Production and Analysis of Composite Construction Materials with Admixture of Coal-Bagasse Based Fly Ash and Perlite by ANSYS Approach

Jilla Naveen[1], Kancharla Bullibabu[2], K.Veeranjaneyulu3, Dr.Md. Abidali[4]

[1] PG student, dept. of mechanical engineering Anurag Engineering college (Autonomous), kodad, Telangana, India.
[2, 3] Assistant professor in dept of mechanical engineering, Anurag Engineering college, (Autonomous), kodad, T.S., India.
[4]Professor in dept of mechanical engineering, Ramachandra college of Engineering, West Godavari (Dt), A.P., India.

---***---

Abstract – *In this paper the effect of compositions of bagasse ash and perlite admixture on thermal stresses and other mechanical properties of Clay were investigated. The raw clay gotten from Suryapet in Telangana state. First processed to very fine particles of clay were also dried at atmosphere temperature to remove moisture present. A composite mixture of this dried bagasse ash and perlite with the processed clay was made at various proportions of the bagasse ash and perlite, with a little addition of water for plasticity. Samples of rectangular dimensions were then produced from the mounting press by the process of compaction with a very high pressure. The samples were dried and then finally fired in the furnace at 800°C for a final curing. Properties which include thermal shock resistance, bulk density, cold crushing strength and porosity were obtained by the appropriate standard test methods. The microstructures and weight loss percentage(%) corresponding to temperature variation of the fired samples were characterized with SEM-EDS and TGA. The results show that the amount of bagasse ash and perlite admixture affects the properties variously; porosity and thermal resistance increases with percentage increase in bagasse ash and perlite, thermal and mechanical properties were also evaluated by ANSYS.*

Keywords: Bagasse ash and perlite, Clay, SEM &TGA

1. INTRODUCTION

In this paper main objective is development of thermal insulated construction material by admixture of Bagasse Ash. Main reason for adaption of Bagasse ash, Perlite it consist excellent thermal resistive properties and cohesive with clay. So mainly in the India human beings are unable to bare the air conditioning systems with peak electric power consumption, because of necessitous economical conditions. So these unsustainable conditions are consideration in this research and focus on to decrease the heat transfer rate through the wall due to change the composition of the constructional material by admixture with Bagasse ash. Mainly in India construction materials are clay and cement bricks. These bricks are very cheap compared to other hallow bricks. The strength of the wall is also good. There is good demand for clay bricks in developing countries like India .Due to increasing urbanization many houses and industries to be construct as per the requirement of the people. Energy saving is an important issue in the world because of both economic and environmental concerns. Consumption of energy from buildings constitutes about 30% of total consumption with about half of this lost through the walls. Indian standard states that, depending on the location and climate, walls should be made of material with a heat transfer coefficient of 0.41–0.72 W/m^2 K, the lower the better. If the thermal resistance is further improved, then heat loss will be decreased and, hence many brick manufacturers are seeking to produce such materials. Earthenware clayey raw material is generally used with few pre-treatment steps for extruded perforated bricks. Firing temperature is generally of the order of 1100^0C. The product consists of vertical perforations to reduce heat transfer through the brick. There are two different thermal conductivity values of these bricks: first involves the bulk of the material constituting the walls, while the second involves thermal conductivity of the entire product consisting of large vertical holes of rectangular cross-section. The Bagasse ash, Perlite as reinforcement in a clay matrix for making composite clay bricks and the Bagasse ash to be cut and crushed to micron sizes for proper mixing with the matrix of clay to develop composites Hand molding technique is employed to manufacturing composite clay bricks. Along developing suitable molds for Mechanical characterization.

