Recent Road Development Its Future Problem and Remedies

[1] Dr. Rashmi Bade, [2]Shekhar Punde,[3]Jagruti Bhat, [4]Sahil Meshram, [5]Pratiksha Wasnik, [6]Aavesh Khan
[1]*Head of Department, Anjuman College of Engineering and Technology, Nagpur, India*
[2,3,4,5,6] *Student of Graduation, Anjuman College of Engineering and Technology, Nagpur, India*

***Abstract*— Recent Road development in our country is at point of attention. The economic growth of country is depended on transportation and supply of materials with respect to demand. For effective transportation it is very necessary to build long life, high strength and durable roads. Nowadays to increase the service life and strength of roads they are built up of concrete. Concrete pavement gives high strength, long service life and durability as compared to flexible and asphalt pavement. In this research we focused on the future problem generating during service life of concrete pavement. The main problem is to be found that the depletion of surface coating which causes the polishing of aggregates. The polishing of aggregates causes the skidding of vehicles. To achieve the skid resistance and polishing resistance, the use of ceramic waste as a coarse aggregate one of the effective solutions. At the end of experiment target strength is achieved.**

Keywords- Ceramic waste; Conventional concrete; Coarse aggregate; Target strength; Compression test.

I. INTRODUCTION

Due to greater durability and lower maintenance costs, concrete pavements are more competitive than asphalt pavements in areas where rigid pavements are required. The construction and demolition waste consist of numerous materials like concrete bricks, ceramic, wood, glass, metals, plastic and other. This has a large influence on the environment and leads to sever pollution and greenhouse gas emission. in particulars, the mass production of ceramics, which has a high mechanical strength as well as high resistance to abrasion and chemicals has also resulted in an increased amount of ceramic waste. The manufacturing industry, service industries, construction and demolition work and municipal solid waste generate several waste materials. The rising awareness of the environmental has immediately contributed to the anxieties associated with the reuse of these wastes generated. Utilization of these wastes will lay to the reduction of usage of naturally occurring conventional construction materials which in turn are draining the natural resources, meanwhile making concrete much economical. Huge amount of ceramic waste is being produced in India. This research work is based on making concrete with replacing of coarse aggregate with ceramic waste. These experiments were performed to determine the density, workability, and mechanical strength parameters like compressive strength of concrete. During the polishing process of ceramic tiles, plenty of ceramic polishing residue (CPR) is generated. In order to evaluate the reutilization of CPR as a supplementary cementitious material (SCM) in mortar/concrete, and investigate its effects on the strength and durability, a series of mortar mixes containing different CPR contents were made for conducting compressive strength test. It is found that adding CPR as a SCM up to 20% could still markedly improve the compressive strength and chloride resistance, while at the same time reduce the waste disposal, cement consumption and carbon footprint for sustainable development. Moreover, the cementing efficiency factor of the CPR in 28-day compressive strength was generally higher than 1.5. Coarse aggregate is replaced by the ceramic waste

II. LITERATURE REVIEW

Guoyang Lua, Zepeng Fanb, Zengqing Sund their research says that Recycling of construction and demolition (C&D) waste is one of the most effective ways to develop sustainable pavements. In this study, the feasibility of using ceramic waste as an alternative source for fine aggregate to improve the polishing resistance of cement mortar is investigated. The recycled fine aggregates used in this study originate from sanitary ceramic waste; the physical and chemical properties of the Recycled Ceramic Aggregates (RCA) were determined. The optimal RCA content in the mortar was determined based on the mechanical strength of the resulting composite. The polishing resistance of course and fine RCA was characterized with the Polished Stone Value (PSV) test and the Wehner/Schulze (W/S) test, respectively. The test results indicate that the polishing resistance of RCA is significantly better than that of commonly used mineral aggregate.

A.M. Mustafa Al Bakri, M.N. Norazian, H. Kamarudin, M.A.A. Mohd Salleh, and Alid -This research was focused on ceramic wastes obtained from the industry in Malaysia. Recently, in the ceramics industry, much of the material becomes waste, and it is not recycled. It has been estimated that about 30% of the daily production in the ceramics industry goes as waste. In this study, an attempt was made to determine the suitability of the industrial ceramic wastes as a possible substitute for conventional crushed stone coarse aggregate. The concrete mixes containing recycled ceramic waste aggregates achieve strength levels between 80 to 95 % compared to the conventional concrete.

