International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 04 | Apr 2024 www.irjet.net p-ISSN: 2395-0072

An Experimental Study on usage of crumb rubber and GGBS in masonry brick

Sujan B Y[1], Sumalatha L D[2], Swathi K R[3], Purushotham[4], Manjunath H S[5]

[1,2,3,4] *Department of Civil Engineering, Rajeev Institute Of Technology, HASSAN.*
[5]*Assistant Professor, Department of Civil Engineering, Rajeev Institute Of Technology, HASSAN*

Abstract –
Concrete has become a vital part of our lives. The use of concrete is increasing at a very high rate. one of the main constituents of concrete is ordinary Portland cement. The manufacturing of cement results in emission of large amounts of CO_2. Thus, the researchers have started finding alternatives for the partial replacement for cement. GGBS is used to make durable concrete structure in combination with ordinary portland cement / or other pozzolanic material. crumb rubber is used in brick, manufacturing to enhance the bricks properties such as durability and insulation it helps recycle rubber waste making the process more sustainable. The bricks are tested for its compressive strength, water absorption, efflorescence, carbon attack test after 14 days and 28 days of curing. The replacement percentages of cement by 10% crumb rubber and GGBS used are 5,10,15 and 20%. water cement ratio adopted in this work is 0.50. For this ratio we got maximum strength for 15% cement is replaced by GGBS. Hence up to 15% GGBS for cement and 10% crumb rubber for fine aggregate can be replaced to get good results.

Key Words: Crumb rubber, GGBS, Carbon attack, efflorescence.

1. INTRODUCTION

Crumb rubber is a term usually applied to recycled rubber from automotive and truck scrap tyres. During the recycling process steel and fluff is removed leaving Tyre rubber with a granular consistency. Continued processing with a granulator and/or cracker mill, possibly with the aid of cryogenics or mechanical means, reduces the size of the particles further. It is not possible to discharge the rubbers in the environment because they decompose very slowly and cause lots of pollution. So, it is necessary to have a relevant use of these wastages. These waste materials can be used to improve some mechanical properties of concrete. Addition of rubber to concrete results in the improvements of some mechanical and dynamical properties. Such as more energy absorption, better ductility and better crack resistance. By using the waste tyre (crumb rubber) one can reduce the harmful effect on environment and provide sustainable concrete.

Combining crumb rubber and GGBS in masonry bricks represents an innovative approach to creating more sustainable and high-performance construction materials. The specific proportions and manufacturing processes would depend on the desired characteristics and local building standards. This practice aligns with the broader trend in construction toward using recycled materials and optimizing the performance of building components.

The combination of crumb rubber and GGBS in masonry bricks reflects a sustainable and technologically advanced approach to construction materials, aligning with efforts to create environmentally friendly and resilient structures. Therefore, in this work we are using crumb rubber and GGBS as principal materials for masonry bricks.

2. PROBLEM STATEMENT

- The issues of tyres disposal present a multifaceted challenge with far-reaching implications.
- Improper tyre disposal poses significant environmental risks, contributing to soil and water pollution while releasing hazardous substances.
- Moreover, challenges in tyre recycling process, including inefficient methods and insufficient infrastructure, hinder sustainable disposal efforts addressing these problems requires a comprehensive approach, including policy analysis to improve regulations, innovative solutions for responsible disposal.
- The utilization of GGBS masonry brick construction presents an opportunity to enhance sustainability. However, the current challenge lies in determining optimal proportion and application method of GGBS.

3. OBJECTIVES

The objectives of this study are:

- To determine the water absorption and compression strength of the brick.
- To conduct efflorescence test, Hardness test and dimensionality test on the bricks.

- To compare the test values of conventional brick and the brick in consideration.
- To study the cost effectiveness compared to the conventional brick.

4. MATERIALS AND METHODOLOGY

4.1 MATERIAL COLLECTION

4.1.1 CEMENT

Cement is a binding material used in construction to make concrete and mortar. It's typically composed of limestone, clay, shale, and silica. Portland cement is the most common type. When mixed with water, cement undergoes a chemical reaction, forming a solid matrix that binds aggregates like sand and gravel. This mixture hardens over time, creating strong and durable structures.

4.1.2 FINE AGGREGATES

Fine aggregate, often referred to as sand, is a crucial component in concrete and mortar. It is composed of small particles that pass through a 4.75 mm sieve. The main sources include natural sand, crushed stone sand, and crushed gravel sand Properly proportioned fine aggregate, when combined with cement and coarse aggregate, forms a cohesive mix that can withstand, fine aggregates like sand play a vital role in brick manufacturing by providing strength, workability, and cohesion to the mortar used in laying brick. they contribute to the overall durability and appearance of bricks structures. proper selection and use of fine aggregates are essentially for achieving high quality brick work.

