AN EXPERIMENTAL STUDY ON PERFORATED BRICKS WITH WASTE CERAMIC MATERIALS AND WASTE GLASS

R.Rajendran[1], M.Sundharam[2], D.Surya[3], P.Suganesh[4], A.Sathishkumar[5]

[1]Assistant Professor, Dept. of Civil Engineering, K. Ramakrishnan College of Technology, Tamil Nadu, India
[2,3,4,5]UG Students, Dept. of Civil Engineering, K. Ramakrishnan College of Technology, Tamil Nadu, India

---

Abstract – *The solid waste generation in India is about 960 million tons annually from industries, agriculture, municipal, and other processes. Of this, 100 million tons per year are waste from ceramic and 21 million tons of Indian glass are produced. It is about fifteen percentage to thirty percentage of waste material generated from the total productions. The ceramic industries are dumping for land fill which results in serious environmental pollution. The quantum of waste is increasing and hence it needs to find solution for disposal. In this regard, the reuse of sanitaryware waste and glass waste are added as one of the compositions of the manufacture of bricks. The results demonstrate the reuse ceramic waste in bricks. The reuse of this kind of waste leads to the well-known sustainable development concept of social, economic and environment dimensions. The reduction in dumping the refuse and decrease in the quarrying conventional natural resources. The optimized use of natural materials and energy reduce the cost of material and achieve a sustainable development. By introducing perforation in bricks reduce the is quantity of material and self-weight of bricks. The term perforation defines holes areas should not exceed the area of 5sq.inches. Three numbers of 30mm diameter holes are provided on frog side of bricks.*

Key Words*:* Ceramic Powder, Glass Powder, Waste, Reusing, Sustainable, Perforation**.**

1. INTRODUCTION

1.1 BRICK

Brick is an artificially moulded blocks with a mass of natural material with uniform size and shape. Bricks are moulded in rectangular shape of suitable size when it's in semi solid condition. The bricks are suitably dried and burnt to achieve strength, durability and to form them into useful artifact for constructing structures. This is often a man-made material which are comparatively small in size and uniform which may be handled easily. Further brick being uniform in size which may be arranged systematically and bonded alongside mortar so on form a homogeneous mass which is named brick masonry. The brick size 230 X 110 X 75mm locally available in all construction. The perforated brick size assigned as 215 X 102.5 X 65mm. The materials used for brick masonry are bricks of ordinary size and mortar of required strength. Mortar helps to bind the individual bricks and to make a cushion to require up the inequalities within the brick and to distribute the pressure evenly and also to refill the interstices within the bricks.by using the following proportions bricks were made.

Table -1: Proportions of perforated bricks

Ceramic powder (%)	Glass powder (%)	Clay (%)
50	10	40
60	15	25
70	20	10

The perforated bricks are made by above proportions and that superior properties compared with conventional bricks by various tests.

1.2 CERAMIC POWDER

Ceramic waste from factories manufacturing construction industry materials has been accumulating on oftentimes, making more and more giant piles. Though they are sometimes with chemicals immobile, the waste assembles relying upon their size and so the scant environmental management exercised, have a giant visual impact that pull down the inborn quality of the perspective. Indian ceramic production is one hundred million ton every year. In ceramic business, regarding fifteen to thirty percentage waste generated from the whole production. This waste is not reclaimed in any kind at the current. However, the ceramic waste is sturdy, exhausting and extremely proof against physical, biological and chemical mortification forces. The ceramic wastes of tiles crushed and pulverized by exploitation the impact strength instrument.

