https://dx.doi.org/10.22161/ijaers.612.46 *ISSN: 2349-6495(P) | 2456-1908(O)*

Experimental Study on Bio-Self Cured Marble Powder Based with M-25 Grade Concrete

Anuj Verma[1], Devesh Kushwaha[2], Pragya lodhi[3], Prof (Dr.) Mukesh Shukla[4]

[1,2]MTech Student, Bundelkhand Institute of Engineering & Technology, Jhansi (UP), India
[3]BTech Student, ANA college of Engineering & management Studies, Bareilly (UP), India
[4]Professor in Civil Engineering Department, Bundelkhand Institute of Engineering & Technology, Jhansi (UP), India

Abstract**—** *Water is most widely used in construction activity for first phase to mix material and final phase to curing. In first phase, we mix water in concrete to achieve workability. Without workability concrete cannot be used for construction. Curing is the most important phase for achieving strength. But now-a-days more problems for water because water is falling in its quantity in environment, so in place of water there an urgent requirement to find substitute to make concrete and for construction works. However, it is not possible to provide sufficient curing because of many causes like different environment, availability of water, fluorides and inattentiveness of human. In this way, it is necessary to invent the self-curing agents prepared by different method like using Biomaterials (Calatropis gigantea, Spinacea oleracea) and chemical admixture (polyethylene glycol) along with waste environmental material i.e. marble powder or dust. Hence, to reduce consumption of water, some admixtures i.e. marble powder, PEG-400, calotropis gigantea and spinacea oleracea were used in such manner so that there was no bad effect on workability, compressibility, split tensile strength, flexural strength of concrete. Marble powder is a by-product of stone industries and affects the environment badly, when thrown in an open area. In this way, 10% of marble powder used in place of cement was appropriate quantity in concrete. It is observed that concrete of M25 grade, mixing with 10% of marble powder and 1% of polyethylene glycol - 400 gives optimum result when compressibility, split tensile strength and flexural strength tests were performed and examined for 7 and 28 days.*

Keywords**— Bio-Self Cured Marble, M-25 Grade Concrete, PEG-400.**

I. INTRODUCTION

Concrete plays a vital role in construction field because it can be found every region. Concrete is high rated construction material as it has high compressive strength and durability. Conventional concrete is a mixture of cement, fine aggregate, coarse aggregate and water required for workability and curing to achieve strength. The objective of internal curing is to provide water in the proper amount with a proper distribution so that the hydrating cementations paste remained moisturized and spontaneously stress free in its entire three-dimensional microstructure. In this study, it is recommended to use the marble powder in concrete construction as fractional replacement of cement. When water is added to cement, hydration occurs that is required for hardening of concrete. Since the ancient time, marble or marble stone are commonly used as a building material. Marble powder (very fine powder) make from the marble industries and disposed in environment that becoming hazardous materials. Marble powder is obtained by marble sawing and shaping. Concrete is prepared with marble powder by replacing some amount of cement. Practically virtuous curing of concrete is not possible in various cases due to absence of proper quality of water and various practical problems. In last two decades, concrete technology has been improving and implemented by some new techniques and methodology. By using admixtures, it is possible to prepare practically good concrete mixed with conventional constituents. Adding Some Self Curing agents, the internally cured concrete will be achieved.

Advantages of Self Curing Concrete

- Reduces autogenously cracking.
- self-curing
- Reduce the permeability.
- Increases mortar strength and early age strength enough to withstand strain.
- Greater utilization of cement.
- Lower Maintenances.

Advantages of water reducing admixture:

- Advantage of addition the admixture is to reduce water –cement ratio and obtained higher compressive strength by concrete with some workability.

https://dx.doi.org/10.22161/ijaers.612.46 *ISSN: 2349-6495(P) | 2456-1908(O)*

- When the admixture is mixed without reducing water-cement ratio, concrete can obtain higher workability at the same compressive strength.
- When admixture is added at lower cement content, compressive strength and workability remain same.

