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DETERMINE THE EFFECT ON CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH COCONUT SHELL ASH AND FINE AGGREGATE WITH GGBS

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ABSTRACT

In the earth surface the amount of waste material from industrial, agricultural has began the sustainability issue of the environment as well as ecology of earth. The production of waste account for the Global warming because it releases CO_2 and other harmful gases during disposal or manufacturing. In this research work we use waste material Coconut Shell Ash (CSA) with replacement of cement. More then 108 specimens were prepared and tested by using CSA with the 0%, 2.5%, 5%, 7.5%, 10% and 12.5% as replacement with cement.

After design mixed, we find the ratio of concrete mixed is 1:2.03:3.10 by weight of cement sand and coarse aggregate at the 0.55 water cement ratio. The properties of concrete and cement were studied include initial setting, final setting time, compressive strength, split tensile strength and flexural strength. The workability of CSA mixed concrete were tested immediately after preparing the concrete mixed and compressive strength were tested at 7 days and 28 days of curing ages. The addition of waste CSA increases the strength of concrete at the certain point after that it decreases. The compressive strength of CSA mixed concrete increases up to 10% of replacement to cement with amount of 28.44 N/mm^2 then decrease. In the case of Split Tensile Strength and Flexural Strength also increases up to 7.5% of replacement of cement in CSA mixed concrete with amount of 3.81 N/mm^2 and 9.16 N/mm^2. Finally, we clearly say that the replacement of CSA to cement is up to 10% for compressive strength and up to 7.5% for the Split Tensile and Flexural Strength.

1. INTRODUCTION

1.1 OVERVIEW

Concrete is a blend of coarse aggregate, fine aggregate (sand), admixtures and water. Today Global Warming (GW) and environmental pollution have become manifest harms in early and recent years, concern about environmental issues. It can happen due to use and production of the mass-waste, mass consumption, mass-production. Normally it can see that glass does not harm to environment due to not produced pollutants matter but it can harm animal as well as human shortly when we do not take care off that time it harmful and it is not non-biodegradable. For that we required new technologies to overcome them from this problem.

The glass has many chemical diversities like Soda-lime Silicate Glass, Alkali-Silicate Glass and Boro-Silicate Glass. These all types of glasses generally used in Civil Engineering work as Pozzolana. The Alkali contents increases the properties of cement. It also used in brick manufacturing & ceramic manufacture. The useful and recycled materials, glasses and glass powder are mainly used in various Civil Engineering project because glass powder as supplementary cementitious material and coarse aggregate. All type of glass is near to 100% recyclable. It also increases concrete durability without affects any property in concrete. In recently glass and glass powder has used as a construction material for reducing environmental pollution. In concrete mixed the coarse & fine glass aggregate produced Alkali Silica Reaction (ASR) but this problem can not happen in the case of glass powder because it has Supplementary Cementitious Material (SCM). Therefore, glass powder used as replacement of SCM.[31]

This work is based on utilization of waste material like coconut shell and glass powder used in concrete construction industry for their valuable application. Use of such waste material not only reduction in land fill cost, saving in energy and protecting environment from possible pollution effect but also getting them utilized in cement and other construction material. It also used as reduction cost of cement manufacturing and concrete construction. [32].

Popoola et al (2019) investigate the use of coconut waste ash in the construction industry reduces the time cost and improve the maximum dry density (MDD), Unconfined Compressive Strength (UCS), Optimum Moisture Content (OMC) and CBR value of soil.[20].

Different effort made by many researchers in using coconut shell ash, coconut shell, coconut husk ash as replacement material for cement, coarse aggregate an cement respectively. This research set out the effect of coconut shell ash.

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1.2 PROPERTIES OF GLASS POWDER

Glass powder materials have the following properties for that reason it used in the concrete directly: -

- Glass powder has good density (2555 kg/m^3) which is best suitable for cement and cementitious material.
- The value of Cao is good of glass powder which is very useful for cement.
- Glass powder have sufficient hardness 9470HK to bear load.[16]
- Glass has sufficient modulus of elasticity 70,000 MPa.
- It also has bending strength up to 45 MPa.
- The melting point of glass is 600^{o}C [15]
- It is not affected with water as well as not absorb water (0%).

