ISSN PRINT 2319 1775 Online 2320 7876
Research Paper , Journal Volume 11, Iss 08, 2022

A STUDY ON MINERAL ADMIXTURES WITH SYNTHETIC FIBRE CONCRETE

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Abstract: *Concrete is the most widely used man-made construction material in the world. It is obtained by mixing cementitious materials, water, aggregate and sometimes admixtures in required proportions. Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape hardens into a rock-like mass known as concrete. The hardening is because of chemical reaction between water and cement, which continues for long period leading to stronger with age. The utility and elegance as well as the durability of concrete structures, built during the first half of the last century with ordinary portland cement (OPC) and plain round bars of mild steel, the easy availability of the constituent materials (whatever may be their qualities) of concrete and the knowledge that virtually any combination of the constituents leads to a mass of concrete have bred contempt. Strength was emphasized without a thought on the durability of structures*

Durable concrete Specifying a high-strength concrete does not ensure that a durable concrete will be achieved. It is very difficult to get a product which simultaneously fulfill all of the properties. So the different pozzolanic materials like Ground Granulated Blast furnace Slag (GGBS), silica fume, Rice husk ash, Fly ash, High Reactive Metakaolin, are some of the pozzolanic materials which can be used in concrete as partial replacement of cement, which are very essential ingredients to produce high performance concrete. So we have performed XRD tests of these above mentioned materials to know the variation of different constituent within it. Also it is very important to maintain the water cement ratio within the minimal range, for that we have to use the water reducing admixture i.e superplasticizer, which plays an important role for the production of high performance concrete. So we herein the project have tested on different materials like rice husk ash, Ground granulated blast furnace slag, silica fume to obtain the desired needs. Also X-ray diffraction test was conducted on different pozzolanic material used to analyse their content ingredients. We used synthetic fiber in different percentage i.e 0.0%, 0.1%, 0.2%, 0.3% to that of total weight of concrete and casting was done. Finally we used different percentage of silica fume with the replacement of cement keeping constant fiber content and M 30 grade of concrete was casted. In our study it was used two types of cement, Portland slag cement and ordinary Portland cement. We prepared mortar, cubes, cylinder, prism and finally compressive test, splitting test, flexural test are conducted. Finally porosity and permeability test conducted. Also to obtain such performances that cannot be obtained from conventional concrete and by the current method, a large number of trial mixes are required to select the desired combination of materials that meets special performance.

I.INTRODUCTION

1.1. Introduction:

Concrete is the most widely used man-made construction material in the world. It is obtained by mixing cementitious materials, water, aggregate and sometimes admixtures in required proportions. Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape hardens into a rock-like mass known as concrete. The hardening is because of chemical reaction between water and cement, which continues for long period leading to stronger with age. The utility and elegance as well as the durability of concrete structures, built during the first half of the last century with ordinary portland cement (OPC) and plain round bars of mild steel, the easy availability of the constituent materials (whatever may be their qualities) of concrete and the knowledge that virtually any combination of the constituents leads to a mass of concrete have bred contempt. Strength was emphasized without a thought on the durability of structures. As a consequence of the liberties taken, the durability of concrete and concrete structures is on a southward journey; a journey that seems to have gained momentum on its path to self– destruction. This is particularly true of concrete structures which were constructed since 1970 or thereabout by which time (a) the use of high strength rebars with surface deformations (HSD) started becoming common, (b) significant changes in the constituents and properties of cement were initiated, and (c) engineers started using supplementary cementitious materials and admixtures in concrete, often without adequate consideration.

The setback in the health of newly constructed concrete structures prompted the most direct and unquestionable evidence of the last two/three decades on the service life performance of our constructions and the resulting challenge that confronts us is the alarming and unacceptable rate at which our infrastructure systems all over the world are suffering from deterioration when exposed to real environments.

The Ordinary Portland Cement (OPC) is one of the main ingredients used for the production of concrete and has no alternative in the civil construction industry. Unfortunately, production of cement involves emission of large amounts of carbon-dioxide gas into the atmosphere, a major contributor for green house effect and the global warming, hence it is inevitable either to search for another material or partly replace it by some other material. The search for any such material, which can be used as an alternative or as a supplementary for cement should lead to global sustainable development and lowest possible environmental impact.

Fly ash, Ground Granulated Blast furnace Slag, Rice husk ash, High Reactive Metakaolin, silica fume are some of the pozzolanic materials which can be used in concrete as partial replacement of cement. A number of studies are going on in India as well as abroad to study the impact of use of these pozzolanic materials as cement replacements and the results are encouraging. The strength, durability and other characteristic of concrete depends on the properties of its ingredients, proportion of mix, method of compaction and other controls during placing and curing.

