Utilization of The Agricultural And Industrial Waste Material In Construction Industry

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Abstract- *Fly ash, Condensed silica fume, blast furnace slag, and rice husk ash are examples of pozzolanic materials that have played an essential role in the manufacturing of high-performance concrete. Mineral additive consumption by the cement and concrete industries has increased since the late twentieth century. Partially replacing cement with supplemental elements in concrete helps to meet the rising demand for cement and concrete. A number of pozzolanic materials have been shown to be effective in the production of high-performance concrete.*

This study focuses on the incorporation of agricultural and commercial waste materials into concrete, which has the potential to improve concrete properties while also being environmentally benign. In this study, rice husk ash (RA) was used to partially replace cement in proportions of 10, 15, 20, and 30%, and shredded steel waste was used to partially replace sand in proportions of 10%, 15%, 20%, and 30%, with both elements being replaced simultaneously in the third mix. Compressive strength was measured after 3, 21, and 28 days, as well as workability by measuring slump cone in a 1:1:2 ratio. It has been discovered that when the percentage of RHA increases, compressive strength improves up to 20% before decreasing. However, as the fraction of steel waste compressive strength keeps on rising.

Keywords- High Performance Concrete (HPC), Rice Hush Ash, Compressive Strength, Split Tensile Strength, Flexural Strength.

I. INTRODUCTION

Concrete Concrete is the world's most frequently used man-made construction material, and it is also the most widely used substance on the earth, second only to water. It is made by proportionally mixing cementing materials, water, aggregates, and sometimes admixtures. Placed in moulds and left to dry, the mixture hardens into a rock-like mass known as concrete. The chemical reaction between water and cement causes hardening, which lasts a long time and makes the concrete stronger over time. The spaces of bigger particles are filled by smaller particles, and the voids of fine aggregate are filled with cement-like binding elements, making hardened concrete an artificial stone. Because cement is used in both mortar and concrete, it is the most important component of the infrastructure and has been recognised as a durable building material. However, experts are becoming increasingly concerned about the environmental qualities of cement, as cement manufacturing is responsible for around 2.5 percent of total universal waste discharges from commercial resources.

II. LITERATURE REVIEWS

Many works have been done to explore the benefits of using pozzolanic materials in making and enhancing the properties of concrete. Thomas and Shehata (1) have studied the ternary cementitious blends of Portland cement, silica fume, and fly ash offer significant advantages over binary blends and even greater enhancements over plain Portland cement. Sandor(2) have studied the Portland cement-fly-ash-silica fume systems in concrete and concluded several beneficial effects of addition of silica fume to the fly ash cement mortar in terms of strength, workability and ultra sonic velocity test results.The enhancement of concrete technology can minimize the consumption of normal assets and energy sources which diminish or destroy the burden of pollutants on the surroundings. At the moment, huge extent of marble powder have been generated in ordinary stone processing plants with an critical collide on the ambiance and life (Aalok and Sakalkale) [3].

Lam, Wong, and Poon [4] in their studied entitled Effect of fly ash and silica fume on compressive and fracture behaviors of concrete had concluded enhancement in strength properties of concrete by adding different percentage of fly ash and silica fume.

Replacement of sand with waste powder as a fine aggregate in concrete draws severe awareness of researchers and investigators. The utmost compressive and flexural strength were experimented for specimens containing a 6% dissipate mud when compared with ordinary mix and it has been also instigate that mixing of waste powders up to 9% could efficiently be used as a preservative material in civil materials (Singh and Nanda)[5].

With the addition of obtained waste marble powder the characteristics of concrete steadily increases up to certain bound. With the addition of Marble powder early strength increase in concrete is elevated. It has been revealed that the best percentage for substitution of marble powder with cement and it is approximately 10% binder for both casted cubes and cylinders (Vaieria et al.)[6].