1.3 PROPERTIES OF COCONUT SHELL ASH

Coconut Shell Ash materials have the following properties for that reason it used in the concrete directly: -

- Coconut shell ash have moisture content is 4.2 % which less and useful for cement.
- Specific Gravity of coconut shell is 2.30. [20]
- Its crushing value is also varied 2.58% to 2.90 % which is more suitable for concrete.
- The abrasion value of coconut shell ash is 1.63 %, which is sufficient for concrete mixed.
- The bulk density of coconut shell ash is 505 kg/m^3[20]
- The impact value of coconut shell ash 15.6 % which is useful for construction.
- The water absorption value for coconut shell ash is 1.46% which is sufficient for cement concrete. [20]

2. LITERATUE REVIEW

2.1 LITERATURE STUDY

In order to understand the quality, quantity and other properties of concrete. Many research done in this area; literature survey was done. Journal papers, international conference papers, articles, and library were referred. In addition to that, internet websites, online journals and electronic data base were also browsed for supplementary information.

Tajamul Magrey et al. (2016), explained about the concrete is the premier civil engineering material. Concrete manufacturing involves consumption of ingredients like cement, aggregates, water & admixtures. Among all the ingredients, aggregates form the major part. More than 50000 billion tons of aggregate are produced each year in the world. Use of natural aggregates in such a rate leads to a question about the preservation of natural aggregate sources. In addition, operation associated with aggregates extraction and processing is the principal causes for environmental concern. The most widely used fine aggregate for the making of concrete is the natural sand mined from the riverbeds. However, the availability of river sand for the preparation of concrete is becoming scarce due to the excessive non-scientific methods of mining from the riverbeds, lowering of water table, sinking of the bridge piers, etc. are becoming common. The present scenario demands identification of substitute materials for the river sand for making concrete. Recently in the environmental issues, restrictions of local and natural access or sources and disposal of waste material are gaining great importance. Today, it becomes more difficult to find a natural resource. Use of the waste materials not only helps in getting them utilized in cement, concrete and other construction materials, but also has numerous indirect benefits such as reduction in land fill cost, saving in energy, and protecting environment from possible pollution effect. It also helps in reducing the cost of concrete manufacturing. In light of this in the contemporary civil engineering construction, using alternative materials in place of natural aggregate in concrete production makes concrete as sustainable and environmentally friendly construction material. In this research, the effect of coconut shell as partial replacement of coarse aggregate and waste glass as partial replacement of fine aggregate on the properties of concrete were studied. The characteristic properties of concrete such as compressive strength, flexural strength, and water absorption of various mixes were reviewed in this work [32].

Abdul Hamdule Rehman et al. (2021), we did the project work for the determination of the effect of the use of „Glass Powder" as a partial replacement of cement to assess the pozzolanic nature of fine glass powder when mixed in concrete and compare the performance when other pozzolanic materials are mixed. The present study shows that waste glass, if ground finer than 600µm shows a pozzolanic behavior. It reacts with lime at early stage of hydration forming extra CSH gel thereby forming denser cement matrix. Thus, early consumption of alkalis by glass particles helps in the reduction of alkalisilica reaction hence enhancing the durability of concrete. Number of tests were conducted to study the effect of 0%, 10%, 20%, 30% and 40% replacement of cement by glass powder on workability

and compressive strength. The results showed that the maximum increase in strength of concrete occurred when 20% replacement was done with glass powder [1].