With the passage of time to meet the demand, there was a continual quest in human being for the development of high strength and durable concrete. The history of high strength concrete is about 35 years old, in late 1960s the invention of water reducing admixtures lead to the high strength precast products and structural elements in beam were cast in situ using high strength concrete. Since then the technology has come of age and concrete of the order of M60 to M120 are commonly used. Concrete of the order of M200 and above are a possibility in the laboratory conditions. The definition of high strength concretes is continually developing. In the 1950s 34N was considered high strength, and in the 1960s compressive strengths of up to 52N were being used commercially. More recently, compressive strengths approaching 138N have been used in cast-in-place buildings. The advent of prestressed concrete technology has given impetus for making concrete of high strength. In India high strength concrete is used in prestressed concrete bridges of strength from 35 MPa to 45 MPa. Presently (in 2000) Concrete strength of 75 MPa is being used for the first time in one of the flyover at Mumbai. Also in construction of containment Dome at Kaiga power project used HPC of 60MPa with silica fume as one of the constituent.

The reasons for these demands are many, but as engineers, we need to think about the durability aspects of the structures using these materials. With long term durability aspects kept aside we have been able to fulfil the needs. The concrete of these properties will have a peculiar Rheological behaviour.

Now a day the construction industry turning towards pre-cast elements and requirement of post-tensioning has made the requirement of the high strength of concrete invariable and the engineers had to overcome these drawbacks, which to a great extent we have been able to do. The construction today is to achieve savings in construction work. This has now turned into one of the basic requirement of concreting process.

1.2. HIGH PERFORMANCE CONCRETE:

In recent years, the terminology "High-Performance Concrete" has been introduced into the construction industry. The American Concrete Institute (ACI) defines high-performance concrete as concrete meeting special combinations of performance and uniformity requirements that cannot always be achieved routinely when using conventional constituents and normal mixing, placing and curing practices. A commentary to the definition states that a high-performance concrete is one in which certain characteristics are developed for a particular application and environment.

Most high-performance concretes have a high cementitious content and a water-cementitious material ratio of 0.40 or less. However, the proportions of the individual constituents vary depending on local preferences and local materials. Mix proportions developed in one part of the country do not necessarily work in a different location. Many trial batches are usually necessary before a successful mix is developed. High-performance concretes are also more sensitive to changes in constituent material properties than conventional concretes. Variations in the chemical and physical properties of the cementitious materials and chemical admixtures need to be carefully monitored. Substitutions of alternate materials can result in changes in the performance characteristics that may not be acceptable for high-performance concrete. This means that a greater degree of quality control is required for the successful production of high-performance concrete.

High speed slurry mixing: It involves the advanced preparation of cement water mixer which is then blended with aggregate to produce concrete. Higher compressive strength obtained is attributed to more efficient hydration of cement particle and water achieved in the vigorous blending of cement paste.

Use of admixtures: Use of water reducing agents are known to produce increase compressive strength.
Inhibition of cracks: Replacement of 2-3% of fine aggregate by polythene or polystyrene “lentcules” 0.025 mm thick and 3-4 mm in diameter results in higher strength. They appear to acts as crack arresters without requiring extra water for workability.
Sulphur impregnation: Satisfactory high strength concrete have been produced by impregnating low strength porous concrete by sulphur. The process consist of moist curing the fresh concrete specimen for 24 hours,

ISSN PRINT 2319 1775 Online 2320 7876
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drying them at 120^0 C for 24 hours, immersing the specimen in molten sulphur under vacuum for 2 hrs and then releasing the vacuum and soaking them for an additional hour for further infiltration of sulphur. The sulphur infiltrated concrete has given strength up to 58 MPa.

Use of cementitious aggregates: It has been found that use of cementitious aggregate has yielded high strength. Cement fondu is a kind of clinker. This glassy clinker when finely ground results in a kind of cement. When coarsely crushed, it makes a kind of aggregate known as 'ALAG'. Using ALAG as aggregate strength up to 125 MPa has been obtained with w/c ratio 0.32.

II.REVIEW OF LITERATURE

2.1. Introduction:

As our aim is to develop concrete which does not only concern on the strength of concrete, it also having many other aspects to be satisfied like less porous, capillary absorption, durability. So for this we need to go for the addition of pozzolanic materials along with superplasticizer with having low water cement ratio. The use of silica fume is many, which is having good pozolanic activity and is a good material for the production high performance concrete. Also now a days one of the great application in various structural field is fiber reinforced concrete, which is getting popularity because of its positive effect on various properties of concrete.

