International Journal of Scientific Research in Civil Engineering
© 2022 | IJSRCE | Volume 6 | Issue 4 | ISSN : 2456-6667

Experimental Investigation of Concrete Utilizing Rice Husk, Iron Slag and Silica Fumes to Enhance its Properties

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Article Info
July-August-2022

Publication Issue :
Volume 6, Issue 4

Page Number : 21-27

Article History
Accepted : 01 July 2022
Published : 20 July 2022

ABSTRACT

As per the statistics India has used around 379 million metric tons of concrete in the financial year 2022 proving to be the most widely used construction material due to its versatility and holds the property of being customized as per the environmental requirement. Without the excessive usage of concrete, human development is impossible in today's reality. Concrete's most significant component is cement. Unfortunately, cement production emits a substantial amount of greenhouse gases and poses a significant threat to the environment. As a result, lowering the reliance on cement for concrete strength is unavoidable for the long-term growth of human life. This is the primary reason for seeking an appropriate cement substitute in order to get high-strength concrete at a reasonable cost. In addition, modern projects necessitate extremely high concrete strength, which can only be achieved by properly combining admixtures into the concrete. In India, industrial waste materials such as silica fume, rice husk ash, and iron slag are readily available. Their disposal has become pricey as a result of recent implemented norms and restrictions. As a result, it is vital to identify a viable use for these waste products. Because of their high siliceous content and pozzolanic qualities, these materials can be utilised to substitute cement in concrete mixes and as admixtures to achieve high strength. The two most significant parameters that determine the performance of concrete in any field application are flexural and compressive strengths. It's crucial to figure out how these admixtures affect concrete's flexural and compressive strength. A comparison research can evaluate the relative effects of different admixtures on concrete strength, allowing the most appropriate admixture to be used in any given context. Keywords: Replacement of Cement, admixtures of concrete, flexural strength, compressive Strength.

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I. INTRODUCTION

Concrete is these days the most broadly utilized man-made construction material on the planet. It is obtained by blending cementitious materials, water, aggregate and infrequently admixtures in required extents. Green concrete is prepared using different biodegradable materials which can be designed in any shape which retains all the properties of traditional concrete and is sometimes capable of performing even better. The solidifying is caused by a chemical reaction between water and cement, which occurs over time, resulting in stronger concrete. Ordinary Portland Cement (OPC) is a key component in the manufacturing of concrete and has no substitute in the civil construction sector.

Tragically, creation of concrete includes discharge of a lot of carbon-dioxide gas into the environment, a noteworthy donor for green house impact and the worldwide temperature alteration, henceforth it is inescapable either to scan for other material as a substitution of bond or incompletely supplant it by some other material. The search for such a material that may be used as an alternative or complement to cement should result in global improvement with the least amount of environmental impact possible. Flexural strength and compressive strength of concrete are two most important properties for the design purposes. These properties directly signify the load bearing capacity of the beam specimen when it is used in field operations. But these properties are greatly affected by the composition of the concrete mix design and also due to the presence of some external materials and other environmental factors. Thus it is very beneficial to analyse the effect of various mineral admixtures on compressive strength and flexural strength when they are used as a partial replacement of cement in concrete mix design so that the response of the hardened concrete mix to external applied load can be evaluated. Also mineral admixtures are generally industrial waste materials that are very abundantly available in India. Their disposal is a big challenge and if disposed carelessly then these have a deleterious effect both on the land and the environment. Also the manufacture of cement in the factories is a major source of emission of greenhouse gases in the atmosphere that are the major causes of global warming. Due to the latest rules and regulations about the disposal and emission of wastes it is necessary to find an alternate way to efficiently dispose or use the industrial waste product and it is a major concern for a sustainable development of human life. Also when used in correct proportions some mineral admixtures can impart very high strength to the concrete and are thus used in the production of High Performance Concrete (HPC). Three admixtures namely Silica Fume, Rice Husk Ash and Iron Slag are used in this project work as partial replacement of cement in the concrete mix. All these materials are industrial waste products and can be easily obtained in India. Silica Fume is a waste product of the silicon industry, Rice Husk Ash and Iron Slag are the waste products from the rice husk boilers and the iron manufacturing industry respectively. All these materials have high siliceous content and pozzolanic properties and due to this can be suitably used to replace cement partially from concrete mix without affecting the strength of hardened concrete due to their high pozzolanic properties.

