

EXPERIMENTAL INVESTIGATION OF PARTIAL REPLACEMENT OF CEMENT WITH MARBLE POWDER AND FINE AGGREGATE WITH GLASS POWDER

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Abstract – Due to urbanization, the usage of cement in the construction industry gets increased rapidly. Due to the increasing demand for cement, marble powder is used as a partial replacement of cement for economic status. Marble waste is a solid waste material generated from the marble processing and can be used as a filler material in cement while preparing concrete. Glass is unstable in the alkaline environment of concrete and could cause deleterious alkali-silica reaction problems. This property has been used to advantage by grinding it into a fine glass powder (GLP) for incorporation into concrete as a pozzolanic material. The use of Glass Powder in the present days as a substitute for cement is to increase the strength of cement concrete.

In this experiment, the behaviour of concrete using marble powder and glass powder are determining. The mix design is done for M25 grade concrete as per Indian Standard. The different percentage of powder (i.e.) marble powder and glass powder at the range of 10% to 20% by weight of cement were used. The concrete specimen with different percentages will cast, cure and test for 7, 14 and 28 days.

Keywords : Concrete, marble powder, glass powder, compressive strength, flexural strength, split tensile strength.

properly without polluting the environment. The most suitable inactivating method nowadays is recycling. Recycling provides with some advantages such as protecting the natural resources, energy saving, contributing to economy, decreasing the waste materials and investing for the future (Kaseva& Gupta, 1999).

Glass is an amorphous (non-crystalline) that in essence, a super-cooled liquid and not a solid. Glass can be made with excellent homogeneity in a variety of forms and sizes from small fibres to meter-sizes pieces. Primarily glass is made up of sand, soda ash, limestone and other additives (Iron, Chromium, Alumina, Lead and Cobalt). Glass has been used as aggregates in road construction, building and masonry materials.

Constituents of Glass:

Silica (SiO₂) - 72.5%

Alumina (Al₂O₃) - 1.06%

Lime (CaO+3) - 0.8%

Iron Oxide (Fe₂O₃) - 0.36%

Magnesia (MgO) - 4.18%

I. INTRODUCTION

These days apart from steel, concrete is the most and widely used as structural material in the construction field. Concrete defined as a composite materials made up of composed granular materials (the aggregate and filler) embedded in a hard matrix of materials (cement or binder) and water that fills the space between the aggregate particles and glues them together. There are many type of concrete with different materials used and mix design. Along with the addition of fibers and nanomaterial plays a predominant role in achieving better strength, durability, water tightness, abrasion resistance, volume stability and resistance to freezing and thawing.

Marble is a metamorphic rock resulting from the transformation of pure lime stone (Malpani, Jegarkal, Shepur,Kiran,&Adi, 2014). The rock is also one of the most important materials used in buildings since ancient times, especially for decorative purposes (Soliman, 2013). Turkey has the 40% of total marble reserve in the world. 7, 000,000 tons of marble have been produced in Turkey annually and 75% of these production have been processed in nearly 5000 processing plants. It can be apparently seen that the waste materials of these plants reach millions of tons. Stocking of these waste materials is impossible (Alyamac&Ince, 2009). These type solid waste materials should be inactivated

II. OBJECTIVE

The main objective of this project are :

- ✓ To determine the behavior of concrete with partial replacement of cement and fine aggregate.
- ✓ To conduct compressive strength, flexural strength, split tensile strength for concrete with marble and glass powder at various percentages are using.
- ✓ To compare the result with control specimen and individual concrete based on the strength and durability of the concrete.

