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A REPORT ON
Instrumentation-II Case Study

Visit Undertaken at
Gorkha Eco Red Bricks Company Pvt. Ltd.
Mahendrajyoti, Nepal

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Libali, Bhaktapur
2023-08-24

Acknowledgment

I would like to express my heartfelt gratitude to the individuals who have contributed to the successful completion of the case study on Instrumentation II, focusing on the Gorkha Eco Red Bricks process.

First and foremost, I extend my sincere thanks to Er. Dinesh Gothe, Head of the Department, for his invaluable guidance, unwavering support, and insightful inputs throughout this case study. Your expertise and encouragement have been instrumental in shaping our understanding of the subject matter. I am also deeply appreciative of the efforts and dedication shown by Ms. Ekata Niraula, our esteemed lecturer. Your thorough explanations, thought-provoking discussions, and willingness to address our queries have been pivotal in enriching our knowledge and driving this case study towards excellence. I extend a special note of appreciation to Mr. Mesun Lakhemaru, our field supervisor, whose practical insights and real-world experience have provided us with a comprehensive understanding of the Gorkha Red Bricks process. Your willingness to share your expertise and guide us through practical intricacies is genuinely commendable.

I would like to express my gratitude to the entire academic community for fostering an environment of learning and exploration. Your collective efforts have played a significant role in our academic growth. Lastly, I would like to acknowledge the support of my fellow classmates and colleagues who have shared ideas, experiences, and resources, contributing to the overall quality of this case study.

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1 Introduction

1.1 About Organization

After a dedicated and focused effort spanning a year and a half, Gorkha Red Brick Pvt. Ltd. has celebrated a significant achievement in the form of the newly launched product "Gorkha Chinese Itta." This accomplishment stands as a testament to their commitment to innovation within Nepal's brick-making industry. Brick production is deeply embedded in Nepal's cultural heritage. Bricks have been an essential building material, especially in regions near the Kathmandu Valley. In this context, Gorkha Red Brick's recent accomplishment signifies a meaningful progression in the tradition of brick manufacturing.

What truly sets Gorkha Red Brick apart is their embrace of modern technology. The introduction of Tunnel Kiln Technology represents a groundbreaking advancement in brick production. With an impressive daily capacity of 100,000 bricks, this cutting-edge approach has revolutionized the manufacturing process. The operation of Tunnel Kiln involves three distinct zones. In the preheating phase, the bricks receive initial warmth. The firing phase, which occurs in the central part of the tunnel, is where the transformation takes place. Finally, the cooling zone ensures the bricks are prepared for use. While the technology is undeniably advanced, its eco-friendliness is equally noteworthy. Gorkha Red Brick's commitment to environmental sustainability is evident in their choice of energy-efficient methods. By prioritizing this approach, they are not only meeting market demands but also contributing positively to the environment.

Gorkha Red Brick's journey to this achievement has been guided by a clear vision. Their focus on innovation is a reflection of their determination to evolve beyond traditional brick-making practices. In successfully bridging the gap between tradition and modernity, they have not only created a superior product but also illuminated a pathway for the industry's future. This accomplishment speaks volumes about Gorkha Red Brick's value as a forward-looking enterprise. Their achievement extends beyond bricks, serving as an embodiment of progress and responsible production. With every brick produced using the Tunnel Kiln Technology, they are shaping a future that is not only promising but also sustainable.

1.2 Composition of Bricks: Ingredients and Functions

Bricks, essential for construction, are rectangular units used in walls, pavements, and masonry when stone is scarce. Brick chips also serve as coarse aggregate in concrete mixtures.

1.2.1 Ingredients and Percentages

The primary ingredients and their proportions in bricks are:

- Silica (SiO_2) - 55%
- Alumina (Al_2O_3) - 30%
- Iron Oxide (Fe_2O_3) - 8%
- Magnesia (MgO) - 5%
- Lime (CaO) - 1%
- Organic Matter - 1%

1.2.2 Chief Ingredients and Functions

- Silica and Alumina: Provide plasticity and prevent cracking.
- Alumina: Acts as a cementing material for molding.
- Silica: Combats cracking, shrinking, and warping.
- Lime: Aids fusion, strengthening, and durability.
- Iron Oxide: Enhances strength and imperviousness.
- Magnesia: Lessens shrinkage and offers color variation.

