

EXPERIMENTAL STUDY OF COARSE AGGREGATE REPLACEMENT WITH COCONUT SHELL AND SCRAP TYRES

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ABSTRACT: Green concrete is a revolutionary subject matter in the records of concrete industry. Concrete is an environmental friendly material and the general effect at the environment according to ton of concrete is restrained. It affords the feasibility of using by way of product substances like 55 and 10% coconut shell and scrap tyres as a replacement of coarse aggregate in concrete. Aggregate give volume requiring little to no effort, containing 66 percent to 78 percent of the solid. With expanding worry over the inordinate misuse of normal and quality totals, the total created from modern squanders and agribusiness squanders being practical new hotspot for building material. This investigation was completed to decide the potential outcomes of utilizing coconut shell and scrap tyres as total in concrete. Using coconut shell and scrap tyres as total in solid creation not just takes care of the issue of arranging this strong waste yet in addition helps save common assets. In this paper, the physical properties of squashed coconut shell and scrap tyres total were displayed. The crisp solid properties, for example, thickness and droop and 28-day compressive quality of lightweight cement made with coconut shell as coarse total likewise displayed. The normal crisp solid thickness and 28-day 3D shape compressive quality of the solid utilizing coconut shell and scrap tyres total were 51.56 kg/m³ and 49.78 N/mm² for 5% and 10% respectively. It is reasoned that squashed coconut shells and scrap tyres are appropriate when it is utilized an alternative for traditional aggregates in concrete. To avoid the pollutants and waste, the prevailing observe is performed. Thus, green concrete is an super substituent of cement as it is cheaper, because it uses waste merchandise, saving strength consumption inside the manufacturing. The concrete is made with concrete wastes which might be green so called as Green concrete. Over and exceptionally green concrete has greater power and durability than the ordinary concrete.

Keywords: Concrete, Eco-Friendly Concrete, Eco-Friendly Construction Material, Efficient Concrete, Green Concrete, Coconut shell, scrap tyres.

I. INTRODUCTION

Concrete is the broadly utilized number one basic material on the planet today. The interest to make this material lighter has been the subject of concentrate that has tested researchers and architects the same. The test in making a green concrete is diminishing the thickness while keeping up quality and without antagonistically influencing expense. Bringing new aggregate in with the general mish-mash configuration is a typical method to bring down a solid's thickness. Ordinary cement contains four parts, concrete, squashed stone, waterway sand and water. The squashed stone and sand are the parts that are generally supplanted with lightweight totals. Lightweight cement is ordinarily made by joining regular or manufactured lightweight totals or by entraining air into a solid blend. A portion of the lightweight totals utilized for preparations are pumice, perlite, extended earth or vermiculite, coal slag, sintered fly debris, rice husk, straw, sawdust, stopper granules, wheat husk, oil palm shell, and coconut shell. (Barsi.H.B et al., 1999, Khedari et al., 2000, Mannan. M.A. furthermore, Ganapathy.C 2002).

The exponential development pace of populace (Loehr RC .1984), advancement of industry and innovation, and the development of social civilization would be considered as the fundamental factors that have causes the expanded waste creation. As of late, the significance of countermeasures to manage squander materials has been called attention to, in light of the fact that such materials keep on expanding in every single year. The utilization of elective total has become need for the development business in view of the financial, ecological and mechanical advantages got from their utilization.

The significant expense of regular structure materials is a central point influencing lodging conveyance in India. In creating nations where inexhaustible rural and mechanical squanders are released, these squanders can be utilized as potential material or substitution material in the development business. This will have the twofold favorable position of decrease in the expense of development material and furthermore as a methods for transfer of squanders. It is right now the above approach is legitimate, commendable and inferable.

WHY GREEN CONCRETE?

Huge impact on sustainability.

Most broadly used cloth on Earth

30% of all materials flows on this planet

70% of all substances flows in the built surroundings.

2.1 billion tonnes in keeping with annum.
 >15 billion tonnes poured every yr.
 Over 2 tonnes according to character in line with annum

Discussions with the Ministry of Environment and Energy, Environmental Protection Agency have resulted in the following priorities regarding environmental impacts applicable to concrete.

ADVANTAGES OF GREEN CONCRETE

Green concrete is component of a movement to create construction materials that have a decreased effect on the environment. It is made from a aggregate of an inorganic polymer and 25 to 100 % industrial waste. Here is a listing of 4 blessings to using green concrete in your subsequent challenge.

