Experimental Study on Partial Replacement of Coarse Aggregate by Ceramic Tiles and Fine Aggregate by Quarry Dust&Copper Slag in Concrete

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Abstract- The cost of concrete can be reduced by the usage of this waste products Partial replacement for coarse and fine aggregate. The main objective of this investigation is to study experimentally the effect of partial replacement for course by ceramic tile and fine aggregate by copper slag and quarry dust on the various strength properties of concrete by using the mix design of grade. Test specimen with 0%, 15% ,30% ,45% of partial replacement for coarse by ceramic tile and fine aggregate by copper slag and quarry dust were cast and tested for various strength after curing period of 28 days. Based on these experimental investigation, it is concluded that the effective utilization of waste materials obtained from the starlight industries, as aggregate gave good results for concrete when compared to the natural aggregate concrete Some of the industrial by-products have been used in the construction industry for the production of concrete. Copper slag is one of the materials that is considered as a waste material which could have been used in construction industry as partial replacement of fine aggregates. For this research work, grade concrete was used and the tests were conducted for various proportions of copper slag replacement with sand of 0%, to 45% in concrete. The obtained results were compared with those of control concrete made with sand.

Keywords: natural sand, alternative materials, quarry dust, copper slag, ceramic tiles.

I. INTRODUCTION

The possible effects of recycled aggregate upon concrete properties such as workability, strength and durability have been discussed in several paper. In ceramic industry, about 30% production goes as waste.The development of concrete properties was observed by substitution of crushed stone coarse aggregate with crushed wasted ceramic aggregate and sand fine aggregate with quarry dust aggregate. The main objective of this research is to study the performance of concrete with ceramic waste aggregate and quarry dust fine aggregate.Concrete is a composite material composed of water, coarse granular material (the fine and coarse aggregate or filler) embedded in a hard matrix of material (the cement or binder) that fills the space among the aggregate particles and glues them together. Concrete is widely used for making architectural structures, foundations,brick or block walls, pavements, bridges or overpasses, highways, runways, parking structures, dams, pools/reservoirs, pipes, footings for gates, fences and poles and even boats. Concrete is used in large quantities almost everywhere mankind has a need for infrastructure.Copper slag is used in the concrete as one of the alternative materials. It is the waste product of copper from Sterlite Industries India Ltd, Tuticorin. The safe disposal of this waste is a lack, costly and causes environmental pollution. The construction industry is the only area where the safe use of waste material (copper slag) is possible. When it is introduced in concrete as a replacement material, it reduces the environmental pollution, space problem and also reduces the cost of concrete.

II. MATERIALS USED

A. Cement

Cement, commonly Portland cement, and other cementitious materials such as fly ash and slag cement, serve as a binder for the aggregate. The cement used in this study is of OPC 53 grade conforming to IS 12269.

B. Fine Aggregate

The Fine aggregate used in this research for preparation of normal concrete is natural river sand conforming to grading zone-II as per IS: 383-1970 with specific gravity 2.6 and having fineness modulus as 3.42. The amount of fines less than 0.125 mm is to be considered as powder and is very important for the theology of the SCC. This material is dried at room temperature for 24 hours to control the water content in the concrete. The maximum size of FA is taken to be 4.75 mm. The testing of sand is done as per IS: 2386 – 1963. The sieve analysis

C. Coarse Aggregate

Coarse aggregate are the crushed stone is used for making concrete . The commercial is quarried, crushed and graded. Much of the crushed stone used is granite, limestone and trap rock. Graded crushed stone usually consist of only one kind of rock and is broken with sharp edged. The sizes are from 0.25 to 2.5 inch (0.64 to 6.35cm) although larger sizes may be used for massive concrete aggregate Machine crushed granite broken stone angular in shape was used as coarse aggregate. The maximum size of coarse aggregate was 20mm and specific gravity of 2.78.

