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GREEN CONCRETE BY USING INDUSTRIAL WASTE MATERIAL- FLY ASH AND MARBLE DUST

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Abstract - *Marble has been usually used as an arte fact since the traditional times. Consequently, Marble waste as a by-product could be a vital material which needs adequate environmental disposal effort. Additionally, exercise waste while not correct management may end up in environmental issues larger than the waste itself. Marble dust could be a stuff shaped throughout the assembly of marble. An outsized amount of dust is generated throughout the cutting method. The result's that concerning twenty fifth of the first marble mass is lost within the variety of dust. These waste materials are going to the atmosphere directly will cause environmental issues like increase within the soil pH, affects the plants, affects the soma etc. Marble dust is a solid material generated from the marble process will be used either as a filler material in cement or fine aggregates whereas making ready concrete. Marble dust will be used as associate degree admixture in concrete, so strength of the concrete will be enhanced. The assembly of cheaper and a lot of sturdy concrete exploitation this waste will facilitate the technologist fraternity to make sure economy within the infrastructural project and redress the environmental degradation downside. This paper highlights the practicability of the substitution of marble waste for cement to achieve economy and environmental conservation.*

Key Words: **Green concrete, Waste Material, fly ash, marble dust, compressive strength, split tensile strength.**

1. INTRODUCTION

Green concrete is extremely usually and conjointly low cost to provide, as a result of as an example, waste product area unit used as a partial substitute for cement, charges for the disposal of waste area unit avoided; energy consumption in production is lower. To boost the environmental friendliness of concrete to create it appropriate as a "Green Building" material. Inorganic residual product area unit used additional expeditiously as inexperienced aggregates in concrete and also the setting is protected against waste deposits. Marble sludge dust, quarry dirt and ash area unit a number of the materials used for creating inexperienced concrete, as property construction [1]. Inexperienced concrete Technology we are able to save the natural materials for future use or the generations, however if we have a tendency to use waste materials for construction Jewess materials are going to become a property material and also because the value can be reduced [2][3].

These area unit the social and accountability of state and trade to resolve the matter of Waste Marble dust (WMD) pollution. Thus, new approaches that contemplate industrial wastes as different raw materials become attention-grabbing, each technically and economically, for a large vary of applications. It's necessary to explore the utilization of arm in cement trade as filler for the assembly of concrete our explicit interest is that the use of arm in cement trade as filler for the assembly of concrete [4].

Use of commercial wastes Associate in publically by product as an combination or stuff is of nice sensible significance developing arte fact parts as substitutes for materials and providing another or supplementary materials to the construction industry during a value effective manner and also the conservation of natural resources[5][6]. In order to properly eliminate this whole bunch to thousands of tons of marble dust, the utilization of innovative techniques to recycle them is very important. While not the right disposal of this dust material, these area unit the key cause to health risks of the general public and also the setting. Therefore, the target of this paper is to check the likelihood to include marble sawing dust wastes as filler in concrete and conjointly in brick product with no major sacrifice of the properties of the ultimate product and thereby reducing the unsatisfied effects of Marble dust [7].

Manufacture of cement clinkers for combustion of commercial solid waste ash. Results show that within the processed clinkers all the key parts of OPC clinker area unit gift. Waste could also be used as a element for the assembly of latest merchandise or as a mixture to permit more practical use of natural sources and defend the setting from waste disposals. The common stone that area unit collected from crushers isn't meet with IS 383-1979.

2. Materials

- **Cement**

  The most common cement used is Portland Pozzolana Cement (Part I-Fly ash) based on IS: 1489 (PART-1) 1991 is getting used [6].

- **Sand**

Natural sand which is easily available and low in price was used in the work. It has cubical or rounded form with smooth surface texture.