Fig -1: Ceramic wastes

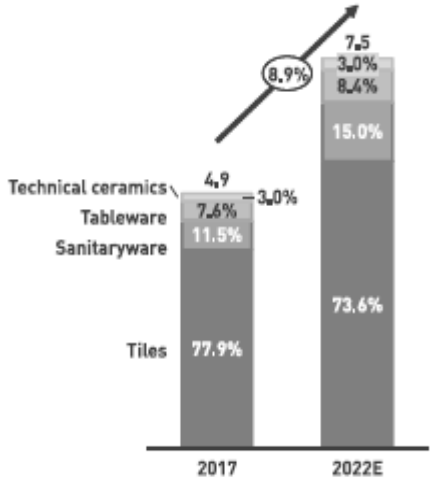

Fig -2: Shows the production of ceramic at 2017 and Future focus 2022

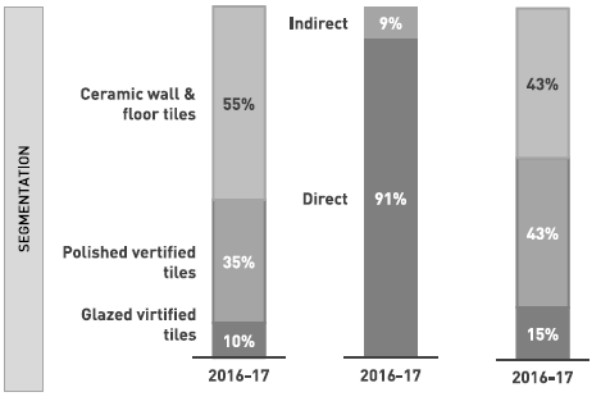

Fig -3: Shows production of different tiles in 2016-17

1.3 GLASS POWDER

Glass has become imperative in life thanks to such properties as its potential to require any form with ease, its Bright surface and resistance wearing, and its safety and sturdiness. Because the vary of uses of glass increase, thus will number of the waste glass. The united nations estimate the amount of solid waste disposed of annually over the globe to be two hundred million tones, seven-membered that is created of glass. For turkey, this quantity appeal one hundred twenty tones, eighty tones of that area unit recycled, and its been reportable that in Germany three million tone of waste glass area unit being recycled. Moreover, not like different waste product, glass is imperishable and therefore harmful to setting.

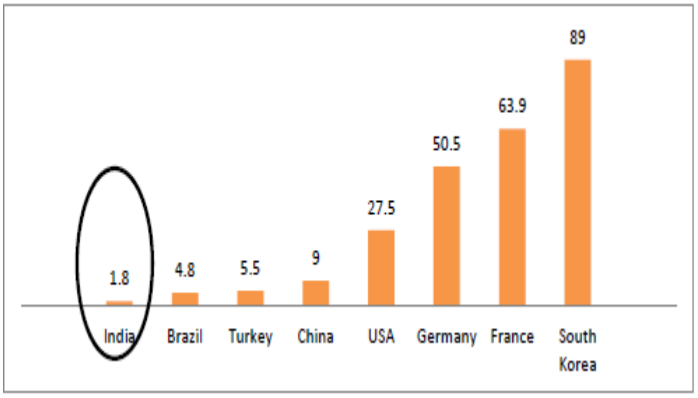

Fig -4: Shows Per capita consumption of container glass (Kgs.)

Source: Hindusthan National Glass & Industries Ltd. investor PPT data through Economist Intelligence Unit (2018)

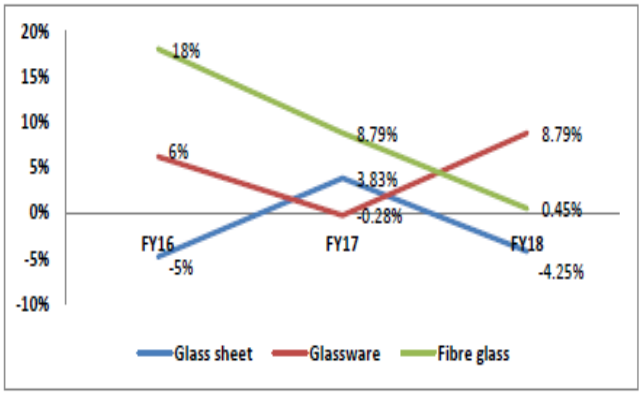

Fig -5: Production of glass (y-o-y growth %)
Source: CMIE

Fig -6: Glass Powder

2. STUDY OF MATERIALS

2.1 SPECIFIC GRAVITY

Fig -7: Pycnometer

The specific gravity of ceramic powder, glass and clay determined as per procedure by using pycnometer. The specific gravity values of ceramic power, glass powder and clay are 2.590, 1.739 and 2.439 respectively.

2.2 SIEVE ANALYSIS

Fig -8: Sieves with shaker

The fineness modulus of the materials computed as per IS codal provisions. Fineness modulus of the ceramic powder, glass powder and clay are 3.756 %, 3.302 % and 4.977 % respectively.

