A Study on the Effect Cause due to Pozzolona on Cement Concrete

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Abstract*—We can give the definition of concrete with high-performance as something that approaches specific combos in terms of performance plus needs in uniformity that may not be forever with the employment of orthodox products and simple mixture, placement with practices of curing. No sooner than the word concrete of high-performance came into existence in the sector, it came up with immense uses in massive structures of concrete that need a lot of durabilities, flowability and strength as well. Concrete that has high strength will forever be high in performance but if it is high in performance, it may not be high in strength. If it is durable and contains immense strength it may not make sure that the concrete is quite durable. So it could be tough to get materials that would offer all the specs all together. So we employ hordes of materials from pozzolana such as GGBS, husk of rice, fumes of silica, metakaolin, fly ash and these are a few products that may enter concrete and lessen the amount of cement that tends to be the arbitrary element to get concrete of high performance. In such a case, we do XRD tests from the products that were given above to ensure the varying quantity of the elements in it. Besides, one of the most important elements is to make sure of the cement and water ratio to least range and thus we employ admixtures that reduce water and these can be called superplasticizers that hold the key when we are producing concrete of high performance. Thus, here we will examine hordes of products like ash from rice husks, GGBS, and fumes of silica to get the needed outcomes. Besides, we do a Diffraction Test of X-Ray on hordes of pozzolanic products to get the recipe that is needed. We employed some fibers like Recron, in varying amounts such as 0 percent, and 0.1 percent and 0.2 percent, and 0.3 percent to the needed amount of concrete when we do the casting. Last, we know distinct amounts of fumes of silica in terms of cement that has to be replaced while employing content of fiber as fixed when we make concrete. In this element. We employed a couple of cement varieties which are OPC and PSC. We make things like prisms, mortar, cylinders and cubes to do the test on compression, test on flexure, etc. We also do examinations for permeability as well as porosity. To get these results which may not have been gotten from orthodox concrete and with the recent methods, a horde of mixes in trial get needed to obtain the required combo of products that ensure the critical performance.

***Index Terms*—GGBS, Rice Husk, Cement, Concrete, Pozzolona.**

I. INTRODUCTION

One of the most critical materials in construction across the globe is concrete and we get it when we mix certain materials of cement with products like aggregates and admixtures and water in needed amounts, Concrete which is plastic is mixed soon and it is capable of getting molded to distinct shapes while it gets hard to behave like a rock and this is defined to be concrete. It gets tough cause of the reaction that happens in cement as in water. This moves forward for longer and develops sturdiness with time. The use plus the gift of an element with its sturdiness made within the last century's first half with the help of OPC and steel bars which were mild, the way it is available freely and the example that and of the combos of the concrete mixture could result in a wonderful mass have attracted attention. We take note of strength even without the sturdiness of these structures. Because of what we take the liberty, the sturdiness of this concrete and their structures could be a journey to the south and this could truly appear to be destroying itself. This could be true for the structures of concrete that they made in 1970s within the time a. With the employment of the rebars of immense sturdiness with the HSD that turns common enough, b. A lot of alterations in the features of this cement took place c. these engineers used some extra materials of cement and even concrete admixes without paying much heed.

These terms that say High in Performance have taken birth only some time back in terms of construction using concrete. As per ACI, we can say high in performance of concrete can be certain concrete that fulfills specific conglomerations of uniform mixture and the performance that may not normally be obtained when we use orthodox materials in terms of mixing, curing and placing etc. According to some comments the concrete that is high in performance could be giving birth to a few features that take place for certain application for the environment. Instances of features that we may need for critical consideration of an element are: Since a lot of features of concrete could match each other, one changes when the other gets changed in terms of features. Concrete which gets high in performance is an element that can be achieved more and more regularly and comes with certain features that may fulfill a lot of criteria. We may take the instance of the Murrow Bridge that floats in Washington. Here it was said that concrete would fulfill certain strength, permeability, and even shrinkage needs. The last of these needed to control in the amount of mix due to which the strength was more than needed by the specifications. This took place because all the above three features were connected. We know that concrete high in strength is forever concrete high in performance, but we cannot say that concrete high in performance will be something high in strength. Concrete high in strength is defined by ACI and it means concrete that has compressive strength reaching 6000 in psi or if we take in MPa, it is 40 or more. Some more countries take note of the least strength in compression while the definition from ACI is open in ends. With the durability of concrete that needs high in strength may not make sure that concrete's durability is readily gotten. While needing some immense strength, some of the durability concrete should have features that make sure durability can be achieved. Back in time, we get concrete's durability when we specify the content of