III. LITERATURE REVIEW

They investigated the use of steel fiber, short discontinues strips of specially manufactured steel and the polypropylene fiber which is the thermoplastic and the by – product of petroleum and the study the compressive strength and compare it with control specimen. The cubes were weighted at 7, 14 and 28 days from the date of remolding and their behavior was plotted in graph against number of days of curing. **Abhijeet Bhawsar, Mayur Singi, Ajay Bidare** International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue:

07 | July-2018, "EXPERIMENTAL STUDY ON CONCRETE AS PARTIAL REPLACEMENT OF CEMENT BY GLASS POWDER". This paper deals with the use of Glass Powder in the present days as a substitute for cement is to increase the strength of cement concrete. The Glass Powder was replaced by 0%, 5%, 10%, 15%, 20% & 25% for 7, 14 & 28 days for Cubes for Compressive strength and Cylinder are casting for Split Tensile Strength and other properties like compacting factor and slump were also determined for three mixes of concrete. The use of cement and production of cement creates much more environmental issues & costlier. To avoid such circumstances, the content of cement is reduced in concrete and replaced by Glass Powder which reduces cost & increases strength & durability of concrete. The subsequent modification of the micro structure of cement composites improves the mechanical properties, durability and increases the service-life properties.

Ms.RuchiChandrakar, Mr.Avinash Singh International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 05 | May -2017 "Cement Replacement in concrete with Marble Dust Powder". This paper deals with the study total 42 cubes were casted. Marble product are mixed in concrete mix M-20 in different percentage (5%, 10%, 15%, 20%, 25%, and 30%) by weight. The cement was replaced by marble powder. After curing (7 and 28 days), cubes were tested.

The replacement of cement with 10% of marble powder gives the maximum compressive strength at both 7 days and 28 days curing period. It was found that marble dust available at every processing plant in huge quantity and its cost is very less compared to cement. So with the replacement of cement by marble dust a cost effective concrete can be achieved.

Jashandeepsingh, Er. R S Bansal International Journal of Technical Research and Applications e-ISSN: 2320-8163, Volume 3, Issue 2 "PARTIAL REPLACEMENT OF CEMENT WITH WASTE MARBLE POWDER WITH M25 GRADE". This paper deals with study the behaviour of concrete, having partial replacement of cement with waste marble powder M25 grade for which the marble powder is replaced by an experimental study was carried out and the effect on compressive strength and split tensile strength characteristics (0%, 4%, 8%, 12%, 16%, and 20%) was studied. The result of this present investigation indicates that the replacement of 12% of cement with waste marble powder attains maximum compressive and tensile strength. The optimum percentage for replacement of marble powder with cement and it is almost 12% cement for both cubes and cylinders and it also minimize the costs for construction with usage of marble powder which is freely or cheaply available more importantly.

MukulDutt Pandey, Abhay Kumar Jha International Journal for Scientific Research & Development| Vol. 4, Issue 05, 2016 "Effect of Glass Powder in High Strength Concrete". This paper deals with when this hydration process goes on it liberate some poisonous gases, there poisonous gases will affect the environment and harm the ozone layer, to reduce this effect on the environment some scientist and researchers concluded that cement which is major ingredient of concrete is partially replaced by waste material like Glass Powder. Basically Glass Powder is a by-product of Glass factories. Glass Powder is present on a satisfactory scale in India and also it shows a great pozzolanic properties, due to this Fly ash we can used as a partial replacement of cement. For this project High strength M60 concrete is designed by IS 10262 and M60 concrete cubes is casted and all mix is

prepared, after mixing concrete cube is casted then these cubes is tested for compressive strength and flexural strength.

Sonu Pal, Amit Singh, TarkeshwarPramanik, Santosh Kumar, International Journal for Innovative Research in Science & Technology Volume 3 Issue 03 "Effects of Partial Replacement of Cement with Marble Dust Powder on Properties of Concrete". This paper deals with the utilization of waste of Marble dust powder in concrete and enhancement of strength of concrete more economically. The Marble dust powder was added in M20 grade of concrete at (0%, 5%, 10%, 15%, 20%, 25% & 30%) with partial replacement by weight of cement. Water/Cement ratio (0.50) was kept constant, in all the concrete mixes. The concrete samples (cube & cylinder) were tested for compressive strength and split tensile strength after 7 & 28 days of proper curing. The results of the laboratory work showed that replacement of cement with Marble dust powder increases up to 10% for both compressive strength and split tensile strength of concrete.