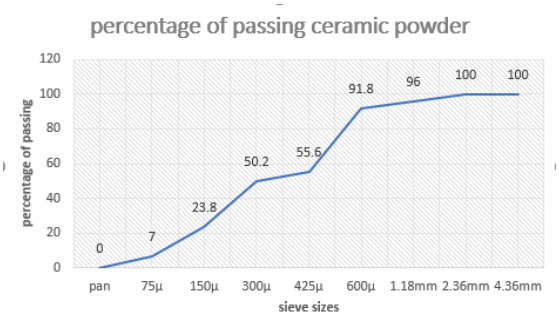

Chart -1: Passing percentage of ceramic powder

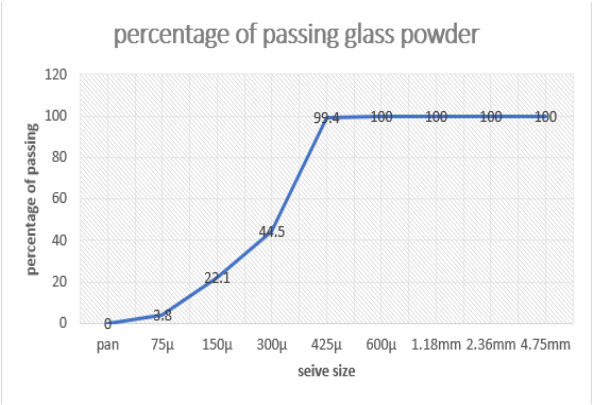

Chart -2: Passing percentage of Glass powder

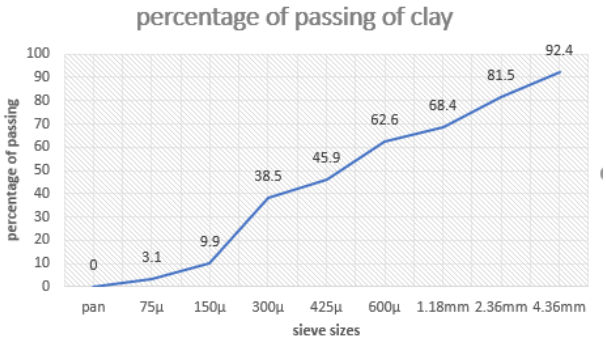

Chart -3: Passing percentage of Clay

3. EXPERIMENTAL WORK

3.1 WATER ABSORBTION

In this test the conventional brick absorbs water in average 14.38 %. In three proportioned bricks, A series has 9.44% of absorption. Due to clay content increasing the water absorption is increasing. But absorption is within the permissible limit. So the perforated brick is good in absorption. It is suitable for construction.

Fig -9: Dry Brick **Fig -10**: Wet Brick

Table -2: For conventional bricks

S.No	Sample	Dry weight (w1) kg	Wet weight (w2) kg	Water absorption Kg	% of water absorption
1.	1	2.537	2.899	0.362	14.26
2.	2	2.542	2.911	0.369	14.51

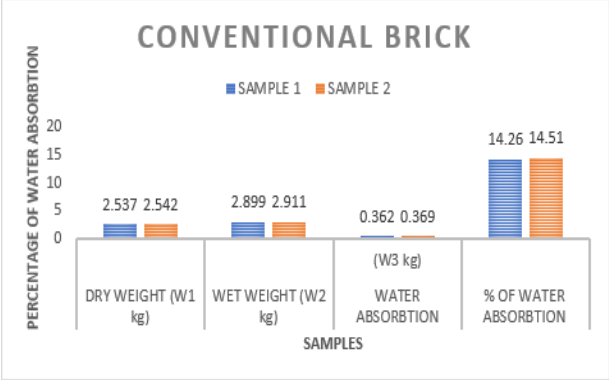

Chart -4: For conventional bricks

Table -3: For 1st Ratio perforated bricks

S.No	Sample	Dry weight (w1) kg	Wet weight (w2) kg	Water absorption Kg	% of water absorption
1.	1	1.964	2.151	0.187	9.56
2.	2	1.952	2.140	0.182	9.32

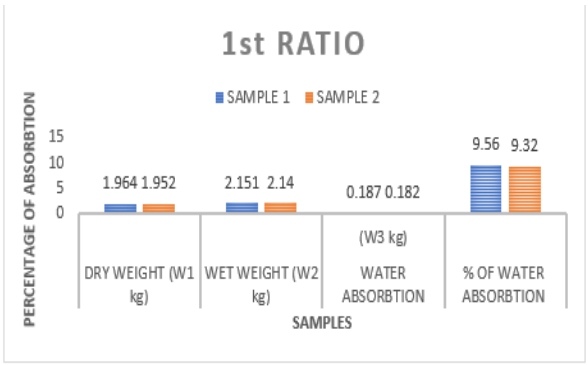

Chart -5: For 1st Ratio perforated bricks

Table -4: For 2nd Perforated bricks

S.No	Sample	Dry weight (w1) kg	Wet weight (w2) kg	Water absorption Kg	% of water absorption
1	1	1.959	2.088	0.139	7.11
2	2	1.962	2.102	0.14	7.18