air, least of content of cement and highest ratio of cement with water. This day, the features of performance may have permeability, resistance to scaling, freezing, and thawing resistance, resistance against abrasion, and a combo of any of these features. Knowing that needed strength in the features is tough to be defined in terms of strength features, we use specs as the combo of their performance with the requirement perspectives like porosity and the highest level of cement and water ratio to get the sturdiest concrete. We may get concrete that is high in strength, but this is the last thing we get when making durable concrete. In most cases, the concrete that is produced these days will come with a product as well as a cement of Portland to get the required strength of compression and performance in durability. Some of these materials may be fumes from silica, fly ash and even GGBS, in combo or used alone. In the specific period, admixtures made of chemicals like these which lessen the water reducing features are elementary to get that the concrete could be transported easily and placed and finished. When the strength of concrete is high, a mineral combo and admixtures of the chemicals are certainly needed to get the essential needed strength.

OPC could be an essential element employed to produce the concrete and it has hardly any second option in terms of the construction industry. But cement production could need the production of huge content of CO2 gases that go to the atmosphere and pay their way to greenhouse changes leading to global warming. Due to this, it is important that we look for some different material or in some content replace the same with a totally different product. The quest for distinct materials that should be employed as a replacement for the cementitious products should get lessen the global warming and promote some development that has the least effect on the environment.

II. LITERATURE REVIEW

There were a lot of distinct researches in the past with the help of pozzolanic products which could replace cement with the help of super plasticizers for developing the concrete of immense performance. Besides, developing the property of concrete that has fiber in a combination of pozzolana. So here we offer a view of the distinct researches in the past.

In 1995, the researcher Aitcin decided to develop some applications in terms of performance of concrete. In the past some time, we have seen a dramatic increment in strength of compression in this concrete. We saw a 120 megapascal concrete that was brought to site in 1988 and in the recent times, even 40 Megapascal was known to be something with immense strength. The immense increment in the strength of compression could be in proportion with the types of technologies evolved, particularly about the invention of the acting dispersal of some super plasticisers due to which we can create flowing concrete with similar amount of water that needs to drench the entire content of cement and even low. Reducing of the cement and water ratio gives in drenched paste of cement with structure that is immensely dense and strong to an extent that aggregates which are coarse will turn into the feeblest elements of concrete. Fumes of silica that are very reactive will make sure the aggregates or the paste get better in terms of interface and lessens the bonds. Final in terms of materials of cement would be fly ash or even the slag that assists in relieving troubles with loss of slum and it turns important when the cement and water ratio is very less.

In 2002, Mr. Radomski and Mr. Ajdukiewicz did one good Polish of reserach on concrete that was high in performance. They tiil the elemental trend for a research and the concrete in Poland. In this, they came across a few instances of smart researches. The basic money-related and engineering issues with the use of HPC in Poland was delivered and even the demands of the enhanced employment of the products was notified in short.