R.M. Senthamarai et al. (2005) substituted conventional crushed stone aggregate with ceramic electrical insulator. Different water cement ratio of 0.35, 0.40, 0.45, 0.50, 0.55 and 0.60 were adopted. Compressive strength, split tensile strength, flexural strength and Modulus of elasticity were found out. It is found that the compressive, split tensile and flexure strength of ceramic coarse aggregate are lower by 3.8%, 18.2% and 6% respectively when compared to conventional concrete.

III. MATERIAL USED

- Ceramic Waste as Coarse Aggregate:

Ceramic wastes, such as flowerpots, tiles, and brick ware were broken into small pieces of about 5 - 40 mm in size by a hammer. These small pieces were fed into vibrator and then sieved to obtain the required sizes of 14 - 20 mm. Fig. 1 shows the sample of ceramic waste coarse aggregate.

- Other Components of the Concrete Mix:

In conventional concrete, crushed stone is used as coarse aggregate and river sand is used as fine aggregate. Coarse aggregate is usually gravel or crushed stone. The size range from the ¼ inch to the maximum size permitted for the job. River sand as fine aggregate consist of particles ¼ inch or less in size. Crushed stone and river sand are commonly use as aggregate in concrete to provide higher volume at lower cost. Ordinary Portland cement, locally available river sand and natural stone aggregate of maximum size 20 mm were used in the conventional concrete.

- Admixture: polypropylene is a admixture was used.

Fig. 1. Admixture

- Mix proportions:

The constituent used were divided into different fractions to determine the mix proportions that would yield the targeted compressive strength at a test age of 7 days. The optimum mix proportions included the optimum ratio of the coarse aggregate, sand, cement and water to give the best properties. Three types of ceramics waste as coarse aggregate mixes were designed by the volumetric method with different water-cement ratio (0.4, 0.5 and 0.7). The conventional concretes mixes were designed with crushed stone coarse aggregate. The volume of individual ingredients was the same for both the ceramic waste coarse aggregate concrete and conventional concrete mixes. In a concrete mixing, the water, cement and sand (as fine aggregate) content used is equal to the conventional concrete mix but it differs according to its aggregate roughness.

Fig. 2. Ceramic waste material

IV. OBJECTIVES

This project aims to characterize the locally available ceramic waste, towards best possible application in increasing strength and durability of concrete roads, through suitable techniques. This study involves technique for improvement of concrete with the help of recycled ceramic waste material.

The incorporation of RCA as fine aggregates in concrete pavements is a promising approach for adding value to pavement engineering while recycling ceramic waste. It can reduce the amount of ceramic waste that is disposed of in landfills, decrease the requirement of the mineral material extracted from natural quarries while improving the polishing resistance of cement mortar.

V. METHODOLOGY

Procedure:

For Normal Concrete Cubes:

First of all, we cleaned the empty cubes plates for better settlement on base plate. Each plate size of 150mm x150mm. After cleaning plates, nine cubes were to be prepared by fixing nuts and bolts tightly. On each Inner side of plates of cubes gracing was done. Due to which the concrete does not stick with plates.

The quantity of cement, sand, aggregates and water was to be taken out specifically as per calculation which is given in annexure. The weighing machine was used for measuring the quantity of each item. Each weighted material was sends to concrete mixer machine for proper mixing purpose. The mixed mortar then laid down on water tight surface.

Then filling of cubes started. Each cube filled with three layers of mortar. Each one of layer of concrete tapered 45 times with the help of tapering bar for proper settling or fixation. After preparing all 9 cubes of conventional concrete proceeds to vibrate under the vibrating machine. It was carried out for 2 minutes for each cube. After vibration these cubes were placed for curing under environmental certain for 24 hours.

Next day all molds extract from cubes and placed under open surrounding for 2 to 3 hours. After that all cubes were send for curing under water for 7days, 14 days, and 28 days. After completion of curing period a compressive strength test will be carried out on each cube.

