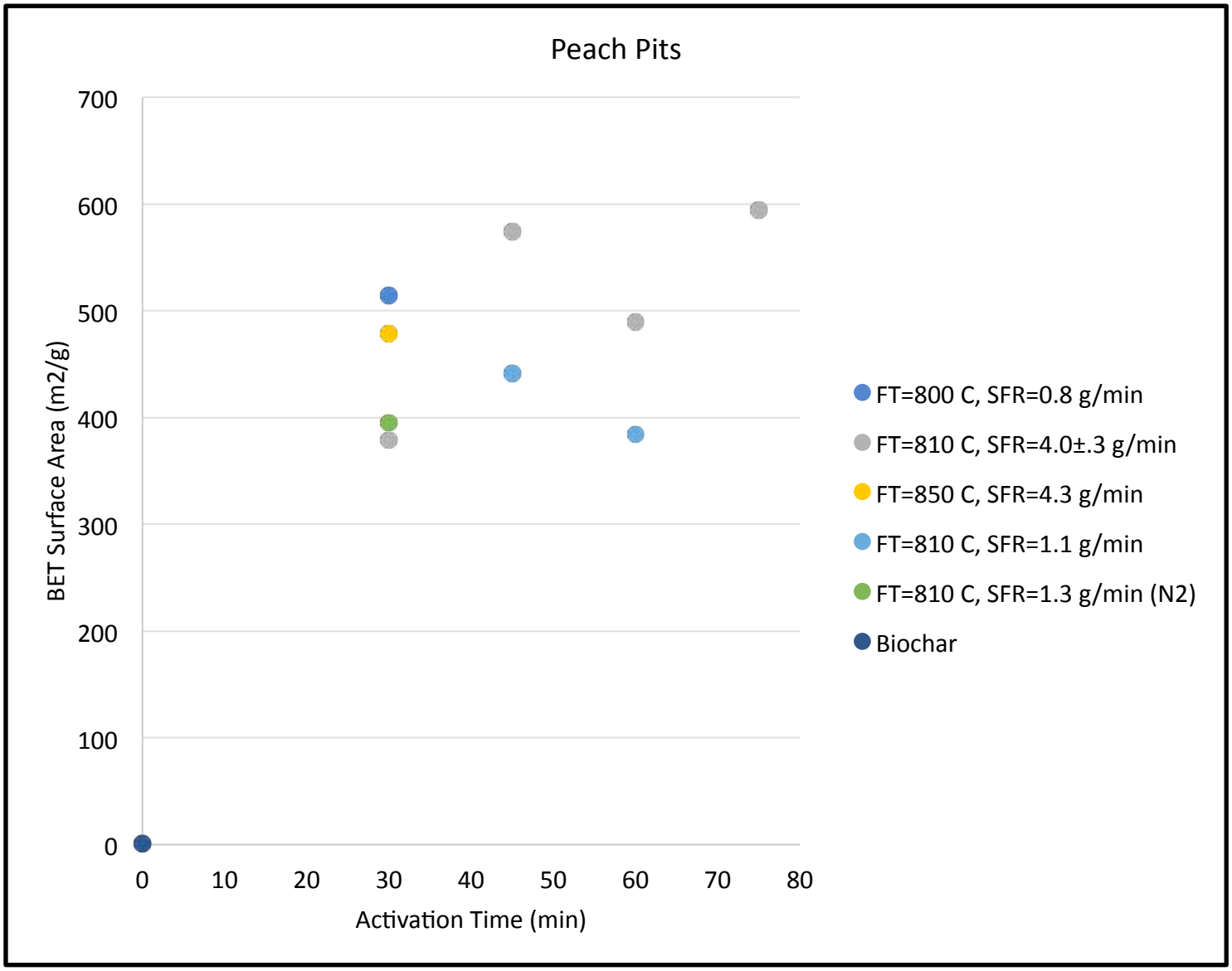
Chlorine	0.100	%
Moisture	1.59	wt %
Ash	20.90	wt %
Volatile Matter	23.41	wt %
Fixed Carbon	54.11	wt %
Carbon	64.58	wt %
Hydrogen	2.47	wt %
Nitrogen	0.57	wt %
Oxygen by Difference	11.36	wt %
Sulfur	0.02	wt %

