GSJ: Volume 8, Issue 8, August 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

SUSTAINABILITY OF CONCRETE MADE FROM RECYCLED MATERIAL.

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Abstract

Portland Cement which act as a binder in concrete structure so the Portland cement play a vital role in construction industry. Portland Cement is big source of emission of Co2 gas which can further effect at local environment where the Portland cement industry exist. Furthermore, the waste residue which are rich of SF and FA who's the researcher can find the cementing properties which can help to reduce the overall emission of Co2 gas. These waste residues are further use in land filling, and a country like Pakistan which is agriculture Country and the land are very precious. So these waste residues are used in construction industry to recycling it. However, use of these waste residue in construction sector is very challenging. To avoid the challenges this paper efforts engineering properties of waste residue.
"Green Concrete" which are the 2nd name of Reused coarse aggregate (RCA) concrete, the green concrete is used to minimize the hazard risk which are related to environment due to the disposal of waste residue. The properties of green concrete can be obtained from two different sample which has a different age group, to whom it's compressive strength check with water cement ratio. In this article we can examine the influence of age on green concrete, such as capillary water absorption, drying shrinkage, air content, flexural strength and tensile failure of concrete. RCA. While compressive strength gradually decreases with the number of recycles, capillary water absorption increases sharply, leading to the conclusion that further recycling may not be advisable.
To achieve sustainable concrete, several researchers encourage the use of SF and FA to improve the engineering properties of the material. To this end, an extensive experimental program was conducted on the compressive strength, flexural strength and tensile strength properties of SF and FA concrete.

Keywords – *Portland Cement, land, Green Concrete, SF, FA*

1. INTRODUCTION

In construction sector the different engineering project had different eco. Portland Cement which act as a binder in concrete structure so the Portland cement play a vital role in construction industry. Portland Cement is big source of emission of Co2 gas which can further effect at local environment where the Portland cement industry exist. The Content Asia whose economy is depended upon the construction sector, and in recent decades the construction has rapidly increasing, especially in Pakistan. The emission of huge amount of Co2 gas which had great impact on local environment, to control the impact of Co2 gas, different cementing materials are added to cement like SF and FA. By using SF and FA in cementing material as a result the quantity of less cement is required as a result lesser emission of Co2 gas is produced by concrete, so local environment will be clean.

As the waste material residue like demolished old road, demolish buildings etc. are increasing day by day which is also the major concern of environment pollution [1]. In Pakistan the Municipal Board publish a report at 2013 that the production of solid waste material is 29 million tons per annum of which 21% are obtained from construction sector waste. So by viewing this it is clear that how much waste are obtain from construction sector throughout the whole world. In order to decrease the value of construction waste material, the recycling of the construction waste material is an appropriate beneficial method from natural resources [2].

By using the demolished, SF and FA material in construction industry is best for use because it is cheaper and the chemical properties of these material are same as of cement to counter the strength balance. However, use of these waste materials in construction industry especially in the making of concrete is highly challenging. By using these material in cementing concrete it is highly recommended to investigate the engineering properties of concrete.

Reused coarse aggregate is a process of recycling the demolished concrete by replacing the natural coarse aggregate either partially or fully to make new concrete stuff. Different scholar has studied the physical and mechanical properties of Reused concrete aggregate and reach to a result that mechanical properties of Reused aggregate strength is lower then Natural coarse aggregate, because of in Reused coarse aggregate there is much pores as compared to Natural coarse aggregate [3], while the physical properties of RCA is depended upon quantity and quality of mortar, because the parent crushing strength depend based on adhered mortar. So by taking these reason in mind RCA shows more permeability, more water concentration, low density and low asset as compared to the NCA. Previous scholars reported that up to 25% decrease in compressive strength has been arose due to above reasons [4].

The Mix design of concrete is depended upon the water cement ratio, by whom the compressive strength is calculated for concrete. AASHTo recommends such association for NCA concrete. The same recommendation is varying for RCA depend upon the age and number of recycling [5]. However, no revisions have been testified on the performance of RCA concrete with favor to beyond characteristics. The current effort remains a try to study the association of Water to cement ratio with compressive strength seeing phase and number of recovering of RCA.

As the construction sector are developing day by day in Pakistan so new ways are open to investigate the method to enhance the quality of RCA as RCA demand are increasing day by day in construction industry. Practice of urease-producing bacteria can identify the problems linked with RCA concrete up to some limit [6]. This bacterium catalysis the hydrolysis. 0f. urea. into. ammonium. and. carbonate. first, urea. is. hydrolyzed. intracellular. to. carbamate. and. ammonia. carbamate. spontaneously. hydrolyzes. to. form. extra. ammonia. and. carbonic. acid. these. products. subsequently. form. bicarbonate, ammonium, and. hydroxide. ions. these. reactions. increase. the ambient. ph, which. in. turn. shifts. the. bicarbonate. equilibrium. resulting. in. the. formation. of. carbonate. ions.

