

INFLUENCE OF GLASS POWDER AND QUARTZITE POWDER ON MECHANICAL AND DURABILITY PROPERTIES OF CONCRETE

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Abstract – Concrete is a very important construction material and consume high amount of natural resources like water, sand and stones. Due to increase in human population the demand of new construction is at peak and increasing day by day. Due to this we utilize large amount of natural resources. Researcher and scientists are searching deferent ways in which they can reduce the amount or find alternates for use of other materials in construction industry. Use of waste materials is one of them. In this study we will be discussing about use of Waste glass powder and Quartzite powder in concrete to find alternates or partial replacement for natural resources in concrete. Various effects of these materials on concrete will be discussed like effects on strength Characteristics and durability. This study includes research, review paper and various journals paper and then conclusion is made up.

Key Words: Glass Powder (GP), Quartzite Dust Powder (QDP), Compressive Strength, Split Tensile Strength, Flexural Strength, Durability test.

1. INTRODUCTION

As we known, In India the conventional concrete is produced using natural sand form river beds as fine aggregate and we also known that the natural resource are very important for us or our future generation. Decreasing natural resources poses the environmental problem and hence State Government imposing restrictions on sand quarrying, resulted in scarcity and significant increase in its cost. Digging sand from stream beds in overabundance amount is dangerous to the climate. If deep pits are dug in river beds affect the ground water level so In order to fulfill the requirement of fine aggregate, some alternative material must be found. The cheapest and the easiest way of getting substituent for natural sand is replacing from other waste materials. The interest of the development network in utilizing waste or reused materials in cement is expanding In light of the accentuation set on maintainable development. The main objective of this experimental work is to study the proportion of glass powder and quartzite powder on the physical and mechanical behavior of the concrete. Reported that quartzite powder, consisting of very fine particles, was one of the environmental problems around the world, also reported many factories produce a high amount of waste glass. The question out come over here why we use the glass powder

as partially replacement with cement and why we use quartzite powder partially replacement with sand. The answer of this question is, according to the study of previous researchers and the chemical properties of glass powder and quartzite powder is similar with cement. In the glass powder, glass powder having 60% of Silica (SiO₂), 1.53% of Alumina (AlO₃), 1.67% of Iron Oxide (Fe₂O₃), Lime (CaO) is 14%, Magnesia (MgO) is 2.41%, Soda (Na₂O) is 8.65%, Potassium (K₂o) is 0.55% and in the cement also having these similar properties. If we talk about the quantity of cement chemical properties i.e. Silica 20.15%. Alumina 4.36%, Iron Oxide 2.75%, Lime 14.56%, Magnesia 2.37% Soda 0.13% and Potassium 0.97%. As we see that the chemical properties of glass powder and cement that is same, the only difference in the quantity of chemicals. So that's why I am using this glass powder as replace with cement at some percentage. And the Quartzite powder also having these chemical properties and the main chemical properties is Silica and Quartzite having above 90% of Silica content in it. The best way to overcome this problem is to reuse these materials for a purpose. There are various research conducted regarding using waste materials in concrete construction and these materials also proves that these materials have high potential of being used as raw materials.

1.1 Materials

1.1.1 Cement: Cement is a fastener, a substance utilized for development that sets, solidifies, and clings to different materials to tie them together. Cement is only occasionally utilized all alone, yet rather to tie sand and rock together. Cement blended in with fine total produces mortar for stone work, or with sand and rock, produces concrete.

1.1.2 Coarse Aggregates: Coarse aggregates are bigger size filler materials in development. The size of molecule is above 4.75 mm. Coarse aggregates are the particles that hold on 4.75mm sifter. Rock, Pebbles, block chips, stone chips, clinkers, ashes and so forth are utilized as coarse totals in cement. The wellsprings of coarse totals for example Dolomite totals, squashed rock or stone, characteristic disintegration of rock are the significant wellsprings of coarse aggregates.

1.1.3 Fine Aggregates: Fine aggregate are little size filler materials in development. Fine aggregate are the particles that go through 4.75 mm sifter and hold on 0.075

mm strainer. Sand, stone screenings, surkhi, ashes, consumed mud's, ashes, fly debris and so on are utilized as fine total in cement. The wellsprings of fine totals .i.e. is River sand, squashed stone sand, squashed rock sand are the significant wellsprings of fine aggregate.

1.1.4 Glass Powder: Glass is a significant part of Indian economy. India creating 21 million metric tons glass every year. What's more, the significant part is that, the wastage of glass is likewise relying upon this creation. Glass Powder is squander material of glass. It is commonly accessible in neighborhood tool stores and large glass industrial facilities. The formation of glass powder is made by the waste cutting pieces of glasses. Basically they gather the waste glass and pound it with the assistance of apparatuses. There are numerous investigates done on glass powder being utilized in cement.

1.1.5 Quartzite Dust Powder: Quartzite Dust Powder is acquiring from cutting of quartzite rocks which are produced using quartz sandstone. It very well may be utilized in concrete as expansion to sand to give it more strength. QDP has restricting properties when interacts with water.

2. Scope of Paper

The strength of concrete plays an important role in construction. Even waste generated from various glass powder and quartzite plants is a important concern now days. This experimental study will focus on how to partial replace sand with mix of glass and quartzite powder and its effect on strength of concrete.

3. Literature Review

Chi sing lam, chi sun poon and Dixon chan [2007] [1] the researcher did a attempt of using glass powder as fine aggregates in the replacement of river sand. He observed that glass powder has high silica content more than 60% and it has similar properties to cement which leads to increase in strength of concrete when partially replaced with sand.