2. EXPERIMENTAL PROCEDURE

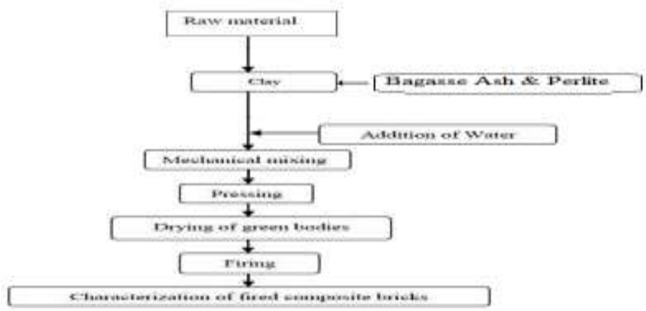

Fig. 1.Flow chart of experimental procedure

2.1 procedures for clay brick preparation

Brick raw materials clay and Bagasse ash, Perlite and wer

e dried at atmospheric temperature. Then they were powdered by centrifugal pulverized mill. Finely prepared dry Bagasse ash, Perlite powder blended with fine soil in centrifugal mixing upto 850rpm for 40 min. These mixtures were compacted by manual force for rectangular shaped specimens. The prepared specimens were dried at room temperature up to one week. Dried specimens were fired in laboratory electrical furnace at the rate of 4.5ºC/m until 800ºC and at 5.5ºC/m until 1100ºC. Fired products were characterized for mechanical properties like compressive strength, Microstructure varied By SEM-EDS & TGA Temperature and weight change.