K.I.M. Ibrahim (2021), the principal goal of this study is to search the appropriateness and the effect of using as a partial substitution of cement weight for three main types of concretes. These three essential types are ordinary concrete, concrete containing silica fume (SF), and concrete containing fly ash (FA). The replacement ratios from cement weight were 0 %, 5 %, 10 %, 15 %, and 20 %. Some mechanical and other concrete properties have been investigated at both hardened and fresh stages. The test results showed the appropriateness of utilization as cement in concrete. Utilizing a 5 % proportion raises the compressive and tensile strengths of ordinary concrete (group 1) by about 8 % and 13 %, respectively, related to the control mix [without waste glass powder]. At all ratios of replacement, the compressive and tensile strengths of silica fume and fly ash concrete (groups 2, 3) decreased compared to control concretes. This reduction was about 13 %– 14 %, respectively, at a 20 % ratio. Additionally, the water absorption and density of plain, SF, and FA concrete mixes incorporating the proportions 5 %–20 % as a partial replacement of cement weight decreased compared to reference concretes [0%]. The fresh and dry density of ordinary concrete (group 1) lessened by around 3 % compared to control concrete at a 20 % ratio. The decreasing ratios in water absorption of groups 1,2, and 3 specimens made of 20 % compared to control concrete [0%] are 27.78 %, 14.75 %, and 18.75 % respectively. The workability increased by increasing the content for all concrete types utilized in this study [18].

M.J. Garba, A.S.J. Smith, et al. (2020), this paper presented the findings of an investigation on coconut shell ash (CSA) as admixture in cement paste and concrete. The CSA used was obtained by controlled burning of coconut shell in an incinerator to a temperature of between 600–650ºC for 3 hours, air cooled, sieved through 75µm sieve and characterized based on its oxides composition determined using X-ray Fluorescence (XRF) analytical method. The effects of CSA on cement paste were investigated with addition of 0, 2, 4, 6, 8 and 10% respectively by weight of cement. The workability of fresh prescribed 1:2:4 concrete mixes with 0.55 water-cement ratio and CSA content in the order above was determined. Harden properties of the concrete were also assessed using 100mm diameter by 200mm long cylinders mould where the concrete mixes were cast and tested for compressive and splitting tensile strengths at 3, 7, 28 and 56 days of curing in accordance with BS procedures. The result of oxide composition of CSA showed that CSA is a good pozzolana and can be used as a mineral admixture. The inclusion of CSA in cement decreased linear drying shrinkage but increased consistency, initial and final setting times and could be used as a retarder. The use of CSA in concrete showed a decrease in workability but increase in compressive and splitting tensile strengths respectively with addition of CSA up to 2%. Therefore, up to 2% addition of CSA is recommended for use as a retarding admixture and strength improver in concrete in normal environment [20].

A Gupta, N Gupta et al. (2020), it is evident that the exploitation of waste increases insignificantly every year worldwide and is not recycled as per the need of the environment. Recycling of waste consumes a lot of energy and also leads to environmental pollution. In recent years, managing the waste which is causing a lot of environmental issues is one of the critical problems faced by the world. This waste mainly includes constructional demolition waste, agricultural waste, glass and plastic waste. All these cause a problem to dispose of after they have been used once. In order to deal with such a situation, the application of such waste in concrete production has become a great means of managing them. These wastes can be utilized as a partial or complete replacement of certain ingredients of the concrete. The recycling of these waste materials in concreting not only helps in managing solid waste but also renders the occurrence of natural resources. This review paper will provide an understanding of the adoption of waste materials as a resource during concrete production [23].

Nitin S. Taksande, G. D. Dhawale et al. (2019), explained the common processes of burning rice husk and the advantages of using the burnt ash in cement to facilitate structural development primarily in the East and South-East Asian regions. We will be investigating prior research from various sources, as well as prepare specimens of our own to perform a range of strength tests. The levels of replacement of cement by rice husk ash, and glass powder are 5%, 10%, 15% and 20%. The properties which are determined and compared in this study are workability, 7-, 14-, 21- and 28-days compressive strength. Pozzolanas are an important ingredient in the production of alternative cementing materials to Portland cement reactive aggregates. Waste glass powder in proper proportion can be used to resist chemical attack. The aim of this project work is to use rice husk ash and glass powder in the range 5%, 10%, 15% and 20% of as replacement of cement and concrete cube, cylinder and beam strength compared with conventional concrete cubes, cylinder and beam respectively. The present study investigates the effect of pozzolanic material in concrete and hence improving the strength of concrete. This work evaluates the performance of Rice Husk Ash and glass powder as a partial replacement of cement in concrete. In this project the rice husk ash percentage is with same replacement of

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glass powder. The strength properties of concrete are compared with the above varying percentage and the result on which it gives maximum strength is found out [24].

