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DESIGN AND FABRICATION OF FOUNDRY CUM FORGING FURNACE

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Abstract
The need to recycle and productively reuse the abundant speck metals in the country led to this paper. The productions of metal in foundries and in all human lives have become a general practice. This paper deals with the design, study, and fabrication and performance of a coal-fired crucible furnace using locally sourced materials. Design, drawings were formed and mild steel sheet was used for the fabrication of the furnace, while the other components needed for the design were selected based on functionality, durability, cost and local availability. The sample products fired in the coal furnace proved that the system operated successfully without problem. In this study, a coal fired furnace, has been developed to fire and melt the metal for using different manufacturing process.

Keywords-- Coal furnace, Efficiency, Coal-fired Crucible, Study, Design.

I.INTRODUCTION

The furnace is the most essential equipment used in the foundry industry, which is an industry that uses logical methods for shaping metals. Mostly all industries rely on castings products whose productions are impossible without the furnace. The importance of the cast iron crucible furnace to the foundry industry as it affects the industrial and technological development of any nation cannot be overemphasized since many machine components are made of cast iron. [1][8]

Energy efficiency, sometimes commonly called efficient energy use, is the effort to reduce the amount of energy required to provide products and services. There are various different motivations to improve energy efficiency and these include; reducing energy use and energy costs which results in a financial cost saving to consumers. Energy efficiency is also seen to have a national security asset because it can be used to reduce the level of energy imports from foreign countries. [2] A look at the history of some industrialized countries like Japan, China and Europe reveals their extensive use of foundry technology. Metalwork has contributed enormously to technological advancement. Coal was more than the black fuel that went into the furnace. It was also the largest expense of a coal furnace and poor management of the fuel production phase of the operation could doom a furnace. Kerosene or petrol is used in furnace for initial combustion of coal as a fire source to heat the crucible and melt the solid metal inside it. A few of the advantages of coal fired crucible furnace are low investment costs, easy operation and maintenance ability, capable of melting small batches of various alloys, the melt can be treated directly in the crucible and the alloy can be immediately and easily replaced as necessary.[8]

II. METHOD OF CONSTRUCTION

A. Trolley

Frame of trolley having cross section of (3ft*1.5ft) made of mild steel L-type angle joined with the arc welding in cross section of rectangle and sheet of 20gauge of mild steel sheet will be place over the frame to form an plane . It will act as supporter or carrier for whole working model. Two rod of same height welds on the two corner of same side of the trolley, weld on the base of rod to make the handle of trolley to drive the whole trolley easily. Rotating wheels are installed on each corner of bottom side of the trolley to easy drive of trolley.

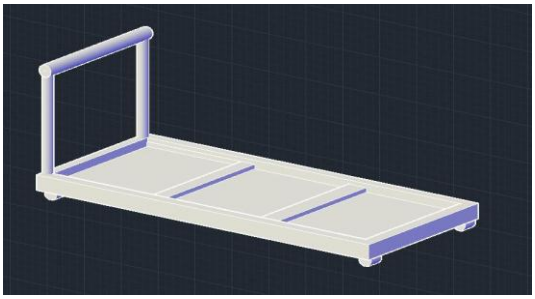

Fig. (1). Trolley

B. Fabrication of the furnace shell

Frame of shell consist of L-type angle having cross section of (1.5ft*1.5ft), height(1.5ft), and a mild steel sheet of 20 gauge are to be weld vertically on all side of the cubic frame except upper side of cubic frame to form as a box .At one side of the box an area of (.2ft*.2ft) is to be cut above 3inch from the bottom for the exhaust of ass and a proper covering or shield for this gate is also to be install, and one more area is to be cut on the adjacent vertical side of the box just below the height of gauge, area is equal to the area of cross section of the outlet of the air blower to install the inlet of the air from air blower. Then this frame is to be set on the trolley. [3]

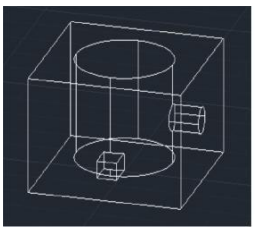

Fig. (2)

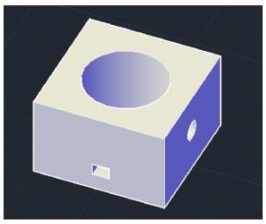

Fig.(3)

C. *Finishing operation*

The entire welded joints were dislagged and thereafter grinded/polished to ensure a smooth finish. Grinding was done with a hand grinding machine. After grinding a first stage painting of the outside part with anti - Rust paint was done and was followed by a second stage and final painting.

