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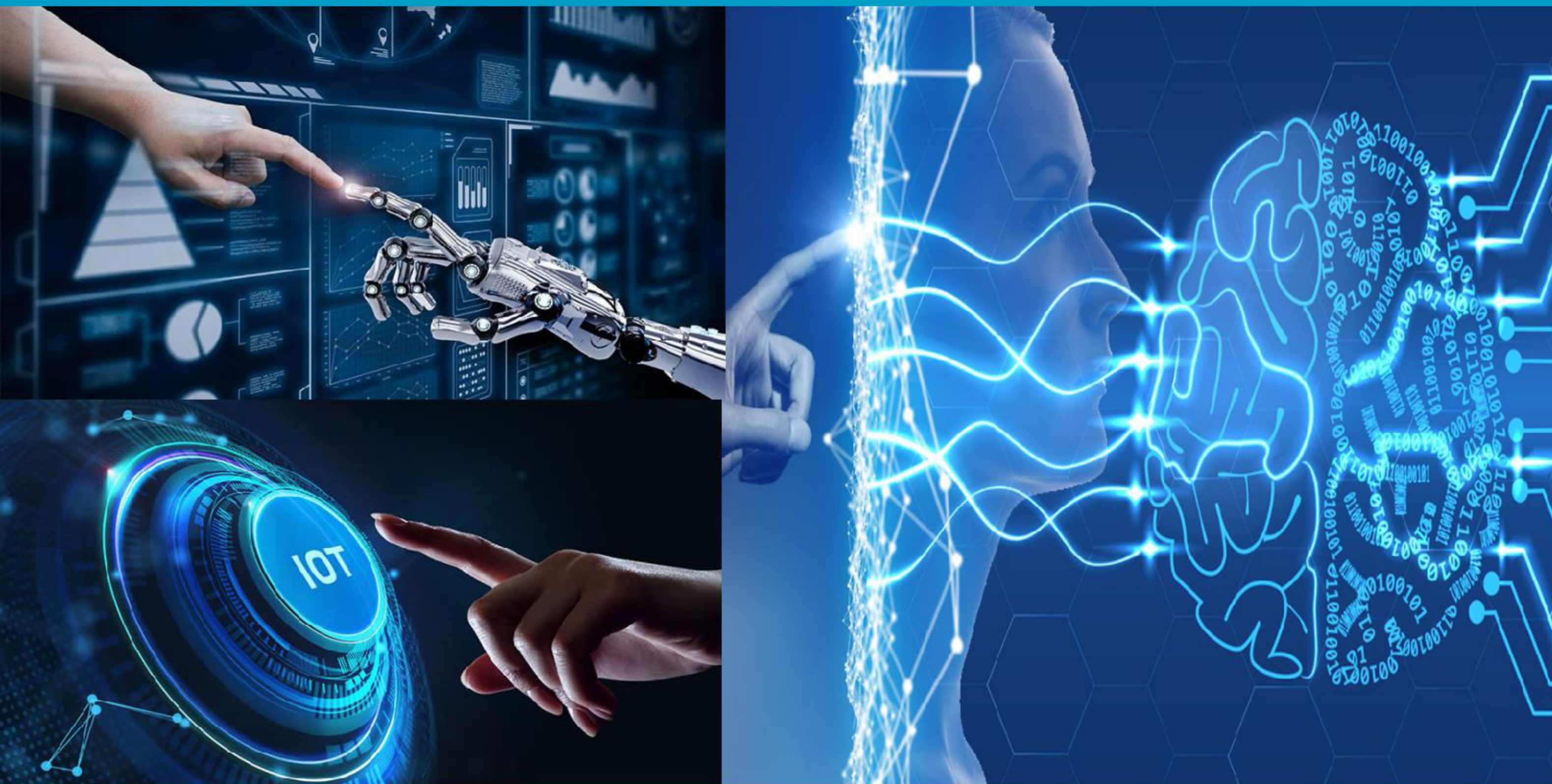

