Low cost portable kiln for rural small-scale potters

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Project Strategy

Field Visit
- Learning about the process
- Finding problem area

Research
- User interview
- Empathetic Analysis
- Desktop Research

Analysis
- Problem Statement
- User Requirements

Prototyping
- Prototype 1
- Prototype 2
- Prototype 3

User testing
- User Feedback
- Reviews from experts
Field Visit
About the community

- Village: Kanalva
- Nearest City: Chhota Udepur
- Occupation: Pottery, Labour Work
- Spoken Language: Gujarati
- Means of Transport: Chagda
- Connected to Electricity; Unreliable.
- Government made toilets.
- Education: Kids go to school.
Production Process

1. Soil Preparation: Mixing of black and red soil in intuitive proportions.
2. Moulding and Drying: Shaping the soil onto moulds and drying under the sunlight.
3. Baking of the pots: Baking the dried pots in a makeshift open air furnace.
4. Lac Preparation: Processing the lac in boiling water and giving it a crayon shape.
5. Lac Application: Applying the lac on freshly baked hot pots with lac crayons.

The entire process takes place in the span of a week.
Problems Identified

Soil Preparation:

- No filtration or grinding of clay
- No standard proportions of red and black soil mixture.
- Unhygienic and damp workspace.
Problems Identified

The Furnace:

- Open air pit, very sensitive to the flow of wind.
- 35 out of 50 pots get damaged after heating
- Uses excessive fuel
- Smoke outlet is randomly distributed in the surroundings.
YOU VS The guy she told you not to worry about
Problems Identified

Lac Preparation:

- Handling the boiling lac with bare hands
- Wastage of water in removing the red dye
- Improper and rough shape of the lac stick
Problems Identified

Lac Application:

- The lac stick sublimates hot vapour as it touches the surface of the pot
- Ash and dirt particles stick in between lac & pot
- The vapour reaches out to nose and mouth.
Selected Problem Area
The inefficiency in furnace

The Fuel

The Insulation

The Smoke exhaust
The Problem Statement

To design a low cost portable kiln for rural small-scale clay potters with a smoke extractor to maximize production output and improve user safety.
Prototype 1
A Closed Underground furnace

- Two chambered closed furnace.
- Combustion chamber connected to exhaust pipe and inlet through a fan.
- A wired mesh to keep the pots on.
- Insulation cap from the top.
Working Principle

Forced respiration through fan
Closed combustion of fuel and heat flow
Smoke exhaustion through pipe
Expectations vs Reality
Conclusions

Pros:

- Majority of the smoke outlet was through the pipe.
- No pots were damaged

Cons:

- Too much manual labour for installation.
- Maximum amount of heat radiated through soil.
- No insulation from top.
- No pathway for ignition of fuel.
- Distance between fuel chamber and pots was too much.
Design Review

Challenges:

- To decrease the manual labour, cost and time.
- To increase smoke extraction efficiency.
- To increase the fuel efficiency.
- To provide better flow of the heat inside the kilm.
Analysis and Research

**Samarika Industries**
A pharmaceutical company that manufactures reactors and humidifiers.

- Material study for our prototype.
- Fabrication help for the prototype.

**Mansukh Bhai**
Award winning Innovator and Founder of Mitticool company.

- Insights in types of insulators, reflectors and kilns.
- Insights in clay making industry.

**Gujarat Matikam Kalakari & Rural Technology Institute**
Government institution for assisting pottery work in Gujarat.

- Information about government policies for providing subsidies in expensive furnaces.
Prototype 2
Kiln with an overhead smoke extraction system
Structure

- 1mm thick tin sheets
- 2mm thickness tin sheets
- Stainless Steel 504
INSTALLATION
ASSEMBLY OF FUEL AND POTS IN THE KILN
ASPIRATION OF AIR THROUGH GAPS PROVIDED
REFLECTION OF HEAT BACK TO COMBUSTION
EXHAUSTION OF SMOKE
COLLECTION OF ASH PARTICLE

Working Stages
Conclusions

Pros:
- Less installation time and effort.
- Less fuel consumption.
- Natural aspiration.
- More than 90% smoke outlet through the chimney.
- 100% product output efficiency.

Cons:
- Rubber adhesive was not heat resistant.
- Some amount of smoke leaked through inlet vents.
- Absence of an ashtray.
Design Review

Need for improvement:

- Installing adjustable windows in the gaps.
- Increasing height of the chimney.
- An alternate way of joining reflectors to the walls of the kiln.
User testing
A “Show, don’t tell” design.

Mr Dule Singh himself loaded and used the kiln without any assistance.
After usage...
Gloves
User Feedback

Mr Dule Singh and Zahudi Ben:

- Very happy by seeing no cracks in their pots.
- Felt safe while using it.
- Reduced their time by half.
- Saved a lot of their fuel.

“They wanted that kiln to be there forever.”
Product Refinement

- Broader dimensions
- Installed windows for restricting outflow of smoke.
- Increased the height of the chimney.
- Asbestos sheets are between tin walls and aluminium composite panels and riveted.
- Did not use any rubber adhesive.
What next?

- Laboratory research on lac and its properties with the help of BSBE Department, IIT Guwahati
- Further development and user testing of the final design with assistance of SRISTI team.
- Pitching the design for mass production under the government subsidy schemes.
Thank You