II. Literature Review

Anitha J et.al (2016) the investigation was carried on performance of concrete with GGBS and different PCE based water reducing admixture the tests on compressive strength and Workability of the concrete with Ordinary Portland cement and Portland pozzolana cement with GGBS and admixture are carried out at different curing periods for M45 grade of concrete to conclude its behavior.

Results stated that Type B admixture gives good workability even after slump retention of 45min and can be used in places where very less loss of slump is required. Places where concrete with slightly less initial workability but good 1 day strength is required, type J admixture can be used. Loss of slump is slightly higher in PPC concrete than OPC concrete due to high surface area and more fineness.The concrete added with PCE based superplasticizers generally showed higher constancy in terms of performances and efficiency in terms of water reduction to attain the same initial workability in normal concrete without PCEs.

Rahul Chaudhary et.al (2017) In this project work cement was replaced with Mineral admixture by 5%, 10%, 15% and 20 %. Beams and cubes were casted for each replacement of cement. The concrete beams were tested after 7, 14, and 28 days from preparation and the cubes were tested after 7 and 28 days. The cement was replaced in concrete mix by mass while keeping all the other components constant. The beams and cubes were kept in fresh curing water at temperature 27 + 2 0C after the removal from mould and were tested in wet condition after taking them out from the water. The beams were tested by Third Point Loading Method according to IS: 516-1959.

Results stated that Silica fume gives the highest values of flexural and compressive strength as compared to RHA and iron slag.ron slag can be suitably used as a replacement of cement as it is an abundantly available waste product and is also very cheap in comparison to silica fume and cement. Steel slag and silica fume gives high early strength to the concrete as compared to RHA and the concrete without any admixture.The compressive strength of concrete containing RHA is always lower than that of concrete without any replacement of cement.

Arossa et.al (2017) in the research paper, Fly ash and mineral powder was used for composite preparation of high strength lightweight aggregate concrete. The performance of concrete with different proportions of admixtures was investigated.

With increase in percentage of the ground fly ash from 30% to 40% with 10% of Silica Fume the strength of concrete is increased. There is a decrease in the strength when 40% of Fly Ash is added with 5 & 15% of Silica Fume. Results concluded that this deficiency could be overcome by using silica fume upto 10% only when added with fly ash.

Ruidong Wu and Juanhong Liu (2018) In order to study the performance of concrete with compound admixture of iron tailings and slag powder under low cement clinker system, the mixture ratio of different iron tailings powder and slag powder was designed to prepare C30 and C50 concrete. The workability, strength, carbonation depth, chloride diffusion coefficient, scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), and X-ray diffraction (XRD) of concrete were measured, respectively.

The test results show that iron tailings powder is beneficial to improve the workability, and the strength of concrete decreases with the increase of iron tailings powder content, while the carbonation depth and chloride diffusion coefficient increase with the increase of iron tailings powder content. Under low cement clinker system, the iron tailings powder should not be used alone (below 70% of mineral admixture). When the ratio of iron tailings to slag powder is 1 :1, the strength, carbonation depth, chloride ion permeation coefficient, and the microstructure of concrete are roughly the same to that of concrete with single slag powder. So, the iron tailings powder can replace S95 grade slag powder in the same quantity. Iron tailings powder does not take part in hydration

reaction, but it can improve particle gradation, reach close accumulation, and increase the quantity of central grains.

Vishal Gadgihalli et.al (2017) research paper presented analysis of properties of concrete using potassium power as admixture and verified the strength of concrete and temperature emitted due to chemical reaction to normal Portland cement.

Results stated that using potassium as concrete admixture takes very less time that is 31 minutes 44 seconds for M20 and 33 minutes 52 seconds for M30 compared to normal concrete taking 34 minutes 13 seconds for M20 and 38 minutes 48 seconds for M30 grade concrete that is approximately 8% and 13% times faster in cooling by M20 and M30 grade of concrete respectively. Hence, the time for reduction of temperature has reduced by using potassium powder as chemical admixture.

