Case Study: Clamp down the Clamp Kilns
HISTORY REVIEW

- Brick making is an ancient industry
- No change in brick making process over centuries
- Many technologies have been developed and introduced in recent years
- Clamps, the oldest & traditional technology has never been talked about
- Most polluting and energy intensive.
CLAMPS: INTRODUCTION

- Constitutes 70% of the total brick kilns in India
- Consists of pile of green bricks interspersed with combustible material
- Two or more fuel beds are used
- Takes 8-12 days for completion of firing
- Innermost bricks are the hardest, the outer bricks are usually under-burnt

Profile of brick kilns in India

- 70% Clamp (~90000)
- 26% VSBK (~150)
- 2% DDK, HDK and Zig-Zag (~2000)
- 2% MCBTK (~3000)
- 2% FCBTK (~13000)
- 0% VSBK (~150)
BRICK PREPARATION

Clay Preparation

Moulding

Sorting

Drying
BRICK SETTING

1. A clamp does not have a permanent kiln structure. It consists essentially of an organised pile of green bricks interspersed with combustible material.

2. The base (2.1) of the clamp is first laid with fired bricks. Generally, in case of coal fired bricks, a thin layer of fuel (2.2) is spread over the base on which the green bricks are stacked (2.3). In case of firewood fired clamps, tunnels are made through the base of the pile to feed firewood. In a rice husk fired clamp, bricks are stacked in parallel columns and the fuel is fed from the top and burned in the gaps between the brick columns. (2.4)

3. In bigger coal fired clamps, to attain the required firing temperature throughout the brick stacking, fuel is also added in the spacing/holes provided in the brick stacking.

4. For stability of the clamp structure, usually the upper part of the clamp has a trapezoidal shape.

5. The clamps are ignited at the bottom. Air required for combustion, enters through the openings provided in the base of clamp (5.1). During burning, the hot air rises up through the bricks and heats the bricks. Smoke and fumes leave from the top of the clamp (5.2). In a clamp, the operator has very little control over the burning rate. The burning rate is affected by the weather particularly by the direction and speed of the wind.

6. Because of heat loss to the surroundings, bricks located on the surface are usually under-fired (6.1). Also bricks located near to the fuel layer are usually over-burnt (6.2).

7. In case of coal fired clamps, the firing process takes around 4-5 days and then the clamp is left for cooling for 8-10 days before the bricks are taken out.

8. To reduce the heat loss from the surface of the clamps, sometimes the outer walls are plastered with mud or the base and the outer walls are permanently built with bricks. In some cases, green bricks are also stacked along the outer walls to utilise the heat from the kiln for drying of bricks.
CLAMPS: WHY AND WHY NOT

Why people prefer

• Cheap and easy to build

• No permanent structure to install

• Mostly built next to supply of clay and fuel

• Production capacity can be varied depending upon the requirement

• Variety of fuel can be used for firing, e.g. Coal, rice husk, saw dust, coconut husk etc

• Mostly remain unnoticed and do not figure in official records of regulatory agencies.

What people ignore

• Large amount of heat loss from walls

• Inefficient consumption and incomplete combustion of fuel

• High emissions of particulates and GHG’s

• High percentage (approx 50%) of under-burnt and over burnt bricks

• High specific energy consumption (sec)
## COMPARISON BETWEEN CLAMP AND OTHER TECHNOLOGY