2.2. Earlier researches:

Some of the early research works had done using different pozzolanic materials with the replacement of cement using superplasticizer for the development high performance concrete. Also the development in the field of fiber reinforced concrete along with pozzolanas. So below an over view of different studies has been represented.

Aitcin[1] (1995) cited on development in the application of high performance concrete. Over the last few years, the compressive strength of some of the concrete used has increased dramatically. In 1988, a 120 MPa concrete was delivered on site, while, until relatively recently, 40 MPa was considered indicative of high strength. The spectacular increase in compressive strength is directly related to a number of recent technological developments, in particular the discovery of the extraordinary dispersing action of superplasticizers with which flowing concretes can be made with about the same mixing water that is actually required to hydrate all the cement particles or even less. The reduction in water/cement ratio results in a hydrated cement paste with a microstructure so dense and strong that coarse aggregate can become the concrete's weakest constituent. Silica fume, a highly reactive pozzolana, considerably enhances the paste/aggregate interface and minimizes debonding. Lastly, the use of supplementary cementitious materials, such as fly ash and especially slag, helps solve slump loss problems which become critical at low w/c ratios.

Ajdukiewicz and Radomski[2] (2002) delve into Trends in the Polish research on high-performance concrete. They analysed the main trends in the research on high-performance concrete (HPC) in Poland. There they sighted on some examples of the relevant investigations. The fundamental engineering and economical problems concerning the structural applications of HPC in Poland are presented as well as the needs justifying the increased use of this material are briefly described.

Aitcin[3] (2003) studied on the durability characteristics of high performance concrete. He examined durability problems of ordinary concrete can be associated with the severity of the environment and the use of inappropriate high water/binder ratios. High-performance concrete that have a water/binder ratio between 0.30 and 0.40 are usually more durable than ordinary concrete not only because they are less porous, but also because their capillary and pore networks are somewhat disconnected due to the development of self-desiccation. In high-performance concrete (HPC), the penetration of aggressive agents is quite difficult and only superficial. However, self-desiccation can be very harmful if it is not controlled during the early phase of the development of hydration reaction, therefore, HPC must be cured quite differently from ordinary concrete. Field experience in the North Sea and in Canada has shown that HPCs, when they are properly designed and cured, perform satisfactorily in very harsh environments. However, the fire resistance of HPC is not as good as that of ordinary concrete but not as bad as is sometimes written in a few pessimistic reports. Concrete, whatever its type, remains a safe material, from a fire resistance point of view, when compared to other building materials.

Al-Khalaf and A. Yousif [4] (1984) examined on use of RHA in concrete. They studied the actual range of temperature require to burn rice husk in order to get the desired pozzolanic product, use of rice husk as partial replacement of cement on compressive strength and volume changes of different mixes. And showed that up to 40% replacement can be made with no significant change in compressive strength compared with the

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control mix. He tested on mortar cube, by testing on 50 mm cubes. In his investigation alsohe deduced that the most convenient and economical burning conditions required to convert rice husks into a homogenous and well burnt ash is at 500^0 C for 2 hours. Also for a given grinding time, there is a considerable reduction in the specific surface area of RHA as burning temperature increases. For mortar mix with constant RHA content, the water requirement decreases as the fineness of the ash increases. The minimum pozzolanic activity can be obtained, when the ash has a specific surface of about 11,500 cm^2/gm. The strength of cement-RHA mortar approaches the strength of the corresponding plain mortar when the specific surface of RHA about 17000cm^2/gm. For 1:2 and 1:3 mortar mixes of standard consistency the maximum percentage of rice husk ash that can be replaced by weight of cement without 60 days strength being less than that of plain mortar was 30% and 40 % respectively. Also he found higher the percentage or RHA, higher is the volume change characteristic corresponding to plain mortar.

III.MATERIALS & PROPERTIES

3.1. GROUND GRANULATED BLAST FURNACE SLAG:

Ground Granulated Blastfurnace slag (GGBS) is a by-product for manufacture of pig iron and obtained through rapid cooling by water or quenching molten slag. Here the molten slag is produced which is instantaneously tapped and quenched by water. This rapid quenching of molten slag facilitates formation of "Granulated slag". Ground Granulated Blast furnace Slag (GGBS) is processed from Granulated slag. If slag is properly processed then it develops hydraulic property and it can effectively be used as a pozzolanic material. However, if slag is slowly air cooled then it is hydraulically inert and such crystallized slag cannot be used as pozzolanic material. Though the use of GGBS in the form of Portland slag cement is not uncommon in India, experience of using GGBS as partial replacement of cement in concrete in India is scanty. GGBS essentially consists of silicates and alumino silicates of calcium and other bases that is developed in a molten condition simultaneously with iron in a blast furnace. The chemical composition of oxides in GGBS is similar to that of Portland cement but the proportions varies.