Elah Olekwu Benjamin and Omeinijie Peter (2015) The research seeks to find the effect of Gum Arabic on some properties of cement and concrete at both fresh and hardened states. Properties of cement and concrete investigated include: setting times and shrinkage of cement, workability, compressive strength and durability of concrete in acidic medium. Quantities of Gum Arabic added as admixture to the cement and concrete were 0%, 0.2%, 0.4%, 0.6%, 0.8% and 1.0% of the weight of cement. Cement pastes containing the above quantities of Gum Arabic were prepared and tested for shrinkage and setting times of cement. Similarly, concrete mix of 1:2:4 (cement: fine aggregate : coarse aggregate) was designed incorporating 0%, 0.2%, 0.4%, 0.6%, 0.8% and 1.0% of the weight of cement in the concrete mixes, varying the water/(cement + Gum Arabic) ratios. Trial mixes were design first to determine the optimum water/(cement + Gum Arabic) ratios which were used for the actual mixes for workability, compressive strength and durability of concrete in acidic medium.

The results of the investigation shows that Gum Arabic could be used as an admixture in concrete and that its use increases the shrinkage of cement, both the initial and final setting times of cement, improves the workability of concrete and reduces its water requirement and compressive strength of concrete but slightly improves its durability in acidic medium. Between 0.2% and 0.6% by weight of the cement is recommended for incorporation in concrete.

Legeto Cosmas Kirui et.al (2016) The research was set out to identify whether chemical admixtures are being used in the construction industry in Kenya and their influence on quality of concrete in a bid to solve the problem. The study adopted a mixed design approach which incorporates both qualitative and quantitative elements of research.

The study came to several conclusions key among them; that chemical admixture are used in the construction sector with good effect on the quality of concrete; chemical admixtures enable projects to be managed easily. The study recommended formulation of legislation to guide the use of admixtures which will lead to solving of the current challenges of counterfeit chemical admixtures, lack of proper training by contractors and lack of interest from building statutory bodies on its use.

A. A. Akindahunsi and H. C. Uzoegbo (2015) research paper examined properties of concrete, such as strength, oxygen permeability and sorptivity using starch [cassava (CA) and maize (MS)] as admixtures. Concrete cubes containing different percentages of the CA and MS by weight of cement (0, 0.5, 1.0, 1.5 and 2.0 %) were cast. Compressive strength tests were carried out after 3, 7, 14, 21, 28, 56, 90, 180, 270 and 365 days of curing. Oxygen permeability and sorptivity tests were carried out on another set of concrete specimens with the same percentages of starch at 7, 28, 90, 180, 270 and 365 days. Oxygen permeability and sorptivity tests data obtained were subjected to Kruskal–Wallis one-way analysis of variance by ranks.

Results stated that incorporation of CA and MS starches into concrete improves the durability properties of the concrete. The statistical analyses of concrete mixed with different starches when compared with control indicated that generally concrete with starches performed better than control. However, overall the concretes with addition of different concentrations of MS starch performed better than concretes with different concentrations of CA starch.

G. K. Patel and S. V. Deo (2016) the objective of the research paper was to investigate the influence of natural organic materials (i.e. gram-flour, ghee and triphala) as admixture on the durability of concrete. A new method was proposed with 70% loading of average compressive strength to know the durability of concrete under practical conditions. Various experiments performed to identify the influence of natural organic

materials as admixture on durability of concrete. Electrical resistivity, ultrasonic pulse velocity (UPV) and carbonation tests were performed on hardened concrete for 0.4 and
0.45 w/c ratios.

The results stated that that addition of gram flour provided better durability in terms of electrical resistivity, UPV and carbonation for both the w/c ratios over normal concrete. Even under 70% loading, better durability results were noticed for concrete with gram flour. Although for concrete with ghee and triphala poor results were noticed.

Rubaiyet Hafiza and Ahsan Habib (2015) research paper explored the effects of using fiber and admixture in the mechanical properties of the strength of concrete of different grades with primary concern to establish the divergence in the strength properties of M20, M25 and M30 concrete with addition of admixture and polymer fiber. The experimental program was planned to quantify the compressive strength of M20, M25 and M30 concrete using admixer and polymer fiber. This investigation was conducted to observe the effects of different additives on concrete, contributing in the compressive strength at various ages of curing.

Results stated that Admixture and polymer mixed concrete shows a slight increase in the compressive strength as compared to plain concrete. It was observed that polypropylene fibers have not contributed significantly towards compressive strength of concrete. Maximum compressive strength was achieved for admixture.

Nikhil NadhV. S and Jayasree S (2018) research paper intended to find the amountof black liquor sludge to be added in M30 and M50 concrete mixes for getting a slump of 100 mm with a water cement ratio of 0.35 for medium workability and to study its mechanical and flexural properties. The primary objective of the research was to develop concrete mixes of BLC30 and BLC50 (concrete of grade M30 and M50 with Black liquor sludge as admixture) for a slump of 100 mm with water cement ratio of 0.35 and find the mechanical and flexural properties of BLC30 and BLC50.