Fig. 4. cubes of conventional concrete

For ceramic waste cubes

Same procedure was followed, we cleaned the empty cubes plates for better settlement on base plate. Each plate size of 150mm x150mm. After cleaning plates, nine cubes were to be prepared by fixing nuts and bolts tightly. On each Inner side of plates of cubes gracing was done. Due to which the concrete does not stick with plates. The quantity of cement, sand, ceramic waste, aggregates and water was to be taken out specifically as per calculation which is given in annexure. The weighing machine was used for measuring the quantity of each item. Each weighted material was sends to concrete mixer machine for proper mixing purpose. The mixed mortar then laid down on water tight surface. Then filling of cubes started. Which was done for 20%, 25% and 30% mix. Each cube filled with three layers of mortar. Each one of layer of concrete tapered 45 times with the help of tapering bar for proper settling or fixation. After preparing all 9 cubes of conventional concrete proceeds to vibrate under the vibrating machine. It was carried out for 2 minutes for each cube.

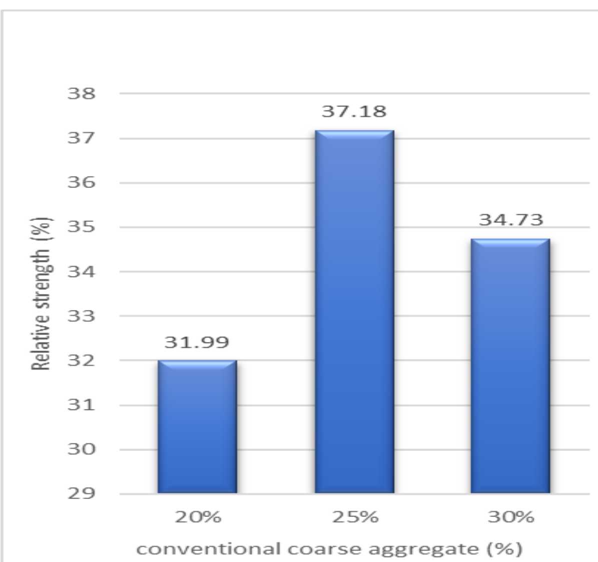
After vibration these cubes were placed for curing under environmental certain for 24 hours. Next day all molds extract from cubes and placed under open surrounding for 2 to 3 hours. After that all cubes of

20%, 25% and 30% mix were sent for curing under water for 28 days. After completion of curing period a compressive strength test will be carried out on each cube.

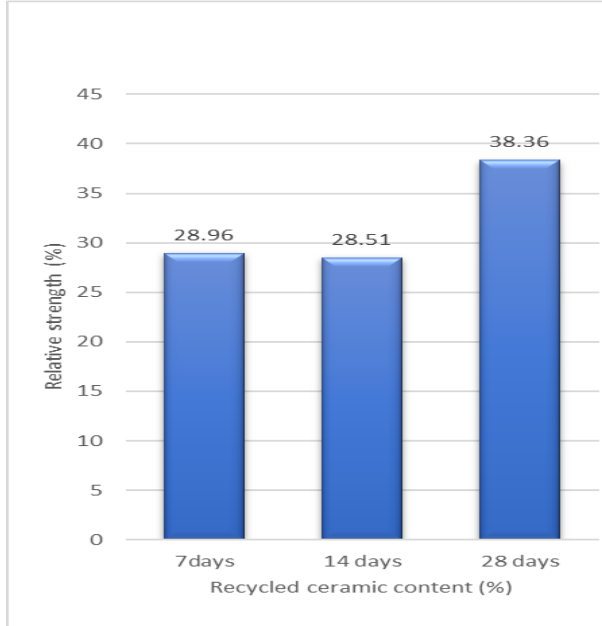
Fig.5. Cubes of ceramic waste concrete mix

Fig.6. compression test machine

VI. RESULT



Graph 1. Results Using Conventional Materials



Graph 2. Results of Replaced Materials

The compressive strength of cement is found as follows:

USING CONVENTIONAL MATERIALS

1. At 7 days: 28.96 N/mm2.
2. At 14 days: 28.51 N/mm2.
3. At 28 days: 38.36 N/mm2.

USING REPLACED MATERIALS

1. At 28 days [20%]: 31.99 N/mm2.
2. At 28 days [25%]: 37.18 N/mm2.
3. At 28 days [30%]: 34.73 N/mm2.

VII. CONCLUSIONS

The target strength is achieved at 28 days by using ceramic waste as a coarse aggregate. It proves that when ceramic waste used as partial replacement of coarse aggregate provide resistance against the polishing of aggregate and also provide skid resistance.

