IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 4, June 2024

Result Analysis on Compressive Strength with Portland cement M15 and M20 Grade Aggregate

Shishupal Singh Jodon[1] and Raushan Kumar[2]

Research Scholar, Department of Civil Engineering[1]

Assistant Professor, Department of Civil Engineering[2]

Eklavya University, Damoh M.P, India

Abstract: *According to the experiment's findings, when the percentage of sand replaced by crumb rubber and coarse aggregate replaced by EPS increased, the prepared M15 and M20 concrete brick samples' water absorption increased but their bulk density and compressive strength decreased. In comparison to regular brick, the experiment's findings demonstrated that concrete brick produced with EPS and crumb rubber in place of some of the coarse aggregate and sand had a sufficient compressive strength. The nominal maximum size of sand, coarse aggregate, crumb rubber and EPS used for the construction of concrete brick sample were discovered as 2.36 mm, 12.5mm, 2.36 mm and 4.75 mm respectively from the sieve analysis. The coarse aggregate obtained had an impact value of 17.06 percent*.

Keywords: Expanded Polystyrene, Crumb Rubber, Grade M20, M15 Concrete Samples, Concrete Brick's Bulk Density, Compressive Strength, Water Absorption

I. INTRODUCTION

The most widely used fine aggregate for making concrete is the natural sand mined from the riverbeds. However, the availability of river sand for the preparation of concrete is becoming demand due to the excessive nonscientific method of mining from the riverbeds, lowering of water table, sinking of the bridge piers, etc. Thus, there is high demand for the identification of substitute materials for the river sand for making concrete. The choice of materials to replace sand in concrete depends on a few factors such as their availability, physical properties, and chemical ingredients. The present demands identification of substitute materials for the river sand for making concrete. A recent successful study on the use of crumb rubber as a new brick material supplement appears to be viable solution not only to the environmental problem but also to the problem of to economic design of building. Large quantity of wastes used in this research is currently disposed in sanitary landfills or open dumped into uncontrolled waste pits and open areas. Similarly, Expanded polystyrene (EPS) can be used as a replacement for coarse aggregate. EPS refers to a strong, durable and lightweight thermoplastic product. EPS is usually white and is made of expanded polystyrene beads. EPS is suitable for the packaging and construction industries due to its light weight, high strength and excellent thermal insulation properties. EPS is highly resistant to biological corrosion. It also reduces the effects of moisture and water vapor, so it is used as a insulation product. EPS is posing a threat to waste disposal as well as for waste management. This material is a cause of concern to environmentalists.

The advantages of replacing sand by crumb rubber for the production of concrete brick are:

1. Lightweight
2. Low thermal conductivity
3. Good sound absorption
4. High flexibility

Similarly, the advantages of replacing coarse aggregate by EPS for the production of concrete brick are:

1. Extremely durable
2. High thermal insulation
3. Resistance to moisture
4. Easily recyclable
5. Versatile in strength

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, June 2024

6. Light weight and portable
7. Manufactured into different shapes, sizes and compression materials
8. High shock absorbency characteristics
9. Compression resistance

These replacement exhibits many benefits over the traditional concrete including reduction in weight of the structure by reducing the dead loads transmitted to the foundation. Replacement of coarse aggregate by EPS becomes more economical as compared to using sand and aggregate in concrete brick. So, in this study, it is attempted to partially replace fine aggregate by crumb rubber and coarse aggregate by EPS beads.

II. RESULT AND DISCUSSION

The overall experimental result obtained from the tests carried out in lab is shown in table below:

Sample Type	Compressive Strength (N/mm^2)	Bulk Density (KN/m^3)	Water Absorption (%)
For M15 Grade concrete			
A	19.08	24.36	2.61
B	16.85	22.56	2.97
C	13.24	21.63	3.24
D	9.41	20.3	3.56
For M20 Grade Concrete			
E	26.08	24.23	2.31
F	18.05	23.9	2.47
G	15.45	22.61	2.67
H	13.76	21.21	2.71

Table 1- Overall result of M15 and M20 concrete brick

The result obtained from the experiment shows that compressive strength and bulk density of the sample decreases with increase in percentage contain of crumb rubber and EPS whereas water absorption of the sample increases with increase in percentage contain of crumb rubber and EPS.