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Marble Dust Mix with Concrete to Test Compressive Strength: A Review

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ABSTRACT: This paper focused on the use of marble waste powder in the manufacturing of cement and concrete, and the following findings and conclusions were reached as a consequence. We were able to use the Ethiopian Marble Processing Enterprise's marble waste powder to make Portland limestone cement since it was confirmed to meet the chemical standard EN 197-1. Concrete may have its water penetration depth reduced by up to 20% by employing marble waste powder as a partial sand substitute. Findings from a research project show that marble debris may be used to produce Portland limestone. Concrete's permeability to water may be improved while its strength and durability are maintained when marble debris is used as a substitute for sand at levels as high as 20%, according to the research.

KEYWORDS: Manufacturing Of Cement, Compressive Strength, Concrete Manufacturing

I.INTRODUCTION

Concrete that is created using Portland cement is most likely the man-made material that is put to use the most frequently over the entire earth. In spite of this, the manufacturing of concrete is one of the worldwide issues that has an effect on the surrounding environment. The most major of these impacts is global warming, which is caused by CO2 emissions that occur during the production of cement. It is believed that the manufacture of cement is responsible for somewhere in the neighbourhood of 3 percent of global anthropogenic emissions of greenhouse gases and 5 percent of global anthropogenic emissions of CO2.Since the combustion of limestone results in the breakdown of nearly half of the CO2 that is produced during the manufacturing of cement, blending is regarded as a highly effective strategy for lowering CO2 emissions.The majority of the blending materials utilised in cement production and included in either plants or sites are various types of industrial waste. This is due to the fact that recycling industrial wastes as blending components delivers benefits in the areas of technology, economics, and the environment, in addition to reducing CO2 emissions produced during the manufacturing of cement.

The enhanced performance of concrete is one way that the utilisation of wastes and by-products in the manufacturing of concrete can demonstrate its significance to the industry. The economic benefit is typically attributed to the reduction in the quantity of expensive or scarce substances, which is replaced with those that are inexpensive. When industrial wastes are recycled, not only are CO2 emissions decreased, but also residual products from other industries are put to new use. As a result, there is a reduction in the amount of material that is dumped in landfills, which in turn results in the preservation of a greater number of natural resources [5].

Due to the reactivity of fly ash, final furnace slag, and silica fume, these industrial wastes are increasingly being utilised in place of cement in the manufacturing of concrete. Pozzolanic behaviour is the technical term for this type of behaviour. Other inert by-products and waste materials, in addition to pozzolanic as, have been utilised in the manufacturing of concrete and mortar as an inert filler for reasons that are analogous to those described previously. Among these, marble waste powder, which is a by-product of a facility that processes marble and can be used in the manufacturing of concrete and mortar as a sander placing or cement replacing material, has been the subject of research conducted by a number of researchers. The vast majority of the studies revealed favourable outcomes and advantages. However, because the by-product, which is the powder, varies chemically depending on the parent marble rocks, which in turn depends on the locality, degree of metamorphism, and other factors; and also because the physical characteristics of the by-product depend on the polishing work, it is necessary to conduct similar research in our country in order to incorporate it in the production of concrete and cement for the purpose of reducing environmental pollution and making more sustainable use of natural resources.

II. PRODUCTION OF MARBLE, AS DIMENSIONAL STONE

The term “dimensional stone” is defined by United States Bureau of Mines as naturally occurring rock material cut, shaped or selected for use in blocks, slabs, sheets or other construction units of specified shapes or sizes and used for

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external or interior parts of buildings, foundations, curbing, paving, flogging, bridges, revetments or other architectural or engineering purposes. The term is also applied to quarry blocks from which pieces of fixed dimensions may be cut.