1.2.3 Harmful Ingredients

- Excess Lime: Melts and disfigures bricks.
- Alkalis (e.g., Sodium, Potassium): Cause fusion, dampness, and efflorescence.
- Pebbles, Stones, Gravels: Result in weak and irregular bricks.
- Iron Pyrites (FeS): Causes crystallization and discoloration.
- Organic Matter: Renders bricks porous and weakens production.

2 Brick Manufacturing Process

2.1 Block Diagram

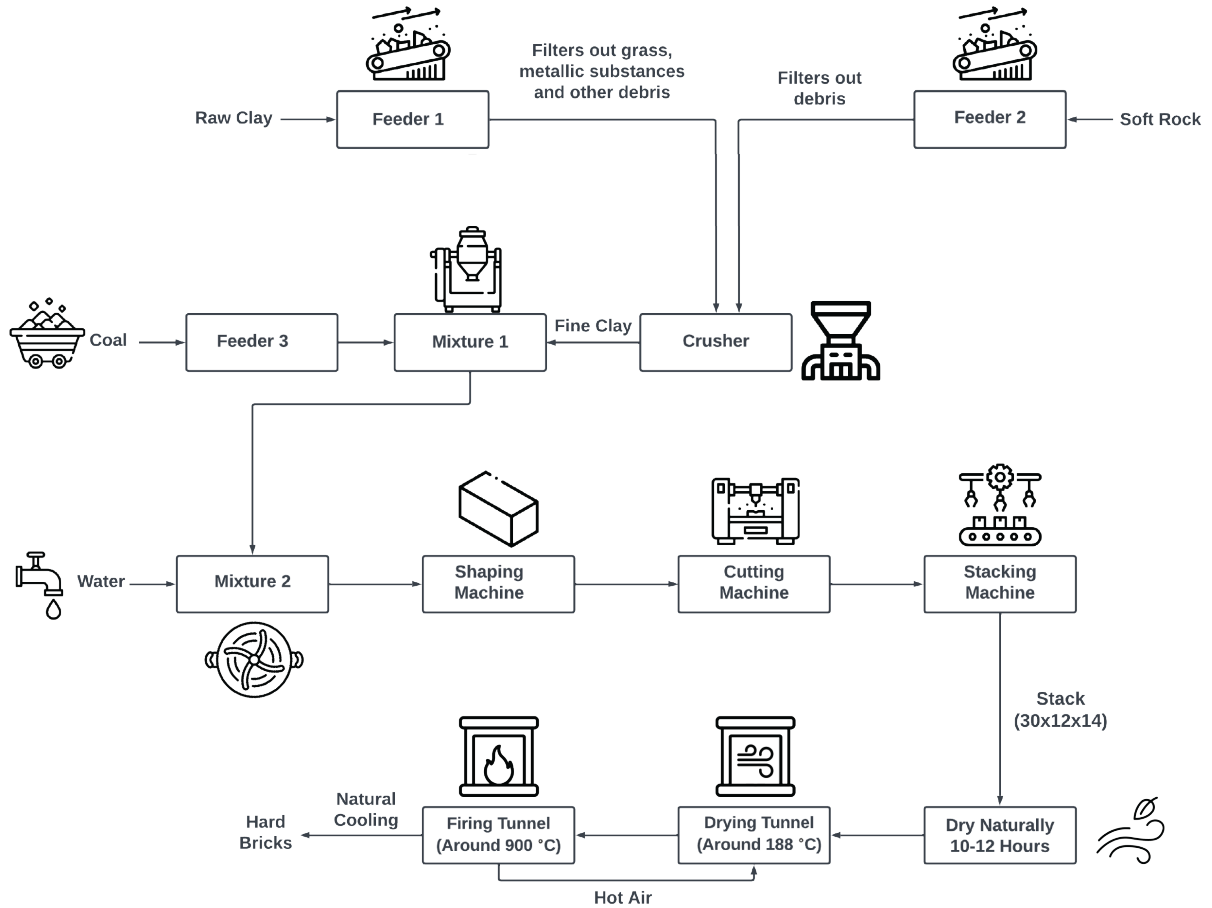


Figure 1: Block diagram for brick manufacture process

2.2 Process Flow for Brick Manufacture

Following are the basic steps of manufacturing bricks:

1. Clay Preparation
2. Cake Molding
3. Drying
4. Firing
5. Gradual Cooling

2.2.1 Clay Processing

First, large chunks of clay are strained using a big strainer. This strainer breaks down the big chunks into smaller pieces. These smaller pieces then pass through a feeder machine. The clay is moved along a rubber conveyor belt to filter out things like grass and unwanted debris. On different parts of the rubber conveyor belt, there are strong magnets placed above to remove any metal from the clay.