To overview the mechanism of silica fume it is also all. other. pozzolanic. materials. silica. fume. is. capable. of. reacting. with. the. calcium. hydroxide. ca(oh)2. to. produced. hydrated calcium silicate (c–s–h), which can further play a role in hardened concrete, which. is. accountable. for. the. strength. of. hardened. concrete.

1.1. OBJECTIVE OF STUDY

The main objective of the present study are:

- To find out the properties of concrete by using SF and FA, and how much their strength is affected.
- To investigate the relation between water cement ratio and compressive strength of concrete.
- Up to what extant RCA concrete are effected by age and recycling number.
- To investigate the engineering behavior of SF and FA.

1.2. SCOPE OF STUDY

The scope of study is following below

- In Pakistan the construction industry uses 90% of slag cement over ordinary Portland cement so in this study we also slag cement.
- Low medium strength concrete is used in this study because the scope of this concrete is greater than high strength concrete.
- only SF and FA are used by partially or fully replacement of cement.

2. LITERATURE REVIEW

The wrinkled material that marks the destruction of old buildings is produced in large quantities all over the world. The current annual rate of construction waste production is 145 million tonnes worldwide [7]. The area required to unload this amount of waste is enormous. Therefore, the recycling of construction waste is crucial, both to reduce the amount of open land needed for landfills and to preserve the environment by conserving resources [8]. Recycling has been widely reported to reduce energy consumption, pollution, global warming, greenhouse gas emissions and costs [9]. This in turn is beneficial and effective for the conservation of the environment.

Several scholars have. examined. the. physical. and. mechanical. properties. of. RCA. and. its. influence. when. the natural. aggregate. is. partially. or totally replaced by the RCA to produce concrete. The mechanical strength of the RCA concrete was found to be lower than that of conventional concrete. This is due to the highly porous nature of RCA relative to natural aggregates and the amount of substitution relative to natural aggregate [10].

The physical properties of RCA mainly depend on the bonded mortar and generally RCA shows more porosity, more water absorption, low density and low strength than natural aggregate concrete. It should be noted that there was a reduction of up to 25% in the compressive strength for the reasons indicated above [11].

Influence of the water reducing additive on the mechanical behavior of the reused concrete. This study shows that the use of plasticizers can improve the properties of reused concrete investigate the mechanical properties of reused aggregate concrete compared to natural aggregate concrete [12].

It is reported that the strength of reused concrete can be 10-25% lower than that of natural aggregate concrete. It was reported that although reused aggregates are inferior to natural aggregates, their properties can be considered within acceptable limits.

[14] investigated the long-term mechanical properties and pore size distribution of reused aggregate concrete. After 5 years of hardening, reused aggregate concrete has lower compressive strength and higher split tensile strength than natural aggregate concrete.

There are several techniques available in the literature [15] to improve the properties of RCA concrete, such as partial replacement of cement with SF and FA, addition of nanoparticles, etc. However, the use of bacteria to improve the properties of RCA concrete has not been attempted by any previous researcher. Similar studies on NCA concrete are also very limited.

Using substitute minerals in concrete helps to conserve raw materials, reduces Co2 emissions and ultimately contributes to a cleaner environment. The increased use of additional fasteners instead of concrete in concrete structures around the world contributes to sustainability in construction. SF, a byproduct of silicon metal, and FA, a byproduct of thermal power plants, are the two additional cementitious materials available worldwide that possess pozzolanic properties [16].

SF, like all other pozzolanic materials, is able to react with calcium hydroxide, Ca (oH) 2 released during cement hydration to produce hydrated calcium silicate (C - S - H), which is responsible for the strength of hardened concrete. The high content of very fine particles of amorphous spherical silicon dioxide (average diameter 100 nm) (present more than 80%) is the main reason for the high pozzolanic activity of SF [17]. There are several studies on improving the compressive strength of hardened concrete using SF available in the published literature [18]. SF can improve chemical and physical properties, which transform the microstructure of concrete and, therefore, reduce permeability and increase strength [19].

The durability and abrasion resistance of SF concrete are also improved [20]. The resistance of concrete to acid and sulphate attack improves with the addition of SF [21]. SF is known to improve the bond between pulp and aggregate [22]. Due to the many advantages of SF, it is used as the most common mineral additive for High Strength Concrete (HSC) [23].