According to Hendriks and Janseen (2003) [7] there are numerous alternatives for the reuse of recycled materials in structures. For each alternative a number of scientific and environmental aspects are applicable. Also, explains numerous models which can be utilized to take the optimal assessment. In common the world-wide used Life Cycle Assessment can be applied s a multi-parameter model for the ecological effects.

Khari et al. (1995) [8] explained that minimum essential mixing time has during mixing. It has been concluded that high w/c values resulted in short stabilization times. In addition, the contents of silica fume and quartz flour as well as the type of cement and super plasticizer affected the stabilization time considerably.

Concrete prepared using recycled aggregates have been used for many years in several countries which go ahead the way in this concept (Kwan et al., 2012) [9]. Many major projects have been completed in these countries with cheering results. Its utilization is so widely spread worldwide, so, that several countries have adopted it and are preparing regulatory documents about its use.

III. MATERIALS AND METHODOLOGY

3.1 Properties of OPC

It was fresh and free from any lumps. For best result cement stored in moisture less storage. To find out physical properties of cement the following test performs which shown in table 1 and the corresponding standard for that parameter as per BIS: 8112-2013 is also listed in Table 1.

Table 1: Properties of OPC 43 grade cement

S.No	Particulars	Result Values After Test	Requirements of IS:1489-1991 (Part-1)	
1	Normal Consistency (%)	32%	---	---
2	Setting Time (Minutes)	---	---	---
	I. Initial Setting Time	150-170 Minutes	30 Minutes	Minimum
	II. Final Setting Time	210-300 Minutes	600 Minutes	Maximum

3.2 CLASSIFICATION OF AGGREGATES

Aggregates are classified into two categories :

1. Natural aggregate
2. Artificial aggregate

Natural aggregates are sand gravel and Crushed rock such as Granite, basalt, sandstone. Artificial aggregates are broken bricks, air cooled slag and sintered fly ash.

3.3.2.1 FINE AGGREGATES

The material which is passed through BIS test sieve no. 480 (<4.75mm) is known as a fine aggregate. Natural river sand is used a fine aggregate.

3.3.2.2 COARSE AGGREGATES:

Coarse aggregate is defined as material retained on BIS test sieve no. 480 (>4.75 mm). Coarse aggregate is made from fractured stone.

The aggregates to be used for cement concrete should be hard durable and clean.

3.4 Shredded Steel Waste

Shredded refers to a portion of material that has been cut or torn away, usually in a narrow strip. Shredded steel trash is a by-product of metal smelting, and hundreds of tonnes of it are created every year in the process of refining metals and creating alloys all over the world. Slag, like other industrial by-products, has a wide range of applications and is rarely thrown away. It can be found in concrete, aggregate road materials, and ballast, and it's also utilised in phosphate fertiliser.

Test Performed on Coconut Shell Ash: -

Figure- 1

3.5 Fly Ash

In thermal power plants, fly ash makes up the majority of the coal combustion products. On several levels, using fly ash as a partial cement replacement in concrete is beneficial. Fly ash improves concrete strength by reducing permeability and heat of hydration. By substituting fly ash for Portland cement, greenhouse gas emissions are reduced. Every tonne of cement produced emits one tonne of greenhouse emissions.

While preserving workability, a fly-ash mix can have the same or superior early strength than normal concrete. FA improves economics by lowering raw-materials costs, and it also has a lower environmental impact because there is a direct link between reduced cement use and lower greenhouse gas emissions.

The addition of 10-20% FA to cement improves strain and bending strength, as well as water absorption and bending toughness. In North America, 15 percent to 18 percent fly ash by mass of cementation material is currently widely employed in modern construction practises. When alkali-silica expansion, sulphate attack, and thermal cracking are a problem, higher levels of fly ash, on the order of 25% to 30%, are indicated. Due to a slower rate of strength growth at an early age, such high quantities of fly ash are not readily accepted by the construction industry.The high-volume fly ash concrete technique solves the problem of poor early strength to a large extent by drastically lowering the water-cementitious materials ratio through a variety of ways, such as utilising the super-plasticizing impact of fly ash when employed in large quantities. The results of compressive testing show that increasing the amount of fly ash affects compressive strength.

