Experimental Investigation on Strength And Durability Properties of Concrete By Utilisation of Granite Waste As Partial Replacement For Cement – A Review

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Abstract- *Concrete is the most widely used construction material in the world. Ordinary Portland cement (OPC) is traditionally used as the binding agent for concrete. The worldwide consumption of concrete is estimated to increase due to the increase of infrastructure especially in a country such as India. The amount of carbon dioxide released during the manufacturing process of OPC is approximately one ton for every ton of OPC produced. Globally, the OPC production contributes about 7% of the world's carbon dioxide. Since it is important to control the trend of global warming by reducing the carbon dioxide emissions, it is appropriate to search for alternative low emission binding agents for concrete.*

One of the main reasons of Environmental pollution is the large quantities of industrial wastes that is being generated at a faster pace. These industrial wastes are dumped in an improper manner leading to pollution of air, water and rendering the land barren. These wastes are causing the natural course of life and causing the climate to change which puts the earth's biodiversity in grave danger.

There is a strong need to promote awareness in people about the industrial wastes. Due to population explosion, large scale infrastructure development is required. This creates a huge demand of construction materials which are not only expensive but are depleting at a rate never seen before.

The ever-increasing cost of construction materials has imposed the scientific community to develop newer and cost-effective building materials. Accordingly, several industrial bi products such as granite quarry waste powder, which are largely left unused and are hazardous to human health and environment may serve as ideal alternatives. Furthermore, these by-products can be effectively used in manufacture of concrete, as they are established to present several desirable properties.

I. INTRODUCTION

The vision is focused mainly on partial replacement of conventional material like cement with granite waste powder to maximum extent possible without compromising the strength and workability of the concrete.

Cement is the largest consumed cementitious material which consumes a lot of energy to manufacture and contributes largely to air pollution. Granite waste powder is used as a partial replacement. Granite powder which is a waste produced in the quarrying industry is the main cause of land fill in the rural areas around the quarry. Granite waste powder is having similar chemical combination as that of pozzolanic materials hence shall serve as a viable partial substitution to cement and expected to produce

This study aims to arrive at the optimum proportions by partially substituting cement with Granite waste powder, with the addition of admixture to achieve a better concrete property, in terms of workability strength and structural behavior.

Hence the area of study under this project serves a purpose to find the feasible replacement to conventional materials and their optimum percentages to be replaced to facilitate the construction industry and the society.

1.1 **NEED FOR STUDY:**

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II. LITERATURE REVIEW

2.1 GENERAL

In this chapter, the previous work done on partially supplementing Cement with Granite waste powder have been discussed and the need for the present study has been delineated.

2.2 STUDIES ON GRANITE WASTE POWDER:

Some attempts have been made in construction industry to incorporate granite waste in concrete in order to produce new green and sustainable concrete.

Digvijay S Chouhan (2017), studied the effect of replacing granite waste with cement on fresh and hardened concrete properties to know the workability and compressive behavior. M25 grade concrete was produced with granite waste replacements varying from 2.5% to 20% with 2.5% denominations. The water to cement ratio followed was 0.45. The compressive strength was carried out on cubes cured only for 28 days. The workability was measured only in terms of slump.

The study has revealed that the compressive strength was higher than conventional concrete between 5% and 7.5% replacements. Beyond 15% replacement the compressive strength falls below that of conventional concrete. The workability went on decreasing has the granite waste percentage increased. The optimum amount of replacement for flexure was found to be 5% beyond which the flexural strength also began to plummet.

Y Yeshwanth Kumar (2015), studied the effect of replacing granite waste with cement on hardened properties of concrete to know the compressive, split tensile and tensile strength of the concrete. M30 grade concrete was produced with granite waste replacements varying from the range of 5% to 20% with 5% denominations. The water to cement ratio followed was 0.39. The compressive strength was carried out on cubes cured only for 28 days. The specific gravity of granite slurry used was 2.53 and fineness modulus was 2.31.

The study has revealed that for 10% replacement of cement with granite waste increases the compressive strength of concrete by 36.59% than the compressive strength of conventional concrete. Further, at 20% replacement of granite waste the compressive strength was slightly higher than that of conventional concrete. The flexural strength also increased by 4.3% at 10% granite waste replacement.

