Overview on brick kiln: pollution, technology and where we need to go?

Centre for Science and Environment

March 11, 2015
‘Under-construction’ agenda

- Massive “Under-Construction” agenda for countries of the south.

- 70 percent of India is yet to be built.

- Homes, offices and factories require large quantities of building material.

- Cheapest building material so far has been – BRICKS!

- Standard practice
  - Dig clay/mud from the field
  - Mould them into bricks
  - Fire them in inefficient furnaces using different fuel source

- Kilns operate from China to Peru, burning anything cheap.
Global brick production: 1.5 trillion bricks/annum

<table>
<thead>
<tr>
<th>Country</th>
<th>Production %</th>
<th>No. Billion P.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>66.67%</td>
<td>1,000</td>
</tr>
<tr>
<td>India</td>
<td>13.33%</td>
<td>200</td>
</tr>
<tr>
<td>Pakistan</td>
<td>3.00%</td>
<td>45</td>
</tr>
<tr>
<td>Vietnam</td>
<td>1.67%</td>
<td>25</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1.13%</td>
<td>17</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.40%</td>
<td>6</td>
</tr>
<tr>
<td>Rest of Asia</td>
<td>0.47%</td>
<td>7</td>
</tr>
<tr>
<td>Total Asia</td>
<td>86.67%</td>
<td>1,300</td>
</tr>
<tr>
<td>USA</td>
<td>0.53%</td>
<td>8</td>
</tr>
<tr>
<td>UK</td>
<td>0.37%</td>
<td>4</td>
</tr>
<tr>
<td>Australia</td>
<td>0.13%</td>
<td>2</td>
</tr>
<tr>
<td>Rest of World</td>
<td>12.40%</td>
<td>186</td>
</tr>
<tr>
<td>Total Rest of World</td>
<td>13.33%</td>
<td>200</td>
</tr>
<tr>
<td>Total World Production</td>
<td>100.00%</td>
<td>1,500</td>
</tr>
</tbody>
</table>
Resource intensive sector

• **Major fuel**: Coal, firewood, heavy oil
• Coal Consumption by Asian Brick Kilns - 110 million tonnes/year
• Highest consumer – China (50 million tonnes/year)
• Kilns have huge variation in efficiency
• Coal consumption varies between 11-70 tonnes coal per 100,000 bricks.
• Clay consumption:
  - China: 1 billion m³
  - India: 350 million tonnes
  - Bangladesh: 45 million tonnes
Brick sector in India

- **Second largest producer – India** (200 billion bricks/year).
- 65% of these made by burning fertile alluvial Indo-Gangetic plains.

<table>
<thead>
<tr>
<th>Furnace</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCBTK</td>
<td>6500 (N), 17000 (E), 400 (C) 7500 (W) and 1000 (S)</td>
</tr>
<tr>
<td>Zigzag</td>
<td>15 (E)</td>
</tr>
<tr>
<td>High Draft</td>
<td>50 (N), 2000 (E)</td>
</tr>
<tr>
<td>Hoffman</td>
<td>500 (S)</td>
</tr>
</tbody>
</table>

- Huge environmental cost associated with this BM:
  - Black carbon emissions
  - Local air pollution
  - Loss of fertile top soil
- Black carbon emissions: as high as 9% of the India’s annual black carbon emission total.
Brick sector in India: Labor issues

- Employs 10 million laborers: unacceptable working conditions
  - Migratory workers
  - Seasonal employment
  - Wages on the basis of number of bricks produced
  - Occupational hazards – no PPE
  - Child labor
  - Non-implementation of Factories Act provision
Technology: Varied & Outdated!

Firing Technologies

- Traditional Intermittent
  - Up-Draught
  - Down-Draught
  - LCBK/ Clamp Scotch
  - Scove Kiln
  - Bull’s Trench Kiln

- Newer Continuous
  - Moving Fire
  - Zig-Zag Kiln
  - Vertical Shaft Brick Kiln (VSBK)
  - Tunnel Kiln

- Moving Ware
## Technology vs workforce

<table>
<thead>
<tr>
<th>Country</th>
<th>Type of Kiln</th>
<th>No. of Kiln</th>
<th>No. of Bricks Produced (in billion/year)</th>
<th>No. of People employed</th>
<th>No. of Bricks produced per employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>Hoffman Kiln &amp; Tunnel Kiln</td>
<td>80,000</td>
<td>1,000</td>
<td>5 million</td>
<td>200,000</td>
</tr>
<tr>
<td>India</td>
<td>FCBTKs, Clamp</td>
<td>&gt;100,000</td>
<td>200</td>
<td>10 million</td>
<td>20,000</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Clamps &amp; MCBTKs</td>
<td>12,000</td>
<td>45</td>
<td>9 million</td>
<td>5,000</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Tunnel &amp; VSBKs</td>
<td>10,000</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td>FCBTKs, zigzag</td>
<td>8,000</td>
<td>17</td>
<td>1 million</td>
<td>17,000</td>
</tr>
<tr>
<td>Nepal</td>
<td>Clamps &amp; BTKs</td>
<td>700</td>
<td>6</td>
<td>140,000</td>
<td>42,857</td>
</tr>
</tbody>
</table>
Technology: Varied & Outdated!

• Clamp technology is equally polluting but without the initial setting up cost (due to no fixed structure).

• That also makes regulation enforcement difficult for these moveable kiln.

• Zigzag kilns are better than FCBTK.

• Air travels in a zigzag path resulting in the reduction of pollutants and black carbon, and is more energy efficient.

• PM emissions: FCBTK – 250 to 1250 mg/Nm³
  Zigzag - Less than 250 mg/Nm³
Energy efficient technology

• Vertical Shaft Brick Kiln is even a better technology.

• Tunnel Kiln is much more expensive to set up but requires less man power compared to FCBTK & Zigzag.

• Best technology available so far for large scale production for brick production in industrialized country.

• The advantages of using Tunnel Kiln are:
  - It can fire a wide variety of products.
  - Good control over the firing process.
  - Ease of mechanization, thus reducing the labor requirement.
  - Has large production volume.
Technology comparison

![Bar Graph](chart.png)

**Black Carbon (g/kg fired brick)**

- **Conventional**
  - Downdraught
  - FCBTK

- **Alternate**
  - VSEK
  - Zigzag HD
  - Zigzag ND
  - Tunnel

**Values:**
- 0
- 0.05
- 0.1
- 0.15
- 0.2
- 0.25
- 0.3
- 0.35
Anil Agarwal Dialogue Issues

• How should the local environment and livelihood costs of brick kilns inform national-global policy?

• What are the best practices in regulations and enforcement for brick kilns in different countries? What is working and what can be done?

• What is the technology roadmap for efficient and clean brick kiln manufacturing in the world? What can countries learn from experiences on the ground?

• Is improvement in technology enough or should the world move towards alternative materials for building?

• How will alternative material be affordable and sustainable?