Lasts Longer: Green concrete profits electricity quicker and has a lower fee of shrinkage than concrete made most effective from Portland cement. Structures constructed the usage of green concrete have a higher risk of surviving a fire (it can face up to temperatures of as much as 2400 ranges on the Fahrenheit scale). It also has a extra resistance to corrosion that's essential with the effect pollution has had on the surroundings (acid rain greatly reduces the toughness of traditional constructing substances). All of those factors add up to a constructing so that it will last a good deal longer than one made with ordinary concrete. Similar concrete mixtures had been discovered in ancient Roman structures and this material changed into additionally used in the Ukraine in the 1950s and Nineteen Sixties. Over forty years later those Ukrainian buildings are still standing. If buildings don't constantly need to be rebuilt, fewer creation substances are wanted and the effect to the surroundings during the system of creating the ones substances is reduced.

As Industrial Waste: Instead of a one hundred percentage Portland cement mixture, inexperienced concrete makes use of anywhere from 25 to one hundred percent fly ash. Fly ash is a by-product of coal combustion and is collected from the chimneys of commercial flowers (such as strength plants) that use coal as a power supply. There are copious quantities of this industrial waste product. Hundreds of hundreds of acres of land are used to dispose of fly ash. A big increase in the use of green concrete in construction will provide a manner to use up fly ash and hopefully free many acres of land.

Energy Consumption: If you use much less Portland cement and more fly ash whilst mixing concrete, then you will use much less strength. The materials that are used in Portland cement require massive amounts of coal or herbal gasoline to warmth it up to the precise temperature to turn them into Portland cement. Fly ash already exists as a byproduct of another business manner so that you are now not expending a lot greater electricity to apply it to create green concrete. Another manner that inexperienced concrete reduces strength consumption is that a building constructed from it is more resistant to temperature modifications. An architect can use this and layout a green concrete building to use energy for heating and cooling greater correctly.

CO₂ Emissions: In order to make Portland cement—one of the main ingredients in regular cement—pulverized limestone, clay, and sand are heated to 1450 degrees C the usage of natural gasoline or coal as a gasoline. This manner is responsible for five to 8 percent of all carbon dioxide (CO₂) emissions global. The production of green concrete releases has up to eighty percent fewer CO₂ emissions. As a part of a international effort to reduce emissions, switching over absolutely to the usage of inexperienced concrete for production will assist drastically.

STATE OF AFFAIRS OF CONCRETE WITH REDUCED ENVIRONMENTAL IMPACT

There is extensive expertise about how to supply concrete with lower environmental impact, so-known as inexperienced concrete. The concrete industry has extensive revel in managing environmental components. The concrete enterprise realized at an early stage that it is a appropriate idea to be in front with regard to documenting the real environmental elements and operating on enhancing the surroundings, as an alternative than being forced to deal with environmental factors due to demands from government, clients and monetary consequences which includes imposed taxes, etc. The know-how and revel in, about a way to produce concrete with decrease environmental impacts can be divided into agencies, concrete blend design and cement and concrete production:

II. OBJECTIVES

- A. To study the effect of coconut shell and scrap tyres on the environment.
- B. To study the effectiveness of concrete by partial replacement of CA by coconut shell and scrap tyres
- C. To determine the strength of new mix design concrete of grade M40.
- D. To determine the various test results like compression test, split tensile test.
- E. To find the optimum percentage of coconut shell and scrap tyres in CA so that we can achieve maximum strength by increasing percentage as 5%, 10%.
- F. With the optimum percentage of waste products we have performed durability test viz. carbonation test and water absorption test.

III. LITERATURE REVIEW

In 2016, Anita Bhatia, et al¹ publishes a paper on inexperienced concrete in which they concluded that inexperienced concrete could be very low power and aid intake, no environmental pollutants and sustainable improvement. One can conclude that overcoming the above demerits would help to use the inexperienced cement concrete with a probably new environmental friendly world. With the waste fabric as an opportunity we can assist to reduce the environmental troubles and protect the certainly available substances for the destiny generation. (1)

In 2016, Praveer Singh, et al² studied approximately the silica fume and springs to the belief that cement is turning into a scarce resource everywhere in the global because of increase in call for daily. The use of silica fume as a pozzolana material has elevated in current years due to the fact whilst jumbled in positive proportions it complements the homes of each fresh and tough concrete. Addition of silica fume in proper share improves sturdiness assault by means of acidic waters and enhancing concrete situations. (2)