The construction industry uses most of these materials, incorporating them into concrete as additional cementitious materials and contributes to sustainability. Such additional materials are FA, SF, metakaolin and granulated blast furnace slag [24], used for their pozzolanic activity. SF is very active in the design and development of concrete. The incorporation of SF concrete into the construction industry has been gaining popularity in recent years, which requires the design and safety assessment of these structures. The randomness and variability of material properties can significantly affect structural performance and safety. Contrary to reality, this phenomenon is often overlooked in conventional structural analyzes and designs that assume deterministic values of the properties of materials. This assumption makes the analysis models less realistic and less satisfactory. With the advancement of computer structures, complex structural analyzes that include the probabilistic nature of the various parameters of the structure are not difficult and have become essential for its response to natural loads such as earthquakes, winds, etc.

There are many studies [25] that report the variability of the compressive strength of concrete. The variability of the compressive strength of concrete is generally represented in the literature by a normal distribution if the coefficient of variation does not exceed 15-20%, although there may be a slight asymmetry. However, when the coefficient of variation is high, the slope is considerable [26] and if quality control is poor, a log normal distribution is more rational to represent the tail distribution areas than a normal distribution.

3. METHODOLOGY:

To achieve the study objectives, the following methodology is adopted.

- The concrete obtains from demolished concrete is RCA concrete, further from these RCA concrete test sample are collected and conduct different tests to assess the RCA concrete age and number of recycling.
- Grow bacteria in the laboratory and incorporate them into RCA concrete to improve their properties.
- Perform microstructure analyzes such as X-ray diffraction (XRD) and field emission electron microscopy (FESEM) to correlate the morphology and microstructure of bacterial concretes with their mechanical properties.
- Design the mixing ratio of SF and FA concrete and evaluate its mechanical properties.
- Propose probability distribution models to describe the variance in mechanical properties of SF and FA based on the quality of fitness tests.

4. RESULT AND CONCLUSION:

The Conclusion of this study can be summarized as

- RCA concrete has been found to require minimal water depending on the base mortar associated with the contribution to strength. This minimum amount of water in terms of water / water ratio for RCA concrete for one and two years was about o.37 and o.42, respectively. To achieve higher compressive strength of RCA (compared to NCA), the w / c ratio should be higher than the above-mentioned maxima. The compressive strength of concrete prepared from older (RC-2) aggregate was found to be about 6% lower in comparison with RC-1. The split tensile strength and flexural strength of RC-2 concrete are about 14 to 28% and 6% to 21% lesser than that of RC-1 concrete respectively.

- Subsequent recycling reduces the quality of the concrete due to the increased water absorption from the reused aggregates. The compressive strength of the concrete after two times of recycling was approximately 2% less than the resistance at the time of recycling. It was found that the capillary water absorption of N2-RC-1 is approximately 9 times greater than that of concrete RC-1 and NCA. Further recycling was found to increase the air content of RCA concrete. Post rotation reduces tensile and flexural strength by 6% and 12%, respectively.
- RCA concrete properties such as compressive strength, capillary water absorption, and drying shrinkage are enhanced by the addition of Bacillus subtilis and Bacillus sphaericus. The compressive strength of RCA concrete at 28 days increased by approximately 21% for B. subtilis (B-3a) and by 36% for B. sphaericus concrete (B-3b) compared to the RCA control mixture at optimal cell concentration. 1o6 cells / ml. Calcium carbonate precipitation was confirmed by B. subtilis and B. sphaericus in calcite form by microstructure analysis using SEM, EDX, and XRD. B. subtilis and B. sphaericus can reduce the dry shrinkage stress and capillary water uptake of RCA concrete thus improving the durability.
- The tensile, compressive, and fracture resistance of concrete increases gradually from a dose of 5% SF to an ideal value of 20%. The 21% cap on previous studies is 20% replacement. This reduction can be attributed to the use of 10% additional cement. The flexural strength of the concrete prism gradually increases with increasing doses of SF6, until it reaches the optimum value of 25%. There is a limit of about 10% compared to previous studies with a 20% replacemen

5. RECOMMENDATION:

Based on the outcomes of the study it is strongly recommended to

- The existing reading can be prolonged to develop the proposal code provisions required for RCA concrete in route with that of normal concrete.
- The existing reading considered RCA concrete taking two ages, one year and two year. This reading can be prolonged to consider extensively older demolished concrete to represent more realistic situations.
- This reading can be prolonged to propose stress versus strain relationship of the RCA concrete considering age and number of reusing as altered limitations.
- The stress versus strain relationship of the RCA concrete incorporating bacteria concrete is not available in literature. This study can be continued in this direction.
- The existing reading used SF and FA from a single source. The present study can be extended to develop the variability descriptions among various sources.

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