Fly Ash Bricks

with Brandon Wilson from **EviroPower Renewable**

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Background Information

- Fly ash: by-product of coal combustion
- Used to make various bricks
- Causes damage to lungs if inhaled
- Currently disposed of in wet landfills
  - Causes pollution of water through leaching

Initial Testing/Constraints

Chemically Set Bricks:

- Mixture 1
  - 47% Type C Fly Ash
  - 10% Lime
  - 43% Sand
- Mixture 2:
  - 32% Type F Fly Ash
  - 25% Lime
  - 43% Sand

- Intended to be a control
  - Failed due to autoclave firing time being insufficient

Initial Testing/Constraints

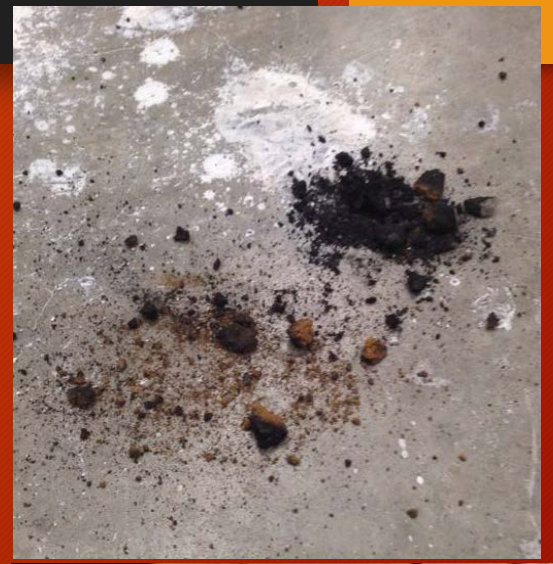
Clay Fired Bricks:

- Mixture 1
  - 60% Type C Fly Ash
  - 40% Sand
- Mixture 2:
  - 60% Type F Fly Ash
  - 40% Sand

- Quick heating evaporates water too quickly, diminishes integrity
- Need even heating for consistency in structural properties
- Need to develop a proper heating procedure
  - Balance of microwave power level and heating time

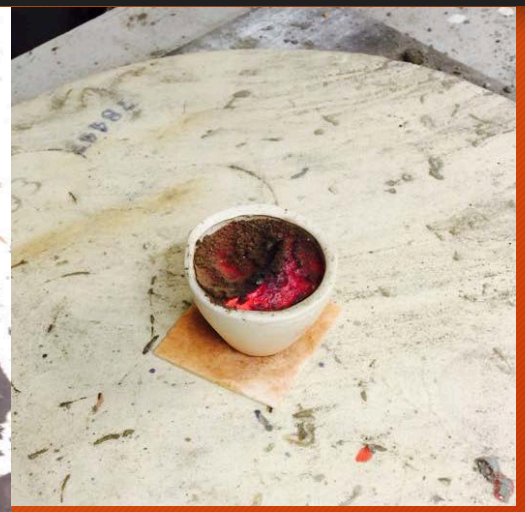
Results

	Type C Fly Ash	Type F Fly Ash
Clay Fired 100% Fly Ash	Successful (17)	Overmelted (20)
Clay Fired 60% Fly Ash 40% Sand	Crumbled (15) Melted outside and unfused inside	Crumbled (15) Not enough fusing
Autoclave	Chemical setting did not occur Cracked inside	Chemical setting did not occur Remained intact



100% Type F

Results - 60/40 Pictures



Type C

Type F

Chemically set

Autoclave - pressure cooker (high heat and pressure)