The four major factors, which influence the hydraulic activity of slag, are glass content, chemical composition, mineralogical composition and fineness. The glass content of GGBS affects the hydraulic property, chemical composition determines the alkalinity of the slag and the structure of glass. The compressive strength of concrete varies with the fineness of GGBS.Ground granulated blast furnace slag now a days mostly used in India. Recently for marine out fall work at Bandra, Mumbai. It has used to replace cement to about 70%. So it has become more popular now a day.

Table 3.1. Chemical composition (%) of GGBS:

SiO_2	39.18
Al_2O_3	10.18
Fe_2O_3	2.02
CaO	32.82
MgO	8.52

Performance of Ground Granulated Blast furnace Slag in Concrete:

The replacement of cement with GGBS will reduce the unit water content necessary to obtain the same slump. This reduction of water content is more pronounced with increase in slag content and also on the fineness of slag. This is because of the surface configuration and particle shape of slag being different than cement particle. Surface hydration of slag is slightly slower than that of cement. Reduction of bleeding is not significant with slag of 4000 cm^2/g fineness but significant when slag fineness of 6000 cm^2/g and above.

Reaction Mechanism of Ground Granulated Blast furnace Slag:

Although GGBS is a hydraulically latent material, in presence of lime contributed from cement, a secondary reaction involving glass (Calcium Alumino Silicates) components sets in. As a consequence of this, cementitious compounds are formed. They are categorized as secondary C-S-H gel. The interaction of GGBS and Cement in presence of water is described as below:

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Product of hydration of OPC

OPC(C_3S/C_2S) + H_2O ————————> C-S-H + CH

Product of hydration of GGBS

GGBS(C_2AS/C_2MS) + H_2O ——————> C-S-H + SiO_2

Reaction of pozzolanic material

SiO_2+ CH + H_2O ——————————————>C-S-H

The generation of secondary gel results in formation of additional C-S-H, a principal binding material. This is the main attribute of GGBS, which contributes to the strength and durability of the structure. The diagrammatic representation of secondary gel formation is shown below.

3.2. RICE HUSK ASH:

Rice husk ash is obtained by burning rice husk in a controlled manner without causing environmental pollution. When it is properly brunt it has high SiO_2 content and can be used as a concrete admixture. Rice husk ash exhibits high pozzolanic characteristics and contributes to high strength and high impermeability of concrete. Rice husk ash essential consists of amorphous or non crystalline silica with about 85- 90% cellular particle, 5% carbon and 2% K_2O. The specific surface of RHA is between 40000-100000 m^2/kg.

India produces about 122 million ton of paddy every day. Each ton of paddy produces about 40 kg of RHA. There is a good potential to make use of RHA as a valuable pozzolanic material to give almost the same properties as that of microsilica. In USA highly pozzolanic rice husk ash is patented under the trade name of Agrosilicaand is marketed.it is having superpozzolanic property when used in small quantity i.e. 10% by weight of cement and it greatly enhances the workability and impermeability of concrete.

Table 3.2. Chemical composition (%) of RHA:

SiO_2	85.88
K_2O	4.10
SO_3	1.24
CaO	1.12
Na_2O	1.15
MgO	0.46
Al_2O_3	0.47
Fe_2O_3	0.18
P2O5	0.34

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3.3. SILICA FUME:

Silica fume also referred as microsilica or condensed silica fume is another material that is used as an artificial pozzolanic admixture. It is a product resulting from reduction of high purity quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy. When quartz are subjected to 2000^{0}C reduction takes place and SiO vapours get into fuels. In the course of exit, oxidation takes place and the product is condensed in low temperature zones. In the course of exit, Silica fume rises as an oxidised vapour, oxidation takes place and the product is condensed in low temperature zones. When the silica is condensed, it attains non-crystalline state with ultra fine particle size. The super fine particles are collected through the filters. It cools, condenses and is collected in bags. It is further processed to remove impurities and to control particle size. Condensed silica fume is essential silicon dioxide (SiO_2) more than 90 percent in non crystalline form. Since it is an airborne material like fly ash, it has spherical shape. It is extremely fine with particle size less than 1 micron and with an average diameter of about 0.1 micron, about 100 times smaller than average cement particles. Silica fume has specific surface area of about 20,000m^2/kg, as against 230 to 300 m^2/kg. The use of silica fume in conjunction with superplasticizer has been back bone of modern high performance concrete. High fineness, uniformity, high pozzolanic activity and compatibility with other ingredients are of primary importance in selection of mineral admixture. As Silica fume has the minimum fineness of 15,000 m^2/ kg, whereas the fumed Silica has the fineness of 190,000 m^2/g which is 6 to 7 times finer than Silica fume. Finer the particle of pozzolano, higher will be the modulus of elasticity, which enhances the durability characteristics of the High performance concrete.