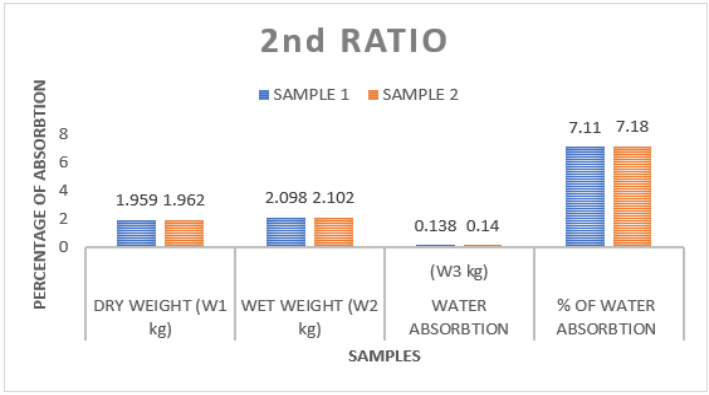

Chart -6: For 2nd Perforated bricks

Table -5: For 3rd Perforated bricks

S.No	Sample	Dry weight (w1) kg	Wet weight (w2) kg	Water absorption Kg	% of water absorption
1	1	1.964	2.088	0.124	6.31
2	2	1.960	2.076	0.116	5.91

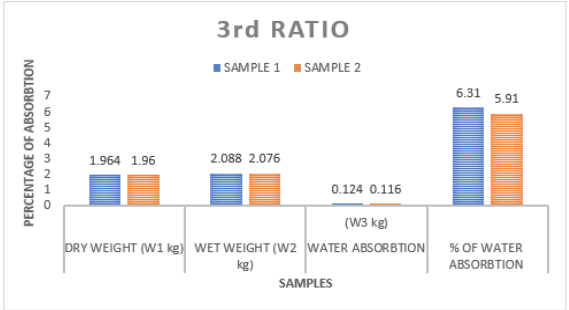

Chart -7: For 3rd Ratio perforated bricks

Table -6: Average values of water absorbtion

S.No	Brick type	Average values
1	conventional	14.38 %
2	First proportion	9.44 %
3	Second proportion	7.14 %
4	Third proportion	6.11 %

3.2 HARDNESS TEST

The perforated bricks made with three proportioned ceramic powder, glass powder and clay are gives good result in hardness test when compared to the conventional bricks. There is no impression made on surface of bricks.

Fig -11: Hardness Test

3.3 SOUNDNESS TEST

In conventional bricks metallic ringing sound occurs when strucking each other. But the perforated bricks with different proportion of ceramic powder, glass powder and clay cause little different metallic ringing sound. Sound changes due to proportion of bricks. The A series brick causes same as conventional bricks. But other bricks cause little different sound. Even though the ceramic and glass powder are suitable for brick manufacturing and construction purpose.

Fig -12: Soundness Test

3.4 COMPRESSIVE STRENGTH

Due to increasing ceramic powder and glass powder the compressive strength of the perforated brick is increasing. In the proportion of 70% ceramic powder, 20% glass powder and 10% clay bricks give compression strength of 5.39 N/mm^2. This is suitable for building purpose. This is also can used as green building material.

Fig -13: Compression Test

Table -7: Compressive strength for conventional bricks

S.No	Brick Dimensions (mm)	Area Of Bed (mm^2)	Maximum Load (KN)	Compressive Strength (N/mm^2)
1	230 X 110 X 70	25300	121	4.78
2	230 X 110 X 70	25300	122	4.82
3	230 X 110 X 70	25300	122.45	4.84

Table -8: Compressive strength for perforated bricks

S.No	Brick Dimensions (mm)	Area Of Bed (mm^2)	Maximum Load (KN)	Compressive Strength (N/mm^2)
1	215 X 102.5X 65	22037	110	4.99
2	215 X 102.5X 65	22037	116	5.26
3	215 X 102.5X 65	22037	119	5.39

