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USE OF MARBLE WASTE AND CEMENT AS BINDING MATERIAL

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ABSTRACT

The present invention relates in a cement binding composition for improving early more workable strength, settting time in comparison to masonry cement and to overcome the shrinkage and temperature movement in the masonry cement for masonry structures.

Conventionally, the binder compositions comprises of cement, sand and lime. The use of cement in the construction of masonry structures is not advisable as cement has high strength and fast setting, non plastic and non cohesive properties and has the drawbacks like, it cannot take up the shrinkage and temperature movement in the masonry, it results in comparatively wider cracks passing right through the bricks or building and distributed hair cracks in the joints which occur also when weaker mortar containing lime are used. The cost factor is high as the product is obtained by inter – grinding a mixture of Portland cement clinker with pozzolanic materials and other ingredients.

A low cost binder composition has been provided that comprised marble slurry waste, fly ash of thermal power plants and lime. However, the composition as a result works slowly due to longer final setting time i.e. the cement mortar formed from the low cost binder composition hardens at such a rate that it causes delay in progress. Further , the lime cement mortar formed in the prior art can be made to possess the desired properties of a good masonry mortar, but the preparation of lime cement mortar is time consuming and unslaked lime and magnesia when present in such mortar can cause delayed expansion and consequently cause defects in the masonry and plaster work.

Further in the prior art, the compressive strength of the binder composition for 7 days is 5.6 kg/cm2. Moreover, the final setting time for the masonry cement being used in the prior art is quite high i.e. around 24hours as per IS 3466.

KEYWORDS: Marble Slurry, Marble Dust, Technical use, Low cost binder,

INTRODUCTION

Embodiments of the present research relate a cement binding composition and a process for preparing the same. Particularly, the cement composition comprised of the following components: a marble slurry waste is processing waste of marble industry, in dry powder form or marble mines lumps waste in powder form or kota stone waste (calcite and dolomite) in powder form is in the range of 30 to 70% Further, the composition comprises fly ash waste taken from thermal power plants in the range of 10 to 50%. The composition utilizes 70-80% of waste materials and 20 to 30% of other ingredients such as: Hydrated lime and waste of lime kiln containing 60 – 80% Ca $(OH)_2$ in the range of 8-25% and Mineral gypsum type IV or industrial waste gypsum in the range of 5 to 8% for improving early workable strength and final setting time.

An embodiment of the present invention further relates to a process for preparing the cement binding composition comprising the following steps: mixing the above ingredients in a continuous mixture , feeding the mixture to the hopper after proper mixing and taking it to another hopper through the conveyor belt. There is a control feeder that will feed the mixture to the Agate mill for inter- grinding to obtain the fineness of 150 micron/40 micron as required for non load bearing works and load bearing masonry structures for grade II and grade I. The Agate mill has been used in this case since it is made of a very cheap stone called Agate or grinding the raw material individually in supergrinding vertical roller mill and blending to have homogenous mixture and the composition is finally prepared. In the preparation of such a composition, there is no need of burning the components. Such a composition results in

better performance by providing a cheaper and light weigh building material as compared to the conventional building material ordinary Portland cement and Portland pozzolana cement available in the market. This new product cement binder will be used for certain categories (of plain construction) of works like masonry mortar and plaster, foundation concrete, pre-cast building block, paving blocks, light weight blocks, levelling course under floors , edge fuller in water bound macadam in road construction etc (This product is not suitable for re-enforcement concrete work).

EXPERIMENTAL MATERIALS & LABORATORY STUDIES

According to another embodiment of the present research, the marble slurry waste present in the composition comprises of Dolomite grade composition having:

CaO in the range of 28 to 40%;
MgO- 12 to 22%;
SiO_2 – 0.32 to 10% ;
Fe_2O_3 – 0.7 to 0.1% ;
Al_2O_3 – 0.2 to 0.8% and
Very small quantity of S and gaseous SO_3
The average chemical composition of marble of Rajnagar – Kelwa belt is given below:

Sample	1	2	3
Sio_2	7.58	11.44	0.32
Fe_2O_3	0.73	0.72	0.64
CaO	30.34	29.40	32.65
MgO	16.99	12.28	21.29
L.O.I	43.94	44.76	45.06
So_3	-	0.34	-

Table 1 : Physical properties of lime stone [5]

Hardness	3-4 on Moh' scale
Water absorption	less than 1%
Density	2.2-2.85 kg/m^3
Compressive strength	1800-2100 kp/cm^2
Weather impact	Resistant
Porosity	Quite low

Table 2 : The estimated reserves in the state of Rajasthan, India[6]

Marble	1100 million tons
Granite	1128 million cum
Sandstone	900 million tons
Flaggy limestone	1800 million tons
Slate	50 million tons

Table 3 : The results of the compaction for the soil (Proctor test)

S/N	Sample	Avg. OMC value	Avg. MDD value
1.	Soil	17.22	1.660
2.	Clay 60%+Marble 40%	13.77	1.848
3.	Clay 50%+Marble 50%	13.82	1.860
4.	Clay 40%+Marble 60%	13.51	1.862
5.	Clay 30%+Marble 70%	13.27	1.877

Table 4 : The results of the California bearing ratio test

S/N	Sample	Avg. CBR value
1.	Soil	0.75
2.	Clay 60%+Marble 40%	2.26
3.	Clay 50%+Marble 50%	4.16
4.	Clay 40%+Marble 60%	0.82
5.	Clay 30%+Marble 70%	0.88

Table 5 : The results of the Specific gravity test

S/N	Sample	Av. specific gravity value
1.	Soil	2.596
2.	Marble	2.680
3.	Clay50%+Marble50%	2.459

Table 6 : The R&D value of the plastic limit, liquid limit and plasticity index

Sample	PL Plastic Limit	LL Liquid Limit	PI Plasticity Index
Soil	18.57	46.90	28.33
Clay 60% + Marble 40%	18.57	41.30	22.73

CONCLUSION

Further , the present binding composition has a mortar mix ratio of 1:3 (one part of cement binder and 3 parts sand), and thus provides a compressive strength of 60.8 Kg/cm^2 for 28days, which covers IS 3406, IS 4098 & IS 2250 requirement, which is well comparable to the 1:6 mix ratio of cement mortar in the market having the compressive strength of 30 – 50 Kg/cm^2 for 28 days . The marble slurry waste in dry powder is sticky, and thus has a water retaining property, which is 80% finer than 100 mesh or 150 micron having liquid limit of 30% and has a plastic index of 12.5%. It is further observed that cement binder composition developed is highly plastic in nature and has got waster retaining capabilities and cohesively. Accordingly it has got good workability in the placement and it spreads firmly and easily, it does not swing after drying and hence develops no shrinkage cracks as are in cement mortars.

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[3] Personnel discussion with authorities concerned with marble slurry.
[4] Inspection of slurry dumping ground.
[5] Consultation with marble processing gang saws unit in Rajasthan.