REDUCTION OF HEAT LOSS IN TUNNEL KILN FOR CLAY PRODUCT MANUFACTURING

Vijay Soni, Mandawar Kunal, Adamane Samir, Waghmare Prachi

Abstract- In India from ancient times clay utensils were used for many purposes before the method of making metal utensils were discovered. the traditional way of making and baking of clay product is still carried out in all over India causing the pollution and wastage of heat. the development of saving energy and waste heat recovery Technologies has surged as a result of Climate Change initiative and require energy intensive energy industry to and their emission and lower energy consumption. In this paper we are including Three Types of baking processes which are traditional baking process, close furnace and tunnel kiln process

Index Terms- Alkaline earth silicate wool (AES-wool) Aluminum silicate wool (ASW), HTIW (High Temperature Insulation Wool, Polycrystalline wool (PCW), Tunnel Kiln.

1 INTRODUCTION

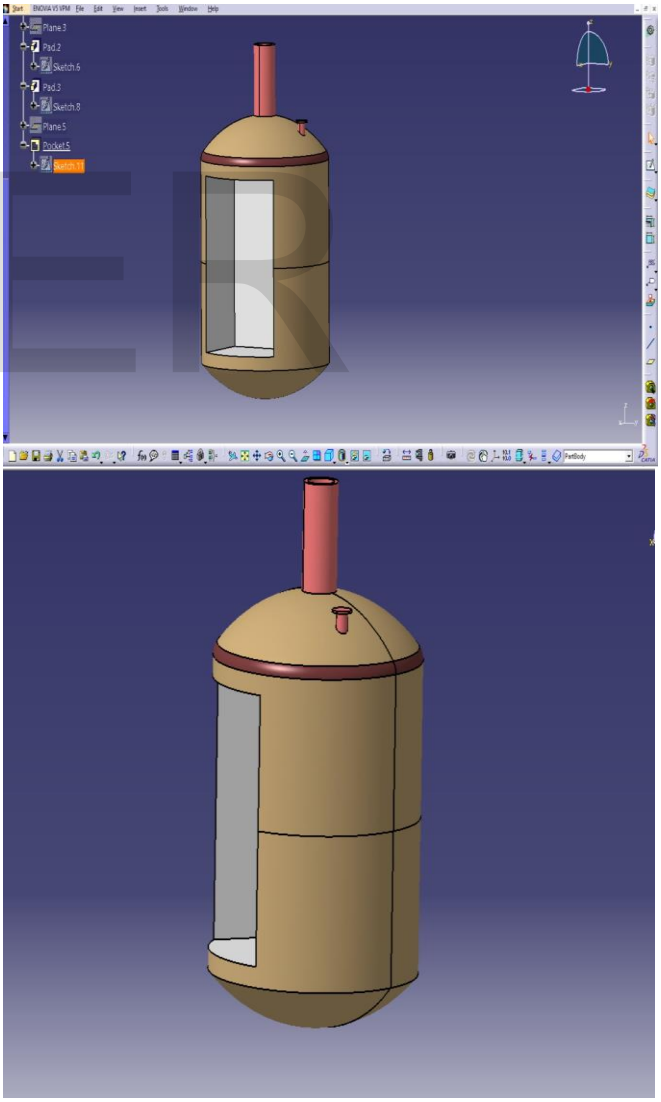
Utilization of earth item and utensils is done from our old occasions. Refining dirt, making batter, squeezing procedure molding mud by packing among thumb and finger loop method where utilizing rope like strands of earth to construct empty ranches, piece strategies hand assembling and tossing are some of significant strategies utilized in customary method of assembling and preparing.

Further as industrialization happened in all viewpoints, the interest of dirt item expanded as they are reusable dangerous free and non-contamination. this builds the interest in market new advancements are proposed such illustration of shut heater conveying around 2,0000 items (kulhad). the pace of warmth move in shut heater is substantially more than in customary preparing heater and less time at about temperature of 500o - 900o C.

1.1 CLOSED FURNACE BAKING SYSTEM

In A closed furnace, the interior surface of heater is covered with high temperature fleece alluded as earthenware fleece about 2.5 inch of thickness additionally called as recalcitrant clay fiber (RCF) which lessens the warmth misfortune at some degree. ceramic fleece or fiber is known as obstinate material a specific substance that has a warmth safe property it fundamentally comprises of aluminum silicate which incorporates fiber produced using different polycrystalline fiber and liquid gases.