Marble, granite, limestone, and sandstone provide the bulk of dimensional stone; although slate, diorite, basalt and diabase are included. The classification of dimensional stone is not strictly adhered to sedimentary, igneous and metamorphic grouping of geology, as the stone trade name under "granite" refers to all true granite and gabbro, norite, and syenite. Likewise, all crystalline limes tone, travertine, sands tone and serpentine that are capable of taking a polish are group edunder marble in addition to the true marble.

The commercial definition of marble refers to all crystalline rocks predominantly composed of calcite, dolomite, or serpentine. The root word for marble-mar more-was used by the Italians in ancient Rome, referring to all hard rocks capable of taking a polish including granite. However, marble in the geologic usage is a metamorphosed limestone or doloseone, which obliterated itsoriginaltexturedueto intensive re-crystallization.

The marble deposits of Ethiopia have been known and exploited for many years. However, thissegment of the stone industry did not start to develop more strongly until the early 1990"s.Atpresent;thereareseveraldimensionalstone producing companies inEthiopia.ThelargestisNational Mining Company working several quarries of limestone (Harar), marble (Wellega) and granite (Harar and Wellega).A modern processing plant is located in Awash. The Ethiopian MarbleProcessing Industries produce marble from Gojam region and limestone from Harar. The companyhasthreemarbleprocessingplants.SabaStoneCompany,inthenorth,producesmarble,graniteandlimestonefrom Tigray region.Several companies are presently joining the industry including the Berta Company and Tis AbayInternational.

Table 1.1: Dimensional stone producing companies in Ethiopia

No	Name of company	Estimated annual production (m²)	Type of stone processed
1	Ethiopian Marble Processing Enterprise	150,000.00	Marble and limestone
2	Saba Stone Company	180,000.00	Marble, limestone and granite
3	NationalMining Corporation	250,000.00	Marble, limestone and granite
4	Berta Marble	25.000.00	Marble and limestone

There are two categories of marble processing by-products. Because of its smaller size and/or uneven shape, marble processing wastes 30% of the stone (in the case of raw stone). This is then sold to semiconductor companies. Scrap is reduced to 2-5 percent in the case of semi-processed slab. Slurry is the other type of waste. It is just marble powder in water. The water is reused until it becomes thick enough to be reused (70 percent water and 30 percent marble powder). It is safe to assume that 1 tonne of marble stone treated with a gang-saw or a vertical/horizontal cutter produces nearly 1 tonne of slurry (70 percent water).

In additiontoloss,disposalofthiswastematerialwillcausethefollowingenvironmentalproblems: Ifthewasteisdisposedonsoils,theporosityandpermeabilityoftopsoilwillbereduced,thefinemarble dust reducesthe fertilityof thesoil byincreasingitsalkalinity.Whenthewasteisdumpedanddriedout,thefinemarbledustsuspendsintheairandslowlyspreadout through windto the nearbyarea.

When dumped along a catchment area of natural rain water, it results in contamination of over ground waterreservoirand also cause drainageproblem.Currently there are more than four marble processing plants in Ethiopia

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located in different towns.The Ethiopian Marble Processing Enterprise and Berta Marble are located in Adiss Ababa. TheEthiopianMarbleProcessing Enterprise has three branches located at Gulele, Nefasilk and Bole sub city.

1. Manufacturing Process of Portland Cement

Portland cement is produced by grinding cement clinker in association with gypsum to specified fineness depending on the requirements of the cement consumers. Cement clinker is produced on large scale by heating finely ground raw materials (Calcareous and Argillaceous materials) at very high temperature up to 1450°C in rotary kilns. Raw mixture preparation and raw mix blending, formation and grinding of clinker are the fundamental stages in the production of Portland cement.