Fig. 2.procedures for clay brick preparation

3. SEM-EDS ANALYSIS

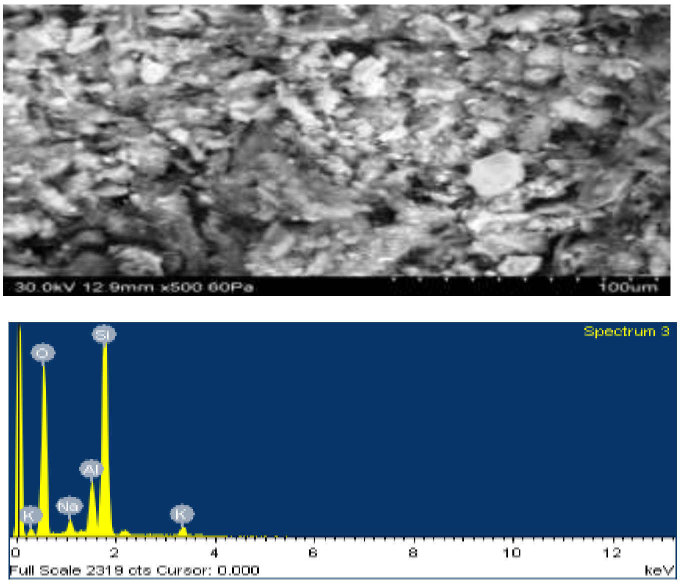

Fig. 3.SEM-EDS of sample -I

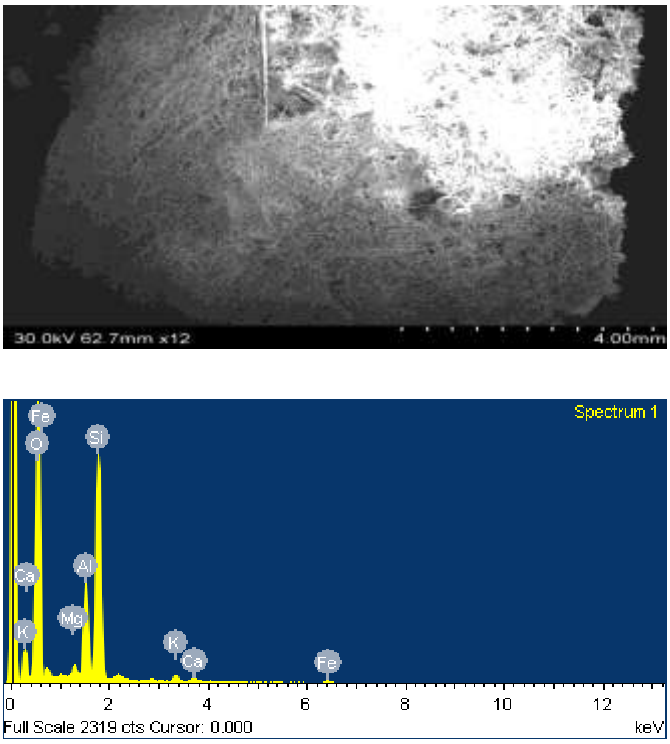

Fig. 4.SEM-EDS of sample –II

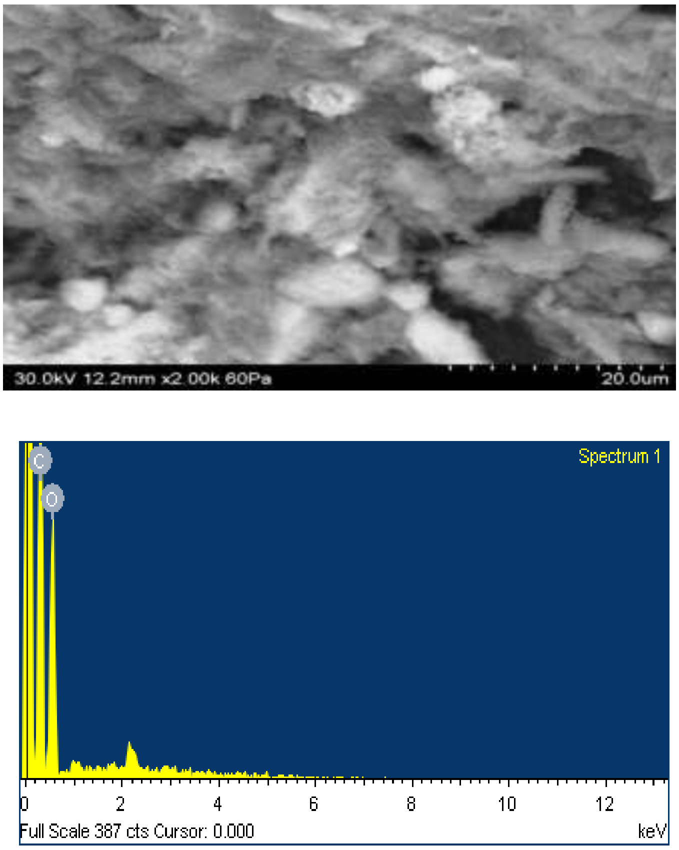

Fig. 5.SEM-EDS of sample –III

4. TG Analysis

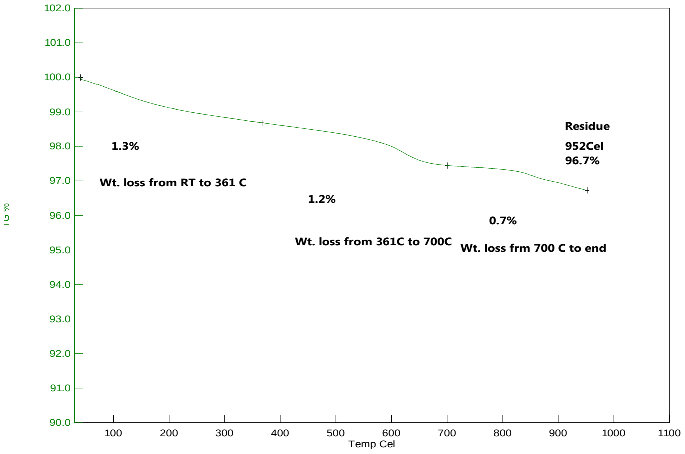

Fig. 6.weight loss vs. increasing temperature for sample-I