R Gopinath, T Ajithkumar et al. (2018), described the high cost of conventional construction material affects economy of structure. With increasing concern over the excessive exploitation of Natural aggregates, lightweight aggregate produced from waste is a viable new source of structural aggregate material. In this work we have partially replaced coarse aggregate with coconut shell and ordinary Portland cement with rice husk ash. The percentage of replacement are 0%, 18%, 20%, 22%, 24% with coconut shell and 0%, 5%, 8%, 10%, 12% with rice husk ash. The characteristic properties of concrete such as compressive strength, split tensile strength using the mix made by partial replacement of coarse aggregate with crushed coconut shell aggregate and ordinary Portland cement with rice husk ash were reviewed in the present work. The results show that high strength is attained at replacement of 18% with coconut shell and 8% with rice husk ash [28].

Murthi Palanisamy, Poongodi Kolandasamy et al. (2020), explained the liquid substance intrusion into concrete is one of the issues that gradually damage its physical and structural integrity. The permeability properties of lightweight self-consolidating concrete containing coconut shell aggregate was investigated in this study. A partial replacement of crushed rock (granite) with coconut shell from 0 to 100% in step of 25% was considered for the mixtures. Rice husk ash (RHA) and Silica fume (SF) were considered for developing binary and ternary blended self-consolidating concrete with total powder content of 450 kg/m3 and 550 kg/m3. The testing of concrete involved the saturated water absorption, sportively and chloride ingress, which were used to examine the permeability properties of the concrete developed. The laboratory investigations showed encouraging results with better performance up to 75% replacement of crushed granite with coconut shell aggregate [22].

3. PROPOSED METHODOLOGY

3.1 GENERAL

This chapter deals with the material those who used to find out the various strengths of concrete and also include the explanation about their following characteristics and properties.

3.2 MATERIAL USED

3.2.1 Cement

Cement formed by crushing, burning and then grinding of the clinker. These clinkers formed by Siliceous, Argillaceous and Calcareous stones. Cement play binding role in concrete mixture while water is added in concrete mixed. Ordinary Portland cement, rapid hardening cement, high alumina cement, super sulphated cement etc. are different types of cement available in the markets and it used different site condition and different desirable purposes.

Cement Compounds

In Civil Engineering Construction Portland cement is primary material spread in the world. It has 4 principal compounds which known as clinker factors (C3S, C2S, C3S and C4AF) respectively. These compound present in the range of 45-60 %, 15-30%, 6-12% & 6-8 % respectively. The C3S and C2S compound are provide strength in the cement paste for that reason it is more important to another compound. These all compound responsible for strengthing of cement at different ages of water curing [25].

3.2.2 Coarse Aggregate

Aggregate is in natural or crushed state and also has collective term for sand gravel and crushed stone. Concrete is a mixture cementing material [21].

Natural sand and gravel deposits, crushed rock, slag and mine refuse etc. is main source of aggregate. Aggregate is present in natural condition as well as man manufactured. It is generally extracted from larger rock formation or blasted to reduce size after that crushed stone screening to find different size of aggregate. Manufactured rock typically consists of industrial byproducts such as slag (byproducts of the metallurgical processing- typically produced from processing steel, tin copper) or specialty rock that is produced to have a particular physical characteristic not found in natural rock (such as the low density of lightweight aggregate). Aggregates typically constitute 75% of volume in concrete. In my whole thesis work I used maximum size of aggregate of 20mm and which is manufactured by man construction. To provide a rigid skeletal structure and reduce the space occupied by the cement paste is required proper size of aggregate. In this present study three most common type of light, normal & heavy weight aggregate. Natural & artificial aggregate considered as normal weight aggregate.

In my thesis work I used 20 mm and 10 mm size aggregate with 50:50 proportion and also calculate SG (Specific Gravity) and FM (Fineness Modulus) after removing of dust and dirt.

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3.2.3 Fine aggregates

In fine aggregate (sand) particle size passing through 4.75 mm BIS sieve **[06]** BIS:383-1970. In the nature (ATM) sand is naturally occurring with action of weathering seasoning and rock spelled in river. Due to weathering action rock convert in small size of stone that stones moved by river water and it concert in another small size stone and finally convert into sand particle. After that it collected from various placed and also screening it by performed sieve analysis for sand as well as aggregate.