Malay. M Patel, Ankit. J.Patel, Jay H Patel, Kushagra T Rawal, International Journal for Innovative Research in Science & Technology Volume 1 Issue 7, "REVIEW PAPER ON PARTIAL REPLACEMENT OF CONCRETE INGREDIENTS" This paper deals with includes use of different waste material as a partial replacement of cement or fine aggregate or coarse aggregate. Industries in India produce lots of waste which may be useful in partial replacement of all the raw materials due to their different properties so hereby we studied as many useful research papers in this field and trying to improve with locally available waste material so it can be proved economical as well. Research in this field and positive results are crucial so as to continue all developments with least damage to surrounding environment and obtaining all infrastructures for services and convenience which are desired to get.

SUMMARY OF LITERATURE REVIEW

From the above literature survey it is understood that for all the experiments the strength and also the characteristics of the marble powder and glass powder given good results by comparing it with control specimen. Five concrete mixtures containing 0%, 5%, 10%, and 20% marble dust powder as cement replacement by weight basis and glass powder as fine aggregate has been prepared. Water/cement ratio (0.45) was kept constant, in all the concrete mixes. Compressive strength, split tensile strength & flexural strength of the concrete mixtures has been obtained at 7 and 14, 21 & 28 days.

IV. METHODS AND METHODOLOGY

CEMENT

Cement is a binding materials used in the preparation of concrete. It binds the coarse aggregate and fine aggregate with the help of water, to a monolithic matter and also it fills the voids in the concrete. There are two requirements for any cement in the



concrete mix design. That is compressive strength development with time attainment of appropriate rheological characteristics, type and production of cement. It occurs when the cement has hardened to the point at which it can sustain some load. The specimen has to taken out of the mould are subjected to the compression of determining the strength.

OPC 53 grade sample was tested to obtain the following characteristics as per IS 12269 – 1987

1. Specific Gravity
2. Standard Consistency
3. Initial Setting Time
4. Final Setting Time
5. Fineness

PROPERTIES OF CEMENT

- It provides strength to masonry
- It is stiffness or hardens easily
- It was posses good plasticity
- An excellent building resistance materials
- Easily workable
- Good moisture resistance

FINE AGGREGATE

The fine aggregate used in manufacturing of concrete should be free from debris, fungi and chemical attack. It plays a vital role in concrete, so it should durable, angular and sharp edges then only it and gives a rich mix concrete and workability.



PROPERTIES OF FINE AGGREGATE

- It should be clean and coarse
- It should be free any organic or vegetable matter
- It is usually 3 to 4 % of clay in permitted
- It is chemically alert and well graded
- The finess modulus of sand should between 2 and 3

COARSE AGGREGATE

Aggregates are the important constituents in concrete. They give body to the concrete, reduces shrinkage and effect economy. Earlier aggregates were considered as chemically



insert materials but now its as to been recognozed that some of aggregates are chemically active and also that certain aggregate exhibit chemical bon at interface of aggregate and paste. That more aggregate

occupy 70-80 percentage of concrete: their impact on various characteristics and properties of concrete is undoubtedly.

PROPERTIES OF COARSE AGGREGATE

- Important parameter of coarse aggregate are shape, texture, grading, cleanliness and nominal maximum size
- Becomes increasingly important as target strength increases, particularly In the case of high strength lightweight aggregate concrete.
- Durability properties notwithstanding, important coarse aggregate properties to consider includes strength, stiffness, bonding potential, and absorption.
- Have found that using coarse aggregates with greater stiffness can increase the elastic modulus while at the same time decrease the strength capacity.
- Angular coarse aggregate provide mechanical bond and are generally more suitable for use in high strength concrete that smooth textured aggregates.

WATER

Water is an important in gradient of concrete as it activity participates in the chemical reactions with cement. The strength of cement concrete mainly from binding action of the hydration of cement.



It get the requirement of water should be reduced that required chemical reaction of unhydrated cement excess water would end up in only formation undesirable voids (or) capillaries in the hardened

cement paste in concrete.

It is important to have the compatible between the given cement and the chemical materials admixtures along with the water used for mixing. It is generally stated in the concrete codes and also in the literature that the water fit for making concrete. This may not to true always. BE suitable for drinking, as they good for cement concrete as the sugar would adversely affect the hydration process.