Application of high performance concrete (HPC) has got momentum in various fields of construction globally in the near past. High performance concrete is being practised in the fields like construction of nuclear reactors, runways at airport, railway sleepers, cooling towers, silos, chimneys and all kinds of bridges. Considerable amount of development has been made in the field of High performance concrete and high strength concrete can be obtained using silica fume as a mineral admixture. Silica fume has been used for one of the fly over at Mumbai, India with concrete strength of 75 MPa.

Table 3.3. Chemical composition of silica fumes in %:

SiO_2	93
Al_2O_3	0.4
CaO	1.2
Fe_2O_3	0.2
MgO	1.2
Na_2O	0.1
K_2O	1.1
SO_3	0.3

3.4. SUPERPLASTICIZER:

A substance which imparts very high workability with a large decrease in water content (at least 20%) for a given workability. A high range water reducing admixture (HRWRA) is also reffered as Superplasticizer, which is capable of reducing water content by about 20 to 40 percent has been developed. These can be added to concrete mix having a low-to-normal slump and water cement ratio to produce high slump flowing concrete. The effect of superplasticizers lasts only for 30to 60 minutes, depending on composition and dosage and is followed by rapid loss in workability.

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One of the important factors that govern the issue water–cement ratio during the manufacture of concrete, lower the water-cement ratio lower will be the capillary pores and hence lower permeability and enhanced durability.

Although Superplasticizer are essential to produce a truly high performance concrete (HPC) characterised by low water-cement ratio and workability level without high cement content. Concrete are being produced with w/c ratio of as low as 0.25 or even 0.20 enabled the production of highly durable high performance concrete. The workability also increases with an increase in the maximum size of aggregate. But smaller size aggregate provides larger surface area for bonding with the mortar matrix, which increases the compressive strength. For concrete with higher w/c ratio use of larger size aggregate is beneficial.

High range superplasticizer was used in all the concrete mixes to achieve good workability. Superplasticizers are added to reduce the water requirement by 15 to 20% without affecting the workability leading to a high strength and dense concrete. To achieve the uniform workability, the admixture dosage was adjusted without changing the unit water content. This ensured the identical W/C ratio for a particular cementitious content and the effect of pozzolanic material replacement can directly be studied on the various properties of concrete.

3.5. CEMENT:

Cement is a material that has cohesive and adhesive properties in the presence of water. Such cements are called hydraulic cements. These consist primarily of silicates and aluminates of lime obtained from limestone and clay. There are different types of cement, out of that I have used two types i.e,

- Ordinary Portland cement
- Portland slag cement

Ordinary port land cement (OPC) is the basic Portland cement and is best suited for use in general concrete construction. It is of three type, 33 grade, 43 grade, 53 grade. One of the important benefit is the faster rate of development of strength.

Portland slag cement is obtained by mixing Portland cement clinker, gypsum and granulated blast furnace slag in suitable proportion and grinding the mixture to get a thorough and intimate mixture between the constituents. This type of cement can be used for all purposes just like OPC. It has lower heat of evolution and is more durable and can be used in mass concrete production.

3.6. AGGREGATE:

Aggregate properties greatly influence the behaviour of concrete, since they occupy about 80% of the total volume of concrete. The aggregate are classified as

(I) Fine aggregate

(II) Coarse aggregate

According to IS 383:1970 the fine aggregate is being classified in to four different zone, that is Zone-I, Zone-II, Zone-III, Zone-IV. Also in case of coarse aggregate maximum 20 mm coarse aggregate is suitable for concrete work. But where there is no restriction 40 mm or large size may be permitted. In case of close reinforcement 10mm size also used.

3.7. FIBER:

In this composite material, short discrete fibers are randomly distributed throughout the concrete mass. The behavioral efficiency of this composite material is far superior to that of plain concrete and many other construction materials of same cost. Due to this benefit, the
use of FRC has steadily increased during last two decades and its current field of application includes airport and highway pavements, earthquake resistant and explosive resistant structures, mines and tunnel linings, bridge deck overlays, hydraulic structures, rock slope stabilization. Extensive research work on FRC has established that the addition of various types of fibers such as steel, glass, synthetic and carbon, in plain concrete improves strength, toughness, ductility, and post cracking resistance etc. The major advantages of fiber reinforced

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concrete are resistance to microcraking, impact resistance, resistance to fatigue, reduced permeability, improved strength in shear, tension, flexure and compression.

The character and performance of FRC changes with varying concrete binder formulation as well as the fiber material type, fiber geometry, fiber distribution, fiber orientation and fiber concentration.