Industrial bricks are chemically set in autoclaves

Type F

Type C

Successes

ALTERNATE
Clay Fired
80% Type C Fly Ash

MOST SUCESSFUL
Clay Fired
100% Type C Fly Ash

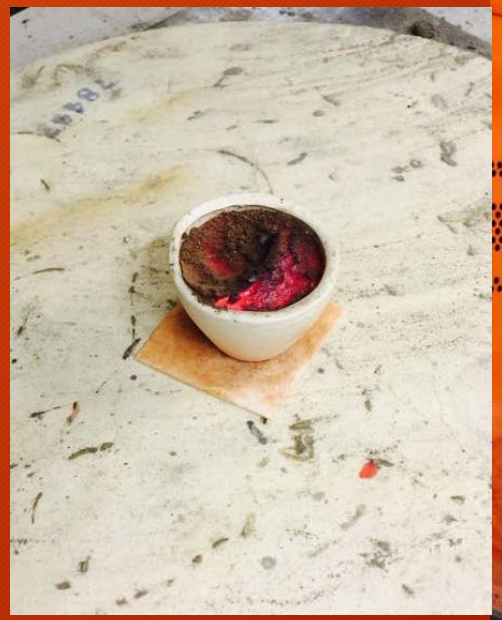
Finalized Procedure

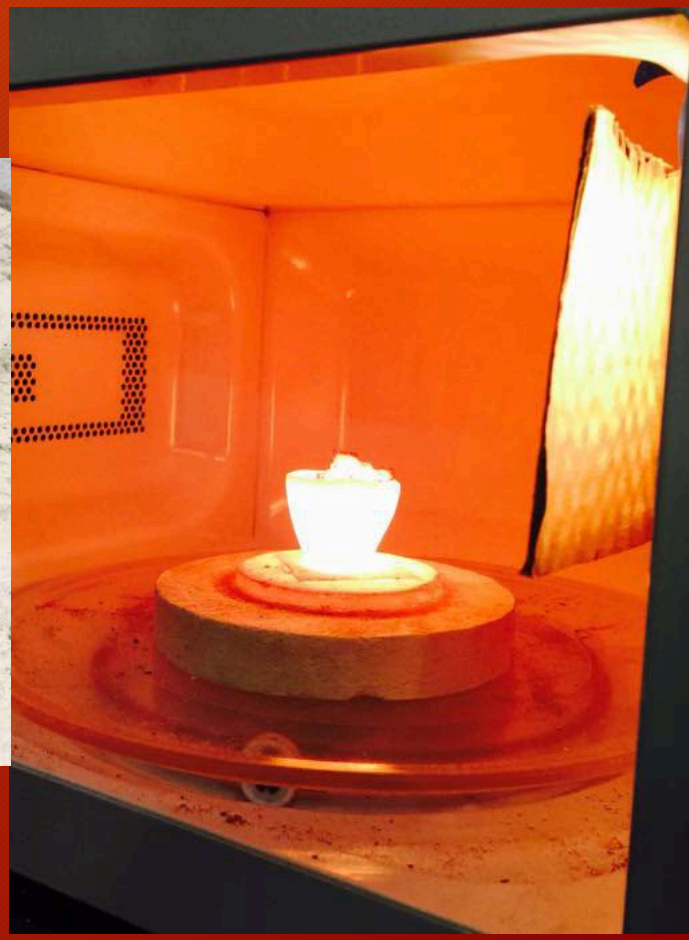
1. Make mixture
2. Heat the fly ash to reduce carbon content
3. Fill into crucibles
4. Put crucible into the microwave kiln
5. Microwave for 3 cycles - 5 min, 5 min, 7 min
6. Wait 2-3 minutes for cooling
7. Turn crucible over and tap

Fusion vs. Sintering

Heating time allows melting and fusion to occur

17 minutes





Microwave Kiln

Economics - Financial Analysis

- Merits of this are:
  - Making a usable building material
  - Trapping a pollutant in a secure form
- Healthy profit margin of 55%
- Alternate business options:
  - Sell the brick for a lower price and maintain profits
  - Invest in a higher throughput microwave
  - Conduct R&D and develop a mixture that is stronger

Assumptions	
Monthly Production (tons):	16.0
Hourly Production:	200
One Time Cost	
Industrial Microwave	$ 20,000
Unit Costs	
Equipment Loan (8% Annual)	$ 0.006
Labor	$ 0.150
Energy	$ 0.030
Unit Revenues	
Materials	$ 0.010
Bricks	$ 0.400
Unit Profits	
Profit	$ 0.224
Profit Margin	55%