AC: 0.8g/min_800C_30min

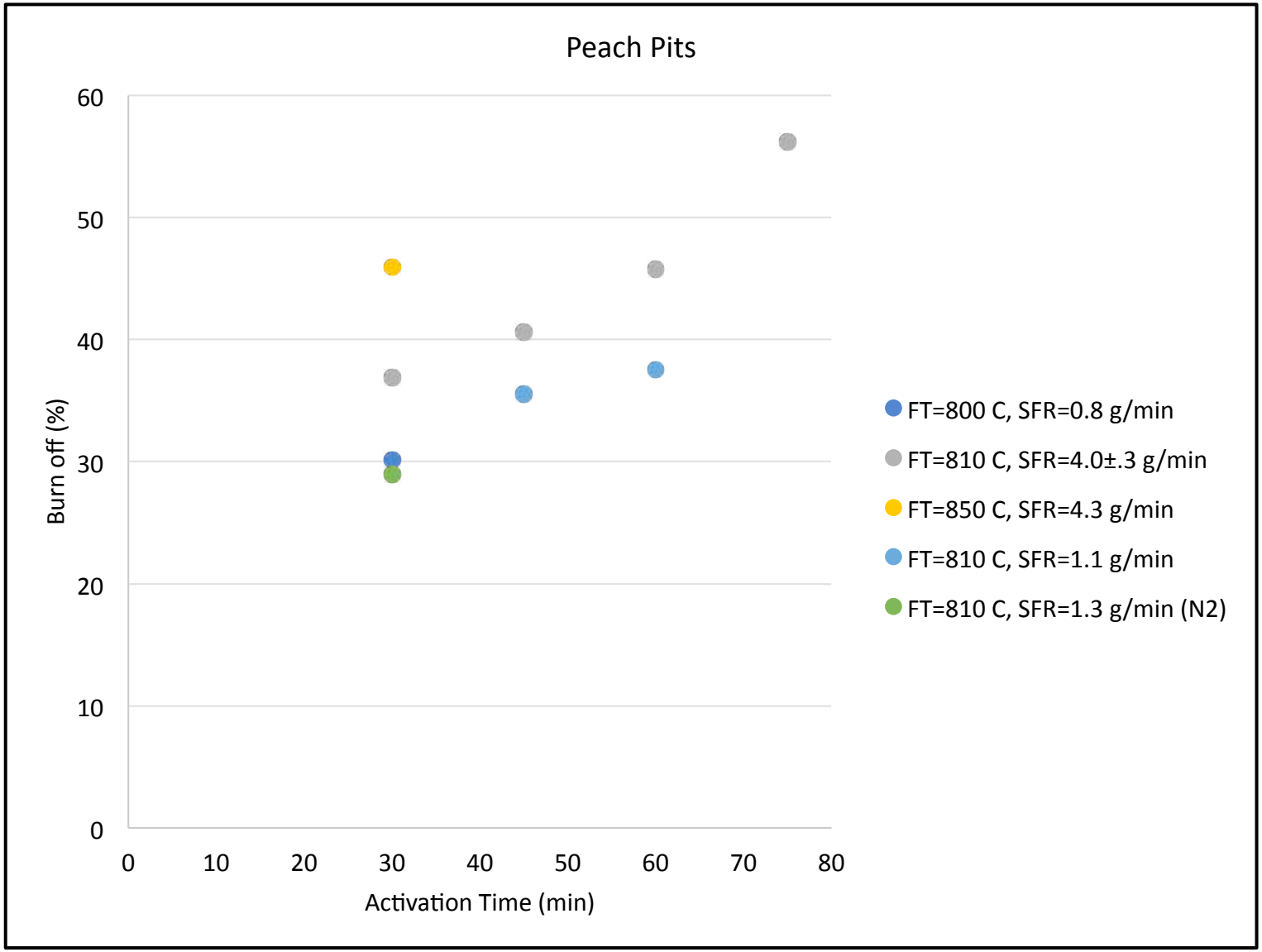
Results as Received

Chlorine	0.0500	%
Moisture	1.01	wt %
Ash	34.65	wt %
Volatile Matter	4.99	wt %
Fixed Carbon	59.35	wt %
Carbon	62.53	wt %
Hydrogen	<0.50	wt %
Nitrogen	0.32	wt %
Oxygen by Difference	2.35	wt %
Sulfur	0.02	wt %