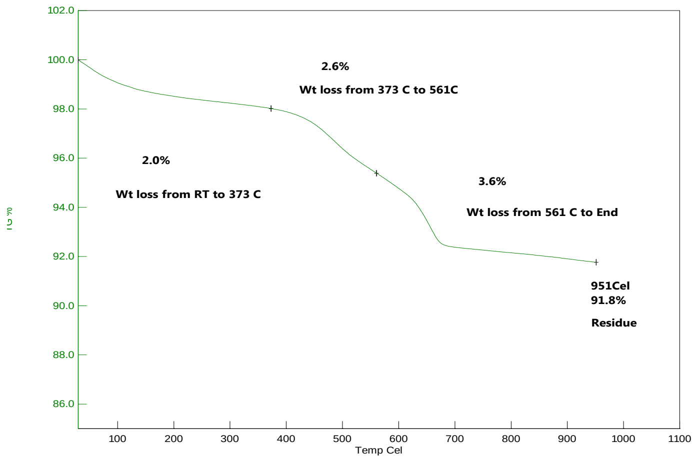

Fig. 7.weight loss vs. increasing temperature for sample-II

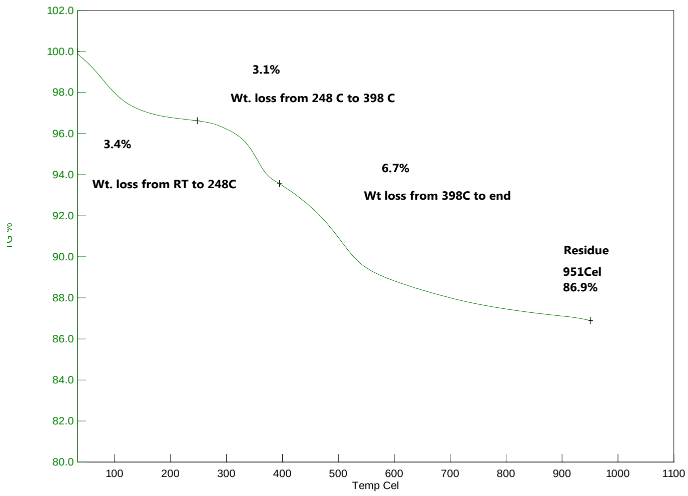

Fig. 8.weight loss vs. increasing temperature for sample-III

5. COMPRESSION TEST

Brick No	Composition	Load(kN)	Breaking stress(KN/m^2)
1	250gms Bagasse ash and 200 gms perlite	7.35	1470
2	200gms Bagasse ash and 300gms Perlite.	5.88	1176
3	150gms Bagasse ash and 250gms perlite	4.7	940

