PARTIAL REPLACEMENT OF CEMENT WITH MARBLE DUST POWDER AND ADDITION OF POLYPROPYLENE FIBRES

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ABSTRACT - To use concrete as a load bearing member it is necessary to increase tensile resistance property of the concrete member. This phenomenon is achieved from hundred year back or more by using primary reinforcement and also by the Application of pre stressing. Both of the two methods provide tensile strength to the structural element but do not increase the inherent tensile strength of concrete matrix itself. The overall performance of reinforced concrete composite material is affected then the individual performance of the concrete itself. This led to the search for new material i.e. two phase composite material in which weak concrete matrix is reinforced with strong fibre to produce composite of superior property and high performance. In two phase composite fibrous material, fibres inhibit the deformation of the concrete matrix and impact to increase the properties of stiffness and strength. The main purpose of adding fiber to concrete is to achieve superior properties of plain concrete.
In this investigation the mechanical properties of fibre reinforced concrete is studied by replacing cement with marble dust powder and addition of polypropylene fibre with different weight fractions with respect to cement.

1. INTRODUCTION

It has been estimated that several million tons of MDP are produced during quarrying worldwide. Hence utilization of marble powder has become an important alternative materials towards the efficient utilization in concrete for improved harden properties of concrete. Marble is a metamorphic rock resulting from the transformation of a pure limestone. The purity of the marble is responsible for its colour and appearance it is white if the limestone is composed solely of calcite (100% CaCO3). Marble is used for construction and decoration; marble is durable, has a noble appearance, and is consequently in great demand. Chemically, marbles are crystalline rocks composed predominantly of calcite, dolomite or serpentine minerals. A large quantity of MDP is generated during the cutting process. The result is that the mass of marble waste which is 20% of total marble quarried has reached as high as millions of tons. Leaving these waste materials to the environment directly can cause environmental problem.
Moreover, there is a limit on the availability of natural aggregate and minerals used for making cement, and it is necessary to reduce energy consumption and emission of carbon dioxide resulting from construction processes, solution to this problem are sought through usage of MDP as partial replacement of cement. In India, MDP is settled by sedimentation and then dumped away which results an environmental pollution, in addition to forming dust in summer and threatening both agriculture and public health. Therefore, utilization of the MDP in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the environment. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently and the environment is protected from waste deposits.

2. OBJECTIVE OF THIS STUDY

- Study of the effect of using Marble Dust Powder as a replacement and Polypropylene as admixture in concrete and its benefits.
- Improve the overall durability and long-term performance of concrete structures.
- An approach towards the use of the alternative materials as concrete thereby reducing the burden on main ingredients.
- Reducing pollution by using waste materials like marble dust powder and fibers.
- Comparative cost study between plain cement concrete and concrete having partial cement replacement with MDP and addition of polypropylene Fibers.

3. LITERATURE REVIEW

Alhozaimy, A.M., et al (1995) carried out experimental investigations on the effects of adding low volume fractions of calculated fibrillated polypropylene fibres in concrete on compressive flexural and impact strength with different binder compositions. They observed that polypropylene fibres have no significant effect on compressive (or) flexural strength, while flexural toughness and impact resistance showed increased values. They also observed that positive interactions were also detected between fibres and pozzolans.

Bentur, (2007). (Hasan Et Al., 2011 Roesler Et Al. (2006), the addition of polypropylene fibres does not have a significant effect on the direct tensile cracking strength (Bentur, 2007). However, in moderate volume replacements (0.33-0.5%) the addition of macro-synthetic polypropylene fibres showed a 10 to 15% increase in splitting tensile strength.

B. V.M. Sounthararajan et.al (2013) they found that the MDP up to 10% by weight of cement was investigated for hardened concrete properties. Furthermore, the effect of different percentage replacement of MDP on the

compressive strength, splitting tensile strength and flexural strength was evaluated. A phenomenal increase in the compressive strength of 46.80 MPa at 7 days for 10% replacement of MDP in cement content was noted and also showed an improved mechanical property compared to controlled concrete

Patil. V. A 2013 did an experimental investigation on polypropylene fiber reinforced concrete by replacing river sand to artificial sand with or without admixture which shows that addition of 0.5% of polypropylene fiber shows maximum compressive and tensile strength.

A. Manju Pawar et.al (2014) A Study has been conducted on Periodic Research, The Significance of Partial replacement of Cement with Waste Marble Powder Partial replacement of cement by varying percentage of marble powder reveals that increased waste marble powder (WMP) ratio result in increased strengths of the mortar and concrete Thus they found out the optimum percentage for replacement of MDP with cement and it is almost 12.5 % cement for both compressive & tensile strength.