According to the Bureau of Indian Standard BIS:383-1970 fine aggregate (sand) divided into 4 Zones (I, II, III&IV) When we go with zone I to zone IV aggregate become finer. After studying I choose II zone fine aggregate sand. After that I determine SP, FM and water absorption before used in the mixed.

3.2.4 Coconut Shell Ash (Powder)

In construction the increased cost of various ingredients of concrete is a main factor. Coconut shell ash used in the concrete production, it reduced and preventing environmental pollution as well as managing the waste generated by these shells. It also decreasing potential use of natural resource hence conserving sources [14].

In Civil Engineering construction industry of cement concrete is the vital material due to it has inbuild properties like workability, economical, durability and easy to construction for that reason recent years some commercial and agricultural waste become popular to use in construction. Coconut shell is the outer cover of the coconut. Coconut shell can be used as reinforced material, aggregate or in powder form when their size is between 20mm to 600 micron and the density near about 1.6gm/cm^3. Coconut shell has higher modulus of rigidity for that it is capable to enhance the concrete properties [23].

The quality of water is very important as it can influence the setting time of fresh concrete and the strength of hardened glass powder and coconut shell ash. On the other hand, water is required for the heat of hydration process of cement and molding and placing of cement concrete in the required shape and location [26].

Stated that the adequate water for the heat of hydration process requires a minimum water/cement ratio of 0.28. Water that is fit for drinking is appropriate for cement concrete used. If there is a high concentration of sodium, high suspended solids or potassium salts contain in the water, the water can't be used for cement concrete mixing. Concern on the water must be taken to avoid pollution of water, such as split admixtures.

3.2.5 Mix Design Results

Table 1 Proportion of Different Materials in our Mix

Cement	Fine Aggregate	Coarse Aggregate	Water
359	730.89	1113.77	197 liters
1	2.036	3.102	0.55
1:2.036:3.102 with 0.55 liters per m^3			

Preparation of Trial Mixes

Based on the concrete mix design by Bureau of Indian Standard (BIS) method, four trials mixes were prepared. Two trials mixes were prepared with W/C ratio of 0.55 and other two mixes were prepared with W/C ratio of 0.50. The 6 cubes were casted for each mix and were tested at 7 and 28 days. The mix proportions for various constituents have been summarized in Table-2

Table 2 Quantities Per Cubic Meter for Trial Mixes (M20)

Mix No	W/C	Slump (mm)	Water (l/m^3)	Cement Kg/m^3	Sand Kg/m^3	Coarse Aggregate Kg/m^3	Average Cube Strength at 7 Days (MPa)	Average Cube Strength at 28 Days (MPa)
Mix-A	0.55	50	186	338	749.7	1142.4	15.30	25.48
Mix-B	0.55	100	197	359	730.89	1113.77	15.50	26.75
Mix-C	0.50	50	186	372	724.6	1143.4	14.45	24.55
Mix-D	0.50	100	197	394	700.8	1113.9	14.98	25.90

The Mix-B was selected as the design mix because its average cube strength is very close to the target mean strength of the concrete with appropriate content of cement among all the mixes.

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3.2.6 PREPARED MIXES FOR TESTING OF THE COMPRESSIVE STRENGTH: -

We prepared the various mixes of concrete for the testing of compressive strength with the variable percentage (0%, 2.5%, 5%, 7.5%, 10% and 12.5%) of glass powder and coconut shell ash.

Table 3 Prepared Mixes for Tests of Compressive Strength of Concrete

Mix No.	W/C Ratio	Slump (mm)	Waste Content in % of Cement Wt	Water (l/m^3)	Cement Kg/m^3	Sand Kg/m^3	Coarse Aggregate Kg/m^3
Mix 1	0.55	100	0	197	359	730.89	1113.77
Mix 2	0.55	100	2.5	197	359	730.89	1113.77
Mix 3	0.55	100	5	197	359	730.89	1113.77
Mix 4	0.55	100	7.5	197	359	730.89	1113.77
Mix 5	0.55	100	10	197	359	730.89	1113.77
Mix 6	0.55	100	12.5	197	359	730.89	1113.77