Objective of Study

- To Study of concrete mixes with conventional concrete with M-25 Grade.
- To study of concrete mixes with 10% marble powder-based concrete.
- To study of compressive strength of internal curing agent with spanicea oleracea, Calotropis Gigantea and Polyethylene Glycol-400 with marble powder-based M-25 grade concrete.
- To study of Split tensile strength of internal curing agent with spanicea oleracea, Calotropis Gigantea and Polyethylene Glycol-400 with marble powder-based M-25 grade concrete.
- To study of flexural strength of internal curing agent with spanicea oleracea, Calotropis Gigantea and Polyethylene Glycol-400 with marble powder-based M-25 grade concrete.
- To study about the property of natural bio self-cured gent effects on the concrete strengths.

II. LITERATURE REVIEW

General

In this chapter we will discussed about the previous research and their results which were concluded by the researchers on the base of the material used in their experimental study.

I. Spinacea oleracea and Calotropis gigantean (Self-curing agents)

R. Malathy[1] (2017) studied that Self-curing concrete is concrete that cured by itself with enough workability, strength and durability. A comparison is made between the dealing and settlement property of self-curing concrete by adding bio material named Spinacea oleracea and Calotropis gigantea and performance of self-curing concrete by using chemical is polyethylene glycol. 30% of fly ash is replaced by cement and check the workability, strength and durability of M20, M30 and M40 grade concrete. The most appropriate quantity of Spinacea oleracea, Calotropis Gigantea and PEG was taken respectively as 0.6%, 0.24%, and 0.3% of cement weight. Performing slump test, a minimum variation is determined between the self-cured concrete and conventional concrete. Observing strength activity index of conventional cured concrete, it is found more than 1 and 1.15 after 28 days and 56 days respectively due reaction of fly ash. However, the durability of concretes results positive in aggressive environment like chloride, sea water and acid attack as well as encouraging bio self-cured concrete, eco-friendly, economical and high-performance materials.

III. POLYETHYLENE GLYCOL-400 (SELF-CURING AGENTS)

Kumar[2] et al. (2012) investigate that now-a-days concrete is the most usable material for construction because of its good compressive strength and durability. Considering type of work, plain concrete is prepared by mixing, coarse aggregate, fine aggregate, cement and water in a specific ratio. It is necessary to remain favorable atmosphere for plain concrete to acquire desired strength by providing water content or minimum duration of 28 days so that a good hydration can take place. Strength and durability of concrete can be affected by indolence in curing procedure. In this way, self-curing concrete is the most favorable concrete in term of enhancing hydration that is affected by inadequate curing because of inattentiveness of human towards curing, poor availability of water in dry areas, unreachable. Construction site or terrains and existence of fluorides in water which have a bad impact on concrete properties. In this study an admixture named polyethylene glycol (PEG-400) was used in concrete. This is a shrinkage reducing material that helps to obtain desired strength because of good hydration. The study consisting of PEG-400 at different percentage i.e. 0% to 2% by weight of cement and effect of this admixture on compressive strength, modulus o rapture and split tensile strength were investigated or M20and M40 grade concrete. As a result, it was got to know that PEG-400 is a good self-curing compound that helps concrete to acquire good strength by conventional curing. It was also investigated that 1% o PEG-400 by weight of cement was the best quantity forM20, whereas 0-5% was the best quantity or M40 grade concrete. Using optimum proportions o PEG- 400 helps to achieve highest strength without affecting workability of concrete.

Heiza[3] et al. (2019) experiment that self-curing of concrete is important in construction activity in term of lack of water. Purpose of this study was to consider the application of concrete with new admixture to obtain self-curing concrete. In this study polyethylene glycol-400 was used as a shrinkage reducing admixture that performed good as a self-curing compound by providing good hydration and to obtain good strength. The study was depending on compressive strength, split tensile strength, water retention and modulus of rapture effected by changing percentage i.e. 0% - 1% of compound (PEG-400)

https://dx.doi.org/10.22161/ijaers.612.46 *ISSN: 2349-6495(P) | 2456-1908(O)*

by the weight of cement in M1 and M2 mixes. It was observed by study that PEG-400 could be a good option as a self – curing agent for acquiring good strength. It was also got to know that the optimum percentage of PEG – 400 by the weight of cement was 0.5%. It was suitable for both type of mixes M1 and M2.