Results stated that the addition of Black liquor sludge of 20 and 25% by replacing water provided a slump of 100 mm in M30 C and M50 C mixes respectively. All the mechanical properties ofBLC30 and BLC50 mixes were found to be within acceptable limit and satisfies

IS specification.The BLC30 and BLC50 beams showed similar behaviour with respect to control specimens.Hence Black liquor sludge can be effectively used as admixture in concrete for increasing workability for both normal strength and high strength mixes. It can be also used for structural applications.

Deepshikha Jain and Jay Shah (2019) research paper presented a blend plan method for elite cement blends. Since rheological parameters and compressive quality are major properties of cement in two distinct phases of generation, the connection between rheological parameters and compressive quality has been utilized as opposed to utilizing water-bond proportion versus compressive quality relationship. Water-bond proportion and total volume to glue volume proportion has likewise been resolved from rheological conduct and utilized in the blend structure. In the proposed technique, the architect can evaluate parameters like compressive quality and efficient costing at the structure organize for a given target quality, notwithstanding elements of cement.

Results stated that steel fiber give more strength on the concrete but its cost is higher, so instead of steel fiber the rice straw and pieces of cement bags and get enough strength. Here more strength is achieved than the require strength in M25 grade so one can reduce the grade like M15 and get the target strength.

Salim Idris Malami et.al (2020) The objective of this research was to explore the effect of sawdust as an admixture in concrete as well as that of sodium chloride solution as a curing medium of concrete.Concrete cubes were casted by replacing 0%, 5%, 10% and 15% of sawdust by weight of cement as an admixture and the workability and compressive strength of concrete cubes at 7, 14, 21, and 28days was determined.

The results show that the slump value of the concrete mix reduces as the amount of the sawdust (admixture) increases. also there is progressive loss of compressive strength of cubes cured in 5% sodium chloride having concentration of 50,000PPT with increase in sawdust content of 0%, 5%, 10% and 15% ranged 17.56 N/mm2 to 16.22 N/mm2 at 7days, 22.27N/mm2 to 16.92 N/mm2 at 14days, 22.77 N/mm2 to 20.09 N/mm2 at 21days and 24.34 N/mm2 to 21.45 N/mm2 at 28days respectively. The results further stated that Sodium Chloride has the properties of impurity reducing the strength of concrete and sawdust is not suitable to be used as admixture because it shows a progressive decrease in the compressive strength of concrete with a corresponding increase in its content.

Jacek Góra et.al (2019) The aim of the research paper was to evaluate the physical properties of lightweight concrete with perlite containing different polymer admixtures. Testing physical and strength properties of concrete with the addition of lightweight perlite in the amount of 10 and 20%. The additive was introduced by volume substituting a part of the sand. In addition, the effect of using siloxane admixtures and a vinyl acetate copolymer with different degree of dosing, as well as applied simultaneously, were analysed. The tests were carried out in the field of bulk density and proper density, determination of tightness and porosity, compressive strength and tensile strength after 28 days of maturation. In terms of durability of concrete, absorption and resistance of concretes to the freeze-up effects after 100 freezing and thawing cycles were tested. The results of the study were subjected to statistical analysis using the analysis of variance. The analysed factors of influence were the amount of perlite addition, as well as the type and amount of the added admixture.

In the case of "compressive strength of samples curing in water" at 28 days the strongest effect was the factor K, with 112 days effect size of all three factors was similar; The weakest interfacial transition zone (ITZ) observed through SEM analysis between the perlite aggregates and the cement paste contributed significantly to the worst physical and strength properties of this concrete.

J. Jaya Chandran and Ku. Mani Kandhan (2019) In the experimental investigation Calcium silicate hydrate(C-S-H) and Glass fiber are used to modify the mechanical behavior of the concrete. The percentage varies from 1%, 2% and 3% of chemical with constant of 0.1 % and 0.2% of glass fiber. The experimental work consist of casting RC Beam, Cube, Prism and Cylinder each specimen are curing for 7 days, 14 days, 28 days and testing this test specimen to evaluate the behavior of concrete. The flexural strength of 1.2m beam also carried out by using ABAQUS software.