Her-Yung and Hou Tsung-Chin [2011] [2] done their investigation of Elevated Temperature on the strength properties of LCD glass powder concrete mortars and presumed that subbing 10% of concrete by glass powder would gain a very promising compressive strength of the mortars, particularly when the added glass has powder fineness. In genuine practices, this measure of glass powder substituent could be intriguingly used to supplant concrete.

K. Surendra Babu¹, G. Nagesh Kumar [2013] [3] in this research, Quartzite is partially replaced with fine aggregates in self compacting concrete mix. This research shows when replaced fine aggregates by 10%, 20%, 30%,

& 40% by quartzite had positive effect on fresh properties. When this quantity increased it start showing –ve effect on fresh properties.

Hongjian Du and Kiang Hwee Tan [2014] [4] in this research paper the pozzolanic activity and strength effect of glass powder in concrete by replacing cement partially was calculated. It was observed that when 60% of cement replaced with glass powder, concrete obtained 75% strength at 7 days and 85% strength at 9 days. It was also observed that the glass powder can also reduce porosity and the pore size distribution.

Veena V. Bhat, N. Bhavanishankar Rao, [2014] [5] contemplated that Glass is a formless material with high silica content(SiO₂) for example 72% waste glass when grounded to exceptionally fine powder (600 micron) responds with alkali in cement.

Fasih Ahmed Khan , Muhammad Fahad, Khan Shahzada , Haris Alam , Naveed Ali [2015] [6] analyst saw that underlying strength of cement was less where glass powder added yet following 28 days it began to increment. Research shows that 15% replacement of glass powder with cement gives maximum strength as compare to standard cement. Also recommended that to improve workability use plasticizers in considerable amount.

M. Adaway & Y. Wang [2015] [7] researchers concluded that glass powder can used as partially replacement of sand. There was an increase in strength of concrete containing 30% fine glass aggregate. It was also observed that workability decreases with addition of fine glass powder due to angular nature of the glass particle. More percentage 30% of replacement leads to formation of microscopic void within the concrete mix.

Ummar Shareef VR Sankar Cheela SSSV Gopala Raju [2015] [8] in this research quartzite and Silica Manganese slag is used as alternative material for coarse aggregate in concrete. This research shows that quartzite had good resistance in crushing and impact tests. It also shows that quartzite has higher 28 days compressive strength compared to conventional aggregates. Water absorption is also high in quartzite as compare to conventional aggregates.

Sayisetti Rajaiah, AVS Sai Kumar & T.Shirisha [2016] [9] researched than when he added 20% of glass powder having particle size less then 90 microns of partially replacement of cement in concrete there is increased in 20% more strength as compare to standard concrete. He also observed when particle size start increasing above 90 micron the strength start is decrease.

Muhammad Tufail, Khan Shahzada, Bora Gencturk, and Jianqiang Wei [2016] [10] in this paper effect of different coarse aggregates, quartzite being one of them

was tested for elevated temperature from 25 to 650 degree C were studied. The compressive, tensile strength, and the elastic modulus of quartzite was 2.94 Mpa, 0.34 Mpa (tension) and 3.26 GPa (Modulus) for every 100 degree C increases in temperature was observed. Quartzite exhibits higher linear thermal expansion as compared to standard coarse aggregates.

K. Kavitha, V R Shankar Cheela, Gopala Raju [2019] [11] this research had an experimental study on replacing sand, Fine aggregate in concrete by quartzite powder. This research shows that overall strength of quartzite sand concrete is higher and workability is lower when compared to standard concrete. There are 14.02% increases in compressive strength at 28 days. This research also shows quartzite sand has low bulk density and specific gravity as compared to natural river sand.

4. CONCLUSIONS

According to literature study it was observed that glass powder and Quartzite powder have beneficial effects on the mechanical and durability properties of concrete. There were various research in which glass powder was used in concrete for partial replacement for cement as well as sand. For quartzite there was less research on it related to strength and durability properties.

4.1 Effect of Glass Powder in Concrete

- Glass powder has high silica content more than 60% and it has similar properties to cement which leads to increase in strength of concrete when partially replaced with sand.
- Up to 10% of cement by glass powder would gain a very promising compressive strength of the mortars, particularly when the added glass has powder fineness.
- When 60% of cement replaced with glass powder, concrete obtained 75% strength at 7 days and 85% strength at 9 days. It was also observed that the glass powder can also reduce porosity and the pore size distribution.
- Glass is an amorphous material with high silica content (SiO₂) i.e. 72% waste glass when ground to very fine powder (600 micron) reacts with alkali in cement.
- 15% replacement of glass powder with cement gives maximum strength as compared to standard cement.
- Workability decreases with addition of fine glass powder due to angular nature of the glass particle. More percentage 30% of replacement leads to formation of microscopic void within the concrete mix.

4.2 Effect of Quartzite Dust Powder in Concrete

- Replaced fine aggregates by 10%, 20%, 30%, & 40% by quartzite had positive effect on fresh properties. When this quantity increased it started showing -ve effect on fresh properties.
- Quartzite had great obstruction in pulverizing and impact tests. It also shows that quartzite has higher 28 days compressive strength compared to conventional aggregates.
- Quartzite being one of them was tried for raised temperature from 25 to 650 degree C were examined. The compressive, rigidity, and the flexible modulus of quartzite was 2.94 Mpa, 0.34 Mpa (strain) and 3.26 GPa (Modulus) for each 100 degree C expansions in temperature was noticed. Quartzite displays higher linear thermal expansion as contrast with standard coarse aggregates.
- 100% of supplanting of QDP with sand should be possible in concrete and positive can be seen.
- Quartzite replaced with fine aggregate, shows that general strength of quartzite sand concrete is higher and usefulness is lower when contrasted with standard cement. There are 14.02% expansions in compressive strength at 28 days.
- Quartzite sand has low bulk density and specific gravity as compared to natural river sand.

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