(i) Variation of compressive strength with bulk density- Figure 1 shows the graph between Compressive strength and bulk density of M15 and M20 grade sample. The graph shows that the compressive strength of concrete brick sample increases with increase in bulk density. Average value of compressive strength and bulk density of M15 grade concrete brick sample type A, B, C and D were plotted. Thus, the result obtained shows that compressive strength is directly proportional to bulk density. The graph of M20 shows that compressive strength increases with increases in bulk density.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, June 2024

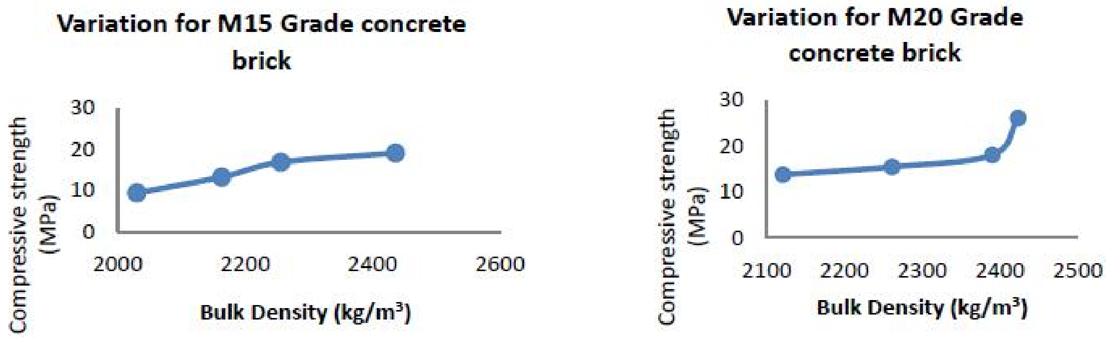


Figure 1- Variation of Compressive strength with bulk density of M15and M20 grade sample

(ii) Variation of compressive strength with water absorption-Figure 2 shows the relation between average value of compressive strength and water absorption for M15 grade concrete brick. The graph was plotted from the experimental results obtained for the sample type A, B, C and D. Thus, the result obtained shows that compressive strength decreased with increased in water absorption value. Similarly, the relation between average value of compressive strength and water absorption for M20 grade concrete brick. The graph was plotted from the experimental results obtained for the sample type E, F, G and H. Thus, the result obtained shows that compressive strength decreased with increased in water absorption value.

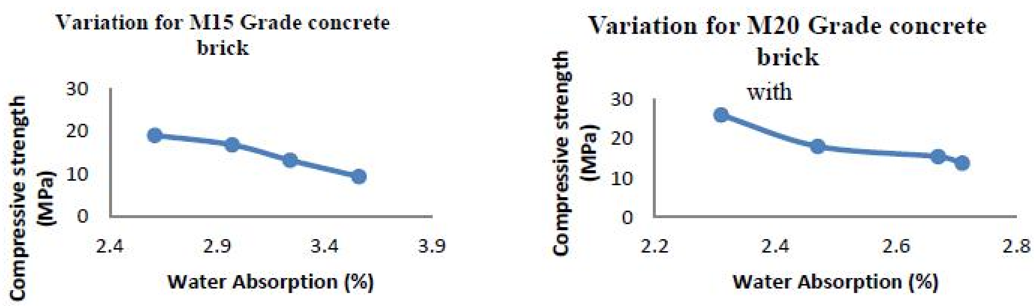


Figure 2- Variation of Compressive strength water absorption of M15 and M20 grade sample

(iii) Variation of bulk density with water absorption- Figure 3 shows the relation between average value of bulk density and water absorption for M15 and M20 grade concrete brick. The graph was plotted from the experimental results obtained for the sample type A, B, C and D. Thus, the result obtained shows that bulk density decreased with increased in water absorption percentage.