IV.MIX DESIGN

4. 1 MIX DESIGN OF ORDINARY PORTLAND CEMENT

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible.

1) M30 GRADE CONCRETE:

MIX DESIGN: FOR M30: According IS 10262-1982

STEP: 1

Target Strength $(f_t) = f_{ck} + t\ s$ $f_t =$
$30+(1.65*5)$

$= 38.25 N/mm2$

TABLE 4.1.1: Suggested values of standard deviation

Grade of Concrete	**Standard deviation for different degree of control in N/mm^2**		
	Very good	**Good**	**Fair**
M 10	2	2.3	3.3
M 15	2.5	3.5	4.5
M 20	3.6	4.6	5.6
M 25	4.3	5.3	6.3
M 30	5.0	6.0	7.0
M 35	5.3	6.3	7.3
M 40	5.6	6.6	7.6
M 45	6.0	7.0	8.0
M 50	6.4	7.4	8.4
M 55	6.7	7.7	8.7
M 60	6.8	7.8	8.8

Note: Appendix A provides guidance regarding the different degrees of quality control to be expected, depending upon the infrastructure and practices adopted at the construction site.

Free water cement ratio for target mean strength of 38.25 N/mm^2

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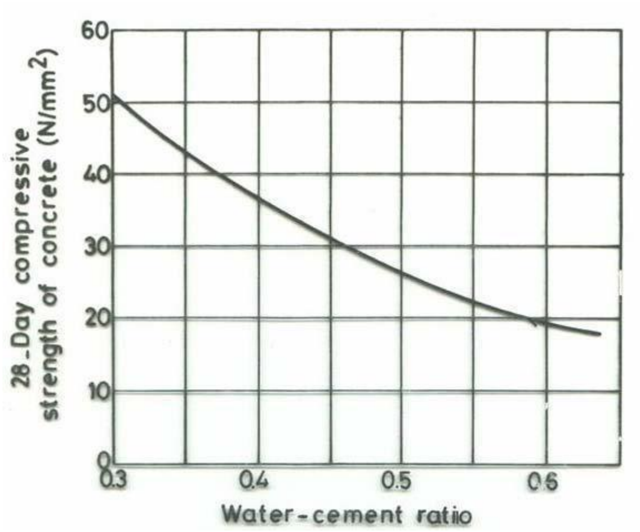

FIG 4.1.1 Graph for compressive strength and water cement ratio

Free w/c ratio =0.44 for 38.25 N/mm^2 from table 9.18 for mild exposure for RCC maximum free w/c ratio is 0.5.Select the least w/c ratio from the above 0.44.

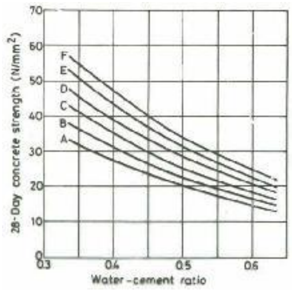

FIG 4.1.2 28- day strength of cement, tested according to is: 4031-1968

STEP: 2

Estimation of entrapped air from table: 3 for 20mm size aggregate

Entrapped air table: 3, pg: 9

Entrapped air=2mm

TABLE: 4.1.2: Appropriate air content

Nominal maximum size of aggregate(mm)	Entrapped air, as percentage or volume of concrete
10	3.0
20	2.0
40	1.0

IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
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STEP: 3

Water content and % sand has total aggregate from table 4, pg: 9 for maximum size of 20 mm aggregate water content of m^3 of concrete is 186 kg.

Sand as% of total aggregate P=35

TABLE: 4.1.3: Approximate sand and water content per m^3 of concrete of grades upto M35

Nominal maximum size of aggregate (mm)	Water content , per m^3 of concrete (kg)	Sand as % of total aggregate by absolute volume
10	208	40
20	186	35
40	165	30

TABLE: 4.1.4: Approximate sand and water content per m^3 of concrete of grades

Nominal maximum size of aggregate (mm)	Water content , per m^3 of concrete (kg)	Sand as % of total aggregate by absolute volume
10	200	28
20	180	25

STEP: 4

Calculation of CA and FA

V=1-2 %=1-(0.02) = 0.98

$0.98 = [(162 + (368.3/3.15) + ((1/0.\ 38)\ (f_a/2.61)]\ (1/1000)$

FA=701 kg

CA= [(1-p)/p] f a (s ca/s fa)

= ((1-0.380)/0.380)*701*(2.7/2.61) =1202 kg/m^3

STEP: 5

Cement content from step: 2 w/c ratio 0.42 and from step 4 (Wt of water/ Wt of cement) =0.42