Results stated that the addition of calcium silicate and the glass fiber give the good mechanical properties such as compressive strength, flexural strength and split tensile strength are compared then convention concrete. It is established that makes M3 and

M6 mixes give the maximum strength limit. It show the admixture of calcium silicate and glass fiber increase the strength of concrete and reduce the cost effectively.

B. Karthikeyan et.al (2022) research paper discussesed the permeation characteristics of concrete made by increasing the fineness of the conventional mineral admixtures and using them as a partial substitute for cement. Silica fume and metakaolin ground to ultrafine state and ceramic powder obtained from grinding waste ceramic tiles were used as mineral admixtures. The mixes were designed for a compressive strength of 50 MPa and were prepared for both binary and ternary blended cases. Binary blended specimens were cast, partially replacing cement with unground silica fume, ground silica fume, unground metakaolin, and ground metakaolin separately in different replacement proportions. Ternary blended mixes were prepared using ceramic powder in 4%, 9%, and 14% and with silica fume in a constant level of 1% percentage. All the cast specimens were compared against the control concrete. A deeper comparative analysis was also made by comparing the performance of specimens made with unground mineral admixtures with that of ground mineral admixtures. Various parameters such as resistance against water absorption, percentage of voids, and sorptivity characteristics were investigated. It was observed that increasing the fineness helps fill up the pores, thereby improving the resistance to permeation action.

Objectives of the research

a. Use Three admixtures namely Silica Fume, Rice Husk Ash and Iron Slag as partial replacement of cement in the concrete mix.
b. To determine the Compressive Strength of concrete by using different admixture in proportion of 0%, 5%, 10%, 15% and 20%.
c. To determine the Flexural Strength of concrete by using different admixture in proportion of 0%, 5%, 10%, 15% and 20%.

III. Material used in the Analysis

The materials used in the study are listed below:

i. Cement
ii. M-Sand(Fine aggregate)
iii. Coarse aggregate
iv. Silica fume
v. Rice Husk Ash (RHA)

vi. Iron slag
vii. Water
viii. Super plasticizer

Cement

Ordinary Portland cement of 53 grades is used for this experiment. Cement is typically the bonding agent or glue of the concrete which keeps all the different elements of concrete together. In addition to that cement also helps in giving strength to mix.

Table 1. Properties of cement

S. No.	Parameters	Test Results
1	Consistency	29
2	Fineness of cement	4.33%
3	Specific gravity	3.15
4	Initial setting time	30 min
5	Final setting time	600min

3.1 Coarse Aggregate

The natural coarse aggregate obtained from the locally available quarries is of maximum size of 20mm and satisfying the grading requirements of BIS (IS 383-1970).

Table 2. Properties of Coarse Aggregate

S. no.	Parameters	Test Results
1	Impact	28
2	Fineness modulus	2.67%
3	Specific gravity	3.15
4	Water Absorption	0.50%

3.1 Fine Aggregate

For the normal mix river sand is used as fine grained throughout this project. Fine aggregates should be clean, hard and free from organic material for the good quality concrete mix.

Table 3 : Properties of Fine Aggregate

S. no	Parameters	Test Results
1	**Impact**	28
2	**Fineness modulus**	2.78%
3	**Specific gravity**	2.8
4	**Water Absorption**	1.00%

Water

Water is required for the hydration processes of the cement. Drinking water is used as mixing water for concrete. The pH value of water is found to be 6.8 that indicate the water is free from the organic matters.

Silica Fume

Silica rage is a by-result of the make of silicon metal and ferro-silicon amalgams. The procedure includes the diminishment of high virtue quartz (SiO_2) in electric circular segment heaters at temperatures in overabundance of 2,000°C. Silica rage is a fine powder comprising principally of round particles or microspheres of mean diameter around 0.15 microns, with a high particular surface region (15,000–25,000 m2/kg). Each microsphere is by and large 100 times littler than a normal bond grain. For this venture the silica rage was gotten that is economically accessible in the Govindpura Industrial area. It is white in shading and is as fine white powder.

Rice Husk Ask (RHA)

Rice husk is an agricultural waste product obtained from the rice crop. This rice husk is used for steam generation in Rice Husk Boilers and thereby giving a black ash as waste product. This black ash is called the Rice Husk Ash and is a very rich source of silica and has high pozzolanic properties. For the purpose of this project rice husk ash was obtained from Itarsi Mill, Itarsi.