C. Fabrication of floor or base

This is done by first construct the surface of the base of the furnace wet with a mixture of water and sodium silicate before pouring a very thin layer (2mm thick) of the refractory mixture before sorting fire bricks into the base of the furnace or the mixture of POP and play sand can also be used to form a base of 3 inch thick base or floor.[1][2]

E. *Lining of refractive furnace drum*

Refractory lined to protect the furnace shell frame from high temperature and abrasive materials inside the furnace. The refractory lining is cooled to further add to the protection against the dispatch of excess heat that can destroy the refractory lining. For all this purpose we use to lining the furnace drum with help of refractory brick or any other refractory material like plaster of Paris (POP).Here we used the mixture of mixture of POP and play sand to form the base, and for the lining of the furnace drum we used refractory bricks and POP mixture.[3]

F. *Fabrication of the furnace drum*

The cover was built from a 5mm mild steel plate. The mild steel plate was cut with oxyacetylene flame and thereafter welded with an arc welding machine using gauge 12 electrodes. The cover was impregnated/ filled with a refractory mixture comprising of sodium silicate, POP, sawdust and water to prevent or reduce the amount of heat loss. In order to firmly acquire the insulating materials to the cover, pieces of rods were welded underneath the bottom part of the cover to hold the refractory mixture. [2][3]

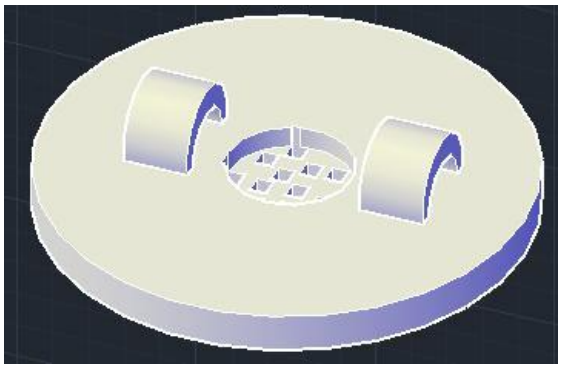

Fig.(4)

III. COMBUSSTION CAVITY

During the lining of the furnace drum make a whole cavity of cylinder shape having diameter with the height of half of shell height and then install a gauge (6mm Bar) over this surface and then complete the remaining cavity of same diameter with the height of shell frame, also form a horizontal cylindrical cavity of diameter equal to the diameter of outlet of air blower for the way of proper air supply from the air blower, as same as an horizontal cavity of same cross section for the exhaust for ash, keep in mind these two horizontal cavity should form during the lining of furnace drum.[3][8]

IV.WORKING PRINCIPLE OF THE CRUCIBLE FURNACE

The furnace is first and foremost preheated before firing it by igniting combustible materials such as kerosene over the coal in the combustible chamber, and ignites the coal with help of safe fire lighter. While the coal is still burning the valves that control the supply air from the air blower through the nozzle slightly opened to allow in limited volume of air under pressure as this continues over time, the temperature rises gradually within and around the crucible, thereby melting its content.

The furnace temperature can be known directly from an optical pyrometer through the chimney on the cover. When the crucible content is fully melted and is ready for pouring, the crucible is lifted out by means of a lifting tong, which is

handled carefully by persons and then poured into the prepared mould cavity or die. The holes on the sides of the furnace are built to keep a balance between the pressure within and outside the system. After take out the of crucible from combustion chamber turn off the air supply valve and air blower so that the temperature of furnace can be down the shut off furnace.[3][4]

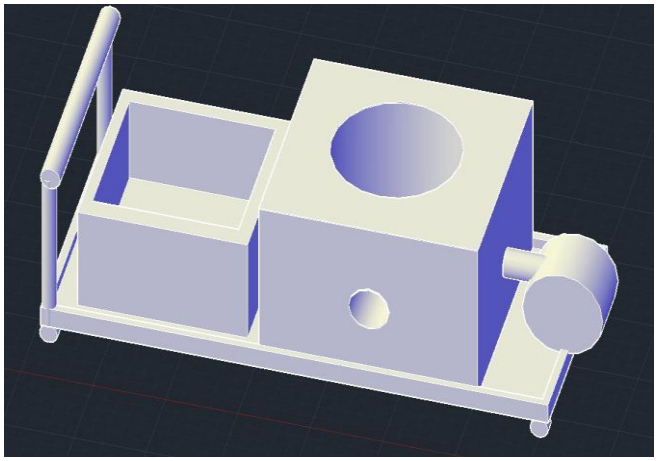

Fig. (5)

V. EFFICIENCY AND PEORMANCE

Efficiency = (amount of heat required for melting− Calorific value of the fuel)/ (Quantity of heat required for melting) ×100

Mathematically,

Efficiency = {(Qm –Cvf)/ Qm} ×100 = 66.78% ≈ 67% [2]

Where: the heating/calorific value of the fuel Cvf (charcoal) used = 29600KJ/Kg [4, 5]. The value of the furnace efficiency as calculated (67%) conformed to the literature value of 50 to 70% [5], which according to the source, varies within the limits; and can be increased by the use of preheated air. [4][10]

IV. CONCLUSION

We have studied that the design and fabrication of forging cum foundry furnace is very useful for various foundry purpose. One of the plus point of coal furnaces that it can be run without electricity. Various materials like sheet metal, refractory brick or any other refractory material like plaster of Paris, mild steel are observed for the construction of furnace. This furnace can be used for small quantities of molten metal for various purposes. Therefore this furnace can be used at various small scale workshops. The design of this furnace could be used as demonstration model in foundry workshop in many institutions. The cost of this furnace is low as compared with imported ones.

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