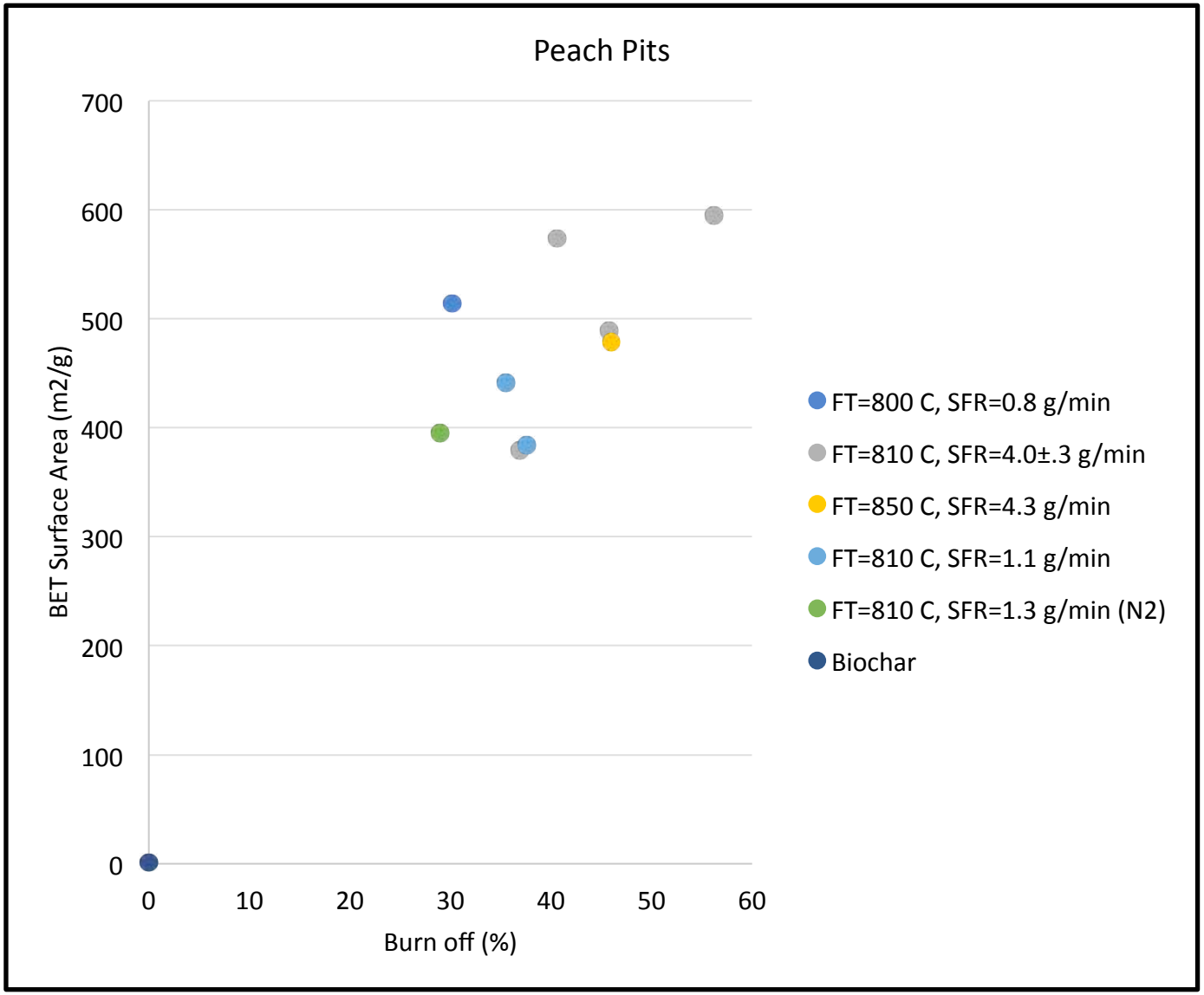
BET Surface Area vs Time