Once the clay is roughly filtered, a suitable amount of soft rocks is added to it. The mixture goes through another filtering process. After the filtering is good enough, the mixture is further processed by hammering and thorough mixing to create a finer blend. A small amount of coal is mixed into this fine mixture. This mixture then goes through another feeder, entering mixing machines. Multiple mixing machines ensure proper blending of the clay. Water is also added to the clay in these machines to create a dough-like mixture.

2.2.2 Cake Molding

The compact form of clay, molded into brick-like shapes, is known as a "cake." This cake is a vital starting point in the brick-making process. The clay, resembling dough in its texture, is carefully fed through a machine that works to create a consistent and tightly packed structure of clay. This process ensures that the clay is ready for the next steps.

Following this preparation, the clay goes through a precision-cutting phase utilizing a pressure wire cutter. This step results in the clay being divided into smaller lengths, setting the stage for the formation of individual bricks. Each length of clay, once cut by this machine, yields approximately 8 separate bricks.

As these batches of bricks take shape, a specialized mechanism steps in to lift and position them onto a waiting cart. Each cart is made to carry a good number of bricks, fitting in dimensions of about 30 by 12 by 14. The bricks are stacked alternatively to ensure stability. These carts, filled with bricks ready for further processing, are then set into motion by automated machinery.

2.2.3 Drying

There are multiple drying steps as explained below:

Natural Drying

This first stage of natural drying is done right after a cart is fully stacked with bricks. The natural drying process is done for about 12 - 24 hours. This helps to remove moisture from the brick. The natural drying process doesn't completely remove all the moisture.

Preheating

In this stage the stacks of brick are preheated to make sure all the moisture are remove from the bricks. It is very crucial to remove moisture from the brick for following reasons:

Enhanced Strength: Excess moisture weakens the structural integrity of bricks. By removing moisture, the bricks become denser and stronger, making them more resilient and suitable for construction.

Preventing Cracking: During firing in the kiln, residual moisture can turn into steam, leading to cracks or even explosions in the bricks. Thorough drying prevents such issues by ensuring that moisture is removed before the firing process.

Uniform Firing: Moisture in bricks can cause uneven heating during firing, leading to inconsistencies in color, texture, and strength. Properly dried bricks ensure a more uniform and desirable end product.

Reduced Shrinkage: Moisture causes bricks to shrink during the firing process, which can result in variations in size and shape. Drying minimizes shrinkage, leading to more standardized and consistent bricks.

Efficient Firing: Drier bricks require less energy to heat during firing, making the process more energy-efficient and cost-effective.

2.2.4 Firing

Following the completion of the preheating stage, the stack of bricks is introduced into the firing tunnel. Here, the bricks are subjected to firing at temperatures of approximately 900°C. The temperature range within the tunnel can fluctuate between 900°C and 950°C, influenced by the surrounding environmental conditions. The firing process persists for roughly an hour per stack of bricks. Throughout this duration, the coal contained within the bricks undergoes combustion, leading to chemical changes. Notably, the iron content in the bricks transforms into iron oxide, imparting orange hue to the bricks.

The temperature within the tunnel is monitored from a designated room. A monitoring system displays the temperature readings from various segments of the Drying and Firing Tunnel. For temperature measurement, Type K thermocouple sensors are positioned above the tunnel, capable of gauging a range up to 0-1200°C. Additionally, each tunnel features approximately 9 small openings for direct monitoring. Within the tunnel, two fans play essential roles—one functions as an exhaust fan, while the other facilitates the circulation of air into the drying tunnel. The heat generated in the firing tunnel is channeled into the drying tunnel to preheat the bricks. The velocity of the fan is regulated using a VFD (Variable Frequency Drive), a motor controller capable of altering motor speed and consequently adjusting fan speed.

2.2.5 Gradual Cooling and Loading

After the bricks undergo the heating process, they need to cool down gradually. This cooling phase takes place by letting the bricks interact with the air around them. This natural cooling is crucial to prevent the bricks from becoming too brittle or prone to cracking. It allows the bricks to adjust to the surrounding temperature and conditions in a balanced way.

Once the cooling process is complete and the bricks have reached a stable state, they are prepared for transportation. Loading the cooled bricks onto transportation vehicles requires careful handling to avoid any damage that could weaken the bricks. This loading process ensures that the bricks maintain their strength and structural integrity during transit.

3 Recommendations of the System

3.1 For Packaging of Bricks

4 Discussion and Conclusion

5 Photo Gallery

6 References