Marble Powder (Replacement of Cement)

Aruntas[4] et al. (2010) study is based on utilization of waste marble dust (WMD) while mixed in cement as on additive material and results were investigated waste marble dust (WMD) was crumbled (grinded) with Portland cement clinker to obtain waste marble dust cement (WMDc). The proportion of WMD and Portland cement clinker were different i.e. 2.5%, 5.0%, 7.5% and 10% by weight. Obtained cement produce mortar prisms of 40 40- and 160-mm. Strength of mortar specimen was tested a different duration i.e. 7, 28 and 90 days. Considering physical, mechanical and chemical properties of CEM I and CEM II, WMDCs have been compared with one another. It was clarified with recorded results that WMDCs follow toEN-197-1 standard. In this way, 10% WMD is optimum quantity to be utilized in cement production in the form of an additive material.

Bhanushali[5] et al. (2018) utilized that marble industry produces large amount of marble waste during mining and processing phases. This waste is dumped onto open huge land which creates a lot of environmental problems Industrial wastes like fly ash, rice husk, marble dust, etc. are found to be an efficient alternative for cement as their composition are identical as that of cement & in particular, they produce less heat of hydration. This review will deploy the use of marble waste powder against cement and sand at many proportions along with material like silica fume in mix.

IV. METHODOLOGY & RESULTS DISCUSSION

General

In this study, we discussed about the physical properties of material used. We are using marble powder as a replacement in cement concrete. Vegetation Calotropis Gigantea, spinacia oleracea and a compound named PEG-400 are used as self - curing agents in concrete. We are going to conduct workability test, compressive strength test, split tensile strength test and flexural strength test for checking all above experiment related properties of concrete.

Cement

Physical Properties of Ordinary Portland Cement -43 Grade

S.No.	PROPERTIES	RESULTS
1	Fineness	6%
2	Specific Gravity	3.10
3	Standard Consistency	37%
4	Initial Setting Time (In Minutes)	28
5	Final Setting Time (In Minutes)	285

Marble Powder

Physical Properties of Marble Powder

S.No.	Properties	Marble powder
1	Specific Gravity	2.98
2	Bulk density (kg/m^3)	1300-1500
3	Fineness modulus (cm^2/g)	5100-5250
4	Water absorption %	22-24

Slump Test for Workability

Mix Design	Slump Value
M_O	85
M_1	87
M_2	100
M_3	90
M_4	95
M_5	110

Result of Compressive Strength on Cubes

Mix	Description	Compressive Strength(N/mm^2) for M-25Grade (7 Days)	Compressive Strength(N/mm^2) for M-25 Grade (28 Days)
M0	Conventional	36.29	38.51
M1	10% Marble Powder	30.51	31.55
M2	10% Marble Powder + 1% Polyethylene glycol-400	40.44	41.47
M3	10% Marble Powder + 0.6% Spinacea Oleracea	37.69	42.22
M4	10% Marble Powder + 0.25% Calotropis Gigantea	38.81	41.48
M5	Mix-up	29.55	32.29

Result of Split Tensile Strength on Cylinder

Mix	DESCRIPTION	Split Tensile Strength(N/mm^2) for M-	Split Tensile Strength(N/mm^2) for M-25

https://dx.doi.org/10.22161/ijaers.612.46 *ISSN: 2349-6495(P) | 2456-1908(O)*

		25Grade (7 Days)	Grade (28 Days)
M0	Conventional	3.62	4.06
M1	10% Marble Powder	3.53	4.31
M2	10% Marble Powder + 1% Polyethylene glycol-400	3.65	4.33
M3	10% Marble Powder + 0.6% Spinacea Oleracea	3.91	3.96
M4	10% Marble Powder + 0.25% Calotropis Gigantea	3.48	3.53
M5	Mix-up	2.83	3.13

Result of Flexural Strength on Beams

Mix	DESCRIPTION	Flexural Strength(N/mm^2) for M-25Grade (7 Days)	Flexural Strength(N/mm^2) for M-25 Grade (28 Days)
M0	Conventional	19.06	25.86
M1	10% Marble Powder	18.42	19.76
M2	10% Marble Powder + 1% Polyethylene glycol-400	20.28	25.33
M3	10% Marble Powder + 0.6% Spinacea Oleracea	17.14	27.10
M4	10% Marble Powder + 0.25% Calotropis Gigantea	21.22	24.46
M5	Mix-up	17.7	22.65

V. CONCLUSION

General

As a conclusion of this study it is cleared that bio-materials give better results in workability and strength when mixed as self-curing agents in concrete of M25 grade along with marble powder. These agents (Spanicea oleracea, Calotropis gigantean and polyethylene glycol) can be mixed in different construction works like pre-stressed, highway construction, RCC works, water tanks etc. to reduce curing and enhance workability and strength.