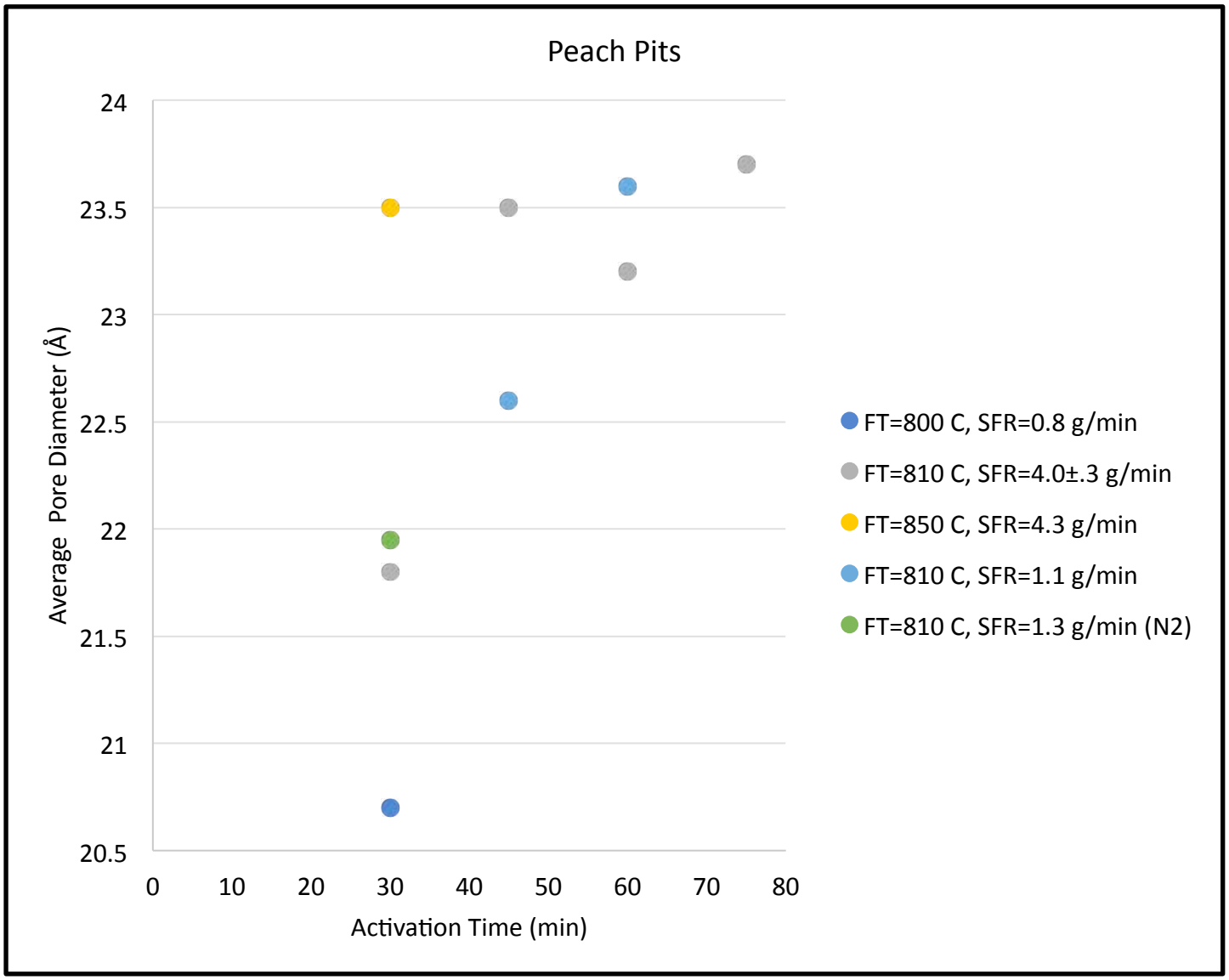
Burn off (%) vs Time