Normally Fly ash is made up of silica, alumina, and iron oxides. In many parts of the world, fly ash is generally processed significantly more to remove undesirable constituents and increase the quantity of amorphous silica. Processed fly ash is the name for this type of fly ash. Pozzolana, or ultrafine fly ash (UFFA), is a relatively novel material. The ultra fine portion of UFFA is mechanically separated from the original fly ash during processing.

3.6 Rice Hush Ash (RA)

These are the ashes of rice grains' hard protective coatings. In addition to safeguarding rice during the growing season, rice husk is obtained from krishi Farms, where rice is harvested from the farm and removed from the rice husk using a thrasher before being burned. The burning of rice husk takes around 48 hours to complete. Due to the cooling process, rice husk ash remained unaffected for 12 hours after 48 hours. The rice husk ash is then ground mechanically to make the rice husk finer, as finer husk produces better results when substituted by cement in concrete.

IV. EXPERIMENTS AND RESULTS

4.1 Following test are conducted on materials in this study

a) Cement test
b) Aggregates test
c) Sand test
d) Concrete test

4.2.1 CEMENT TEST:

It is necessary to utilize ordinary Portland cement grade 43, as defined by I.S. 12269-1987[12]. Cement must gain the necessary strength. It ought to convey the right amount of power. It has to depict the correct rheological behavior.

Following tests are taken for cement.

1. Field test of cement.
2. Laboratory tests of cement.

4.2.1.1 FIELD TESTS OF CEMENT:

1. The cement should be a greenish grey colour.
2. There should be no lumps in the cement.
3. Put your hand into the cement bag; it should feel cool to you.
4. Take a pinch of cement between your fingers and rub it together; it should feel smooth.
5. Pour a small amount of cement into a bucket of water; the cement should sink down and not float in the water.

4.2.1.2 LABORATORY TESTS OF CEMENT:

The following tests are usually conducted in the lab.

1. Fineness of cement
2. Standard consistency test
3. Setting time of cement

4.2.1.2.1 FINENESS OF CEMENT:

The fineness of cement has a significant impact on the pace of hydration and strength increase. Finer cement has a larger surface area, which allows for faster hydration and strength development.

Fineness of cement is tested by sieving.

SIEVE TEST:

Fill a normal IS sieve no. 9 with 100 grammes of cement (90 microns). For 15 minutes, sieving is done continuously in a circular and vertical motion. Weigh the residue that has accumulated on the sieve. For regular cement, the weight must not exceed 10%.

4.2.1.2.2 STANDARD CONSISTENCY TEST:

A metric known as standard consistency must be used to determine initial setting time, end setting time, cement soundness, and strength.

A cement paste's standard consistency is defined as the consistency that allows a vicat plunger with a diameter of 10mm and a length of 50mm to penetrate to a depth of 33-35mm from the top of the mould and 5-7mm from the bottom. Vicat apparatus is the name given to this device. This equipment is used to determine the amount of water required to make a standard consistency cement paste.

4.2.1.2.3 SETTING TIME OF CEMENT:

For setting of cement as initial setting time and final setting time. Both are find out by vicat apparatus.

Vicat apparatus consist of 3 needles.

1. Plunger
2. Initial setting time needle
3. Final setting time needle is called collar arrangement.

INITIAL SETTING TIME:

The interval between adding water to the cement in the mortar and the paste losing its flexibility is known as the initial setting time.

For O.P.C. initial setting time is 30 min.

FINAL SETTING TIME:

The interval between adding water to the cement in the mortar and the paste losing its flexibility is known as the initial setting time.

for O.P.C. Final setting time is 10 hours.