Iron Slag

Iron slag is a waste product of the iron manufacturing and purifying process. During the iron manufacturing process the blast furnace is charged with iron ore and coke and fluxes are added to the ore in the furnace. The iron is mainly oxidized in the form of iron oxide and the impurities are remained as waste product called Iron Slag. This slag is then dried up and grinded to obtain the iron slag in powdered form. For the purpose of this project Iron Slag was obtained from Gallantt Industries, Govindpura.

Mix Proportion

Concrete mix of grade M30 confirming to IS:

10262-2009 was designed for the preparation of test samples. The proportion of various components of the concrete mix are given in table below

Type of Component of Mix	Weight per m3 (kg)
Cement	354
Fine Aggregate	815
Coarse Aggregate	1217
Water	152
Super Plasticizer	1% of weight of cement

The ratio of cement: fine aggregate: coarse aggregate is calculated as 1: 2.3:3.43Water/ cement ratio is taken as 0.43. Then the cement was replaced in different proportion by different mineral admixtures by mass using one admixture at a time. Cement was replaced by 5%, 10%, 15% and 20% by mass and test samples of prismatic beams and cubes were casted for different proportions of cement and mineral admixtures to calculate the flexural and compressive strength respectively. The various types of mixes prepared and their proportions are given in table below.

Here Mix 0 is for the concrete mix without any admixture used and Mix 1, Mix 2, Mix 3 and Mix 4 denotes the concrete mix proportions containing 5%, 10%, 15% and 20% admixtures as partial replacement of cement.

Type of Mix Proportion	Quantity of cement (kg/m3)	Quantity of Admixture (kg/m3)	Coarse Aggregate	Type of Mix Proportions	Quantity of cement (kg/m3)	Quantity of Admixture (kg/m3)
Mix 0	354	0	1216	815	148	3.54
Mix 1	336.3	17.7	1216	815	148	3.54
Mix 2	318.6	35.4	1216	815	148	3.54
Mix 3	300.9	53.1	1216	815	148	3.54
Mix 4	283.2	70.8	1216	815	148	3.54

Test Samples

Total 39 Beams and 24 Cubes were casted for different proportions of cement and mineral admixtures. The replacement of cement was given in the proportion of 5%, 10%, 15 % and 20 % using one admixture at a time.

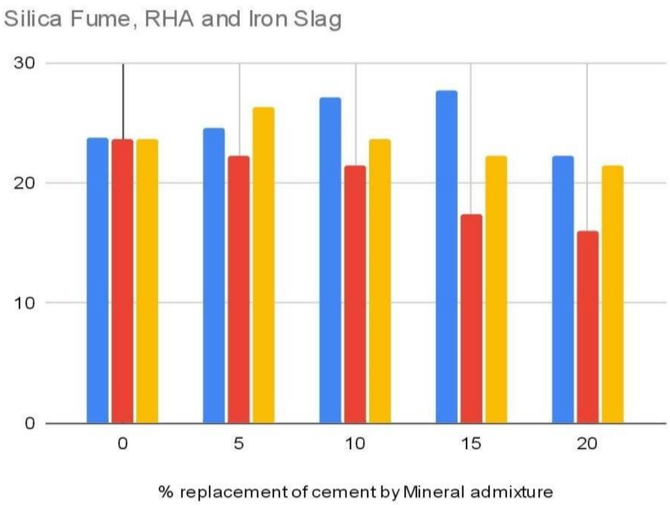
The prismatic beams were tested on 7, 14 and 28 days after curing in fresh water. The cubes were tested on 7 and 28 days after preparation.

The results were obtained for flexural strength and compressive strength according to the guidelines of IS :516-1959 and the results were obtained for replacement of cement with different mineral admixtures. The results were shown in graphical form and then comparative analysis graphs showing the effect of various mineral admixtures on the flexural and compressive strength of concrete were drawn for 7, 14 and 28 days.