Table 4 Mix Proportions of Different Concrete Mixes for Coconut Shell Ash (CSE)

Mix	W/C Ratio	CSE %	CSE kg/ m^3	Cement kg/m^3	Fine aggregates kg/m^3	Coarse Aggregate kg/m^3	Water l/m^3
Mix 1	0.55	0	0	359	730.89	1113.77	197
Mix 2	0.55	2.5	8.975	359	730.89	1113.77	197
Mix 3	0.55	5	17.950	359	730.89	1113.77	197
Mix 4	0.55	7.5	26.925	359	730.89	1113.77	197
Mix 5	0.55	10	35.900	359	730.89	1113.77	197
Mix 6	0.55	12.5	44.875	359	730.89	1113.77	197

4. TEST RESULTS AND DISCUSSION

4.1 GENERAL

This chapter deals with the test results those conducted on the prepared samples for various test like compressive strength, split tensile strength and flexural strength test. The performance of various mixes containing different percentage of coconut shell ash and glass powder is discussed in this chapter. All the tests conducted were in accordance with the methods described in the previous chapter.

4.2 COMPRESSIVE STRENGTH OF CSA MIXED CONCRETE

The compressive strength of all the prepared mixes was determined at the ages of 7,14 and 28 days for the various addition levels of CSA with cement concrete. The values of average compressive strength for different mixes prepared by addition of CSA (0%, 2.5%, 5%, 7.5%, 10% and 12.5%) at the completion of different curing periods (7 days, 14 days and 28 days).

Table 5 Combine Compressive Strength of Coconut Shell Ash (CSA) Mix Concrete for all Mixes

S. No.	CSA %	Compressive Strength After 7 Days N/mm^2	Compressive Strength After 28 Days N/mm^2
1	0%	15.78	25.63
2	2.5%	16.29	26.29
3	5%	17.07	27.04
4	7.5%	17.85	28.06
5	10%	19.26	28.66
6	12.5%	17.93	27.78

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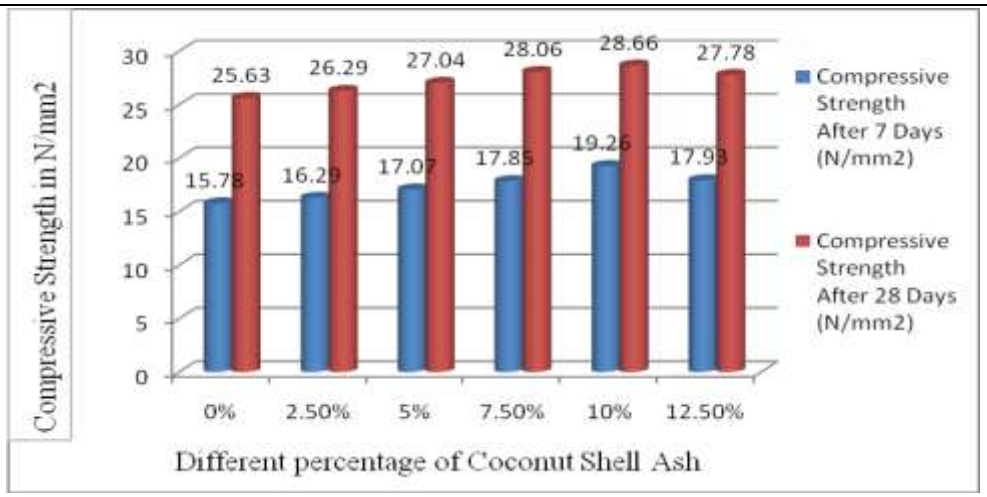

Figure 1 Combine Compressive strength at 7 day and 28 days for all mixes of Coconut Shell Ash

By these test results we can say that compressive strength of coconut shell ash concrete can be achieved approximately 28.66 N/mm^2 by adding waste coconut shell ash 10% of the weight of the cement content. It is also clear by these results that more than 10% waste coconut shell ash start reducing the compressive strength of coconut shell ash concrete.