4.1.3 CRUMB RUBBER

Crumb rubber is a recycled rubber material that is derived from the processing of end-of-life tires. The tires undergo a mechanical process, typically shredding or grinding, to produce small, granulated particles known as crumb rubber. The use of crumb rubber in brick manufacture involves incorporating recycled rubber into the brick-making process. This is typically done by mixing finely ground rubber particles with clay or concrete to create a composite material for brick production. Overall, incorporating crumb rubber into brick manufacture is an innovative approach to sustainable construction.

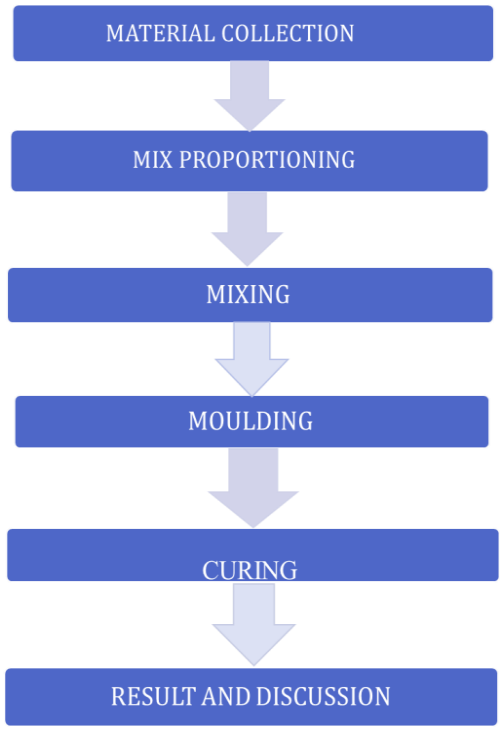
Fig:1 crumb rubber

4.1.4 GGBS

Ground Granulated Blast Furnace Slag (GGBS) is a valuable byproduct derived from the iron and steel industry's production process. To obtain GGBS, molten iron slag is rapidly cooled through quenching in water or steam, resulting in the formation of glassy granules. These granules are then finely ground into a powder. Comprising primarily silicates and alumina-silicates of calcium, GGBS serves as a supplementary cementitious material.

Fig:2 GGBS

4.2 METHODOLOGY

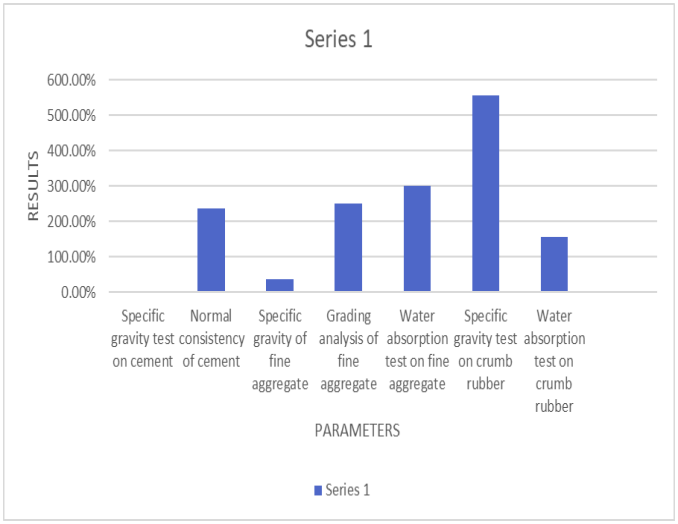


5. RESULT AND DISCUSSIONS

5.1 RESULTS

Table -1: Initial Test results on materials

Initial Tests Results			
SL NO	**Parameters**	**Unit**	**Initial results**
1.	Fineness of cement	cm^2/g	4.6%
2.	Specific gravity test on cement	-	2.37
3.	Normal consistency of cement	%	36%
4.	Specific gravity of fine aggregate	-	2.52
5.	Grading analysis of fine aggregate	%	3
6.	Water absorption test on fine aggregate	%	5.55
7.	Specific gravity test on crumb rubber	-	1.55
8.	Water absorption test on crumb rubber	%	0.044
9.	Specific gravity test on GGBS	-	2.78



Graphical representation 0f initial test

Final results

Table 2: Compression Strength Test

% of usage of 10% crumb rubber & % of GGBS	14 days compressive strength in N/mm2			
	Specimen 1	**Specimen 2**	**Specimen 3**	**Average**
5%	6.4	6.1	6.5	6.33
10%	7.1	7.3	7.0	7.13
15%	7.9	8.1	7.9	7.96
20%	7.5	7.6	7.3	7.46

Highest strength of 7.96 is achieved for 15% of usage of GGBS and 10% CR.