Table.1. Load vs stress

6. STRUCTURAL ANALYSIS OF COMPOSITE BRICK

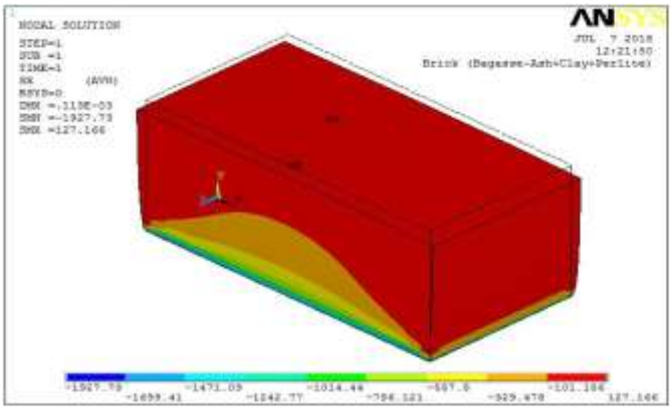

Fig .9.Stress Distribution along X-direction

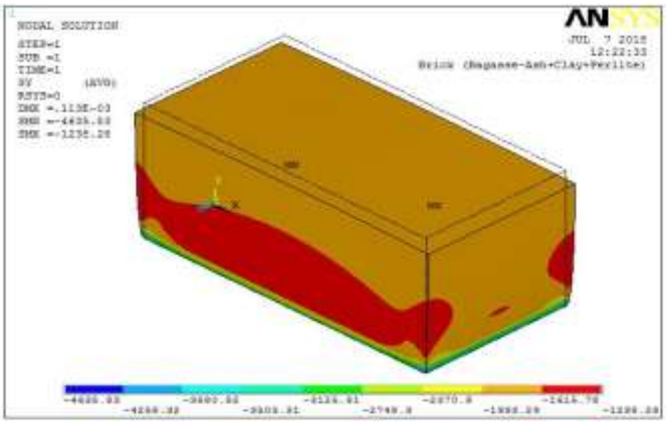

Fig .10.Stress Distribution along Y-direction

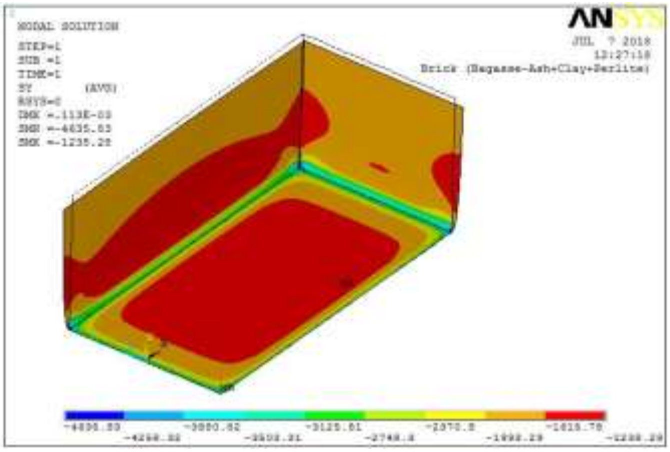

Fig .11.Stress Distribution along Z-direction

7. THERMAL ANALYSIS OF COMPOSITE BRICK

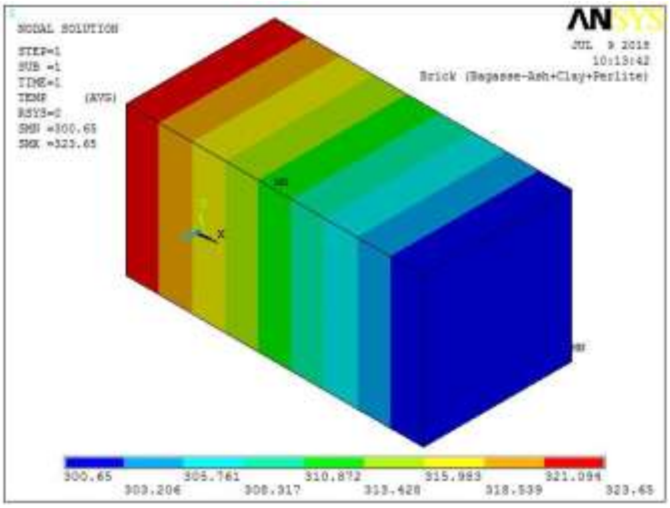

Fig .12.Temperature distribution at 10 am

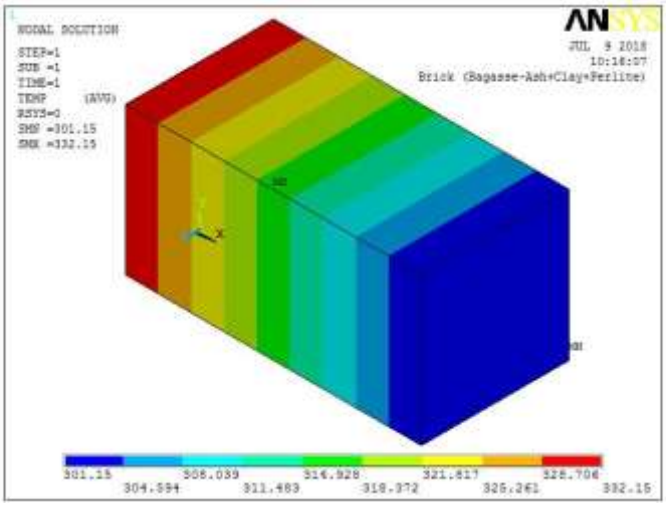

Fig .13.Temperature distribution at 12 Pm

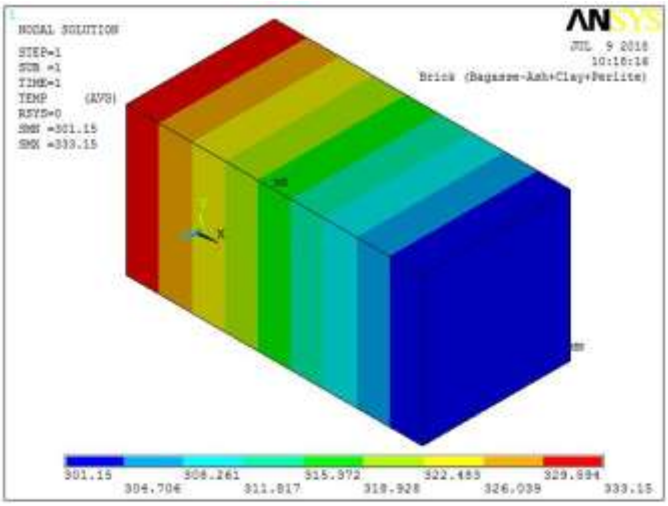

Fig .14.Temperature distribution at 2 Pm

8. Results and discussions

In this paper an investigation of the reduction of thermal conductivity of composite is due to the insulating effect of fly ash and perlite particle in clay, which has a lower thermal conductivity compared to that of cement matrix. It is evident from these results that the aggregates with less thermal conductivity produced because it consist huge amount of Al_2O_3 and Sio_2. Earlier investigations reveal that the type of aggregate would greatly influence the thermal conductivity of materials. The corresponding relationship between thermal conductivity and dry unit weight of the composite. The thermal conductivity k (W/mK) decreases with decreasing unit weight q (kg/m3). The derived correlation is of the type: k = 0.1236). The variation obtained is similar to that reported in previous work conducted on lightweight concretes. The decrease in thermal conductivity is also related to air content in the matrix that results in less unit weight.