Wt of cement C = 368.3 k

IJFANS
International Journal of Food And Nutritional Sciences
Official Publication of International Association of Food and Nutrition Scientists

ISSN PRINT 2319 1775 Online 2320 7876
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For mild exposure for reinforced concrete minimum cement is 320 kg/m^3. Adopt the maximum of the above two values, take cement content as 368.3 kg.
W/c ratio obtained=0.44 W/c ratio
(table: 4) =0.60

Compaction factor (C.F) =0.8(given) Compaction factor
from table: 4 (C.F) =0.92

The value for the table: 4 and corresponding value in our design deviate by small amount hence correction should be applied from table: 6

STEP: 6

Quantities of material required for making $1m^3$ of concrete

Cement: FA: CA: Water

(368.3/368.3) :(701/368.3) :(1202/368.3) :(162/368.3)

1: 1.90: 3.26: 0.43

V.EXPERIMENTAL PROGRAMMES

5.1. OUTLINE OF PRESENT WORK:

Rice husk ash is a product confirming to engineering requirements in terms of physical and chemical properties. So in our present study we are going to put our great diligence in study of RHA which can be made as a partial cement replacing material simultaneously achieving required strength testing on mortar cubes. GGBS is a non-metallic product essentially consists of silicates and alumino silicates of calcium and other bases. The four major factors, which influence the hydraulic activity of slag, are glass content, chemical composition, mineralogical composition and fineness. The granulated material when further ground to less then 45 micron will have specific surface of about 400-600 m^2/kg (Blaine). But here in our present study we have delved into the use of GGBS in different percentages in mortar testing, where we have used GGBS passing through 75 micron sieve. Here the specific surface of about275-550 m^2/kg. We are going to use of GGBS as partial replacement of cement because of its advantages like lower energy cost, higher abrasion resistance, lower hydration heat evolution, higher later strength development.

Synthetic fiber i.e Recron fiber is used in concrete for the production of fiber reinforced concrete. We are going to use Recron fiber in different percentage i.e, 0%, 0.1%, 0.2%, 0.3% to the weight of concrete and study the 7 days and 28 days compressive strength, splitting tensile and flexural strength of concrete to that of normal concrete with maintaining the water cement ratio in the range of 0.35-0.41. Then with different percentages of silica fume i.e, 10%, 20%, 30% fixing constant fiber percentage at 0.2% cubes, cylinders and prisms were casted and tested to analyse the change in compressive, splitting tensile and flexural strength. We used two types of cement for our study i.e Portland slag cement and ordinary Portland cement (53 grade). XRD test was being conducted to idealize the chemical composition RHA, GGBS, silica fume. Finally Porosity and Capillary absorption test was conducted on different specimens to analyse the affect of silica fume on concrete.

Different material used in this study are given below for the strength evaluation of concrete using different pozzolanic material , fiber and super plastisizer.

Cement:

For the experiment following two types cements were used,

(a) Portland Slag Cement

(b) Ordinary Portland cement (53 grade)

The chemical composition and different properties are shown below.

Fineness – 340 m^2/kg

Specific gravity- 2.96

Initial setting time - 120 min

Final setting time – 240 min

Table 5.1. Properties of Portland slag cement:

Specific gravity	2.96
Initial setting time (min)	125
Final setting time (min)	235

Table 5.2. Properties of Ordinary Portland cement:

Specific gravity	3.1
Initial setting time (min)	90
Final setting time (min)	190

Fine 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.

Table 5.3. Properties of fine aggregate:

Properties	Results Obtained
Specific Gravity	2.65
Water absorption	0.6%
Fineness Modulus	2.47

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Coarse aggregate:

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.

5.2. RESULTS AND DISCUSSION OF XRD TEST:

XRD was conducted on RHA-I, RHA-2, GGBSS and Silica fume, to idealize the different chemical composition of these pozzolanic material. Test was performed at an angle 45° with 2θ equal to 90° and different graphs are obtained, which were analysed using "X-pert High Score" software.

In case of GGBS from the graph it is inculcated that compound purely in amorphous form. Here we got the formation of $Mg_2Al_2O_4$ corresponding to no. 74-1133 and Mg_2SiO_4 with no.74-1680. From the XRD graphs of RHA-I and RHA-II obtained from X-pert High Score software, it was visualised that RHA-I (black type) somehow is in crystalline form as compared to RHA-II (white type). But in both the form of rice husk ash we found crystabalite low temperature silica type with no. 76-0939 as to that of software. The graph shows silica fume also is in amorphous state with having compound SiO_2 and CaO with nos. 03-0865 and 80-2146 respectively in the software used.