Replacement of crumb rubber & GGBS for coarse aggregate	28 days of compressive strength in N/mm2		
	Specimen 1	Specimen 2	Average
5%	8.2	8.5	8.35
10%	8.7	8.9	8.8
15%	9.2	9.3	9.25
20%	8.6	8.8	8.7

Highest strength of 9.25 is achieved for 15% of usage of GGBS and 10% CR.

Table 3: Water Absorption Test

Replacement of crumb rubber & GGBS by coarse aggregate in %	14 days of water absorption test (%)
5%	4.5
10%	4.3
15%	3.9
20%	4.1

Highest strength of 4.5 is achieved for 5% of usage of GGBS and 10% CR.

Replacement of crumb rubber & GGBS by coarse aggregate in %	28 days of water absorption test
5%	4.6
10%	4.5
15%	3.8
20%	3.9

Highest strength of 4.6 is achieved for 5% of usage of GGBS and 10% CR.

Table 4: Efflorescence Test

Replacement of crumb rubber & GGBS by coarse aggregate in %	14 days of efflorescence test
5%	Nil
10%	Nil
15%	Nil
20%	Nil

Highest strength achieved nil of usage of GGBS and 10% CR.

Table 5: Carbon Attack Test

Replacement of crumb rubber & GGBS by coarse aggregate in %	Depth of carbon attack in mm
5%	3
10%	2
15%	2
20%	3

Highest strength of 3 is achieved for 5% and 20% of usage of GGBS and 10% CR.

CONCLUSION

The crumb rubber and GGBS used in the manufacturing of masonry bricks using 1:3 mix ratio and 0.50 water cement ratio. The compressive strength of the bricks is tested for 14 days and 28 days and got highest strength of 7.96 N/mm^2 and 9.25 N/mm^2 is achieved for 15% of usage of GGBS and 10% CR. For water absorption test we got the value of 3.9% and 3.8% for 15% of usage of GGBS and 10% CR. For efflorescence test we got (zero) nil of usage of 15% GGBS and 10% CR. For carbon attack test we got 3mm depth for 15% of usage of GGBS and 10% CR.

REFERENCE

[1] "Achieving masonry brick sustainability using crumb rubber and GGBS" Blessen s Thomas, Hamsah T, Khalil, Science direct, Volume 160,12 May 2023.

[2] "Utilization of GGBS for the brick industry and new generation building materials" Priyadarshini M, Ruchi Smitha Mahakhud, Jyothi Prakash Giri, Science Direct, 2023.

[3] "Partial replacement of crumb rubber in masonry brick" A. Charan, M. R. Wakchaura and Mr. Prashant. International Journal of Innovative Research in Science, Engineering and Technology, Volume 11, Issue 5, May 2022.

[4] "Influence of Ground Granulated Blast Furnace Slag (GGBS) as Cement Replacement on the Properties of Sand Cement Brick" Noor azlina Abdul Hamid. International journal of sustainable construction engineering and technology. Vol 13 NO. 4 (2022) 338-349,2022.

[5] "Evaluation of concrete bricks with crumb rubber under impact loading" Ankush thakur, Senthil kasilingam, amrit pal singh. Volume 315, Science Direct,10 Jan 2022.

[6] "Crumb rubber in masonry brick". Rachit Sharma, A. P Singh, K Senthil, Volume 32, Part 4 Science Direct,2020.

[7] "Crumb rubber concrete for practical application in masonry brick design and processing "Rajeev Raychand, Rabecca Gravina, Tom Benn, Xing Ma. Volume 260, Science Direct,10 November 2020.

[8] "Improving the masonry bricks ductility using mortar bed joint from rubber tire crumbs". Faizah, Bekhiti, Eldin. Journal of Physical Science. Vol – 29 Supp.2, 117-132, 2018.

BIOGRAPHIES

NAME: Mr. SUJAN B Y
8TH Sem Civil Engineering
Rajeev institute of technology
Hassan
Email: sujansuju2428@gmail.com

NAME: Ms. SUMALATHA L D
8TH Sem Civil Engineering
Rajeev institute of technology
Hassan
Email: sumalathald88@gmail.com

NAME: Ms. SWATHI K R
8TH Sem Civil Engineering
Rajeev institute of technology
Hassan
Email:
swathikrswathikr29@gmail.com

NAME: Mr. PURUSHOTHAM
8TH Sem Civil Engineering
Rajeev institute of technology
Hassan
Email:
purushothampriya7@gmail.com