1.2 DESIGN AND EXPERIMENTAL SETUP



1.3 HIGH – TEMPERATURE INSULATION WOOL (HTIW)

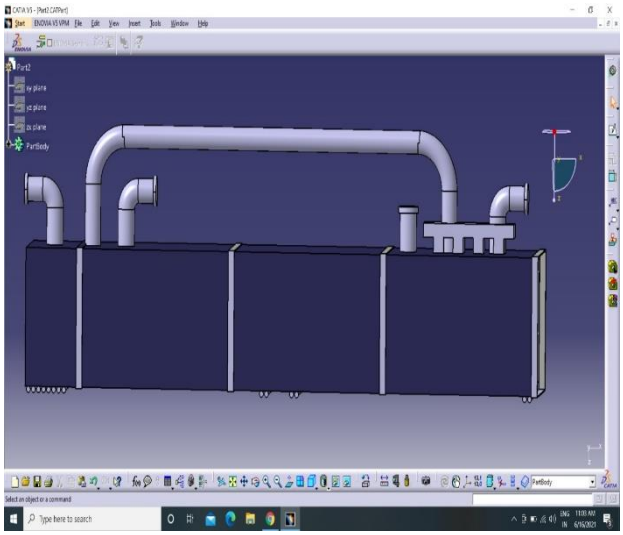
High temperature insulation wool (HTIW) belongs to the group of man-made mineral fibers, which also includes mineral wool and glass wool. The application temperatures of mineral and glass wool are below 650°C with few exceptions. The material is called high-temperature wool when the application temperature is above 1000 ° C. This group includes:

1. Alkaline earth silicate wool (AES-wool)
2. Aluminum silicate wool (ASW) and
3. Polycrystalline wool (PCW).
4. High-temperature insulation wool products are used in industrial furnaces and plants up to 1800 ° C.

1.4 TRADITIONAL BAKING SYSTEM

In traditional baking system, clay products are baked in an open furnace supported by cast iron rod of area 5x5x8 ft. insulated by ceramic wool baking capacity of 20000 products (kulhad) taking almost 36 hrs. to bake and cool down process causing major heat loss and by burning 240 kgs of wood.

1.5 DESIGN AND EXPERIMENTAL SETUP



2. SALIENT FEATURES OF LITERATURE REVIEW

•The literature review demonstrates that the warmth misfortune in different earth item preparing techniques is concentrated by different examiners and specialists on research just as designing frameworks.

•It has been proposed that heat misfortune can be constrained by oven technique.

•It is apparent from the writing that the crude material can be supplanted by LPG gas to the framework gives obvious change in the presentation.

•The specialists utilized High Temperature Insulation Wool to lessen the warmth misfortune causing in the passage.

•Most of the examination work is centered around the minimization of warmth misfortune by utilizing different techniques like conventional strategy, shut heater strategy and oven burrow strategy

•Presently, Kiln Tunnel strategy is for the most part utilized in blocks making framework as new exploration and further examinations are being issue that remains to be worked out in the preparing of mud items generally utilized in India.

Considering the above it is felt that; the further examination work should be possible in the space of warmth misfortune in preparing framework whether it very well might be blocks or earth item as fuel properties of LPG gas, burning rate, heat move rate and accordingly by and large impacts on climate and costing. Consequently it is proposed to embrace the venture with the accompanying targets.

3.PROBLEM STATEMENT

1. Heating equipment, for instance, heater and stove experience basic radiation setbacks at a temperature above 1000°F-1500°F.

2. Hot surfaces exude energy to the colder surfaces in their view.

3. The most noteworthy energy misfortune in the heater activity is achieved by the entryways remaining open longer than required.

4. The past interaction utilized by the business is a practice method of preparing which is taking just about 36 Hours for 20000 Kulhad heating.

4.OBJECTIVE

To fabricate the ability to fire the clay products, better order over the terminating measures. To limit the mileage of the mud items through astounding warming association and timing. To extend the capacity to Bake the thing at the same time correspondingly and to similarly disperse the warmth. To reduce the misfortunes and breakage to limit the time taken by heating of one space I.e., 20000 kulhad at a time should be brought down.

The best energy misfortune in the heater activity is achieved by the entryways remaining open longer than required. Hot surfaces radiate energy to the colder surfaces in their view ability to fire the mud things, better order over the terminating measures. To limit the mileage of the mud items through astounding warming association and timing. To extend the capacity to Bake the thing all the while likewise and to similarly disperse the warmth.

The vehicles stacked with dried green blocks are pushed in the furnace. The vehicles are moved inside the furnace irregularly at fixed time stretches. The term of the terminating cycle can go from 30 to 72 hours.

Fuel (granulated/crushed coal) is taken care of into the terminating zone of the oven through feed openings gave in the furnace rooftop. The terminating zone normally reaches out up to 8 vehicles. The temperature in the terminating zone is kept up at 500′ – 900′C.