<table>
<thead>
<tr>
<th>Type of Kiln</th>
<th>SEC (mJ/kg of fired brick)</th>
<th>% of good quality bricks</th>
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</thead>
<tbody>
<tr>
<td>Clamp</td>
<td>2.10</td>
<td>50</td>
</tr>
<tr>
<td>FCBTK</td>
<td>1.30</td>
<td>60</td>
</tr>
<tr>
<td>HHK</td>
<td>1.20</td>
<td>90</td>
</tr>
<tr>
<td>Zigzag (natural)</td>
<td>1.06</td>
<td>85</td>
</tr>
<tr>
<td>Zigzag (induced)</td>
<td>1.03</td>
<td>80</td>
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<tr>
<td>VSBK</td>
<td>0.8</td>
<td>90</td>
</tr>
<tr>
<td>Tunnel</td>
<td>1.4</td>
<td>95</td>
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### EMISSIONS DATA FROM CLAMPS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPM (µg/m³)</td>
<td>MP</td>
</tr>
<tr>
<td>RSPM (µg/m³)</td>
<td>84-225</td>
</tr>
<tr>
<td>SO₂ (µg/m³)</td>
<td>5-10</td>
</tr>
<tr>
<td>NO₂ (µg/m³)</td>
<td>21-25</td>
</tr>
<tr>
<td>CO (ppm)</td>
<td>ND</td>
</tr>
</tbody>
</table>

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<tr>
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<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPM (µg/m³)</td>
<td>MP</td>
</tr>
<tr>
<td></td>
<td>352-799</td>
</tr>
<tr>
<td>RSPM (µg/m³)</td>
<td>75-418</td>
</tr>
<tr>
<td>SO₂ (µg/m³)</td>
<td>6-9</td>
</tr>
<tr>
<td>NO₂ (µg/m³)</td>
<td>19-25</td>
</tr>
<tr>
<td>CO (ppm)</td>
<td>ND</td>
</tr>
</tbody>
</table>

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<tr>
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<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPM (µg/m³)</td>
<td>MP</td>
</tr>
<tr>
<td>RSPM (µg/m³)</td>
<td>68-126</td>
</tr>
<tr>
<td>SO₂ (µg/m³)</td>
<td>5-10</td>
</tr>
<tr>
<td>NO₂ (µg/m³)</td>
<td>15-21</td>
</tr>
<tr>
<td>CO (ppm)</td>
<td>ND</td>
</tr>
</tbody>
</table>

**MP:** Indore  
**AP:** Patancheru  
**TN:** Thittakudi  
**KA:** Malur (Bangalore)  
**GJ:** Rajkot  
**MH:** Raigarh
CLAMPS IN MAHARASHTRA: A CASE STUDY

• Total no of clamps in state: 7,000
• Western Maharashtra region is called the hub of clamps.
• Areas include districts of Pune, Khapoli, Ahmednagar, Solapur, Satara, Sangli, Karad, Pimpalwadi and Kolhapur.
• Consists of small, medium and large scale clamps.
• Good alluvial soil on banks of River Krishna, Warana, Koyana and Panchganga.
• Alluvial soil needs less coal for burning.
• Produces good quality bricks.
• Coal consumption in clamp in Maharashtra is 12-15 Tons/100,000 bricks out of total 16-19 Tons/100,000 bricks consumption in India.
• Petition was transferred at NGT, Pune in 2013 against a clamp brick unit operating amidst residential area.
• After hearing all parties, NGT directed MPCB to formulate and notify emission standards rules for clamp type kilns.
• MPCB has notified new guidelines for establishment of clamp type kilns called as The Maharashtra clamp type traditional Brick kilns (Siting criteria for Establishment) Rules, 2016.
Hit: The Rules may be called as The Maharashtra clamp type traditional Brick Kilns (Siting criteria for Establishment) Rules, 2016.

Miss: The Rules are Siting guideline but do not specify about emission standards.

Hit: Clamps with batch size >50000 bricks have to adhere by the notification for brick kilns issued by MoEFCC on 22nd July, 2009 and the National Ambient Air Quality standards whereas clamps with batch size <50000 bricks needs to comply only with the National Ambient Air Quality Standards.

Miss: The said MoEFCC notification does not mention anything about the clamp type kilns. It is unclear whether the kiln owners have to comply with the BTK, DDK or VSK standards.
Hit: Use of hazardous waste, petcoke, plastic, rubber, leather, explosive chemical, etc is prohibited.