Structural and thermal analyses are carried out on a clay and Bagasse ash, Perlite composite brick (335g). Structural analysis is carried out to observe the stress distribution and deformation patterns in 3 dimensionally which is induced due to 2940 kPa compressive pressure load.

9. CONCLUSIONS

Their fired densities varied between 1.79 and 1.23 g/cm3, which correspond to a decrease of 27%, when compared to the density of the brick without admixture. Apparent water absorption values were increased with increase in Bagasse ash,Perlite addition. Pressing direction of the bricks and shape of the pores in samples has a considerable effect on mechanical strength. Due to increase the content of Bagasse ash,Perlite and palm fruit Bagasse ash,Perlite addition, then compressive strength of the samples decreased but compressive strength of the samples was still higher than the standard strength values. Their thermal conductivity values decreased by up to 40% while required mechanical strength could be maintained. Results indicated that the Bagasse ash, Perlite could be easily utilized as pore-forming additives into brick bodies to facilitate production of thermal insulated bricks. In this structural analysis, we have modeled a clay, Bagasse ash and Perlite composite brick.

It is observed that the magnitude of stress and displacements are maximum in the Y direction due to compressive load. Thermal analysis is carried out to observe temperature distribution pattern in brick at various time steps. After conducting thermal analysis, it is observed that temperature distribution is linear. Finally, by FEA simulation we understand stress distribution, deformation and temperature distribution in clay and Bagasse ash, Perlite brick. Temperature distribution along thickness of brick is observed at various day times (10:00 AM, 12:00 PM, 2:00 PM) is observed.

REFERENCES

1. kancharla.Bullibabu & Dr.MD. Abid ali ‘‘production and characterization of low thermal Conductivity clay bricks by admixture of Bagasse and perlite’’Vol. 8, Issue 3, Jun 2018, 809-816.

2. Kancharla.Bullibabu, Dr Md AbidAlib, and K.Veeranjaneyulu ‘‘Characterization and production of thermal Insulating admixture of Bagasse and Palmyra fruit fiber’’Materials Today: Proceedings 5 (2018) 6973–6980.

3. P. Wouter, Energy Performance of Building: Assessment of Innovative Technologies, ENPER-TEBUC, Final Report, 2004.

4. M. S. Al-Homoud, performance characteristics and practical applications of common building thermal insulation materials,Bulid. Environ. 40(2005) 353-366.

5. C. Schidt, A. A. Jensen, A. U. Clausen, O. Kamstrup, D. Postelwhite, A comparative life cycle assessment of building insulation products made of stone wool, paper wool and flax, Int. J. Life cycle Asses.9(2004) 53-66.

6. Duman V, Mladenovic A, Suput JS. Cement Concrete Res 2002;32:223–6.

7. Kearsley EP, Wainwright PJ. Cement Concrete Res 2001;31:105–12.

8. Savastano Jr H, Warden PG, Couts RSP. Cement Concrete Comp2000;22(5):379–84.

9. Yue YL, Li GZ, Xu XS, Zhao ZJ. Cement Concrete Res 2000;30(5):1983–6.

10. [10] R. Garcia, R.V. Villa, I. Vegas, M. Firas, M.I.S. Rojas, Construction and Building Materials 22 (July (7)) (2008) 1484–1490.

BIOGRAPHIES

Jilla Naveen, PG student, department of mechanical engineering Anurag Engineering college(Autonomous)kodad, T.S, India.

Kancharla Bullibabu,M.Tech (Refrigeration & Airconditioning) from JNTUA(2009-2011),Ph.d Research Scholar at KLEF Guntur& Assistant professor in department of mechanical engineering, Anurag Engineering college(Autonomous), kodad, T.S., India.