MARBLE POWDER

Marble has been commonly used as a building material since the ancient times. The industry's disposal of the marble powder material, consisting of very fine powder, today



constitutes one of the environmental problems around the world. Marble blocks are cut into smaller blocks in order to give them the desired smooth shape. During the cutting process about 25% the

original marble mass is lost in the form of dust With the use of these waste material the quantity of waste material can be minimize. Hence it is a waste optimization technique. With the replacement of cement by marble dust powder we can

achieve a greener construction. Marble powder was collected from marble factories and passed through sieve #200 to achieve the same level of cement fineness.

GLASS POWDER



Glass is an amorphous (non-crystalline) that in essence, a super-cooled liquid and not a solid. Glass can be made with excellent homogeneity in a variety of forms and sizes from small fibers

to meter-sizes pieces.

Primarily glass is made up of sand, soda ash, limestone and other additives (Iron, Chromium, Alumina, Lead and Cobalt). Glass has been used as aggregates in road construction, building and masonry materials.

V. RESULT AND DISCUSSION

1. COMPRESSIVE STRENGTH

Compressive strength test out is completed at particular ages about cubes. The specimen of standard dice of (150 mm back



button 150 logistik x one hundred and fifty mm) utilized to determine the compressive strength of concrete. Dice specimen of size 100mm x 100mm x 100mm can also be used. The fabric was assessed and the

supplies were blended manually. The concrete was filled in distinct layers inside the mould and layer was compacted with the aid of tamping fishing rod. The example of beauty was taken out of mould following 24 hours, treated in tidy water to get 7 and 28 days and nights. After 1 week and twenty eight days of solving, the individuals are applied for, wiped dry out and then analyzed for compressive strength according to Indian Common in compression testing equipment. The dice is placed so that the load works perpendicular for the compacted aspect. Load can be applied before the failure in the specimen. The supreme load is certainly noted

Compressive strength of the specimen is calculated using the formula,
 $f_{ck} = P/A$

Where, f_{ck} = Compressive strength (N/mm²)

P = Ultimate load (N)

A = Loaded area (150mm x 150mm)

2. FLEXURAL STRENGTH

The example of standard crystal of 100 x 100 x 500mm was utilized to decide the flexural quality of cement. Three examples were tried for 7 and 28 days. The material was gauged and the materials were blended physically. The solid was filled in various layers in the shape and each layer was compacted with the assistance of packing pole. The example was expelled from form following 24 hours, relieved in clean

water for 7 and 28 days .After 7 days and 28 days of restoring, the examples are taken out, cleaned dry and afterward tried for flexural quality according to Indian Standard in general



testing machine. Flexural quality is discovered utilizing focus point stacking framework. The example is situated in the gear so that the weight is put on the best surface as cast inside the shape. The

hub of example is typically cautiously agreed with the hub of the starting gadget. Burden is connected until the disappointment of the example. A definitive burden and breaking load is noted. The flexural quality of the example is communicated as modulus of burst, f_b and is determined utilizing the equation

$$f_b = (N/mm^2)$$

Where, P = Ultimate load (N)

L = Centre to centre distance between the supports (400mm)

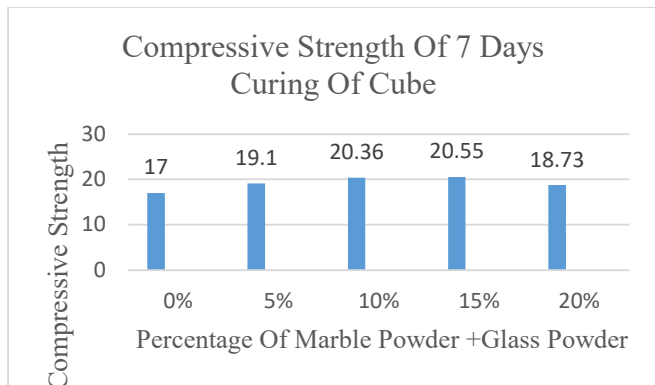
b = Breadth of the specimen (100 mm)

d = Depth of the specimen (100 mm)