4.3 SPLIT TENSILE STRENGTH OF CSA MIXED CONCRETE (IS:5816-1970) [09]

At the age of 7 and 28 days split tensile strength is measured when we replaced with the CSA material. The values of average strength for different replacement levels of CSA with cement (0%, 2.5%, 5%, 7.5%, 10% and 12.5%)) at the end of different curing periods (7 days and 28 days).

Table 6 Combine Split Tensile Strength of Coconut Shell Ash (CSA) Mix Concrete for all Mixes

S. No.	CSA %	Split Tensile Strength After 7 Days (N/mm^2)	Split Tensile Strength After 28 Days (N/mm^2)
1	0%	1.17	2.54
2	2.5%	1.24	2.73
3	5%	1.65	2.79
4	7.5%	1.82	3.41
5	10%	1.76	3.25
6	12.5%	1.67	3.23

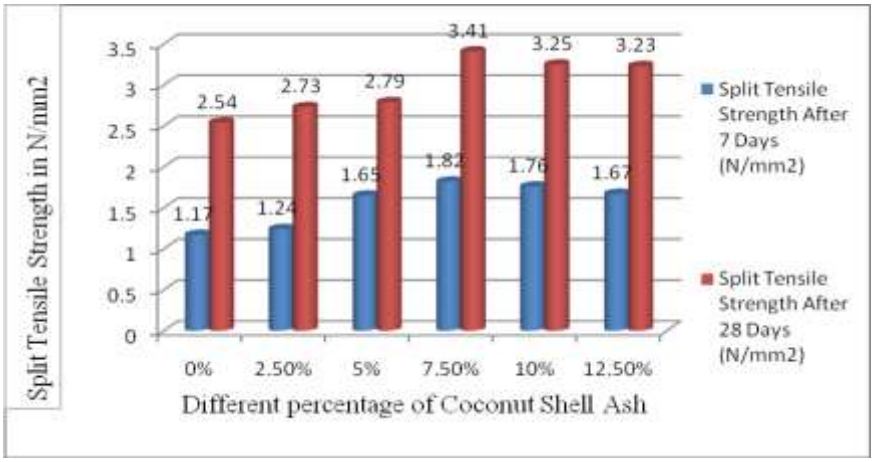

Figure 2 Combine Split Tensile strength at 7 day and 28 days for all mixes of Coconut Shell Ash

By these test results we can say that Split Tensile strength of Coconut Shell Ash concrete can be achieved approximately 3.41 N/mm^2 by adding waste coconut shell ash 7.5% of the weight of the cement content. It is also clear by these results that more than 7.5% waste coconut shell ash start reducing the split tensile strength of coconut shell ash mixed concrete.

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4.4 FLEXURAL STRENGTH OF CSA MIXED CONCRETE (IS: 516-1959) [11]

The flexural strength test of beam, a specimen of size (700*150*150) mm is placed over two-point loading arrangement and the stress produced during breakage of specimen

Table 7 Combine Flexural Strength of Coconut Shell Ash (CSA) Mix Concrete for all Mixes

S. No.	CSA %	Flexural Strength After 7 Days (N/mm^2)	Flexural Strength After 28 Days (N/mm^2)
1	0%	5.15	6.80
2	2.5%	6.04	7.81
3	5%	6.35	8.096
4	7.5%	7.25	9.16
5	10%	6.53	8.49
6	12.5%	6.52	8.31