- **Fly Ash**

When fine coal is burn to get heat, the residue contains 80% ash and 20 % bottom ash. Ash made in Indian power stations area unit light-weight to mid- grey in color and have the looks of cement. Use of ash concrete in situ of PCC won't solely change substantial savings within the consumption of cement and energy however additionally gives economy. The use of fly ash has some number of advantages. It is theoretically possible to replace 100% of Portland cement by fly ash, but replacement levels above 80% generally require a chemical activator. Studies have found that the optimum replacement level is around 30%. Moreover fly ash can improve certain properties of concrete, such as durability. Because it generates less heat of association, it's notably likeminded for mass concrete applications. The employment of ash in concrete in optimum proportion has several technical advantages and improves concrete performance in each recent and hardened state. Ash use in concrete improves the workability of plastic concrete, and therefore the strength and sturdiness of hardened concrete. Generally, ash advantages concrete by reducing the blending water demand and raising the paste flow behavior [4].

Table -1: Physical and Chemical properties of fly ash

Physical Properties			
SR.NO.	DESCRIPTION	VALUES	REQUIRMENT AS PER IS:3812-2003
1	Specific Gravity	2.05	-
2	Fineness (m^2/kg)	333	320
Chemical Properties			
SR.NO.	DESCRIPTION	VALUES	REQUIRMENT AS PER IS:3812-2003
1	SiO_2 (% by mass)	62.92	35
2	Al_2O_3 (% by mass)	30.96	-
3	SiO_2+ Al_2O_3+ Fe_2O_3 (% by mass)	93.88	70
4	MgO (% by mass)	0.74	5
5	SO_3 (% by mass)	0.23	3

- **Aggregates**

Aggregate has high compressive and shear strength, as well as enough permeability for interlocking. Two types of aggregates are coarse and fine aggregates respectively range in between 10 mm to 12 mm and below 2.36 mm to be used.

Table -2: Test of Aggregate

Sr. No	Type of Test	Type of test	Test Result	MORTH 2013 Specification
1	Aggregate Impact CA FA	IS-2386 Part I	 10.59 % 6.58 %	< 27%
2	Los Angeles Abrasion CA FA	IS-2386 Part I	18.36 % 15.09 %	< 35%
3	Aggregate crushing CA FA	IS-2386 Part I	22.85 % 26.89 %	< 30%
4	Water absorption CA FA	IS-2386 Part III	1.2 % 0.5 %	< 2%
5	Specific gravity CA FA	IS – 2386 Part III	2.63 2.41	2-3

- **Marble Dust**

Marble dust is characterized by its fine dusty texture, similar to that of crushed limestone. Since marble is a harder, crystallized rock, the dust is not comprised of soft particles. The dust also has a slight shimmer to it because of the crystallized particles, and it can also be discolored with brown, grey, yellow, pink or even greenish particles due to impurities in the original marble. Marble has been normally used as a building material since times of yore. Disposal of the waste materials of the marble business, consisting of terribly fine dusts, is one in all the environmental issues worldwide these days. However, these waste materials are with success and economically used to enhance some properties of contemporary and hardened properties of mortar and concrete. Marble waste dust is an industrial waste containing heavy metals in constituent. Fineness with 90% of particles

passing by 300µ sieves. Marble dust was collected from the deposits of marble factories throughout shaping. It was absolutely preserved on IS-150µ sieve before mixing in concrete [4].

Table -3: Chemical Component of various wastes Material.

Composite	Sludge of Marble	Sludge of Copper	Sludge of Silica	Sludge of Iron
SiO_2	0.8	30.60	92.26	31.5
Al_2O_3	0.1	2.96	0.89	10.1
$Fe2O_3$	0.2	59.08	1.97	56.1
CaO	58.1	0.66	0.49	4.2
MgO	0.1	0.92	1.31	2.0

Marble stone industry generates both solid waste and stone slurry. Whereas solid waste results from the rejects at the mine sites or at the processing units, stone slurry is a semi liquid substance consisting of particles originating from the sawing and the polishing processes and water used to cool and lubricate the sawing and polishing machines. Stone slurry generated during processing corresponds to around 20% of the final product from stone industry. Therefore the scientific and industrial community must commit towards more sustainable practices. There are several reuse and recycling solutions for this industrial by-product, both at an experimental phase and in practical applications.

Table -4: Physical Properties of Marble waste dust.