D. Water

Water is then mixed with this dry composite, which produces a semi-liquid that workers can shape (typically by pouring it into a form). The concrete solidifies and hardens to rock-hard strength through a

chemical process called hydration. The good quality water is used in this study.

E. Ceramic tiles

Ceramic waste is a recycled aggregate is coming in to the ceramic industry. Ceramic waste is generated as a waste during the process of cutting, and marking. In this project study an attempt has been made to find the suitability of the ceramic industrial wastes as a possible replacement for conventional coarse aggregate. Mainly this type of recycled aggregate is used for the developments of concrete with non-conventional aggregates to improve the properties of concrete and reduce the cost.

F. Quarry dust

In quarry dust industry, the quarry dust production goes as waste. The source of quarry dust was from the Pan Industries Sdn Bhd Batu Pahat, Perlis. The quarry dusts are sieved until the fine aggregate was achieved is close to sand fine aggregates. The sizes of the quarry dust fine aggregate are between 2.36 mm

G. Copper slag

Copper slag is a by-product obtained during matte smelting and refining of copper. One of the greatest potential applications for reusing copper slag is in cement and concrete production. The use of copper slag in cement and concrete provides potential environmental as well as economic benefits for all related industries, particularly in areas where a considerable amount of copper slag is produced.

III. OBJECTIVES

- The main objective of the present investigation is to evaluate the possibilities of using quarry dust and copper slag a replacement to fine aggregate.
- The study of replacement coarse aggregates with ceramic waste. .

IV. LITERATURE REVIEW

Gurpreet Singh, Rafat Siddique (2011): This paper evaluates the strength and durability properties of concrete mixtures, in which natural sand was partially replaced with quarry dust. Compression strength test and splitting tensile strength test were carried out to evaluate the strength of the concrete at the age of 7, 28 & 91 days. As a result maximum increase in compressive strength, splitting tensile strength and modulus of elasticity of concrete was observed with 15%, both at 28 and 91 days. Construction and Building materials-January 2012, pp 13-14. EFFECT OF QUARRY DUST PARTIAL REPLACEMENT OF SAND ON THE STRENGTH, ULTRASONIC PULSE VELOCITY AND PERMEABILITY OF CONCRETE

Md Daniyal, Shakeel Ahmad (2007): Using these waste in concrete production could be an effective measure in maintaining environment and improving the properties of concrete. The compressive and flexural strength of optimal concrete was found 5.43% and 32.2% higher than reference concrete. Analysed the flexural strength of waste concrete 32.2% higher than flexural strength of reference concrete. The greater compressive strength was observed for C5-10 concrete. International Journal of Innovative Research in Science, Engineering and Technology vol-4, Issue 12, December 2015, pp 12808-12815. APPLICATIONS OF WASTE CERAMIC TILE AGGREGATES IN CONCRETE

Rafat Siddique, Geert De Schutter (2008): In the partial replacement of fine aggregate with quarry dust, the tests such as compressive strength test, splitting tensile strength test, flexural strength test and modulus of elasticity test were conducted. Results of this investigation suggest that quarry dust could be very conveniently used in making good quality concrete and useful construction materials. Construction and building materials 23(2009) ,pp 976-980. EFFECT OF QUARRY DUST ON THE MECHANICAL PROPERTIES OF CONCRETE

Hemanth Kumar, Ananda Ramakrishsna(2015) : This paper is to study the suitability of waste crushed tiles in the concrete mix and to understand the behaviour and performance of ceramic solid waste in concrete. Authors have studied to understand the combined behaviour of ceramic materials with partial replacement of coarse and fine aggregates at different compositions .As the result is maximum compressive strength is obtained for the mix having 20% of tiles powder and 10% of crushed tiles. Increase in tiles powder leads to increasing in workability of concrete was observed. International Advanced Research Journal in Science Engineering and Technology Vol 2, Issue 6, June 2015, pp 13-16 EFFECT OF WASTE CERAMIC TILES IN PARTIAL REPLACEMENT OF COURSE AND FINE AGGREGATE OF CONCRETE

