

A Review Paper on Computational Analysis of Heat Transfer Phenomenon of Fly Ash Brick Manufacturing Process

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ABSTRACT: Fly ash is a fine, glass-like powder recovered from gases created by coal-fired electric power generation. Flyash material is solidified while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the particles solidify while suspended in the exhaust gases, flyash particles are generally spherical in shape and range in size from 0.5 μm to 100 μm . They consist mostly of silicon dioxide (SiO_2), aluminum oxide (Al_2O_3) and iron oxide (Fe_2O_3). Computational Fluid Dynamics (CFD) software, ANSYS CFX is being applied to evaluate performance of heat transfer in fly ash brick manufacturing process.

KEYWORDS: Fly ash, ANSYS CFX, CFD.

I. INTRODUCTION

The use of high percentages (high volumes) of fly ash has been studied extensively over the last 15 years, and the benefits of this type of concrete have been well documented. When properly designed and constructed, the increased benefits of concrete made with 40, 50, and 60 percent fly ash replacement include dramatically reduced concrete permeability, and excellent resistance to all forms of premature deterioration.

General Properties

Fly Ash is

- Fine powder in grey colour
- having no virtual odour
- Non – Toxic
- Non – Flammable
- Non – Explosive

Key advantages of using fly ash

- Improved workability
- Reduced permeability
- Reduced heat of hydration
- High sulphate resistance
- Increased long term strength
- High chloride corrosion resistance
- Greater resistance to alkali reactivity
- Better concrete finish
- Reduced shrinkage
- Improved workability

RAW MATERIAL use in fly ash brick manufacturing process: Fly ash forms the major component of the raw min for Fly ash bricks. Therefore it controls to a large extent the properties of the finished product. As the ash is non-plastic, a binder must be added either plastic clay or Portland cement. Fly ash content ranges from 60 to 80%. 2. Lime It is

generally desirable to use a high calcium lime of reasonable purity as it is the most important constituent which reacts with silica and alumina etc. present in the fly ash to form the binder under hydrothermal conditions other burnt lime is not desirable as it does stake readily. The particles of lime should be fine enough to be thoroughly distributed and coat the grains of the mix. It should also satisfy IS: 712-1973. Lime content range from 20 to 30%. 3. Water Generally potable water from a well or a river is required. Series of Fly ashes from various Thermal Power Station

MANUFACTURING PROCESS:

Fly ash (70%) Lime (10%) Gypsum (5%) and sand(15%) are manually feed into a pan mixer where water is added to the required proportion for homogeneous mixing. The proportion of raw material may vary depending upon quality of raw materials. After mixing, the mixture are allowed to belt conveyor through feed in to automatic brick making machine were the bricks are pressed automatically. Than the bricks are placed on wooden pallets and kept as it is for two days thereafter transported to open area where they are water cured for 10 -15 days. The bricks are sorted and tested before dispatch.

What is CFD?

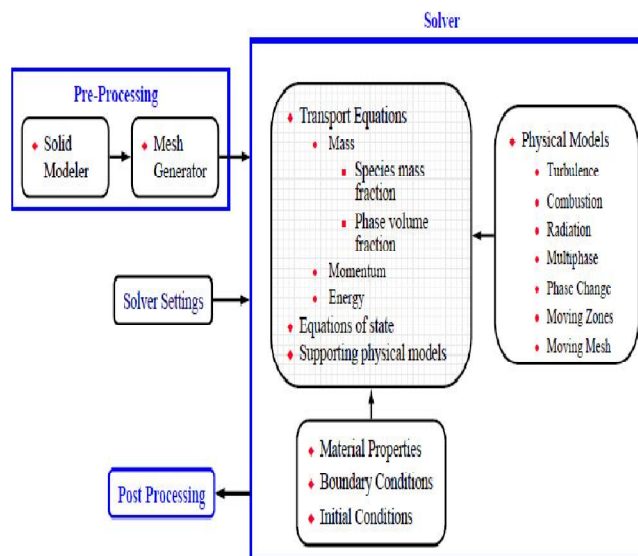
Computational fluid dynamics (CFD) is the science of predicting fluid flow, heat and mass transfer, chemical reactions, and related phenomena by solving numerically the set of governing mathematical equations. Conservation of mass, momentum, energy, species, etc. <The results of CFD analyses are relevant in:

- conceptual studies of new designs
- detailed product development
- troubleshooting
- redesign

CFD analysiscomplements testing and experimentation.