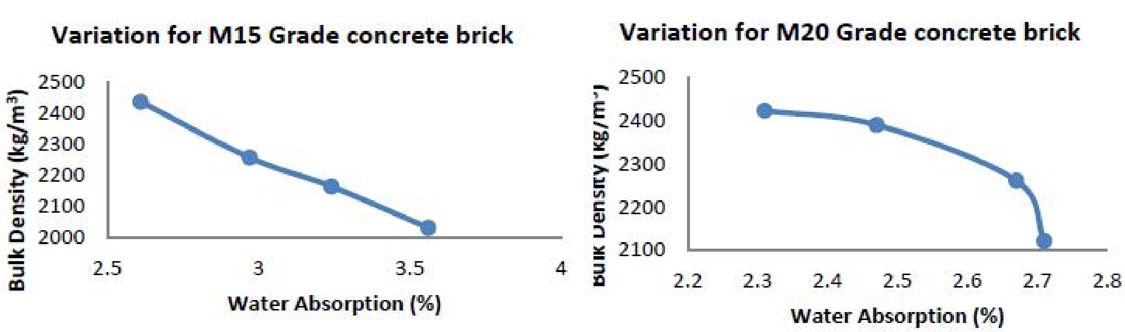


Figure 3- Variation of bulk density with water absorption of M15 grade sample

IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 4, June 2024

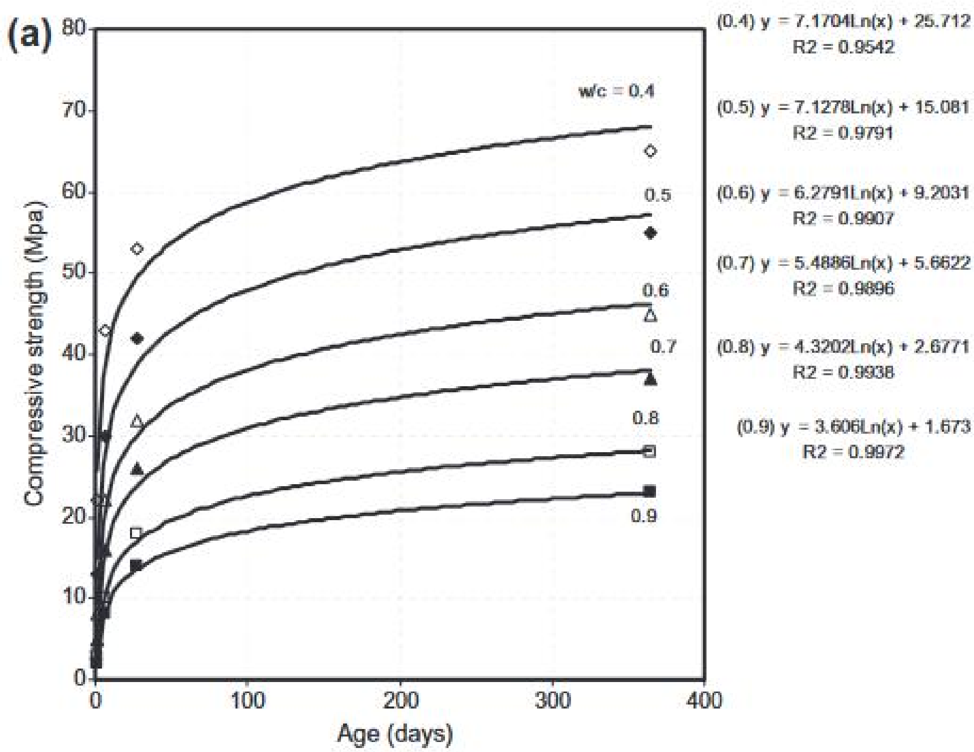
III. STRENGTH DEVELOPMENT FOR PORTLAND CEMENT CONCRETE

The Portland cement concrete strength level and rate of gain are dependent on many factors. Hydration rate and percentage are two factors related to the used cement. Besides the used cement, there are many factors contributing to both of strength level and its rate of gain at different ages. Mix composition, aggregate type and properties, temperature degree, curing time and method are some factors among the factors affecting both strength level and gain rate at different ages. The experimental results for Adnan are considered to investigate the relationship between age and strength of Portland cement concrete at normal temperature (20 °C). Figure 4a and b show the relationship between age and strength for concrete mixes containing w/c from 0.4 up to 0.9. Regression lines of the form f t = A ln(t) + B could be drawn for the given results with a correlation coefficient greater than 0.97. So, the relationship between age and compressive strength for concrete mixes could take the following shape:

$$f_t = A\ln(t) + B$$

where, (f t) is the compressive strength at age (t) days and (A) and (B) are constants. Considering the regression equation for concrete strength with age as given the value of constant (B) could be

understood as the intersected part of the strength axis by the regression line. It changes from mix to other depending on the values of the compressive strength along with the age. That constant will be denoted as the level of strength constant (grade constant). Whereas, the constant (A) denotes the slope of the regression line that will be called rate of strength gain constant (rate constant). Experimental data pertinent to values of compressive strength fc at different ages for a large number of concrete mixes are gathered from several research papers. For each concrete mix, the compressive strength versus age is plotted then a regression curve is fitted of the form given in Eq. (9) from which the values of the constants A and B are estimated.