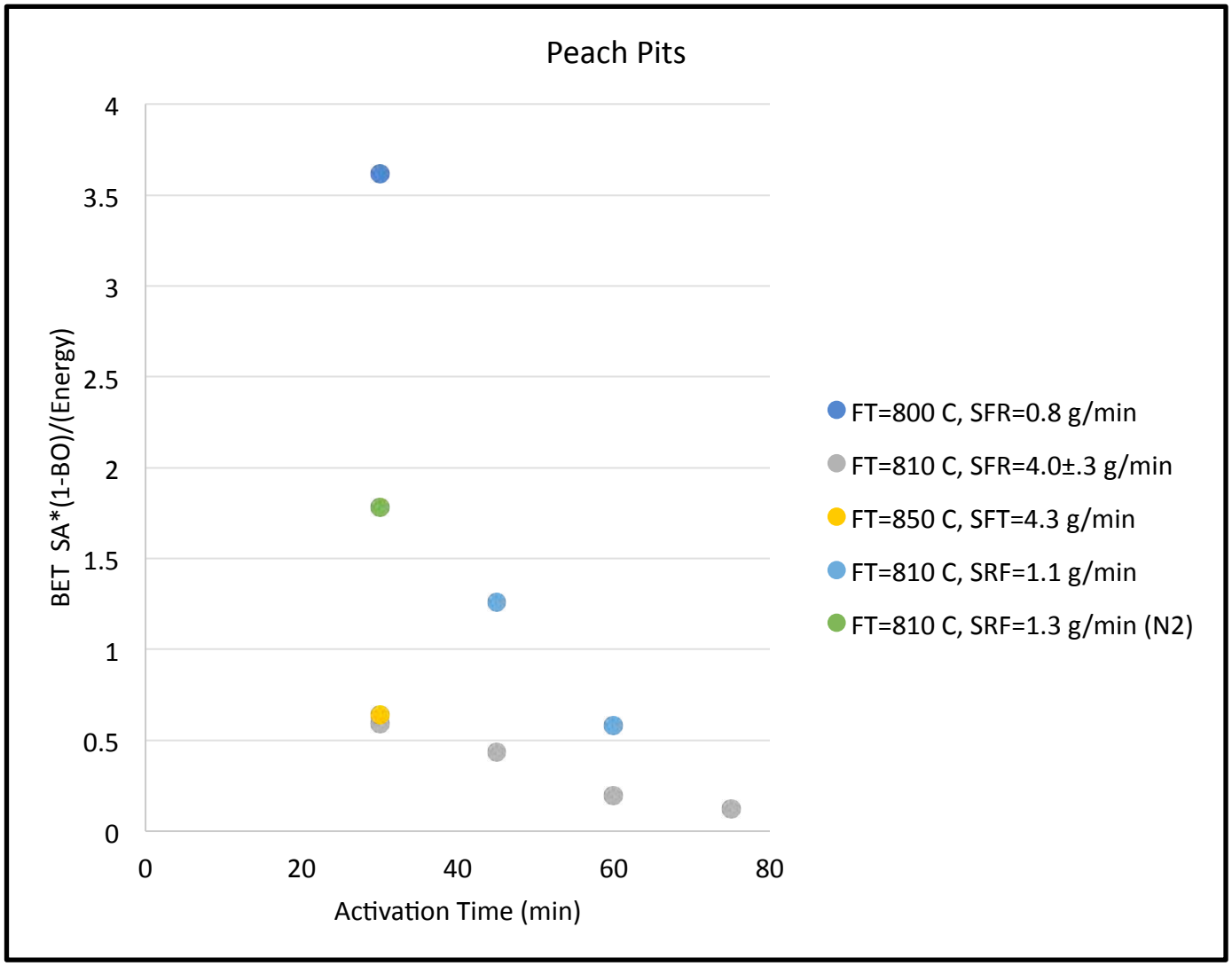
BET Surface area vs Burn off (%)