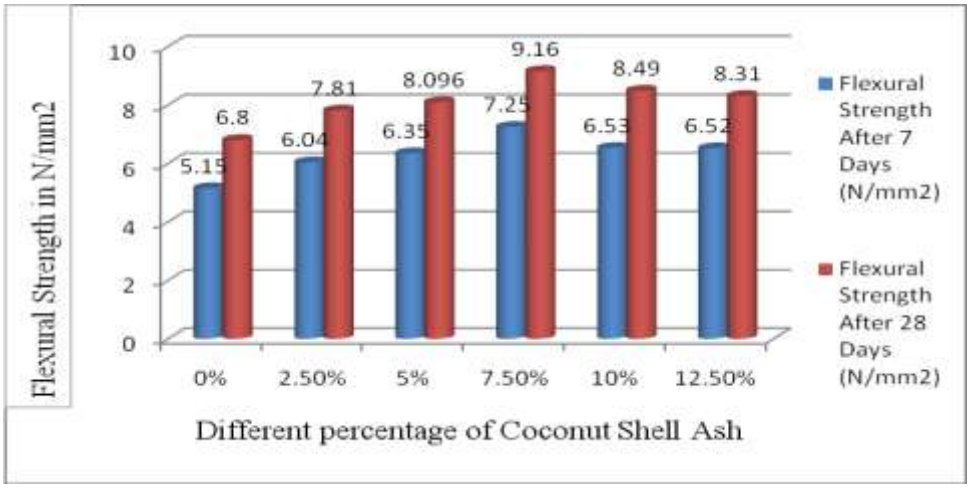

Figure 3 Combine Flexural strength at 7 day and 28 days for all mixes of Coconut Shell Ash

By these test results we can say that Flexural strength of Coconut Shell Ash concrete can be achieved approximately 9.16 N/mm^2 by adding waste coconut shell ash 7.5% of the weight of the cement content. It is also clear by these results that more than 7.5% waste coconut shell ash start reducing the Flexural strength of coconut shell ash mixed concrete.

5. CONCLUSION AND RECOMMENDATION FOR FUTURE WORK

5.1 CONCLUSION

After the detail analysis of the test results, we can say that the addition of waste coconut shell ash and glass powder significantly affect the 7 days and 28 days compressive strength, split tensile strength and flexural strength of the concrete. From the critical difference, it can be clearly seen that the addition of waste coconut shell ash and glass powder in certain amount i. e. (0-7.5) % of the weight of cement increases the compressive strength as well as split tensile strength and flexural strength increases. Experimental results also show similar trend. Hence, the results of statistical analysis are equivalent to the experimental results. From the experimental investigation this research work can be concluded as follows: -

- CSA waste material improves the Compressive Strength, Split Tensile Strength and Flexural Strength of Concrete.
- The addition of waste CSA does not affect very much the density of concrete mix.
- The addition of waste CSA increases the strength of concrete for all curing ages up to a certain point. After that there is an abrupt reduction in the strength of the CSA mixed concrete. Because at higher dosage, concrete loses its ability to make a proper bond.
- The gradual increase seen in the compressive strength of Coconut Shell Ash mixed concrete at 7 days and 28 days curing with 10% addition of CSA in the amount of 28.66 N/mm^2 but after that it starts reducing the compressive strength with increase of CSA addition.

- The gradual increase seen in the Split Tensile Strength of Coconut Shell Ash and Glass Powder mixed concrete at 7 days and 28 days curing with 7.5% addition of CSA in the amount of 3.41 N/mm² but after that it starts reducing the Split Tensile Strength with increase of CSA addition.
- We also find that the Flexural Strength of Coconut Shell Ash & Glass Powder mixed concrete at 7 days and 28 days curing with 7.5% addition of CSA in the amount of 9.16 N/mm² but after that it starts reducing the Flexural Strength with increase of CSA addition.
- The mix which was prepared with the addition of 10% CSA with 0.55 W/C ratio possess the maximum compressive strength. Therefore, this mix is recommended for maximum strength.

5.2 RECOMMENDATIONS

In the construction industries that is purely managed work has good communication and clear guideline on the scope of the work are essential in the construction to avoid undesirable and confusion.

1. For the right and the accurate result, we have to prepare assessment report for every activity and every step of work to ensure the proper degree of control.
2. We prepare for result new and accurate machine and updated IS codes for formulation.
3. Allocation of financial and skilled human resources for the purpose of effective and efficient quality management should be provided.
4. There should be training program and quality guidelines to assure desired quality.

5.3 SCOPE FOR THE FUTURE

1. Further studies need to be conducted for the test of durability, soundness, thermal insulation, crack pattern and water absorption of the concrete.
2. Further studies need to be conducted by using other waste materials (combination of artificial and natural material) with cement could increases strength of concrete.
3. If we increase the plastic limit of CSA in concrete then we increase huge the strength in compressive strength and flexural strength.
4. Experiments can be performed to study the behavior of soil reinforced with CSA material.

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