In 1984, Yousif and Khalaf studied the employment of concrete and RHA. They examined the key heat needed to char the husk of rice so that the required features of pozzolana can be obtained, and if can partially replace cement with husk of rice for strength of compression and alterations in the volume of distinct mixtures. They displayed that with about 40 percent of change could be delivered without bringing any change in the strength of compression when we use some control mix. This was used on cube of mortar and they have a size of 50mm. In their study the came with the theory that was pocket-friendly and extremely easy fo that the huslks of rice that can get burned at around 500 degrees will turn to one homogenous in about 2 hours. For a certain time needed for grinding, there could be a lot of lessening in terms of RHA's surface area since the temperature of burning gets increase. For an agglomerate of mortar along with RHA that is contant in content, the amount of water that is needed lessens as the ash gets finer. The least of activity of pozzolana can be ascertained when teh specific surface required for this ash is approximately 11500 square centimeters per gram. The durability of the RHA in mortar with cement gets close to the durability of the adjacent mortar mix when this surface-specific if the RHA would be approximately 17000 square centimeter per gram. For a mix of ratio 1 to 2 and 1 is to 3, the highest amount of husk or rice ash that can be changed with the cement weight in less than 2 months and it is lesser in vase of plain mortar that is about 30 percent or 40 percent in order. He came to know that more is the percent of the RHA, or will the change in volume features as per the simple mortar.

In 2006, Mr. Sensale examined the change in strength in this concrete with the employment of ash of rice husk. In his paper, he gave this experiment where the strength of compression was developed with around concrete of 91 days assisting the RHA and in this RHA residue, from a field of paddy with training the produced RHA was burned in a controlled manner and in USA we used to for comparing. A couple of distinct percentage RHA of the cement was employed and it was 10 percent and 20 percent. Besides, 3 distinct cement and water ratios were used and these were 0.5, and 0.4 and 0.32. When we put it against the concrete where no RHA was there in terms of strength in tension and permeability in the air, we could that the RHA in residue offers a much better action on the strength of compression at past stages. However, the future result in the concrete in terms of RHA that get out of the burning towers tend to be highly effective. The outcomes of tensile strength and the test and the permeability test deliver the action of pozzolana and filler for some concrete where the Residue of RHA and it gets created when the incineration is in control.

In 2000, Cajun and Jueshi examined the performance of materials in the cement for slag of some factories and they came to a conclusion that factory produce slag are employed when we not take all the pros of the features or when we throw them before using. The slag from factories that contains pozzolana or cement could be employed as a part-time of complete alternative of the cement from Portland against the heavy aggregates or even the ballasts since the cost of cement is high, which is credited to the consumption of immense energy in developing cement. The orthodox method of using a metallic slash in the adhesives could be replacing cement of Portland and this is normally due to low and less strength and setting time that lasts very long. In the vicinity of the activating agents, we can enhance the breaking of these structures with the slag and their hydration. Some examinations show that alkalis and clinkers that get activated with slags have more strength and volume structure with more strength as against cement of Portland. With the help of the paper, we see the latest results in developing cement of high performance against the slaves that are activated and these could be BFS, slag fro copper, steel and phosphorus etc.

In this they saw the latest working of the activity and the cement features of distinct slags. Slags that had alkalis like the one from blast furnace or from steel or from copper or even from phosphorus contain immense early strength and strength later on and they also saw more resistivity to corrosion against plain cement or Portland. Portland cement needs a lot of energy to get produced and even making it fine will consume about the 10 percent of the total energy needed in complete production. When the cement features of pozzolana features get activated in the slag of metals, this would be a huge topic of interest for the materials in construction.