REFERENCE

1. Strength of Concrete Based Cement Using Recycle Ceramic Waste As Aggregate A.M. Mustafa Al Bakri, M.N. Norazian, H. Kamarudin Advanced Materials Research Vol. 740 (2013) pp 734-738.
2. Improving the polishing resistance of cement mortar by using recycled ceramic

Guoyang Lua,b,c , Zepeng Fanb , Zengqing Sund , Pengfei Liub , Zhen Lengd,∗∗, Dawei Wanga,b,∗ , Markus Oeser ,Resources, Conservation & Recycling 158 (2020) 104796.

3. Lu, G., Liu, P., Wang, Y., Faßbender, S., Wang, D., Oeser, M., 2019. Development of a sustainable pervious pavement material using recycled ceramic aggregate and biobased polyurethane binder. J. Clean. Prod. 220, 1052–1060.
4. Torgal, F.P., Jalali, S., 2011. Compressive strength and durability properties of ceramic wastes based concrete. Mater. Struct. 44 (1), 155–167.
5. Adding ceramic polishing waste as paste substitute to improve sulphate and shrinkage resistances of mortar L.G. Li,Z.Y. Zhuo, J. Zhu, A.K.H. Kwan. Volume 362, 15 February 2020,149-156
6. Effects of existing concrete pavement condition on performance of unbonded jointed plain concrete overlay by Gauhar Sabih, Rafiqul A. Tarefder journal of traffic and transportation engineering 2019;6(6):567-576
7. Reutilizing ceramic polishing waste as powder filler in mortar to reduce cement content by 33% and increase strength by 85% L.G. Li, Z.Y. Zhuo, J. Zhu a, J.J. Chen, A.K.H. Kwan.Volume 355, October 2019,119-126
8. Properties of Cement Mortars Modified with Ceramic Waste Fillers Wioletta Jackiewicz-Rek , Kamil Załęgowski, Andrzej Garbacz, Benoit Bissonnette. Volume 108, 2015, 681-687
9. Use of recycled concrete aggregates in asphalt mixtures for pavements: A review, Juan Gabriel Bastidas-Martínez, Fredy Alberto Reyes-Lizcano Volume 9, Issue 5, October 2022,725-741
10. Potentialities of cement-based recycled materials reinforced with sisal fibers as a filler component of precast concrete slabs Paulo R. Lopes Lima, Alex B. Roque, Cintia M. Ariani Fontes, José M. Feitosa Lima, Joaquim A.O. Barros. 2017, 399-428
11. Sustainable reuse of ceramic waste powder as a supplementary cementitious material in recycled aggregate concrete: Mechanical properties, durability and `microstructure assessment. Xuyong Chen, Di Zhang, Shukai Cheng. Volume 52, 15 July 2022, 104418
12. Effects of recycled ceramic aggregates on internal curing of high performance concrete Fengming Xu, Xiaoshan Lin. Volume 322, 7 March 2022, 126484
13. A review on utilization of recycled concrete aggregates (RCA) and ceramic fines in mortar application. N. Garg, S. Shrivastava. Volume 73, Part 1, 2023, Pages 64-73 Durability of concretes bearing construction and demolition waste as cement and coarse aggregate substitutes. B. Cantero, I.F. Sáez del Bosqu, M.I. Sánchez de Rojas. Volume 134, November 2022, 104722
14. Senthamarai R.M., P.Devadas Manoharan: Cem. Concr. Compos. Vol. 27 (2005), p. 910.
15. Nehdi Monce, Khan Ashfaq: Cem. Concr. Agg. Vol. 23(1) (2001), p. 3.
16. Basri H.B., Mannan M. A., Zain M. F. M.: Cem. Concr. Res. Vol. 29 (1999), p. 619.
17. Padmini A. K., Ramamurthy K., Mathews M. S.: Concr. Res. Vol. 53 (6) (2001), p. 367.
18. Palmquist Shane M, Jansen Daniel C, Swan Christopher W.: J. Mater. Civil Eng. Vol. 13(5) (2001), p. 389.
19. Akhtaruzzaman A. A., Hasnat A.: Concr. Inter. Vol. 5(2) (1983), p. 58.
20. Chi Sun Poon and Dixon Chan: Constr. Build. Mater. Vol. 20 (2004), p. 569.
21. References European Commission, 2016. EU Construction & Demolition Waste Management Protocol.
22. IS:456 -2000 "Code of Practice for Plain and Reinforced Concrete".
23. IS:10262 -2009 "Code of Practice for concrete mix design proportioning"'.
24. IS:10262 -2019 "Code of Practice for New-Mix-design".
25. IRC:58-2015"Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Fourth Revision)".