VI. RESULT AND DISCUSSION

7 DAYS CURING FOR CUBE

S1 No	Percentage of replacing material(Marble powder +glass powder)	Sample	Load (KN)	Average
1	0%+0%	S1	17.0	17
		S2	16.8	
		S3	17.2	
2	5%+5%	S1	18.66	19.10
		S2	18.88	
		S3	19.77	
3	10%+10%	S1	20.00	20.36
		S2	20.44	
		S3	20.66	
4	15%+15%	S1	20.56	20.55
		S2	20.65	
		S3	20.44	
5	20%+20%	S1	18.66	18.73
		S2	18.44	
		S3	19.11	



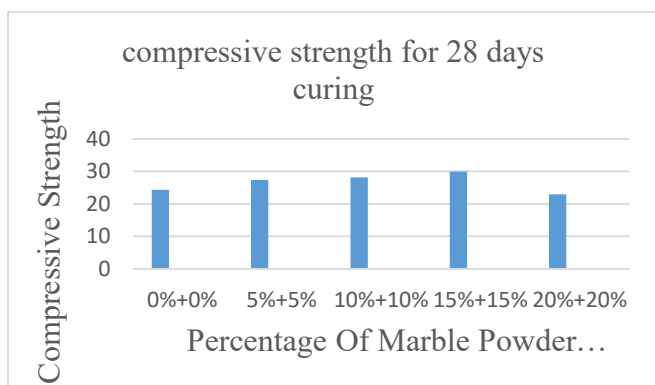
also the comparison of the control specimen and the admixture concrete. So as per the literature review the strength of the admixture concrete is increased by the adding of admixture

REFERENCE

- Sourav Ghosal, S. Moulik International Journal of Engineering Research ISSN:2319-6890(online),2347-5013(print) Volume No.4, Issue No.9, “Use of Rice Husk Ash as Partial Replacement with Cement In Concrete- A Review”
- M. Mohamed Barveen International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 5, “STUDY ON THE EFFECT OF RICE HUSK ASH IN COCONUT SHELL CONCRETE”
- R Gopinath1 , T Ajithkumar2 , M Nithin3 , V Sanjay Srikanth4 , P Sivakumar5, International Journal of Scientific & Engineering Research Volume 9, Issue 4, April-2018, “EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF COARSE AGGREGATE BY COCONUT SHELL AND ORDINARY PORTLAND CEMENT BY RICE HUSK ASH”.
- Shahiron Shahidan1,a, AlifSyazani Leman2 , MohamadSyamir Senin3 , Nurullzzati Raihan Ramzi Hannan4, MATEC Web of Conferences 87 , 01005 (2017), “Suitability of Coconut Shell Concrete for Precast Cool Wall Panel-A Review”
- Shaikh Tanzeem et.al; International Journal of Advance Research, Ideas and Innovations in Technology, (Volume 4, Issue 3), “Replacement of fine aggregate with plastic in concrete”
- IS : 383 – 1970, specification for coarse aggregate from natural sources for concrete.
- IS : 383 – 1970, specification for fine aggregate from natural sources for concrete.
- IS : 10262 – 1980, recommended guidelines for concrete mix design.
- IS : 516 – 1959, compressive strength of concrete.
- IS : 516 – 1959, flexural strength of concrete.
- IS : 5816 – 1999, split tensile strength of concrete.
- IS : 10262 – 2009, for mix design.

28 DAYS CURING FOR CUBE

Sl No	Percentage of replacing material(Marble powder + glass powder)	Sample	Load (KN)	Average
1	0%+0%	S1	18.66	24.73
		S2	24.88	
		S3	25.33	
2	5%+5%	S1	28.00	27.40
		S2	26.66	
		S3	27.55	
3	10%+10%	S1	28.50	28.13
		S2	27.90	
		S3	28.00	
4	15%+15%	S1	30.22	29.92
		S2	30.66	
		S3	28.88	
5	20%+20%	S1	23.55	22.96
		S2	23.11	
		S3	22.22	



CONCLUSION

Concrete will have better result in strength compared to control specimen as per literature review. The following points are concluded from the literature collected so far

- ❖ The study on the effect of concrete with different proportions can still be a promising work as there is always a need to overcome the problem of brittleness of concrete.

Here the compressive, tensile and flexural strength of the control specimen is determined. And the strength of the admixture concrete will be determined at the next phase and