In 2016, Tae Hyoung Kim, et al³ does examine about the CO₂ emission from concrete and concluded that concrete, a common construction fabric, is known to emit large quantity of environmentally risky waste all through the tactics related to its manufacturing, creation, maintenance, and demolition. The CO₂ emitted in a concrete production have an effect on the acidification and global warming. (3)

In 2015, Kasi Rekha, et al⁴ studied approximately the brick wastes and concluded that the recycled brick aggregate concrete is made used for the manufacturing of low grade recycled aggregate suitable for concrete manufacturing. The consequences showed that recycled brick aggregate concrete done better than granite combination concrete at excessive temperature. The hearth resistance of recycled brick aggregate concrete is higher than the hearth resistance of granite aggregate concrete. (4)

In 2015, Dhiraj Kumar Tiwari, et al⁵ research about the inexperienced concrete and concluded that green concrete capable for sustainable improvement is characterized by application of business wastes to lessen consumption of herbal sources and energy and pollution of surroundings. Application of green concrete is an effective manner to lessen environment pollutants and enhance durability of a concrete beneath excessive conditions. Green concrete has the coolest thermal & fire resistance. (5)

In 2015, Xian LI, et al⁶ carried out an experiments on concrete having best mixture alternative through demolished brick waste and that they comes to the conclusion that recycled waste brick aggregate has apparent distinctive properties from recycled concrete mixture and is hardly ever regularly occurring due to its lower energy the impact of recycled waste brick fine combination on compressive strength and flexural energy of mortar changed into studied. A right bond exists among recycled brick mixture & the cement paste. The fire resistance of recycled brick aggregate concrete is higher. (6)

In 2015, Kakamare M.S., et al⁷ studied about the Sustainable Construction Materials & Technology in which they concluded that inexperienced concrete is a sort of concrete which resembles the traditional concrete but the manufacturing or uses of such concrete requires minimum amount of electricity and causes least damage to surroundings. Green concrete is a completely low power and resource intake, no environmental pollutants, sustainable improvement. Green Concrete has appropriate thermal and fire resistance, sound insulation than the traditional granite rock. (7)

In 2015, Mohammed Tarek Uddin¹, et al⁸ studied approximately the demolished brick waste replacement as an mixture and that they concluded that investigations have been completed to explore the opportunity of recycling of demolished brick mixture concrete as coarse and fine aggregate. The compressive strength of mortar portion of concrete is higher than the compressive energy of recycled aggregate concrete; it indicates that failure of concrete specimen is initiated in recycled coarse mixture. (8)

In 2014, Dewanshu Ahlawat, et al nine replaces the coarse aggregate by using coconut shell & concluded that concluded that the rising cost of production cloth is an issue of problem. The cause for boom in value is excessive call for of concrete and scarcity of raw fabric. Hence the concrete technologists should look for some low-budget opportunity to the course aggregate. Increase in percentage substitute with the aid of coconut shell reduces compressive strength of concrete. (9).

IV. MATERIAL USED & MIX PROPORTION

A. Cement:

In this study, Ordinary Portland Cement (OPC) of 53 Grade confirming to IS specification is used. Properties of the cement are presented in Table 1.

Table 1 Properties of OPC 53 grade cement

PROPERTIES	TEST RESULTS	TECHNICAL REFERENCES
Specific gravity	3.15	IS4031 (PART 11):1988
Consistency (%)	31.5	IS4031(PART 4): 1988
Fineness of cement (%)	3.1	IS4031(PART 2): 1996
Initial setting time (minutes)	35	IS4031(PART 5): 1988

B. Fine Aggregate Manufactured sand (River Sand)

Manufactured sand (M-Sand) is an alternative to river sand for construction. M-sand is a product acquired from crushing of hard granite stone. The size of M-Sand is less than 4.75mm. Due to the scarcity of river sand, any other exchange fabric synthetic sand has been used for production purposes. Another cause for use of M-Sand is its ease of availability and much less transportation fee.

Also its miles a dirt free cloth, causing very much less pollution. Properties of pleasant combination are supplied. Here we have used river sand with size 4.75 mm.