2. Raw mix preparation and blending

The raw materialsfor Portland cement production are a mixture (as fine powder in the 'dry process'or in the form of a slurry in the 'wet process') of minerals containing calcium oxide, silicon oxide,aluminium oxide, ferric oxide and magnesium oxide. The raw materials are usually quarried fromlocal rock, which in some places has already practically the desired composition and in other placesrequires the addition of clay and limestone, as well as iron ore, bauxite or recycled materials. Theindividual raw materials are first crushed, typically to below 50 mm. In many plants, some or all ofthe raw materials are then roughly blended in a "pre-homogenization pile". The raw materials arenext ground together in a raw mill. Silos of individual raw materials are arranged over the feedconveyor belt. Accurately controlled proportions of each material are delivered onto the belt byweigh feeders. Passing into the raw mill, the mixture is ground to raw mix. The fineness of raw mix is specified in terms of the size of the largest particles, and is usually controlled so that there are less than 5%-15% by mass of particles exceeding 90 μm in diameter. It is important that the rawmix contains no large particles in order to complete the chemical reactions in the kiln, and to ensurethe mix is chemically homogenous. In the case of a dry process, the raw mill also dries the rawmaterials, usually by-passing hot exhaust gases from the kiln through the mill, so that the raw mixemerges as a fine powder. This is conveyed to the blending system by conveyor belt or by a powderpump. In the case of wet process, water is added to the raw mill feed, and the mill product is slurrywith moisture content of 25-45% by mass. This slurry is conveyed to the blending system byconventional liquid pumps [11]. The raw mix is formulated to a very tight chemical specification. Typically, the content of individual components in the raw mix must be controlled with in 0.1%orbetter.Calciumandsilicon are present in order to form the strength producing calcium silicates. Aluminium and iron areused in order to produce liquid ("flux") in the kiln burning zone. The liquid acts as a solvent for thesilicateforMingreactions,andallowsthesetoccuratаneconomicallylowtemperature.Insufficient aluminiumand iron lead to difficult burning of the clinker,while excessive amountsleadtolowstrengthduetodilutionofthesilicatesbyaluminatesandferrites.Verysmallchangesincalciumcontentledtol argechangesinthe ratioof alite tobelite inthe clinker, andtocorresponding changes in the cement's strengthgrowth characteristics.The relative amounts ofeach oxide are therefore kept constant in order to maintain steady conditions in the kiln, and tomaintain constant product properties. In practice, the raw mix is controlled by frequent chemicalanalysis (hourly by X-Ray fluorescence analysis, or every three minutes by prompt gamma neutronactivation analysis). The analysis data is used to make automatic adjustments to raw material feedrates. Remaining chemical variation is minimized by passing the rawmixthrough a blendingsystemthat homogeniesup to aday'supplyof rawmix.

III. CONCLUSIONS

The construction sector poses a significant threat to the quality of the surrounding environment, both in terms of the pollution it generates and the damage it causes as a result of the huge quantities of finite natural resources it consumes. The recycling of industrial wastes is one of the solutions that is receiving attention all over the world as a way to safeguard the environment and make more cost-effective and sustainable use of resources. The recycling of marble waste powder for the production of cement and concrete has been researched in this investigation, and the following observations and inferences have been drawn as a result.

1. The marble waste powder that was provided by The Ethiopian Marble Processing Enterprise and utilised in this research was found to be in compliance with the chemical standard requirement of EN 197-1 for the production of Portland limestone cement. In addition, the natural fineness of the marble waste was found to be comparable to that of the fineness of modern cements that can be used as filler.

2. When replacing up to five percent of the conventional Portland cement with marble waste powder, the resulting compressive strength is equivalent to that of ordinary Portland cement made up of one hundred percent ordinary Portland cement. The compressive strength of replacement at ranges of 10 percent, 15 percent, and 20 percent is lower than that of replacement with 100 percent ordinary Portland cement. According to the EN 197-1 standard, blended

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cements that have replacement ranges of 5 to 15 percent satisfy the criteria for high early strength of class 42.5MPa, whereas mixed cements that have replacement ranges of 20 percent satisfy the standard for high early strength of class 32.5MPa.