- Reduces the total effort required in the experiment design and data acquisition

CFD Modeling Overview



CFD Analysis – The Basic Steps

Problem Identification and Preprocessing

1. Define your modeling goals.

2. Identify the domain you will model.
 3. Design and create the grid.
- Solver Execution
4. Set up the numerical model.
 5. Compute and monitor the solution.
- Post-Processing
6. Examine the results.
 7. Consider revisions to the mode

II. RELATED WORK

1. Conduction / Natural convection analysis of heat transfer across multi-layer building blocks by H. Baig and M. A. Antar KFUPM, Dhahran, 31261, Saudi Arabia King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia: Heat loss across a multi-layer wall that includes hollow blocks is studied numerically. Conjugate conduction-natural convection heat transfer is carried out to compute the heat leak/ R-Value for different numbers of air-filled cavities and for different cavity layouts. Interaction between conduction and convection at the boundaries is considered rather than the classical isothermal and adiabatic boundary conditions reported in open literature. This is believed to provide more accurate estimation of the heat transfer rate across the walls. Therefore, boundary conditions include a heat balance at the boundaries between the two heat transfer modes. Results show that increasing the number of cavities can be effective in reducing the heat flux without compromising the building blocks strength. Nevertheless, a considerable reduction in the heat flux or increase in the R-value can be achieved through changing the layout of the cavities within the wall. The effect of both techniques can compensate for removing the insulation layer in the cavity used to increase the wall thermal resistance. This is due to decreasing the cavities width that contributes significantly in suppressing the convection heat transfer effects (reduced value of Ra). Conduction / Natural convection conjugate heat transfer within masonry blocks with hollow cavities is investigated numerically. Changing the layout of the cavities can play a substantial role in increasing the R-value (decreasing the heat leak) and hence enhances thermal insulation through increasing the R-value by 13.5% (case 2 compared to case 1) and up to 17.65% (case 3 compared to case 1) without affecting the structural characteristics of the blocks. Decreasing the thickness of the solid material used (within the safe limits) decreases the thermal bridges and thus avoids unnecessary conduction heat leak. In addition, using cavities of high aspect ratio (case 3 instead of case 2) and less width decreases the convection heat transfer effects since decreasing the cavity width reduces the Rayleigh number and hence reduces the convection heat transfer coefficient. It is believed that these results will provide guidelines to masonry block manufacturers for better energy conservation.
2. HEAT TRANSFER ANALYSES USING COMPUTATIONAL FLUID DYNAMICS IN THE AIR BLAST FREEZING OF GUAVA PULP IN LARGE CONTAINERS by W. M. Okita, M. J. Reno, A. P. Peres and J. V. Resende: Heat transfer during the freezing of guava pulp conditioned in large containers such as in stacked boxes (34 L) and buckets (20 L) and unstacked drums (200 L) is discussed. The air velocities across the cross-section of the tunnel were measured, and the values in the outlet of the evaporator were used as the initial conditions in computational fluid dynamics (CFD) simulations. The model tested was turbulent standard $k-\epsilon$. The CFD-generated convective heat transfer coefficients were mapped on the surfaces for each configuration and used in procedures for the calculation of freezing-time estimates. These estimates were compared with the experimental results for validation.

The results showed that CFD determined representative coefficients and produced good correlations between the predicted and experimental values when applied to the freezing-time estimates for the box and drum configurations. The errors depended on the configuration and the adopted mesh (3-D grid) construction. In this work, the predicted values provided satisfactory results to represent the airflow pathways and heat transfer

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization

Volume 6, Special Issue 1, January 2017

International Conference on Recent Trends in Engineering and Science (ICRTES 2017)

20th-21st January 2017

Organized by

Research Development Cell, Government College of Engineering, Jalagon (M. S), India

III. OBJECTIVE

1. TO CALCULATE THE HEAT TRANSFER IN FLY ASH MANUFACTURING PROCESS BY CFD ANALYSIS
2. TO STUDY THE MANUFACTURING PROCESS AND TO CALCULATE THERMAL STRESS
3. TO CALCULATE HEAT FLOW RATE

IV. METHODOLOGY

- To study the properties of fly ash
- To do the CFD analysis in Ansys
- In CFD analysis first to select properties like thermal conductivity, etc.
- To select material properties in solver.
- To calculate heat transfer rate, Thermal stresses.
- In post processor we get graphical result

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