International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES),(UGC APPROVED)
Impact Factor: 5.22 (SJIF-2017),e-ISSN:2455-2585
"International Conference on Modern Trends in Civil Engineering"(ICMTCE-2019)
(Towards Sustainable Development Goals)
Volume 5, Special Issue 02, Feb.-2019

A Review article on Non-Conventional Building Materials

Vishwa Deepak[1], Mohd. Zain[2], Shubham Srivastava[3]

[1]M.Tech (Pursuing) Shri Ramswaroop Memorial University
[2&3]Assistant professor Faculty of Civil Engineering Department Shri Ramswaroop Memorial University

Abstract: ***Our earth has finite stock of natural resources and natural resources are depleting rapidly for meeting human development goals while at the same time the waste material generated from industries and other human activities are increasing substantially. As a result, sustainable development becomes a very important aspect for preserving our ecosystem and securing it for generations to come while still moving towards development. The sustainable development in the field of construction involves the use of non conventional and innovative materials and recycling waste materials in order to compensate for the limited availability of natural resources. Various studies and researches are being performed to find replacements for conventionally used materials in preparation of cement, concrete and other building material such as bricks, steel, timber wood etc. Proper studies and tests are required on the modified product made from non-conventional substitute materials to make sure we are not compromising with the stability and durability of the structure. In this review studies performed on various substitute materials for concrete such as copper slag, rubber tyres will be compared.***

Keywords: Concrete, copper slag, rubber tyres, flexural strength

Introduction

In India about 290 million tonnes of inorganic waste products are being generated due to industrial and mining activities. Disposal of these waste products can cause environmental pollution. These waste products have huge potential to be used in construction industry. In this review we will compare and conclude to what extent we can use these waste products in concrete and how much it affects the strength, durability and performance of concrete.

Copper Slag

Copper slag is a by product material which is produced in industries during the smelting and refining process of copper. It contains silica (Sio2) like sand and has physical properties similar to sand. Therefore copper slag is an ideal replacement for river sand which is used as fine aggregate in concrete. Copper slag is a waste product of low cost material therefore it can help in reducing the cost of concrete.

Abhishek H Honnakkalavar performed various tests on M25 grade of concrete which was prepared according to the guidelines laid down by IS 10262:2009 with replacement of fine aggregates by copper slag. The mix proportion obtained is 1:1.66:2.66 (C:FA:CA) with waster cement ration of .50% and copper slag was added at varying percentage of 0% , 20% , 40% , 60%, 80% in replacement of fine aggregates. Results showed that 40% replacement of fine aggregate by copper produced maximum values of compressive strength, split tensile strength and flexural strength. The 7^{th} day and 28^{th} day compressive strength was 30.52 N/mm^2 and 32.4 N/mm^2 respectively. Split tensile strength at 40% replacement of fine aggregate by copper slag was 2.77 N/mm^2 and flexural strength was 4.1 N/mm^2

M.V. Patil performed similar test on concrete of grade M 30 by replacing natural sand with copper slag as fine aggregate and he also studied water absorption in copper slag in comparison to natural sand. According to test results it was found copper slag has lower water absorption as compared to natural sand. Water absorption values were about 0.65% for copper slag and 1.01% for natural sand. So it can be concluded copper slag can increase workability of concrete mix due to the presence of more free water as compared to natural sand. It was found that concrete achieved maximum compressive strength at 20% replacement of fine aggregate. Compressive strength after 7 days and 28 days with 20% copper slag were 36.33 N/mm^2 and 48.13 N/mm^2 respectively

Brindha, Baskarn and Nagan performed experimental study on various corrosion and durability tests on concrete containing copper slag as partial replacement of sand and cement. Compressive strength and split tensile strength showed that copper slag is superior to corresponding control concrete and corrosion rate of copper slag admixed uncoated rebar is somewhat higher when compared to controlled specimens. But when the rebar is coated with zinc phosphate paint the corrosion rate became zero.

Alnuaimi used copper slag as replacement for fine aggregate in RC slender column and found replacement of up to 40% of fine aggregates with copper slag caused no major changes in column failure load increasing the ratio of copper slag to fine aggregates reduced the concrete strength and column failure load and increase concrete slump, lateral and vertical deflection

Madhavi studied the behaviour of retaining walls against seismic forces using copper slag as backfill material instead of sand. It was found that retaining walls with copper slag backfill showed lesser faces deformations compared with sand.

Tamil Selvi P studied the workability parameters of concrete containing copper slag in fresh state and compressive strength, split tensile strength and flexural strength in hardened state. Based on the observations of experimental work it was found that compressive strength at 7^{th} and 28^{th} day was maximum for concrete containing 40% copper slag. At 7^{th} day compressive strength was 26.49 n/mm^2 and at 28^{th} day compressive strength was 35.64 n/mm^2. The maximum split tensile strength was found to be at 40% fine aggregate replacement of about 3.09 n/mm^2. The flexural strength was found maximum at 40% fine aggregate replacement of about 7.73 n/mm^2.

Rubber Tyre

The Indian automotive industry has registered almost double digit growth during last fiscal year. The total vehicle sales in India during 2018 grew by 9.2% with total sales of about 4.02 million units. Keeping such significant growth in automotive market we can conclude that it will also result in increase of waste products such as discarded rubber tyres, spare parts etc. Strategically recycling of these waste products can save our environment from pollution. Discarded rubber tyre waste can be utilized in the construction for replacement of coarse aggregates.