Average Pore Diameter vs Time



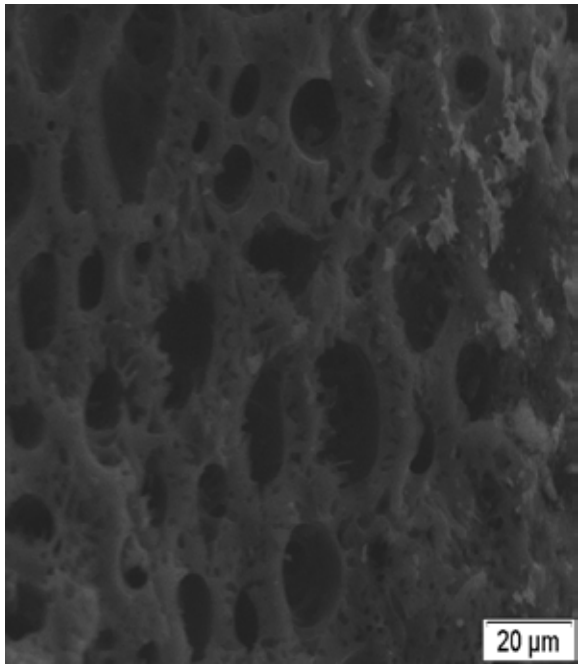
BET (1-BO) / Energy vs Time



SA: Surface Area, BO: Burn off

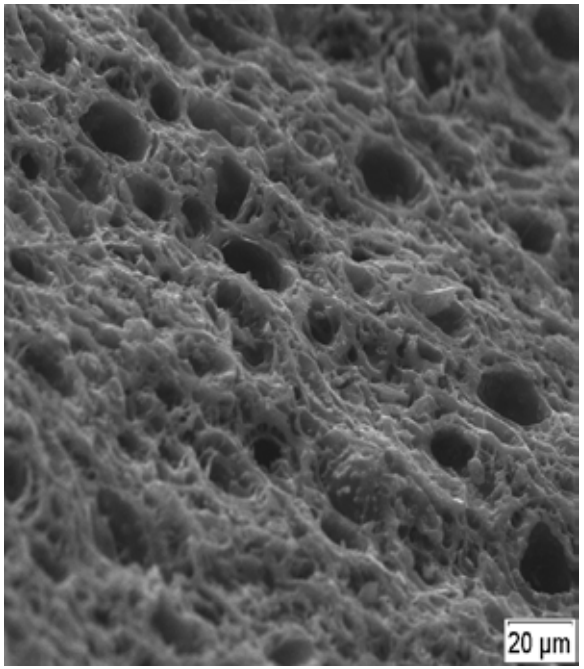
Peach Pits Activated Carbon

Biochar



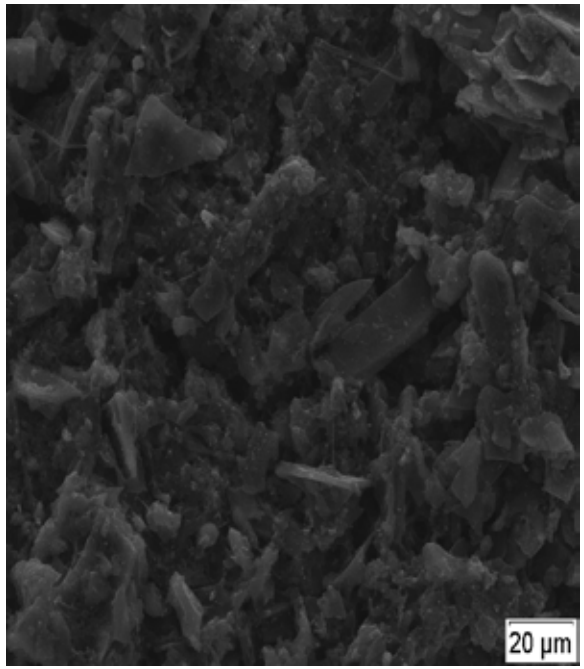
- A_{BET} <1 m^2/g
- Mean pore size: 52 Å
- Total pore volume: 0.001 cm^3/g

0.8g/min_800 C_30min



- A_{BET} 514.1 m^2/g
- Mean pore size: 20.7 Å
- Total pore volume: 0.27 cm^3/g
- Burn off= 30.2%

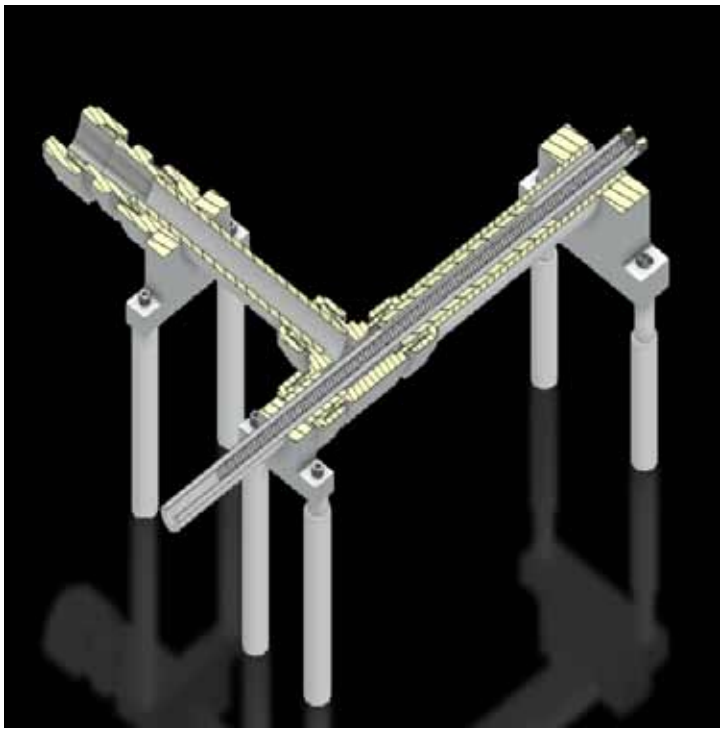
4.2g/min_810 C_75min



- A_{BET} 594.4 m^2/g
- Mean pore size: 23.7 Å
- Total pore vol.: 0.35 cm^3/g
- Burn off= 56.3%

Plasma-Enhanced Biochar Activation

- Lower steam temperature than conventional physical activation
- Use plasma to modify adsorption properties of the biochar
- Reactor with temperature control



- Plasma parameters: Voltage, Power, frequency

Ponderosa Pine

Results coming soon!

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