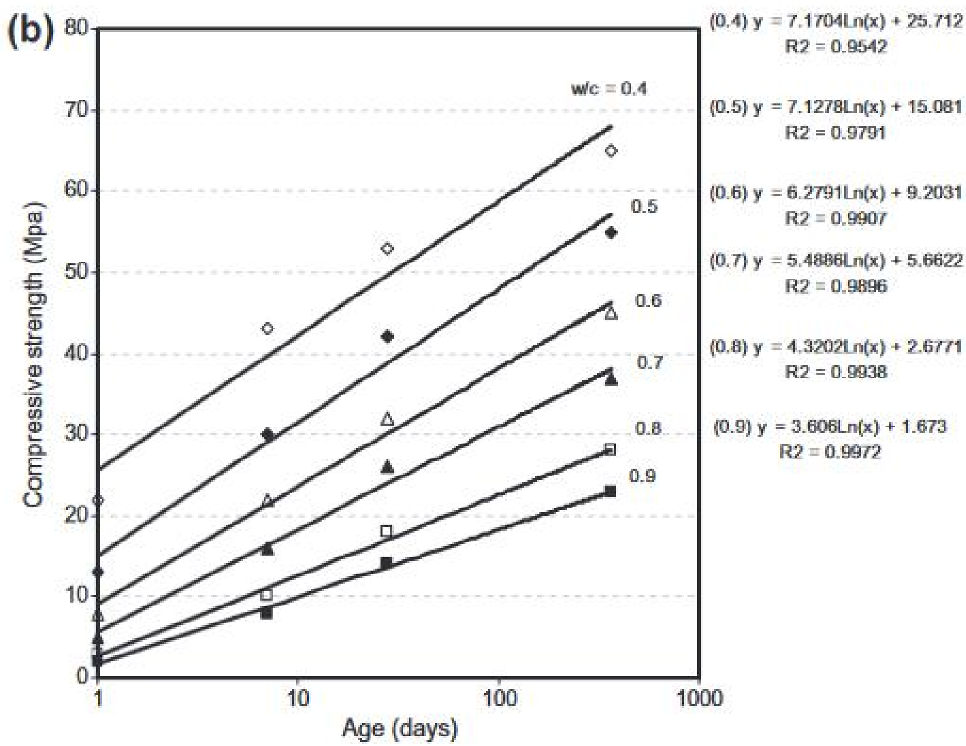


Figure 4- Relationship between compressive strength and age for concrete mixes (a) Normal scale and (b) log scale

IV. CONCLUSION

When the percentage content of crumb rubber and EPS was increased from 0% to 30% as a partial replacement of sand and coarse aggregate, respectively, the compressive strengths of M15 and M20 concrete brick reduced from 10.08 to 9.41 MPa and 26.08 to 13.76 MPa, respectively. Similarly, while increasing the percentage content of crumb rubber and EPS as partial replacement of sand and coarse aggregate, respectively, from 0 to 30%, the bulk densities of M15 and M20 concrete brick decreased from 24.36 to 20.3 KN/m3 and 24.23 to 21.21 KN/m3, respectively. This demonstrated that adding more EPS and crumb rubber to concrete brick makes it lighter. Similarly, M15 and M20 concrete brick's water absorption rose from 2.61 to While increasing the percentage content of EPS and crumb rubber to partially replace sand and coarse aggregate, respectively, from 0% to 30%, the corresponding percentages were 2.56% and 2.31 to 2.71%. The findings showed that as the fraction of sand replaced by crumb rubber and coarse aggregate by EPS increases, so does water absorption.

REFERENCES

[1] M.S. Shetty, Concrete Technology Theory and Practice, S. Chand & Company Ltd., New Delhi, 2006 (Chapter 7).

[2] ACI 318–11, Building Code Requirements for Structural Concrete and Commentary.

[3] ECP 203Egyptian Code for Designing and Executing the Building Works, 2nd ed., HBRC, Egypt, 2009.

[4] A. Duff, Design of Concrete Mixtures Bulletin No. 1, Structural Materials Laboratory, Lewis Institute, Chicago, 1918, p. 20.

[5] F.A. Oluokun, Fly ash concrete mix design and water–cement ratio law, ACI Materials Journal 91 (4) (1994) 362–371.

[6] K.G. Babu, G.S.N. Rao, Efficiency of fly ash in concrete with age, Cement and Concrete Research 26 (3) (1996) 465–474.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, June 2024

[7] C. Yeh, Generalization of strength versus water–cementitious ratio relationship to age, Cement and Concrete Research 36 (2006) 1865–1873.

[8] ASTM C 1074–93, Standard Practice for Estimating Concrete Strength by the Maturity Method.

[9] J.W.A. King, Further Notes on the Accelerated Test for Concrete, Chartered, Civil Engineering, 1957, pp. 15–19.

[10] V.M. Malhotra, Accelerated strength testing is it a solution to a contractor's dilemma?, Concrete International 3 (1981) 17–21

[11] N. Garino, Tests and Properties of Concrete, ASTM STP 169C, 1994.

[12] J.J. Beaudoin, V.S. Ramachandran, A new perspective on the hydration characteristics of cement phases, Cement and Concrete Research 22 (4) (1992) 689–694.

[13] S.A. Mironov, L.A. Malinina, Accelerated Concrete Hardening (in Russian), International Transport Research Documentation (ITRD) (in English), Stroiizdat, Moscow, 1964.

[14] P.C. Hewlett, Lea's Chemistry of Cement and Concrete, Elsevier Butterworth-Heinemann, New York, 2005 (Chapter 6).

[15] A. Colak, A new model for the estimation of compressive strength of Portland cement concrete, Cement and Concrete Research 36 (7) (2006) 1409–1413.

[16] A. Givi, S. Rashid, F. Aziz, M. Salleh, The effects of lime solution on the properties of SiO2 nanoparticles binary blended concrete, Composites B 42 (3) (2011) 562–569.