Mohod. V. M 2015 studied the effects of addition of various proportions of polypropylene fibres on the properties of high strength concrete (M30 and M40 mixes). . A notable increase in the compressive, tensile and flexural strength was observed. However, further investigations were highly recommended and should be carried out to understand more mechanical properties of fibre reinforced concrete.

Chaid. R et.al 2015 studied on the influence of marble powder on high performance concrete behaviour in which he concluded that the marble powder is suitable for the formation of high performance concretes (HPC) and their properties are significantly better compared to the reference concrete(RC).His analysis showed that on addition of 15% content of marble powder with a fineness modulus of 11500cm^2/g, in concrete in a chloride environment contributes positively to the perfection of its mechanical characteristics, its durability with respect to migration of chloride ions and oxygen permeability.

Kore. D, 2016 studied the impact of marble waste as coarse aggregate on properties of lean cement concrete. The main objective of this study was utilization of marble waste as a replacement for conventional natural coarse aggregate in concrete. Conventional natural aggregate was replaced by marble aggregate in different percentages 0-100% by weight with water- cement ratio of 0.60 for concrete formulations.. It was observed that workability of concrete mixes containing marble aggregate was 14% more than that of control concrete. The average compressive strength of all the concrete mixes containing marble aggregate increased by 40% and 18% at 7 and 28 days...

Artir.Ret.al 2016 studied the durability properties such as water adsorption and permeability, chloride penetration and carbonation, sulphate attack and abrasion resistance, and lastly performance at high temperature and freezing and thawing cycle of conventional or self-compacting concrete were investigated.. As a result, it was found out that the use of waste marble in the conventional or self-compacting concrete mix as an admixture material or aggregate is suitable as it can improve durability properties of the concrete. Especially, properties of water absorption & permeability and resistance of chloride penetration & sulphate attack were improved by incorporation of waste marble in concrete.

Prof. Veena, G. Pathan studied the Feasibility and Need of use of Waste Marble Powder in Concrete Production. Test results indicate that the 10% of marble dust in the cement concrete gives the best results. And also increase in curing days will increase the strength of marble dust concrete when compared from 14 days to 28 days.

4. PURPOSE AND EFFECT OF ADDING FIBERS IN CONCRETE

Plain, unreinforced concrete is a brittle material, with a low tensile strength and a low strain capacity in order to improve these parameter sugarcane is added to pcc and also to increase resistance to impact and toughness. It is of course, cheaper ways of increasing the strength of concrete. The fibers are able to hold the matrix together even after extensive cracking. The polypropylene in concrete matrix reduces micro-cracking and shrinkage. The polypropylene fiber in plain cement concrete provide Multi-dimensionl secondary reinforcement and one more important requirement of sugarcane in concrete is to improve strength of concrete at lower volume reasonable cost and cannot reduce the requirement of primary reinforcement.

Proper mixture of fiber can make batter mechanical property of plain or reinforced cement concrete. Amount of fibre in concrete is within the specific limit. As we increase the percentage beyond 3%, it may reduce the workability of concrete mix and will given the formation of mat and balling which is difficult to separate by vibration. More the modulus of elasticity of fiber means higher the load carrying capacity of the structural element

More the L/W (aspect ratio) more will be the flexural strength and toughness of the concrete matrix. But impact resistance of micro fiber is generally greater for longer fiber. Smaller polypropylene fiber improves bridges action of micro-crack, and this leads to a higher the tensile strength of the concrete. Figure given below shows the effect of varying percentage of fibre in concrete specimen and conventional concrete. This increase in strength was due to the fibre bridging properties in the concrete. The fibre reinforced concrete was split as pull-out behaviour when the concrete crack. The control batch specimen containing no fibre failed suddenly once the concrete cracked. The fibre reinforced concrete has ability to absorb energy in the post-cracking state.

5. ADVANTAGES OF ADDING FIBRES TO CONCRETE

By adding fibres to concrete insane old method to achieve better mechanical properties of concrete. The following are the advantage of fibre reinforced concrete are as under:

1) Resistance against micro-cracking.
2) Resistance against impact
3) Resistance against fatigue
4) Primary reinforcement requires unnecessary labour.
5) Improves shear strength, tensile strength flexural strength
6) FRC reduce permeability of concrete matrix
7) Improves the Fatigue Strength of concrete.
8) Lowers the limit weight of concrete.
9) Increases the Elasticity of concrete.