Vema Reddy, S.Sridhar (2015): In this study, mainly concern with the mechanical properties of concrete by partial replacement of artificial sand by quarry dust as fine aggregate. Authors have studied to know the fresh concrete properties of quarry dust concrete and also the behaviour of compressive and split tensile strength of foundry sand. The result of this study is to increase the compressive and split tensile strength up to 60% and will decrease after 60% up to 100% was observed. SSRG International of Civil Engineering (SSRG-IJCE) – volume 2 Issue 12 December 2015, pp 5-12. USAGE OF QUARRY DUST IN CONCRETE

J.swathi,Ms.V.gnanadevi (2015): In this project control concrete is casted for M40 grade and the partial replacement of concrete material were decided to reuse industrial waste such as copper slag as fine aggregate replacement in rang 20%,40%,60% by weight of sand and ceramic waste tile as course aggregate replacement in 10% , 20% ,30% by weight of coarse aggregate. The replacement of copper slag has attain high strength of at 40% replacement, compression strength attain 58.5Mpa at 28days and split strength attain 4.48 Mpa. As per ASTM C1202 the value obtained for all partial replacement. International journal of Emerging Technology in Computer science &

Electronics(IJETCSE) ISSN:0976-1353 Volume 13 Issue 4- MARCH 2015 PARTIAL REPLACEMENT OF COPPER SLAG FOR FINE AGGREGATE AND CERAMIC WASTE WITH COARSE AGGREGATE.

Suresh Reddy.S, Kishore Kumar.M (2013): The concrete made of copper slag replacing sand up to 50% are used to study the strength and flexural strength of both M30 and M40 grade of concrete mixes. Sand was replaced with copper slag in proportion of 0-50%. The compressive strength of concrete mix increases up to 40% replacement of sand by copper slag the age of both 28 and 56 days. The split tensile strength and flexural strength of concrete mix increases up to 40% replacement of sand by copper slag the age of both 28 and 56 days. Internal journal of mechanical engineering and computer application, vol 1, Issue 7, December 2013, ISSN 2320-6349. UTILIZATION OF COPPER SLAG AS A PARTIAL REPLACEMENT OF FINE AGGREGATE IN CONCRETE.

D.Brindha and S. Nagan (2015): This study report the potential use of granulated copper slag from sterile industries as a replacement for sand in concrete mixes. Leaching studies demonstrate that granulated copper slag does not pave way for leaching of harmful element like copper and iron present in Slag. The percentage replacement of sand by copper slag were 0%,5%,10%,15%,20%,30%,40% and 50%. The compressive strength was observed to increase by about 35-40% and split tensile strength by 30-35%. The experimental investigation showed that percentage replacement of sand by copper slag shall be up to 40%. . International journal of Emerging Technology in Computer science & Electronics (IJETCSE) ISSN: 0976-1353 Volume 13 Issue 4- MARCH 2015 REPLACEMENT OF FINE AGGREGATE WITH COPPER SLAG.

P. Pradeep, Rama Mohan Rao .P (2014): In this paper M30 grade of concrete has been used for the entire study. The replacement both the material is done individually as 10%-50%. It is recommended that up to 10-40% of copper slag can be replacement for fine aggregate. 10-20% of quarry dust can be used. The compression strength high in C2 mix in 7 and 28 days of copper slag replacement ratio of 10-30% and quarry dust 10-20% replacement ratio is obtained strength. The split tensile strength of the concrete is high in 10-30% replacement ratio in both copper slag and quarry dust concrete mix. International journal of engineering (IJE), Singaporean journal of scientific Research (SJSR) vol 6. No.2 2014 Pp. 89-94. STUDIES ON INFLUENCE OF COPPER SLAG AND QUARRY DUST AS FINE AGGREGATE REPLACEMENT IN CONCRETE.