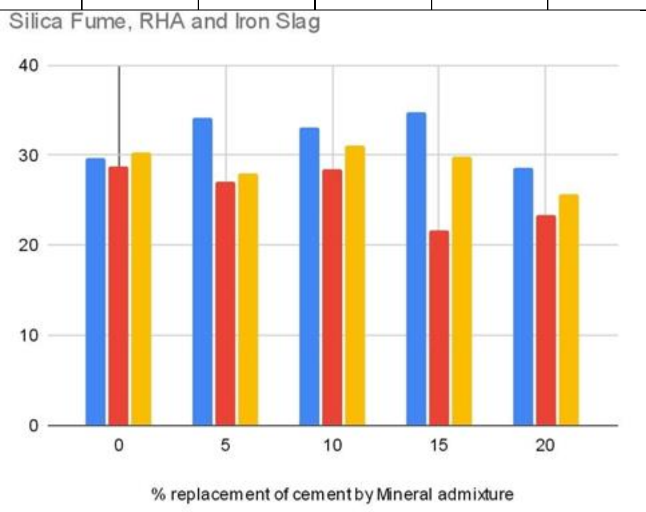
Compressive Strength of concrete

Compressive Strength

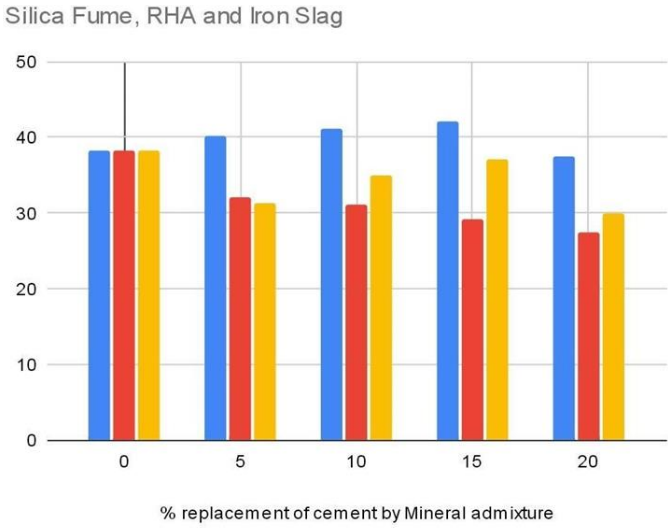
S. no	% replacementof cement by Mineral admixture	Compreasive Strength (MPa)								
		7 days			14 days			28 days		
		Silica Fume	RHA	Iron Slag	Silica Fume	RHA	Iron Slag	Silica Fume	RHA	Iron Slag
1	0	23.7	23.6	23.6	29.7	28.8	30.2	38.2	38.2	38.2
2	5	24.6	22.3	26.3	34.2	27.1	28	40.2	32	31.2
3	10	27.1	21.4	23.6	33.1	28.4	31.1	41.1	31	35
4	15	27.7	17.4	22.3	34.8	21.7	29.75	42	29.1	37
5	20	22.3	16	21.4	28.6	23.4	25.6	37.4	27.5	30



Compressive Strength for 7 days



Compressive Strength for 14 days



Compressive Strength for 28 days

Discussion: To obtain a comparative effect of different admixtures on the compressive strength of concrete the values obtained for different proportional replacement of cement with the admixtures were shown in a collective manner in table and the comparative variation was shown by drawing graphs on a common scale for all the three different admixtures.

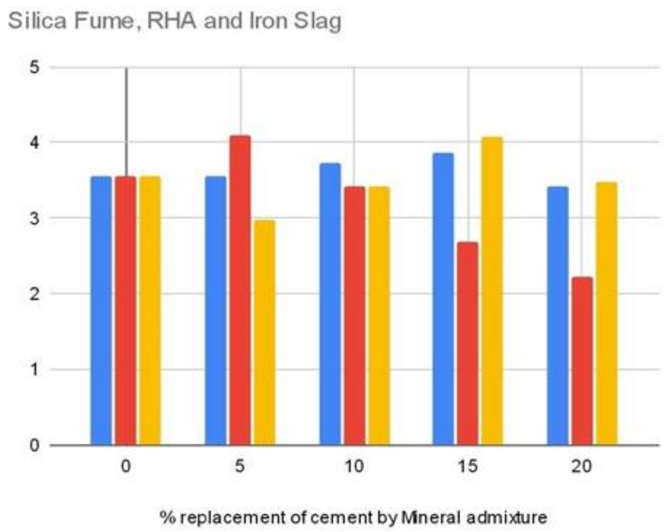
Silica fume gives the highest values of compressive strength followed by iron slag and RHA gives the lowest value of compressive strength which is much lower than the compressive strength of concrete without any replacement of cement.