III. MATERIALS AND METHODS

1) Materials

- Ground Granulated Blast Furnace Slag (GGBS)
- Rice Husk Ash
- Silica Fumes
- Superplasticizer
- Cement
- Aggregate
- Fiber

2) Methodology

The husk of rice is a material that can satisfy the engineering needs in accordance with the chemical and physical features. So in this assessment, we will devote a lot of attention to RHA that is possibly the product that can replace cement partially and can also get the needed tests for strength on the cubes of mortar. Talking about GGBS, we can say that it is a non-metal and comes with some silicates such as from aluminum and calcium etc. The quad for factors that affect the hydraulic features of these slags and the content of glass, the composition which could either be chemical mineral or the ability to be fine. The materials in granules if getting a further grind to lesser than about 45 microns may achieve some specific surface reaching 400 meter square per kilogram to 600 meter square per kilogram. But in this assessment, we have made use of the GGBS that gets passed from a sieve of 75 microns. It has a surface that can range from 275 meter square per kilogram to 550 meter square per kilogram. We will employ GGBS as the smaller replacement need for the cement since the pros like less cost of energy, more resistance to abrasion and less heat of hydration etc. can be found.

Synthetic Fiber or the fiber or Recron is employed in our concrete when we make the concrete reinforced with fibers. We will employ the fibers of Recron in distinct amounts and these are 0 percent, 0.1 percent, and 0.2 percent, and 0.3 percent to the concrete mass and we examine it for about 7 days and then for about 28 days to find the strength in compression, tension in splitting and strength in flexure in the matter against concrete that is normal and we also take the cement and the water ratio in between 0.35 and 0.41. And then as the percentages of the fumes of silica varies which is 10 percent, and 20 percent, and 30 percent etc. while keeping the percentage of fibers at around 0.2 percent of the cubes and cylinder and even the prisms were made to test and to know the changes in the strength of compression, tension in splitting and strength of flexure. We employed a couple of cement variants in our study and these were PSC and OPC of the grade 53. We will do an XRD test to know the composition of the chemicals of the fumes of silica, RHA, GGBS. Apart form this, we test porosity and the absorption test by capillary action on distinct samples to know the action of fumes of silica on concretes.

IV. RESULTS

1) Results for Material Testing

a) Cement

	Portland Slag Cement	Ordinary Portland Cement
Specific Gravity	2.96	3.1

Initial Setting Time	125	90
Final Setting Time	235	190
Fineness	340 m2/kg	340 m2/kg

b) Aggregate

In this study it was used the sand of Zone-II, known from the sieve analysis using different sieve sizes (10mm, 4.75mm, 2.36mm, 1.18mm, 600µ, 300µ, 150µ) adopting IS 383:1963.
The coarse aggregate used here with having maximum size is 20mm. We used the IS 383:1970 to find out the proportion of mix of coarse aggregate, with 60% 10mm size and 40% 20mm.

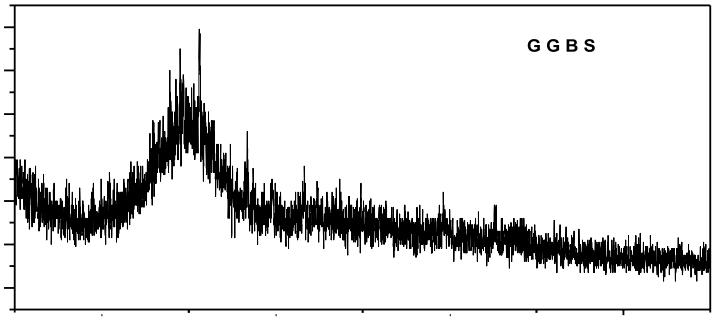
	Fine Aggregate	Coarse Aggregate
Specific Gravity	2.65	2.67
Water Absorption	0.6%	0.4%
Fineness Module	2.47	4.01

c) Fiber

In this project work it was used Recron fiber. It is a type of synthetic fiber. In different weight fraction (0.0%, 0.1%, 0.2%, 0.3%) to concrete it was used.

d) Ground granulated blast furnace slag (GGBS)

As pozzolanic activity greatly depends on fineness, so GGBS passing through 75 micron whose fineness of order of 275-550 m2/kg was used. Specific gravity test was conducted using Le-Chatelier apparatus and found to be 2.77. X-Ray diffraction test was conducted shown below in figure