5.3. EFFECT OF GGBS AND RHA ON PROPERTIES OF CEMENT

To know the properties of GGBS and RHA on mortar we performed different tests

- Consistency test
- Compressive strength

The amount of water required to produce a standard cement paste to resist a specified pressure is known as normal or standard consistency. In other word it is the limit of water required at which the cement paste resist the penetration of standard plunger (1 mm diameter) under a standard loading up to a distance of 5-7 mm from the base of Vicat apparatus. The consistency of cement depends on its type and fineness. More water is required in cement with higher fineness value. The water quantity was calculated by [(P/4) + 3] % of 800 gm. Consistency test was performed with both GGBS and rice husk ash of different percentage content. That is GGBS with 0, 10, 20, 30, 40 % and RHA with 0, 10, 20, 30 %. Then mortars of standard size were casted with different percentage of GGBS (0%, 10%, 20%, 30%, 40%) and RHA (0% and 20%) with the replacement of cement. Portland slag cement and sand of zone- II was used in this experiment. Then compression test was conducted of mortars in Compression testing machine.

VI. CONCLUSION:

In this present study with the stipulated time and laboratory set up an afford has been taken to enlighten the use of so called pozzolanic material like ground granulated blast furnace slag, rice husk and silica fume in fiber reinforced concrete in accordance to their proficiency. It was concluded that, 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.

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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.

6.1. SCOPE OF FURTHER WORK:

The research work on pozzolanic materials and fiber along with pozzolanas is still limited. But it promises a great scope for future studies. Following aspects are considered for future study and investigation;
Percentage and actual fineness of GGBS require as partial cement replacement for good strength development.
Use of RHA as cement replacement with properly burned in controlled temperature and grinded which may lead proper strength development.
Replacing cement with different percentage of silica fume to judge the optimum percentage of silica fume to be used to get better strength result.
Research on Recron fiber and silica fume with greater fineness as a partial cement replacing material, by which we can minimise the cost and at the same time achieve the durability and strength for the production of High Performance Concrete.
It requires a proper mixing propertions for the development of high strength, high performance concrete which may not be possible manually. So it needs some global optimisation techniques to develop the desire result with greater accuracy and time saving.

REFERENCES:

1. Pierre-Claude Aitcin, “Developement in the application of high performance concrete”, Construction and Building Material, Vol. 9. No. 1, 1995, 13-17

2. Andrzej Ajdukiewicz and Wojciech Radomski, “Trends in the Polish research on high-performance concrete”, Cement and Concrete Composite, Vol. 24, 2002, 243-251

3. Pierre-Claude Aitcin, “The durability characteristics of high performance concrete”, Cement & Concrete Composite, Vol. 25, 2003, 409-420

4. Moayad N Al-Khalaf and Hana A Yousif, “Use of Rice husk ash in concrete”, The International Journal of Cement Composites and Lightweight Concrete, Vol. 6, November 4 1984.

5. Muhammad Soaib Ismail and A. M. Waliuddin, “Effect of rice husk ash on high strength concrete”, Construction and Building Material, Vol. 10. No. 7, 1996, 521-526

6. Gemma Rodriguez de Sensale, “Strength development of concrete with rice-husk ash”, Cement & Concrete Composite, Vol. 28, 2006,158-160

7. A Oner & S Akyuz, “An experimental study on optimum usage of GGBS for the compressive strength of concrete”, Cement & Concrete Composite, Vol. 29, 2007, 505-514.

ISSN PRINT 2319 1775 Online 2320 7876
 Journal Volume 11, Iss 08, 2022

8. Caijun Shi and Jueshi Qian, "High performance cementing materials from industrial slags", Resourses Conservation & Recyclin, Vol. 29, 2000, 195-207

9. K Ganesh Babu and V. Sree Rama Kumar, "Efficiency of GGBS in Concrete", Cement and Concrete Research, Vol. 30, 2000, 1031-1036.

10. M. Collepardi, "Admixtures used to enhance placing characteristics of concrete", Cement & Concrete Composite, Vol. 20, 1998, 103-112

11. I. Papayianni , G. Tsohos, N. Oikonomou, P. Mavria, "Influence of superplasticizer type and mix design parameters on the performance of them in concrete mixtures", Cement & Concrete Composite, Vol. 27, 2005, 217-222

12. Ronald F. Zollo, "Fiber-reinforced Concrete: an Overview after 30 Years of Development", Cement & Concrete Composite, Vol. 19, 1997, 107-122

13. A. M Alhozaimy, P Soroushian & F Mirza, "Mechanical Properties of Polypropylene Fiber Reinforced Concrete and the Effects of Pozzolanic Materials, Cement & Concrete Composite, Vol. 18, 1996, 85-92.