6. APPLICATIONS OF MDP AND POLYPROPYLENE FIBRE

- These materials participate in the hydraulic reactions contributing significantly to composition and microstructure of the hydrated products.
- The use of marble powder dust offers cost reduction, energy savings, arguably superior products and fewer hazards in environment.
- Its addition helps in sustainable development.
- Marble powder adsorbs more water than cement. As a result, the ratio of water available for hydration is reduced leading to better mechanical strengths.
- The water demand is nil for polypropylene fibers.
- The orientation leaves the film weak in the lateral direction which facilitates fibrillations. The cement matrix can therefore penetrate in the mesh structure between the individual fibrils and create a mechanical bond between matrix and fiber.
- It avoids the creation of micro cracks in the concrete.
- It increases the lifetime of this piece of concrete – especially true where this is exposed to changing weather conditions.
- Improves impact and abrasion resistance.

7. SCOPE OF FURTHER

- Disposal problem of marble dust powder can be eliminated by effectively using it in concrete.
  - Sustainable Development.
- The cost required to produce concrete by using marble dust powder and polypropylene fibres is comparatively less as compared to normal concrete.
- The marble dust powder used in concrete makes the concrete mix more dense by occupying the pores.

REFERENCES

1. **Artir. R, Bilir.T, Ulubeyli .C.G "study of durability properties of concrete produced by marble waste as aggregate or mineral additives**".
a) Department of Civil Engineering, Bulent Ecevit University, Zonguldak, 67100, Turkey
b) Department of Metallurgical and Materials Engineering, Marmara University, Istanbul, 34722, Turkey. Procedia Engineering 161 (2016) 543 – 548.

2. **Chaid.R, Ghernouti. Y, Perrot. A "study of durability of concrete with marble powder".**
a)Laboratory of mineral & composite materials, University of Boumerdes, Algeria.
b) University of Brittany the south of Lorient, French 5th International conference on Environment science and engineering, vol.83 of IPCBEE (2015).V83.6.

3. **Kore. D. S, Vyas. A. K "study of impact of marble waste as coarse aggregate on properties of lean cement concrete".** Department of civil engineering, Malaria institute of technology, Jaipur, Rajasthan 302017, India. Case study in construction materials 4 (2016) 85-92.

4. **Mohod. V.M "study of performance of polypropylene fibre reinforced concrete"** Assistant professor, Department of Civil engineering, Prof. Ram Meghe institute of technology and research, Bandera, Amravati, India. IOSR journal of Mechanical and civil engineering(IOSR-JMCE) e-ISSN:2278-1684,p-ISSN:2320-334X, vol.12 , Issue 1 Ver.1(jan-feb.2015),PP 28-36 www.iosjournals.org

5. **Patil. V. A, Sathe. A. P "study of experimental investigation on polypropylene fiber reinforced concrete with artificial sand.**
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International journal of science and research (IJSR) ISSN (online):2319-7064 Index Copernics value (2013): 6.14.Imapct factor (2013):4.438.Volume 4 Issue 6, june 2015 www.ijsr.net

6. **B. V.M. Sounthararajan et.al (2013)** They found that the MDP up to 10% by weight of cement was investigated for hardened concrete properties

7. **Manju Pawar et.al (2014)** A Study has been conducted on Periodic Research, The Significance of Partial replacement of Cement with Waste Marble Powder Partial replacement of cement by varying percentage of marble powder reveals that increased waste marble powder (WMP) ratio result in increased strengths of the mortar and concre

8. **Vaidevi C (2013**) Study on marble dust as partial replacement of cement in concrete .ISSN 2319 – 7757.PP14-16.

9. Prof. Veena G. Pathan1, Prof. Md. Gulfam Pathan2 Feasibility and Need of use of Waste Marble Powder

in Concrete Production IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 23-26

10. Valeria Corinaldesi, Giacomo Moriconi, and Tarun R. Naik (2005) "Characterization Of Marble Powder for Its Use In Mortar And Concrete"

11. "International Journal of Civil and Structural Engineering Volume 1, No 4, (2011)." By Baboo Rai, Khan Naushad H , Abhishek Kr , Tabin Rushad S, Duggal S.K, (Influence Of Marble Granules In Concrete Mix).

12. Pooja. J. Chavhan et al Int. Journal of Engineering Research and Applications ISSN: 2248-9622 vol.4, April 2014.

13. **Bahar Demire (2010),** "The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete

14. **Saenz, A., Rivera, E., Brostow, W. and Castan˜o, V.M., "J. Mater," (Ed.),** Vol..21, No.267 (1999).

15. **Dodson, V.,** "Concrete and Mixtures" Van Nostrand Reinhold: Structural Engineering Series, New York (1989

16. **Ramaswamy, H. S., Ahuja, B. M.** and Krishnamoorthy, S., "J. Mex. Inst. Cement Concrete" Vol. 22 No. 161 (1984).