Hit: Local agro waste residue shall be encouraged for use as internal fuel to replace coal in a phased manner.

Miss: Use of internal fuel has not made mandatory. Utilization of waste in brick making has not been mentioned.

Hit: Clamp establishment are not allowed in reserved and protected forest, national parks, world heritage sites, eco sensitive zones and residential areas.

Hit: Min. distance from national highway, state highway and human habitation (population >1000) shall be 200 mts.

Miss: The distance mentioned is very less. Does not talk about de-clustering of clamps and minimum distance to be maintained between two clamps.

Miss: The guideline misses to specify anything about the change in design or inclusion of any air emission control system in clamps.
SURVEY BY CSE

Study area includes:

- Hinjewadi, Pune
- Khopoli
- Islampur
- Ankali- Miraj Road, District Sangli
- Pimpalwadi, Shirdi

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Hinjewadi</th>
<th>Khopoli</th>
<th>Islampur</th>
<th>Ankali- Miraj Road</th>
<th>Pimpalwadi, Shirdi</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of kilns</td>
<td>20-25</td>
<td>10-15</td>
<td>150</td>
<td>200</td>
<td>80</td>
</tr>
<tr>
<td>Avg no of bricks/yr</td>
<td>30,00,000</td>
<td>15,00,000</td>
<td>8,25,00,000</td>
<td>20,00,00,000</td>
<td>16,00,00,000</td>
</tr>
<tr>
<td>Fuel used</td>
<td>Coal/Wood/Furnace Oil</td>
<td>Coal/Rice Husk</td>
<td>Coal/Wood/Baggage</td>
<td>Coal/Wood/Foundry waste</td>
<td>Coal/Wood/Baggase/Fly ash</td>
</tr>
<tr>
<td>Avg fuel consumption /1 lakh bricks</td>
<td>15-18 tons</td>
<td>16-18 tons (10-11 ton coal and rest rice husk)</td>
<td>16-18 tons</td>
<td>12-15 tons</td>
<td>9-10 tons</td>
</tr>
<tr>
<td>Rate of land lease/acre/yr</td>
<td>1,20,000</td>
<td>30,000</td>
<td>50,000</td>
<td>80,000</td>
<td>40,000</td>
</tr>
</tbody>
</table>
OBSERVATIONS

- Use of baggase/rice husk/ coal dust/fly ash as internal fuel practiced
- Clamps operate adjacent to agricultural fields/roads
- Location of some kilns are very near to human settlements
- No clearance obtained from regulatory body
- Entrepreneurs hesitant to shift to newer technology due to:
  - Lack of understanding and clarity of different technologies in brick entrepreneurs
  - Irregular availability of raw material
  - Uncertainty of regulatory norms
  - Leased land for small duration
  - No incentives from government
PROPOSED RECOMMENDATIONS

**General:**
- Multi layer fuel placement while stacking green bricks to reduce SEC
- Use of internal fuel in green brick making
- Mixing of wastes into clay while making green bricks
- Adequate distance between clamps

*For Small Scale Brick Manufacturers (Batch size: 10,000-25,000 bricks):*
- Operate if used for internal purpose only (non-commercial use)
- Temporary plastering of side walls and roofs of the clamps and the platform
For Medium Scale brick manufacturers (Batch size: 25,000-1,00,000 bricks)

- Permanent or removable enclosure on three sides and top of kiln to reduce energy losses and increase efficiency of clamp.
- Channelization of exhaust gases through chimney for dispersion of emissions.
- Adequate stack height depending upon the batch size of the clamp.
- Water sprinkling and paving of internal roads to reduce emission of particulate matter around the kiln area.

For Large scale brick manufacturers (Batch size: >1,00,000)

- Switch to zig-zag technology
- Procurement & storage of raw material in sufficient quantity for systematic functioning of kilns.
THANK YOU
CLASS EXERCISE

What should be the recommendations for small, medium and large scale units?