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

<table>
<thead>
<tr>
<th></th>
<th>Type C Fly Ash</th>
<th>Type F Fly Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay Fired 100% Fly Ash</td>
<td>Successful (17)</td>
<td>Overmelted (20)</td>
</tr>
<tr>
<td>Clay Fired 60% Fly Ash 40% Sand</td>
<td>Crumbled (15)  Melted outside and unfused inside</td>
<td>Crumbled (15) Not enough fusing</td>
</tr>
<tr>
<td>Autoclave</td>
<td>Chemical setting did not occur</td>
<td>Chemical setting did not occur</td>
</tr>
<tr>
<td></td>
<td>Cracked inside</td>
<td>Remained intact</td>
</tr>
</tbody>
</table>
Results - 60/40 Pictures

Type C

Type F
Chemically set

Autoclave - pressure cooker (high heat and pressure)
Industrial bricks are chemically set in autoclaves
Successes

Most Successful
Clay Fired
100% Type C Fly Ash

Alternate
Clay Fired
80% 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

Store No : 100418

Specification:
Outer Size 120*90mm
Inner Size 70*45mm
Hole Meter 12mm
Net Weight 0.44kgs
Economics - Financial Analysis

- **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%

- **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