Sr. No.	Properties	Value
1	Moisture Content	
	Wet	21.22
	Dry	1.43
2	Bulk Density	1007 kg/m³
3	Fineness Modulus	2.01
4	Effective size	0.12 mm

3. Methods

Concrete Mix Design: In the regular day study, M20 grade with combine of ingredient as per IS 456-2000 was used. The concrete combine proportion (cement: fine aggregate: coarse aggregate) is 1:1.5:3 by volume and a water cement quantitative relation of 0.5.

Marble dusts were added in concrete an interval of 5% up to 20%. For each percentage of marble dust replacing Cement. Cubes & cylinders were casted for 7 days, 14 days and 28 days. Final strength of cube & cylinder were tested after 7 days & 14 days, 28 days of curing [6].

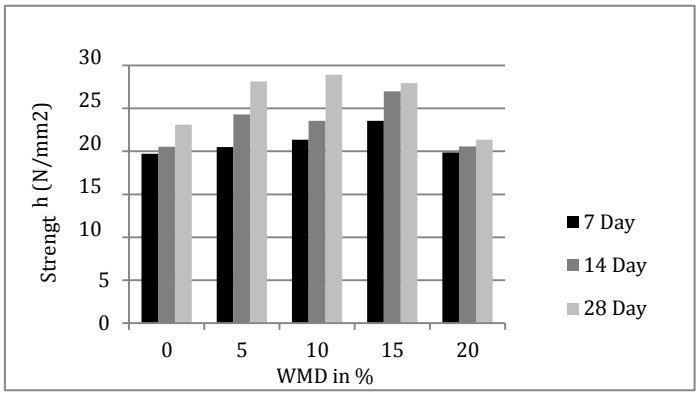

Figure-1: Compressive strength (cube)

Compressive strength of concrete is tested on cube at different percentage of marble dust content in concrete. The strength of concrete has been tested on cube at 7 days, 14 days and 28 days of curing. 7 days check has been conducted to see the gain in initial strength concrete. 28 days test provides the information of ultimate strength of concrete at 28 days curing. Compression testing machine is used for testing the compressive strength test on concrete. At the time of testing the cube is taken out of water and dried then tested keeping the smooth faces in higher and lower part.

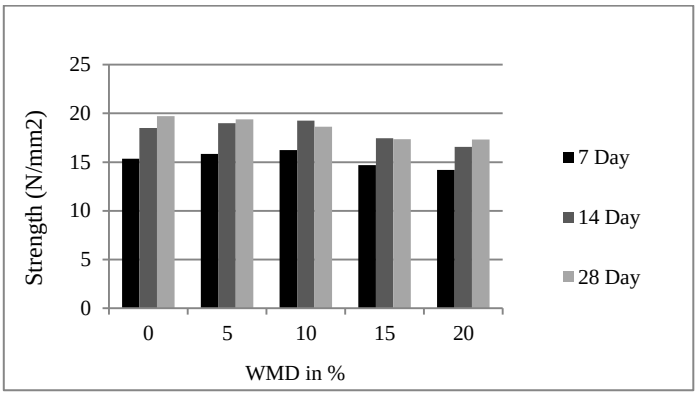

Figure-2: Compressive strength (Cylinder)

Split durability of concrete is tested on cylinders at totally different proportion of marble dust content in concrete. The strength of concrete has been tested on cylinder at 7 days, 14 days and 28 days of curing. 7 days check has been conducted to see the gain in initial strength of concrete. 28 days test provides the information of final strength of concrete at 28 days of curing. Compression testing machine is employed for testing the Split durability check

on concrete long with 2 wooden boards. At the time of testing the cylinder taken out of water and dried then tested.