Allam ME (2016), The study revealed that the splitting tensile strength for mixes containing 5% of fine granite waste as a partial replacement of cement was 20% higher than the control mix. Increasing the replacement ratio of cement 10% led to a value for the splitting tensile strength equal to that measured for the control mix. However, exceeding this ratio caused drop in tensile strength measured. Replacing sand in the concrete mixes by granules granite waste with up to 25% replacement ratio led to higher values of splitting tensile strength than that obtained from the control mix.

The flexural strength of mix containing 5%, 10% and 15% of fine granite waste as a partial replacement of cement were 19%, 30%, and 37%, respectively lower than the control mix. By replacing the sand in the concrete mixes by granite waste granules of 10% replacement ratio, the values of the flexural strength were increased by 34% higher than that obtained from the control mix. By increasing the replacement

and hardened concrete. From the compression test results it is found that the concrete mix with 15% replacement of cement with Granite Waste Powder showed the higher compressive strength than the Reference concrete mix for both 7 days and 28 days curing.

Cost analysis was a very important factor considered, while analyzing the experimental work. Based on the cost analysis, the cost for Reference concrete mix was Rs.5471 per m 3 and for concrete mix with 15% GDP was Rs.5017 per m3 which is 8.3% less than the cost of reference mix.

From the experimental analysis, it was concluded that GD3 mix, which is 15% replacement of Granite Waste Powder, was found to be the most preferable one when compared with other mixes by analyzing its Compressive strength, Workability and Cost. It was recommended as favorable mix for both Structural and Non- Structural applications.

Telma Ramos (2013), has surveyed that Granite waste powder is an abundant waste from granite rock processing, causing serious environmental concern. The effect of granitic sludge from a quarry in northern Portugal was analyzed as a partial cement replacement in mortar in terms of strength and durability, to envisage its use in concrete.

The experimental program included chemical analyses, laser particle size distribution and scanning electron microscopy of granite waste powder, as well as mechanical strength, expansion due to alkali silica reaction and chloride penetration resistance on mortars containing different dosages of cement replacement with granite waste ground to different fineness levels.

Results showed that granite waste, if ground to sufficient fineness, produces a denser matrix promoting up to 38% reduction in expansion due to ASR and almost 70% improvement in resistance to chlorides, without compromising workability and strength. This surprising improvement in terms of chloride resistance seems to derive from captivation of chlorides by aluminates present in the waste with formation of chloroaluminates.

Divakar Y (2012), attempted to experimentally investigate the Strength Behavior of Concrete with the use of Granite Fines as an additive. Concrete is prepared with granite fines as a replacement of fine aggregate in 5 different proportions namely 5%, 15%, 25%, 35% and 50% and various tests such as compressive strength, split tensile strength and Flexural strength are investigated and these values are compared with the conventional concrete without granite fines.

The split tensile strength remains same for 0%, 25% and 35%. For 5% replacement there is an increase of 2.4% of strength and for 15% replacement there is a reduction of tensile

Dr. G Elongovan (2015), studied the effects of blending of granite waste powder with cement on the performance of fresh

The cost of construction was minimized by using Granite Powder which was available at free of cost.

Furthermore, Environmental Pollution could be minimized by reducing the production of cement and the health hazards can be controlled by using the Granite powder as the partial replacement to Cement.

Dr. G Prince Arulraj (2013), investigated the effect of using powder and granules as constituents of fines in concrete by partially reducing quantities of cement as well as other conventional fines. The values of workability, compressive strength and flexural strengths were found. Partial replacement of cement and usual fine aggregates with varying percentage of granite powder (0%, 5%, 10%, 15%, and 20%) and granite granules revealed that increased Waste Granite Powder or Waste Granite Granule resulted in increase in workability and compressive strength of mortar concrete.

III. INFERENCES

After a detailed study of compressive strength of the concrete by partial substitution of cement with granite waste powder the following conclusions can be drawn:

1. The granite waste powder used as partial replacement to cement exhibit properties similar to that of cement, hence is a suitable partial replacement for cement.
2. For the 15% granite waste powder as partial replacement for cement results of compressive strength is greater than that of target strength as well as conventional concrete.
3. 30% and 45% replacement show comparatively less compressive strength then 15% replacement.
4. 15% replacement with accelerated curing has the highest compression strength according to the results.
5. 45% replacement has the least compressive strength when compared to 30% and 15% replacement.
6. Our results states that 15% replacement of granite waste as partial replacement is ideal and is cost saving in construction.

7. And it also states that by using granite waste as a construction material we can save the environment from getting polluted by this hazardous waste.

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