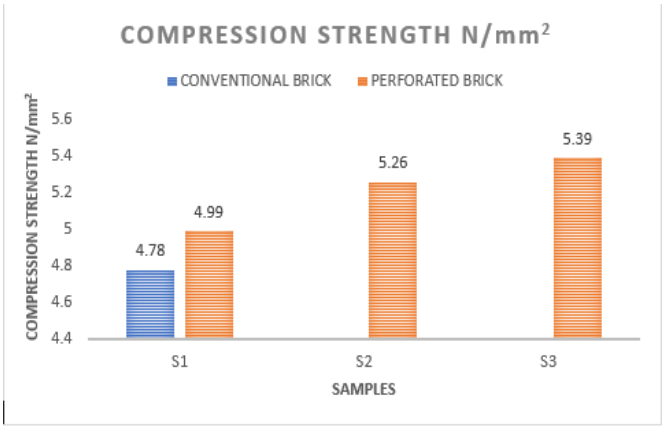

Chart -8: Compression strength of bricks

3.5 STRUCTURE TEST

In perforated bricks there was no such as defects, lumps and debris. The perforated bricks are good in structure test as same as the conventional bricks.

Fig -14: Structure Test

3.6 EFFLORESCENCE TEST

The efflorescence test for perforated bricks was conducted and the test results were compared in which grey or white deposits are not seen on the surface area in perforated bricks. So the observation report is **NIL.**

Fig -15: Wet brick **Fig -16**: Efflorescence Test

4. CONCLUSIONS

Based on the study, this new step towards reuse of waste ceramic materials and waste glass materials has given satisfactory result in all these results conducted. This also replaces ordinary brick which leads to benefits such as replacement of clay, reduce in cost, simple methods of manufacturing. Reusing waste ceramic and glass reduces landfill which in turn reduces soil pollution.

The specimen has been tested for three different mix proportions. The mechanical properties such as compressive strength, hardness, soundness, shape and size of sample were studied for different mix proportions. From the result it was deduced that, among the three mix proportions the compressive strength is utmost 70 % ceramic powder, 20 % glass powder and 10 % of clay bricks. The bricks produced metallic ringing sound and there is no holes, external maters not are present in the sludge bricks. The maximum absorbed moisture content of perforated bricks is less than 20%. Hence the perforated bricks are suitable for construction purposes.

REFERENCES

[1] Sabry A. Ahmed, M.E. Metwally and S.E. Zakey "Assessment of Ceramic Tiles Sludge as a Brick Manufacturing Material". ISSN: 2278-0181, Vol.5 issue 10.

[2] Ismail Demir "Reuse of waste glass in building brick production". ISSN: 0734-242X waste management & research 2009: 27: 572-577.

[3] G. M. Sadiqul Islam, M. H. Rahman,Nayem Kazi " Waste glass powder as partial replacement of cement for sustainable concrete practice".

[4] Alaa.A.Shakir, Sivakumar Naganathan, Kamal Nasharuddin Bin Mustapha "Development of Bricks from waste material. A review paper". ISSN: 1991-8178.

[5] Patricia Ponce Peña,1 María Azucena González Lozano,1 Alicia Rodríguez Pulido,1 René Homero Lara Castro,1 Zoe V. Quiñones Jurado,2 Juan Carlos PérezMedina,3 Martha Emilia Poisot Vázquez,4 and Axel Villavicencio Torres5 "Effect of Crushed Glass Cullet Sizes on Physical and Mechanical Properties of Red Clay Bricks. Vol. 2016., Article ID: 2842969

[6] Dr.M.Swaroopa Rani "A Study on Ceramic Waste Powder". ISSN: 2348-8352,. Vol.,3 issue 7.

[7] Hariharan.S1, Jebaraj.G2 "manufacture of bricks with partial replacement of clay with waste glass powder".ISSN: 2320-7345., Vol.,6 issue 2.

[8] Hathaichanok Warnphen1,a, Nuta Supakata2,3,b,*, and Vorapot Kanokkantapong2,3 "The Reuse of Waste Glass as Aggregate Replacement for Producing Concrete Bricks as an Alternative for Waste Glass Management on Koh Sichang". ISSN: 2331-7758 Vol .5., issue .3, 2017.

[9] Achsah elizabeth jacob1, er. akash aggarwal2 , yogengra kumar kushwaha3 "utilization of ceramic waste as a replacement of aggregates and its effect on variation of expenditure". ISSN: 2327-7758, Vol.5., Issue 3.

[10] Mohammad shahid arshad, dr. P.y. pawade "reuse of natural waste material for making light weight bricks".ISSN: 2277-8616., Vol. 3, Issue 6.