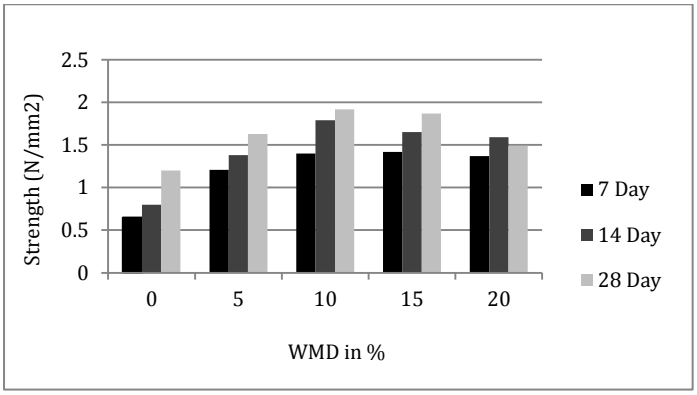

Figure-3: Split Tensile Strength

Tensile strength of concrete ranges from 10 to 18 you look after the compressive strength. It may be measured by the direct tensile loading check. Throughout casting the cubes is automatically vibrated on table vibrator (figure 3). But the applying of direct tensile load to the test specimens is quite tough. For this reason the strength of concrete is sometimes measured by the indirect tension test like splitting test. Tensile splitting strength tests of concrete block specimens were determined at 28 days. When curing, the specimens shall test for Split strength using a label compression testing machine of 2,000 KN capacities. The loading rate on the cube is 10N/mm^2 per min[6].

Split tensile strength was conducted on varied specimen as per guidelines given in IS -516-1959.The cylindrical specimen was tested at the age of 7 days, 14 days & 28 days after surface drying same. The test was conducted on Universal Testing Machine. The result obtained at the curing age of 7days, 14 days & 28 days given in table.

4. Results and Discussion

- **Compressive strength of concrete (Cube & cylinder)**

Compressive strength of concrete is tested on cube at unique probability of marble dust content in concrete. Concrete has given their strength at 7 days curing and 28 days. 7 days test has been conducted to check the gain in original strength concrete. 28 days test gives the data of final strength of concrete at 28 days curing. Compression testing operators is used for testing the compressive strength test on concrete. At the time of testing the cube is taken out of water and dried and also tested keeping the smooth faces in upper and lower part. The investigation disclosed that substitution of cement with marble waste dust up to 20% nothing reduces the slump of concrete mixes, whereas replacement of sand by marble waste dust up to 20% enhances the slump of the concrete mixes. In concrete production replacement of 50% cement by waste marble dust provides comparable compressive and flexural strength as of marble waste free concrete specimens; however increasing the replacement range on the far side results in strength reduction.

- **Split Tensile strength of concrete (Cylinder)**

Split Tensile strength of concrete is tested on cylinders at unique probability of marble dust content in concrete. Concrete has given their strength at 7 days curing and 28 days. 7 days test has been conducted to check the gain in initial strength of concrete. 28 days test gives the data of final strength of concrete at 28 days curing. Compression testing machine is used for testing the Split Tensile strength test on concrete along with 2 wooden boards. At the time of testing the cylinder taken out of water and dried and then tried, in concrete production, substitution of sand up to 20% by marble waste dust provides similar strength as of concrete mixes with 100% sand each at early and latter ages. On the premise of the sooner experimental studies the unit weight of the concrete raised due to the high specific gravity of WMD and also filler impact of marble dust because it's finer particles than fine sand aggregate. As a matter of truth marble dust had a filler impact (particularly vital at early ages) and contends an understandable role within the hydration method. Cement being kept constant it's an expected outcome that an enhancement within the mechanical and physical properties has taken place by virtue of the marble dust's contribution to the hydration method. The consistency of the concrete decreased and increase with percentage of marble dust additions.

5. Conclusion

The waste marble dust that are normally dumped in near the quarry site and create unacceptable environmental impacts.The Compressive strength of Cubes are increased with addition of waste marble dust up to 10% replace by weight of cement and further any addition of waste marble dust the compressive strength decreases. The Split Tensile strength of Cylinders are increased with addition of waste marble dust up to 10% replace by weight of cement and further any addition of waste marble dust the Split Tensile strength decreases. Thus we found out the optimum percentage for replacement of marble dust with cement and it is almost 10% cement for both cubes and cylinders. We have place forth an easy step to reduce the prices for construction with usage of marble dust that is freely or cheaply available; additional significantly. We've additionally stepped into a realm of the environmental

pollution by cement production; being our main objective as Civil Engineers. The replacement of total fine aggregates with 50% marble dust and 50% of quarry rock dust gives an excellent result in strength aspect and quality aspect. Increase the marble dust content by more than 50% proves the workability.

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