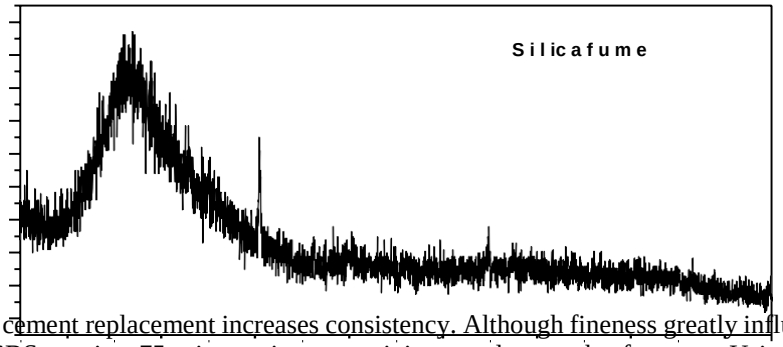


e) **Rice Husk**

In this study we have used two types of Rice husk Ash. First type which was low burned having greater percentages of carbon (which is having negative impact on strength development), so looking black and second type is looking white because it was being burnt in higer temperature. Here in second type of RHA the percentage of carbon is low. The specific gravity test was carried out using Le- Chatelier apparatus and found to be 2.21 for RHA– I and 2.20 for RHA-II. X-Ray diffraction test was carried out

f) Silica Fume

Silica fume is used in different percentage (0%, 10%, 20%, 30%) with the replacement of cement for its greater pozzolanic activity along with fiber. The specific gravity of silica fume was found out using Le-Chatelier apparatus and found to be Specific gravity- 2.36. X-Ray diffraction test was conducted



V. CONCLUSION

- Use of GGBS as cement replacement increases consistency. Although fineness greatly influenced on proper pozzolanic reaction still GGBS passing 75-micron sieve not giving good strength of mortar. Using GGBS more than 10% in Portland slag cement the strength reducing rapidly.
- With replacement of cement with RHA the consistency increases. Use of RHA which burned properly in controlled

temperature improves the strength of mortar. But use of RHA not giving satisfactory strength result.

- With the use of superplasticizer, it possible to get a mix with low water to cement ratio to get the desired strength.
- In case of Portland slag cement with the use of Recron fiber, the 28 days compressive strength at 0.2% fiber content the result obtained is maximum. The 28 days splitting tensile and flexural strength also increases about 5% at 0.2% fiber content to that of normal concrete. Further if fiber percentage increases, then it was seen a great loss in the strength.
- As the replacement of cement with different percentages with Silica fume increases the consistency increases.
- With Portland slag cement keeping 0.2% Recron fiber constant and varying silica fume percentage the compressive, splitting tensile, flexural strength affected remarkably. Using 20% silica fume with 0.2% fiber percentage the 28 days compressive strength increases 7% more than concrete with 0.2% fiber only. 28days split tensile and flexural strength increases further, about 12% and 10% that of normal concrete.
- So it is inculcated that 0.2% Recron fiber and 20% SF is the optimum combination to achive the desired need.
- In case of OPC the compressive strength is increasing as the percentage of silica fume increases from 0-30% and 0.2% Recron fiber and it is about 20% more than strength of normal concrete with OPC.
- The splitting tensile strength increases about 15% at 10% SF and constant 0.2% Recron fiber, then decreases with increasing the SF percentage. Flexural strength is not giving good indication and goes on decreasing and it is about 40% decrement as the SF percentage increases to 30%.
- Ordinary Portland cement gives good compressive strength result as compared to Portland slag cement in case of mix with SF and 0.2% Recron.
- The capillary absorption coefficient (k) with decreases great sign as SF percentage increases at constant fiber percentage i.e 0.2%. At 20% SF content the k value decreases progressively with 70% reduction that to without SF content concrete.
- The porosity value also decreases as the SF value increases from 0-30% in Recron fiber reinforced concrete.

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