Zunaithur Rahman performed experimental investigations on concrete prepared by replacing coarse aggregate with rubber aggregates. These rubber aggregates were prepared by mechanically cutting the discarded waste tyres. Maximum nominal size of rubber aggregates was kept equal to 20mm.Slump value and compressive strength of 0% , 10%,20%,30% was tested. Slump value of concrete containing 10% rubber aggregates was maximum i.e. 73mm.Average compressive strength at 14 days and 28 days was maximum for concrete containing 10% rubber aggregates. At 14 days compressive strength was 20.19 N/mm^2 and at 28 days compressive strength was 23.11 N/mm^2 .Weight of concrete significantly decreased from 8.431kg (0% rubber aggregates) to 7.624 kg for

concrete containing 10% rubber aggregates and it was least for concrete containing 30% coarse aggregate i.e. 6.815 kg.

Malek K. Batayneh studied compressive strength , split tensile strength and flexural strength of concrete containing rubber content in form of rubber crumbs. The compressive strength , split tensile strength and flexural strength was found maximum for concrete containing 20% rubber crumb content. Compressive strength for concrete containing 20% rubber crumb was found 18.290 MPa , split tensile strength was 1.840 MPa and flexural strength was 2.550 MPa.

M. Mavroulidou studied the characteristics of concrete containing rubber content in form of coarse aggregates and fine aggregates. Based on his experimental observations it was found that average loss in compressive strength of concrete increased with the increase in percentage of rubber content in form coarse aggregate and fine aggregate . It was observed that minimum average loss in compressive strength after 7 days of curing occurred when 10% of fine aggregates were replaced by rubber content. 32% loss in average compressive strength occurred when 10% of fine aggregate were replaced with rubber content .Whereas 53% loss in average compressive strength occurred after 7 days of curing when 10% of coarse aggregate were replaced by rubber content.

Kaloush K.E based on his observations of experimental tests on concrete containing rubber content concluded that compressive strength of concrete decreases significantly with the increase in rubber content and this decrease in compressive strength occurs due to the presence of entrapped air. So the compressive strength of rubberized concrete can be improved by adding some de-airing agents into rubberized concrete.

Conclusion

- Concrete containing 35-40% copper slag as replacement of fine aggregate produced most satisfactory results in terms of compressive strength of concrete
- Copper slag improves the workability of concrete because of its less water absorbing property.
- Density of concrete containing copper slag is higher when compared to control mix concrete.
- Concrete with scrap rubber aggregates produced satisfactory results for 10% replacement of coarse aggregate.
- Concrete containing copper slag showed better performance in terms of compressive, flexural and split tensile strength as compared to concrete with scrap rubber aggregates.
- Concrete with scrap rubber aggregate showed reduction in density as compared to concrete with copper slag and control mix concrete.
- Concrete with scrap rubber aggregate shows some ductile behaviour before failure.
- Concrete with fine rubber aggregate has higher compressive strength as compared to concrete with coarse rubber aggregates.

References

[1] Abhisheka H Honnakkalavar , Mohammed Asif , Shivaleela F Kallaganad , Vinay R , Ganesh S , B Shivakumar , Experimental Study on concrete using Copper Slag as Replacement Material of Fine Aggregate, Dept. of Civil Engineering, STJ Institute of Technology, Ranebennur, Karnataka, India , Vol 5 **(2018)**

[2] Tamil Selvi P, Laxmi Narayan P , Ramya G , Experimental Study on Concrete Using Copper Slag as Replacement Material of Fine Aggregate , Department of Civil Engineering, Dr. Sivanthi Aditanar College of Engineering , Tiruchendur ,Tamil Nadu , India **(2014)**

[3] M. C. Nataraja , G. N. Chandan , T. J. Rajeeth , Concrete mix design using copper slag as fine aggregate, Department of Civil Engineering , Sri Jayachamarajendra College of Engineering , Mysore , India , Vol 9 pp 90-99 **(2014)**

[4] Brindha , D. Baskaran , T Nagan , Assessment of Corrosion and Durability Characteristics of Copper Slag Admixed Concrete , International j. Civil and Structural Engineering , Vol , pp. 192-211 **(2010)**

[5] AS Alnuaimi , Department of Civil and Architectural Engineering, Sultan Qaboos University, Al-Khoud, Muscat, Sultanate of Oman , Vol 9 , pp. 90-102 **(2012)**

[6] M. V. Patil , properties and effects of copper slag in concrete , Applied Mechanics Department, S.V. National Institute of Technology, Surat, Gujarat ,India , Vol 2 **(2015)**

[7] Anwar Khitab, Ishtiaq Arif, Faheem Aslam Awan, Ateeq Anwar, Adil Mughal , Use of Waste Rubber Tyre in Concrete , Department of Civil Engineering, Mirpur University of Science and Technology , Mirpur, Pakistan , Vol 3 **(2017)**

[8] Zunaithur Rahman , Jeyamugesh. S., Sivaranjani. S., and Vijayaraghavan. J. Study on Waste Rubber Tyre in Concrete for Eco-friendly Environment , Vol 1 **(2016)**

[9] India Brand Equity Foundation. www.ibef.com

[10] M. Chockalingam , D.Jayganesh , J.Vijayaraghavan , Dr.J.Jegan , Scope for reuse of copper slag in concrete, Highways Department, Natham, Tamil Nadu, India, Vol 4 , pp. 89-100 **(2013)**

[11] Nouman Khattak , Umer Ammar Mahmood , Nouman Khattak , Use of Rubber as Aggregate in Concrete, Department of Civil Engineering, University of Engineering and Technology Peshawar Pakistan , Vol 4 **(2015)**

[12] M. Mavroulidou , J. Figueiredo , Discarded Tyre Rubber as concrete aggregate : A possible outlet for used tyres , Department of Urban Engineering , London South Bank University , London , UK , Vol 12 , pp 359-367 **(2010)**