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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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Contents

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: Function of ingredients

Bricks are rectangular units of construction material. Bricks are used in masonry construction, walls, and pavements. It is used as a substitute of stone, where the stone is not readily available. Brick chips are often used as coarse aggregate in the concrete mix. Percentage of Constituents of Brick (Weight Basis). There are six major ingredients of brick. The general percentage of these ingredients in brick is given below:
Ingredient Percentage in brick Silica (SiO_2) 55%
Alumina (Al_2O_3) 30%
Iron Oxide (Fe_2O_3) 8%
Magnesia (MgO) 5%
Lime(CaO) 1%
Organic Matter 1%

Chief Ingredients of Brick and Their Functions Silica (Sand) and Alumina (Clay), these two are the most prominent ingredients in brick clay. When mixed with water in proper proportions, it gains plasticity. The plastic mass can be easily molded and dried. It should not go through cracking, shrinkage or warping.

Alumina
Alumina is the main constituent of clay. It acts as a cementing material in raw brick. Brick clay is plastic due to the presence of alumina. This plasticity ensures that bricks can be molded. An excess amount of alumina in clay may cause the bricks to shrink, warp or crack on drying and burning as any other cementing material.

Silica
Good quality bricks contain 50-60% silica. It is present in both free and combined form. As frees sand, it remains mechanically mixed with clay. In combined form, it reacts with alumina to form aluminosilicates. Silica prevents raw bricks from cracking, shrinking and warping. The higher the proportion of sand, the more and shapely and uniform in texture will be the brick. Although, excess silica destroys cohesion between the brick clay particles and makes brick brittle and weak. The durability of bricks largely depends upon the proper proportion of silica and alumina.

Lime
Bricks should contain a little amount of finely powdered lime. It enables silica (of a required portion) to melt at the furnace temperature of 1650oC and binds the particles of brick together resulting in strong and durable bricks. At about 1100 degC, lime acts as a catalyst to elevate the furnace temperature to 1650oC at which silica fuses. This slightly fused silica works as a strong cementing material. Excess lime in brick clay will cause vitrification of bricks. It causes bricks to melt, as more than the required amount of silica will fuse. The bricks then lose their shape and become disfigured.

Iron Oxide
Bricks contain a small quantity of Iron Oxide. Iron Oxide acts a flux like lime, thus helps silica to fuse at low temperature. It imparts a red color to bricks upon burning. Iron also increases the durability and impermeability of the bricks.

Magnesia
A small proportion of magnesium decreases shrinkage and gives a yellow tint to the bricks. An excess amount of it causes bricks to decay.

Harmful Ingredients of Brick
Lime
Excess lime melts the bricks and disfigures it. If $CaCO_3$ exists (in the purest form, i.e., if it contains at least 95% CaO) in lime-lump in brick clay, it converts into quicklime on burning. When these bricks come in contact with water, quicklime slakes and expands. And causes disintegration of bricks.

Alkalis
Alkalis are mainly salt of Sodium (Na) and Potassium (K). It acts as a flux in the kiln and causes fusion, warping, and twisting of bricks. Alkalis absorb moisture from the atmosphere and cause dampness and efflorescence in bricks (because of the presence of hygroscopic salts, e.g., $CaCl_2$, $MgCl_2$, etc.).

Pebbles, Stones and Gravels
Their presence does not allow thorough mixing of earth, thus the bricks produced are weaker. Such bricks cannot be broken at the desired section and they break very irregularly.

Iron Pyrites (FeS)
Iron Pyrites causes crystallization and disintegration of bricks while burning. It discolors bricks in the form of black slag.

Organic Matter
Organic matter in bricks makes bricks porous resulting in low density and weaker bricks production.

2 Brick Manufacturing Process

2.1 Block Diagram

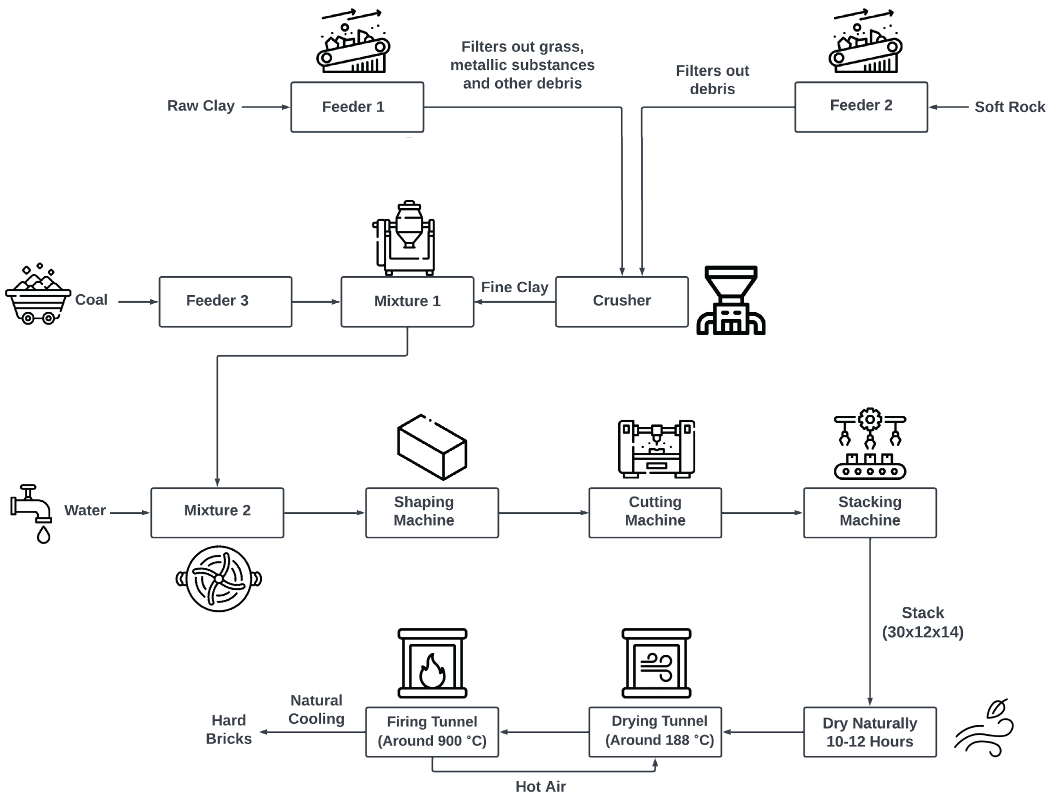

Figure 1: Block diagram for brick manufacture process

2.2 Process Flow for Brick Manufacture

Following are the basic steps of manufacturing bricks:

1. Clay Preparation
2. Cake Molding
3. Drying
4. Kiln 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.

3 Recommendations of the System

3.1 For Packaging of Bricks

4 Discussion and Conclusion

5 Photo Gallery

6 References