3. When a higher amount of marble waste is added to ordinary Portland cement, the overall compressive strength of the mixture is reduced. Other characteristics of blended cements made from marble waste, such as consistency, setting times, insoluble residue, sulphate residue, and soundness, however, continue to fall within the tolerable parameters of the various standards.

4. According to the findings of the investigation, the slump of concrete mixes is improved when marble waste powder is used to replace up to 20 percent of the sand in the mixture. On the other hand, the slump of concrete mixes is improved when marble waste powder is used to replace up to 20 percent of the cement in the mixture.

5. In the production of concrete, the substitution of marble waste powder for 5 percent of the cement results in compressive and flexural strengths that are comparable to those of marble waste-free concrete specimens. However, increasing the replacement range beyond 5 percent results in a weakening of the concrete's overall strength.

6. When producing concrete, replacing up to 20 percent of the sand with waste powder from marble produces the same level of strength as concrete mixes made with 100 percent sand, both after the concrete is young and when it has aged.

7. When marble waste powder is used to replace 5 percent of the cement in concrete specimens, the water penetration depth is decreased. However, when the replacement range is increased beyond 5 percent, the water penetration depth of the concrete specimens is increased.

8. The water penetration depth of concrete examples can be decreased by using marble waste powder as a partial replacement for up to twenty percent of the sand.

9. According to the findings of the study, marble scrap can be utilised in the manufacturing of Portland limestone.

10. According to the findings of the study, the use of marble waste at levels up to twenty percent can successfully replace sand while also improving the strength and durability of concrete in relation to its permeability to water.

REFERENCES

[1] Abebe Dinku, Construction Materials Laboratory Manual, Addis Ababa University Printing Press, 2002.
[2] Birhanu Bogale, Comparison of Concrete Durability as Produced by Various Cements Manufactured in Ethiopia, M.Sc Thesis, Addis Ababa University School of Graduate Studies, 2007
[3] Calcium Carbonate Fillers,www.cementdistribution.com/calcium-carbonate-fines-for- sustainable-concrete.pdf
[4] Cement, http://www.scribd.com/doc/39643059/
[5] Cements, http://www.fhwa.dot.gov/infrastructure/materials grp/cement.htm/
[6] Characterization of Marble Powder for Use in Mortar and Concrete, http://www.4. uwm. edu/cbu/abstracts/05-09.pdf
[7] Concrete Basics/Portland Cement Association (PCA), www.cement.org /basics/concrete basics
[8] Concrete Strength, www.logicsphere.com/products/firstmix/hlp/htm/stre1cis.htm
[9] Concrete: Scientific Principles, www.matse 1.matse.illinois.edu/concrete/prin.html Utilizing Aggregates Characteristics to Minimize Cement Content in Portland Cement Concrete–ICAR 401, http://www.icar.utexas.edu/reports/icar-401/ICAR-401-Final-Report. pdf
[10] Dimensional Stone in Ethiopia, http://www.mome.gov.et/dimension.htm/
[11] Ethiopian Marble Industry-Public Enterprise Profile,www.ppesa.gov.et/Public Enterprise Profile.aspx
[12] Hakan Avsar, Control, Optimization and Monitoring of Portland cement (pc 42.5) Quality at the Ball mill, M.Sc Thesis, Izmir Institute of Technology School of Graduate Studies, .2006, www.library.iyte.edu.tr/tezler/master/kimyamuh/T000365pdf
[13] Industry and Environment on the Sustainability of the Concrete http://vmjohn.pcc.usp.Br/Arquivos/On the Sustainability of the Concrete.pdf
[14] Influence of Marble & Limestone Dust as Additives on Some Mechanical Properties of Concrete, http://www.acedemicjournals.org/sre/pdf 202007/Binici20et/20al.pdf
[15] Limestone Literature, http/www.ccaa.com.au/homepage/pdf

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