MATERIAL REULTS

Cement

S.NO	PROPERTY	TEST RESULT
1	Specific gravity	3.05
2	Standard consistency	27%
3	Initial setting time	30min
4	Final setting time	10 hrs

Fine Aggregates

Physical properties	Values
Specific gravity	2.53
Fineness Modulus	2.68

Coarse Aggregates

Physical properties	Values
Specific gravity	2.80
Fineness Modulus	7.53

VI. EXPERIMENTAL INVESITIGATION

For any successful investigation numerous test have to be performed and the trend of result should be carefully before arriving at the final conclusion. To realize the result from the tests experimental set up and testing procedures are required. Material characteristics are the following:

Ordinary Portland cement 53 grade Specific gravity of 3.05

Locally available sand with fineness modulus of 2.86 and Specific gravity of 2.61.

Locally available coarse aggregate fineness modulus of 5.27 and Specific gravity of 2.78.

Copper slag in granular from with fineness modulus of 3.22 and Specific gravity of 3.93.

Water confirming to the requirements of water of concreting and curing.

Mix proportions for normal conventional concrete.

- ***Compression test Results***

SPECIMEN NO	COMPRESSION TEST N/	COMPRESSION TEST N/
DAYS	7 DAYS	14 DAY
NORMAL	14.40	18.32
MIX 15%	15.17	18.41
MIX 30%	18.43	19.32
MIX 45%	16.73	18.31

IX. CONCLUSION

- ✓ It is found that compressive strength of concrete mix is increases and it was maximum up to 30% replacement after that it reduces gradually.
- ✓ It is also found that split tensile strength increases up to 30% replacement after that it also reduces gradually.
- ✓ Workability of concrete mix increase with increase in percentage of quarry dust and waste ceramic tiles as compare to regular concrete.
- ✓ Disposing the waste ceramic tiles and quarry dust in an economical manner.
- ✓ Maximum Compressive strength of concrete increased by 15 % replacement of fine aggregate, and up to 30% replacement ,concrete gain more strength than normal concrete strength.
- ✓ It is observed that up to 30% replacement of natural sand by copper slag, the flexural strength of concrete is increased by 32%. and all percentage
- ✓ Replacement of fine aggregate by copper slag the flexural strength of concrete is more than normal mix.
- ✓ Compressive strength and flexural Strength is increased due to high toughness of copper slag. As the percentage of copper slag increases workability increases in concrete.

REFERENCES

- Sani D, moriconi G, Fava G,Corinaldesi V. Examined the mechanical behavior of concrete manufactured with recycled aggregate. Waste manage 2005; 25:177-82.
- Augustine UcheElinwa and Yakubu Abba Mahmood. Studied the Ash from timber waste as partial replacement of cement. Cement Concrete Composites 2002.
- Bashar Taha. Conducted properties of concrete contains mixed colour waste recycled glass as cement replacement.J.Mater.Civ.Eng.2009.
- Roz-Ud-Din Nassar and ParvizSoroushian. Studied the strength of recycled aggregate concrete containing milled glass as partial replacement for cement. Construction and Building Materials.2012.
- Alnuaimi AS,(2012), "Effects of Copper Slag as a Replacement for Fine Aggregate on the Behavior and Ultimate Strength of Reinforced Concrete Slender
- Columns", TJER,Vol. 9, No. 2, pp 90-102.
- Ariño Antonio M.Barzin Mobasher, (1999), "Effect of Ground Copper Slag on Strength and Toughnessof Cementitious Mixes", ACI Materials Journal, Vol. 96, No.1, pp 68-74.
- Barnett Stephanie J., Marios N. Soutsos, John H. Bungey, Steve G. Millard,
  (2007), "Fast-Track Construction with Slag Cement Concrete: Adiabatic Strength Development and Strength Prediction", ACI Materials Journal, V. 104, No. 4, pp388-396. Brindha D. And S. Nagan, (2011), "Durability Studies on Copper Slag Admixed Concrete", Asian Journal of Civil Engineering (Building and Housing), Vol. 12,