Compressive strength test

Usage of marble powder in concrete improved the compressive strength and the value of compressive strength was found different for different curing duration. It was evaluated 30.51 N/mm^2 for 7 days curing and 31.55 N/mm^2 for 28 days. When PEG-400, spinacea oleracea and calotropis gigantea were used as self-curing agents, they provided better compressive strength to the concrete. Computation of compressive strength was found 40.44, 37.69 and 38.81 N/mm^2 for PEG-400, spinacea oleracea and calotropis gigantea respectively. This value was determined after 7 days curing. Determined compressive strength value after 28 days curing was 41.47, 42.22 and 41.48 N/mm^2 for PEG-400, spinacea oleracea and calotropis gigantea respectively.

When all the self-curing agents were mixed together in marble powder-based concrete, the strength of conventional concrete.

Split Tensile Strength

When marble powder is mixed in concrete as additional material, split tensile strength of concrete was found good. It was obtained 3.53 N/mm2 for 7 days curing and 4.31N/mm2 for 28 days curing. Spinacea oleracea and calotropis gigantea were used as self-curing agents and they both have a good impact on split tensile strength. While using spinacea oleracea, split tensile strength of concrete was found 3.91 N/mm2 and 3.96 N/mm2 respectively for 7 days and 28 days curing. When calotropis gigantea was mixed in concrete, the result of split tensile strength was obtained 3.48 N/mm2 and 3.53 N/mm2. That was according to 7 days curing and 28 days curing respectively. Additionally, PEG-400 was also used as an admixture, then split tensile strength was found 3.65 N/mm2 and 4.33 N/mm2 for 7 days curing and 28 days curing respectively.

The result of split tensile strength of concrete was not good when all the admixture was mixed together in concrete. That showed less split tensile strength than that of conventional concrete.

Flexural Strength

https://dx.doi.org/10.22161/ijaers.612.46 *ISSN: 2349-6495(P) | 2456-1908(O)*

In concrete, marble powder was used as a replacing agent of cement while PEG-400, spinacea oleracea and calotropis gigantea were used as self-curing agents. Flexural strength for all the admixtures was found good and different for different curing duration. Flexural strength on concrete with marble powder was 18.42 N/mm2 and 19.76 N/mm2 respectively for 7 days and 28 days curing. When PEG-400, spinacea oleracea and calotropis gigantea were mixed in concrete, flexural strength was obtained 20.28 N/mm2, 17.14 N/mm2 and 21.22 N/mm2 respectively for 7 days, while 25.33 N/mm2, 27.10 N/mm2 and 24.46 N/mm2 respectively for 28 days curing. Though, flexural strength was found less than that of conventional concrete when all the additional agents were mixed together in the concrete.

REFERENCES

[1] Malathy, R., (2017) "Experimental Study on Strength and Durability Properties of Bio- Self-Cured Fly Ash Based Concrete under Aggressive Environments". World Academy of Science, Engineering and Technology, International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering, 11(3), pp.328-333.

[2] Kumar, M.J., Srikanth, M. and Rao, K.J., (2012) "Strength characteristics of self-curing concrete". International Journal of Research in Engineering and Technology, Nature, 20, p.M40.

[3] ELWakkad, N.Y. and Heiza, KH. M. (2019) "Mechanical properties of self-curing concrete incorporating peg400" Menoufia University Faculty of Engineering Second International conference (Tenth Conference of Sustainable Environmental Development) Sharm El Sheikh, Egypt.

[4] Demirel, B., (2010) "The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete". International journal of physical sciences, 5(9), pp.1372-1380.

[5] Aruntaş, H.Y., Gürü, M., Dayı, M. and Tekin, I., (2010) "Utilization of waste marble dust as an additive in cement production". Materials & Design, 31(8), pp.4039-4042.

[6] Memon, PR., Sam, ARM., Awang, AZ. and Memon, UI., (2018) "Effect of Improper Curing on the Properties of Normal Strength Concrete" Engineering, Technology & Applied Science Research 8(6), 3536-3540.