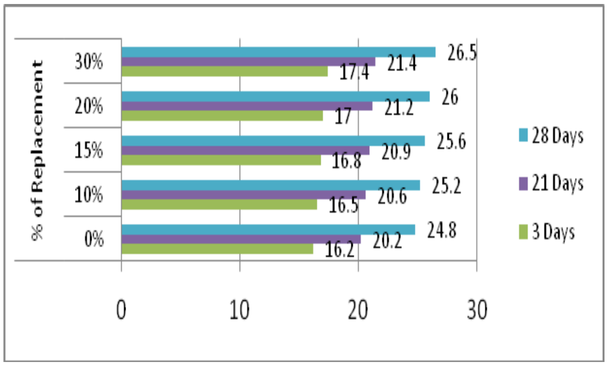
PROCEDURE INITIAL SETTING TIME AND FINAL SETTING TIME TEST

For determination of initial setting time and final setting time of cement paste of cement we used Vicat'sapparatus. This apparatus is referenced by IS: 4031 (Part 4) -1988, IS: 4031 (Part 5) - 1988, IS: 5513-1976,

1. Making of Test Block - Gauge the cement with 0.85 times the water necessary to make a paste of standard consistency and make a 300 gms cement paste. The paste must be made using clean or distilled water.
2. Stop watch- Begin when the cement has been weighed. After that, water is added to produce a paste. Fill the Vicat'smould with a cement paste gauged as if it were on top of an inactive Vicat'smould on a non porous plate. Fill the mould completely and flatten the paste's surface to make it level with the top of the mould.
3. Place the test block in the wet closet or moist room as soon as possible after moulding and leave it there until time of setting determinations are made.
4. Determination of Initial Setting Time - Place the test block, which is restricted in the mould and sitting on the non-porous plate, under the needle-bearing rod (C); gradually lower the needle until it comes into touch with the test block's surface, then swiftly release it, allowing it to penetrate into the test block.
5. The first setting time will be determined by repeating this technique until the needle, when placed in contact with the test block and released as indicated above, fails to puncture the block beyond 5.0 0.5mm measured from the bottom of the mould.
6. Determination of Final Setting Time: Replace the needle (C) of the Vicatapparatus by the needle with an annular attachment (F).

Table -2 **Results of compression tests for M1 concrete mix in MPa**

S. No.	Days	% of Replacement				
		0%	10%	15%	20%	30%
1	3	16.1	16.4	17.0	17.3	16.7
2	21	20	20.4	20.7	21.2	20.6
3	28	24.8	25.3	25.5	30	24.5



Graph-1 **Results of compression tests for M1 concrete mix in MPa**

V. DISCUSSION AND CONCLUSION

5.1 Discussion

Utility of materials such as Rice husk ash (RA) and shredded steel (SSW) in construction industry reduces the use of Portland cement and thus reduces the construction cost.

In the present concrete mixes have been prepared by adding these materials in different percentage. Concrete mixes formed are tested for compressive strength and slump values and compared with ordinary Portland cement concrete values.

5.2 Conclusions

Following are the conclusions of the present work -

1. By replacing cement with RA in M1 mix compressive strength increases up-to 205 and then decreases with increase in percentage of cement.
2. Compressive strength has been found to be highest at 20% replacement of cement by RA in M1 mixes.
3. Slump value is found to be decreasing by increasing the percentage of RA.
4. Compressive strength increases and Slump value decreases by increasing the percentage of replacement of sand by SSW in M2 mixes.
5. Hence, from above results it has been recommended to replace cement about 20% with RA for higher compressive strength and optimum workability.
6. Results indicate that compressive strength increases with the combined use of SSW and RA in concrete.
7. Slump value is higher in case of M3 concrete mix when compared with M1 and M2 mixes. However, with the increase in percentage of replacement value of slump cone decreases in all the three concrete mixes M1, M2 and M3.

V. RECOMMENDATIONS FOR FUTURE WORK

Few more properties such as compactness, consistency and other strengths are required to be tested by adding supplementary materials. Increased volume of experimental data with other materials and is to be collected and used to study the suitability of different waste materials. Resistance to chloride attack, carbonation and corrosion of reinforcement and other environmental attacks is required to investigate.

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