Flexural Strength

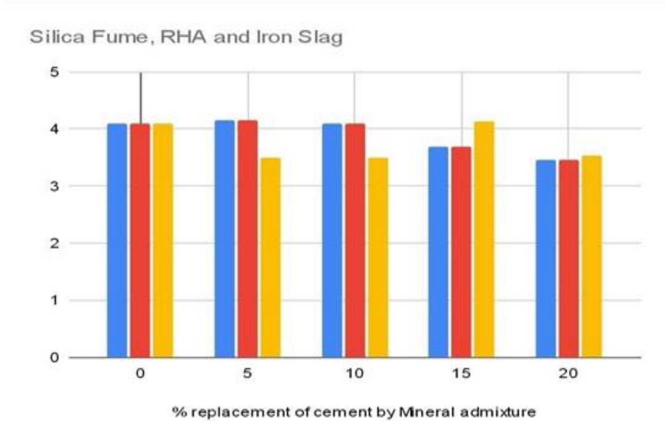
S. no	% replacementof cement by Mineral admixture	Flexural Strength (MPa)								
		7 days			14 days			28 days		
		Silica Fume	RHA	Iron Slag	Silica Fume	RHA	Iron Slag	Silica Fume	RHA	Iron Slag
1	0	3.55	3.55	3.55	4.1	4.1	4.1	4.4	4.4	4.3
2	5	3.55	4.1	2.97	4.16	4.16	3.5	5.05	5.1	4.3
3	10	3.72	3.41	3.41	4.1	4.1	3.49	5.35	4.37	5.19
4	15	3.87	2.68	4.082	3.68	3.68	4.13	5.64	4.01	5.24
5	20	3.41	2.23	3.47	3.45	3.45	3.53	4.7	3.74	4.22

IV. CONCLUSION

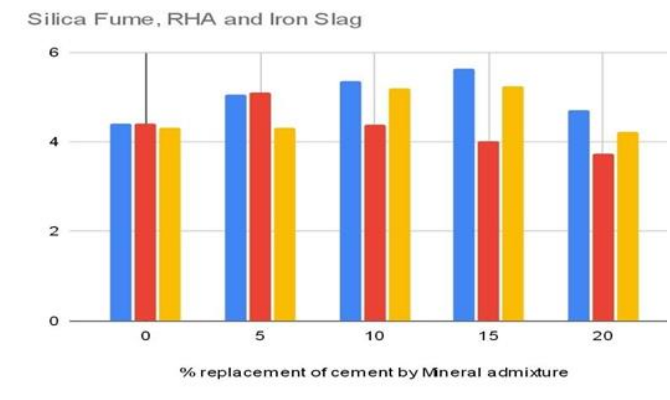
Here authors state that concrete properties can be enchance or can be deplete utilizing various admixtures. Even waste materials of industries can be initiate to use in concrete technology



Flexural Strength for 7 days



Flexural Strength for 14 days



Flexural Strength for 28 days

Discussion : flexural strength for replacement of cement with silica fume is much higher in comparison to the strength obtained by iron slag and RHA. Of all the three mineral admixtures used RHA gave the lowest values in all the three tests. Thus silica fume is the most suitable mineral admixture to replace cement to obtain High Performance Concrete

V. CONCLUSION AND FUTURE SCOPE

In this research work Flexural and compressive strength tests were conducted on concrete beams and cubes samples. The results obtained at 7, 14 and 28 days were shown graphically. The various conclusions that can be drawn from this project work are given below:

- Different mineral admixtures can be used as a partial replacement of cement in the concrete mix to give improved flexural strength.
- Silica fume gives the highest values of flexural and compressive strength as compared to RHA and iron slag.
- The highest value of flexural strength is obtained by 15% replacement of cement with silica fume.
- The result obtained with the replacement of cement with iron slag also gives the highest value of flexural and compressive strength for 15 % replacement.
- The test specimens created with RHA as replacement of cement have a lowest value of both compressive and flexural strengths.
- The 28 days flexural strength for 5% replacement of cement with Silica fume, RHA and Iron slag increases by 17.21 %, 16.28 % and 0.1% respectively in comparison to concrete having no admixture.
- For 10 % replacement of cement with Silica fume, RHA and Iron slag the 28 days flexural strength increases by 24.19%, 1.4% and 20.7% respectively in comparison to concrete having no admixture.
- For 15 % replacement of cement with Silica fume and Iron slag the 28 days flexural strength increases by 30.93% and 21.86% respectively and it decreases for RHA.

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Cite this article as :

Savita Choudhari, Sulekha Patel, Ravindra Gautam, "Experimental Investigation of Concrete Utilizing Rice Husk, Iron Slag and Silica Fumes to Enhance its Properties", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 6 Issue 4, pp. 28-40, July-August 2022.
URL : https://ijsrce.com/IJSRCE22645