5.METHODOLOGY

The 3D model of the tunnel is planned by utilizing CAD programming like CATIA V5 R20 according to the measurement.

The examination of warmth misfortune conduct of fuel i.e., gas is done, when utilized in furnace like innovation. Subsequently we need to search for the warmth misfortune at the hour of stacking and dumping of items. Fuel (granulated/crushed coal) is taken care of into the terminating zone of the furnace through feed openings gave in the oven rooftop. The terminating zone normally stretches out up to 8 vehicles. The temperature in the terminating zone is kept up at 500′ – 900′C.

The vehicles stacked with dried green blocks are pushed in the oven. The vehicles are moved inside the furnace discontinuously at fixed time stretches. The term of the terminating cycle can go from 36 to 72 hours.

6.CALCULATIONS

1. Heat loss calculated in ancient baking system

•Heat Loss Formula: Q=U*A* T Q = U*A* T

Q = Heat Loss =0.32206*210*400

U = Heat Transfer Coefficient =27053.04 Btu/hr.

A = Surface Area Q = 7.9284 Kilowatt/hr.

T= Temperature Difference

For entire process of 36 hour the total heat loss is 285.4224KW/hr.

2. Heat loss calculated in furnace

• Heat Loss Formula: Q=U*A* T Q= U*A* T

Q = Heat Loss =0.32206*150.7964*400

U = Heat Transfer Coefficient =19426.19543 Btu/hr.

A = Surface Area Q = 5.6932 Kilowatt/hr.

T= Temperature Difference

For entire process of 20 hour the total heat loss is 113.864 KW/hr.

3. Heat loss calculated in Tunnel Kiln

• Heat Loss Formula: Q=U*A* T Q= U*A* T

• Q = Heat Loss =0.2808*1609.25*600

• U = Heat Transfer Coefficient =271213.3395 Btu/hr.

• A = Surface Area Q = 79.4847 Kilowatt/hr.

• T= Temperature Difference

• For entire process of 4 hour the total heat loss is 317 KW/hr.

7. EXPECTED OUTCOME

1.Minimizing the heat loss as much as possible

2.Lowering the baking time

3.Wear and tear should be should be lowered to certain limit

4.Equal distribution of heat should take place while operation of baking

5.Maximum number of products to be baked at one time lowering the risk of accidents.

6.Eco friendly and no hazardous gases secreted by entire system.

7.ZPollution controlled at maximum extend and no requirement of cutting wood.

8.RESULT AND DISCUSSION

1. Experimental results of heat transfer in setup of traditional baking process where wood is the raw material used for baking for the quantity of 20,000 kulhads and time required for the process was 36 hours is 285.4224kw/hr. The setting contains of 240 kgs of wood for burning for entire amount of kulhads to bake. As area comprised of total burning of wood makes a lot of heat loss shown in fig. 1. Top side of the baking system is open causing maximum heat loss is discussed.

2. In closed furnace experimental setup, again raw material was wood of quantity 240 kgs for burning the number of 20,000 kulhads, here it took less time comparatively to the traditional baking process causing heat loss of 113.864kw/hr and time required was about 20 hrs. As shown in design analysis of closed furnace in fig. 2 one door type structure in closed furnace causes more heat loss which was insulated by High Temperature Insulation Wool (HTIW). In results the heat loss is much lesser.

3. In Tunnel Kiln the amount of kulhads baked are much more than the other two processes where material used for baking purpose was LPG gas. The time required for about 1,50,000 kulhads to bake was 4-5 hrs, the fuel required was 132 litre of LPG gas. In previous two process the quantity of baking kulhads was less henceforth the less area was required to bake. In Tunnel Kiln process we are baking about 7 times more kulhads and hence area required for entire system is much more than the traditional and closed furnace baking process. As the area is directly proportional to heat loss hence the

heat loss observed in tunnel kiln process was about 317kw/hr.

9.FUTURE SCOPE

This project presents an outlook of different fuels can be used as are material for heating and baking. It's clear that a lot of work is done in this field but there is always scope of improvement. It is cleared by researches that heat transfer loss can be minimised by using different materials as an insulator i.e., ceramic wool or High Temperature Insulation Wool (HTIW). By timely increasing/changing the specification and dimensions of tunnel and the insulation material in tunnel so that the efficiency could be increased and heat loss could be decreased and heat loss could be decreased to peak level.

10.CONCLUSION

Subsequent to utilizing the customary heating technique and shut heater preparing strategy referenced already, we have made a model of gas burner and Tunnel Kiln utilizing Catia programming. In this undertaking we can do the Theoretical investigation of Tunnel that by utilizing this innovation our fundamental point is of limiting the warmth misfortune during the activity can be brought close down to most extreme. In this innovation the warmth coming

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