Table 2 Properties of Fine aggregate

PROPERTIES	TEST RESULTS
Specific gravity	2.74

C. Coarse Aggregate

Aggregates having particle length distribution more than 4.75 mm, however generally tiers between 10 mm to 40 mm in length. Coarse combination offer strength, toughness, and hardness residences to concrete and provides resistance to abrasion. Coarse aggregate used in the experimental study become confirming to IS 383:1970. Properties of coarse mixture are indexed in table 3.

Table 3 Properties of Coarse aggregate

PROPERTIES	TEST RESULTS
Specific gravity	2.74
Fineness modulus	6

D. Coconut shell

The new and elective structure development materials created utilizing agro-modern squanders have sufficient degree for presenting new building segments that will decrease to a degree the expenses of building materials. One such option is coconut shell (CS), which is a type of farming strong waste. It is one of the most encouraging agro squanders with its potential uses as coarse total in the creation of cement. This can possibly use in regions where squashed stones are exorbitant. Factual information of coconut creation shows that, India is delivering about 27% of all out world generation and the yearly generation of coconut is accounted for to be in excess of 12 million tons. By and by the coconut shell squander being utilized for making mosquito loops, agarbattis, and so on (www. Foodmarketexchange.com). Only barely any investigations have been accounted for on utilization of coconut shells as total in concrete (Olanipekun E.A.2006)). This paper talked about the physical properties of squashed coconut shell total and the compressive quality of the solid made with coconut shell coarse total.

E. Scrap tyres

Scrap tyres is one of the hugest natural dangers around the world. In light of the expansion in auto portable creation, there is a need to appropriately arrange the tremendous measures of utilized elastic tires. Inferable from the way that the accessible destinations for squander transfer are quickly draining, different nations have just banned the maintenance of waste-tire elastic in transfer regions. Thus, endeavors are being made to find the forthcoming utilization of waste-tire elastic in development innovation. Piece elastic is believed to be a potential material for use in solid innovation. It is considered as an option in contrast to the common totals, utilized as filler in solid network. Inferable from lower quality, the rubber treated cement is prescribed for non-load bearing structures and auxiliary individuals. Elastic totals in concrete are precisely sliced to the necessary sizes. It was effortful, tedious and was difficult to deal with at the underlying stages. Be that as it may, every one of these complexities can be effectively made sense of if huge scale gadgets, legitimate cutting instruments and machines are accessible for this specific use.

MIX PROPORTIONS FOR TRIAL CUBE:

Cement Water= 350 kg/m
 Water= 140 kg/m
 Fine aggregate=896 kg/m
 Coarse aggregate=1140kg/m
 Chemical admixture == 7 kg/m'
 Water-cement ratio=0.4

Final mix proportion = Cement: Sand: Coarse Aggregate = 474: 646: 1040 = 1 : 1.3 : 2.1

Design Mix as per 150 mm cube in kg

Cement: Sand: Coarse aggregate = 1.599: 2.180: 3.510

V. RESULTS

COMPRESSIVE TEST

The 150 mm size concrete cubes for the compressive strength test. The effects of general cubes are compiled. The Indian standard method resulted in particularly conservative outcomes of compressive strengths for the M 40 grades of concrete. Compressive test were acquired as consistent with IS: 516-1959. The 7 days, 14 days and 28 days compressive strength test of green concrete are shown in table respectively The authors advise that a barely much less energy of concrete at early age, in a few diploma, is useful to the durability of the concrete. The compressive strength testing of cubes was carried out on a universal testing machine of capacity 1000kN.

Compressive strength of concrete = ultimate load/ cross sectional area (N/mm²)

Table 5 Materials required for replacement of CA with 5% and 10% of coconut shell and scrap tyres

MATERIALS	QUANTITY
CA replaced with coconut shell and scrap tyres (5%)	4062(101.55+101.55)
CA replaced with coconut shell and scrap tyres (10%)	4062(101.55+101.55)
Water	500 ml
Cement (kg)	1250
Fine Aggregate (kg)	3200

Table 6 Compressive strength test for replacement of CA with 5%, 10% mixture of coconut shell and scrap tyres

Days	0% Replacement	5% Replacement	10% Replacement
7	32.45	33.35	31.33
14	40.68	43.12	42.23
28	48.00	51.56	49.78

SPLIT TENSILE STRENGTH TEST

Split tensile strength test carried out on cylinder of 150mm in diameter and 300mm height specimens. For this, look at M 40 grade concrete is used. A overall 12 no. of cylinder have been forged for purchasing split tensile strength of concrete after 28 days.

$$\text{Split Tensile Strength} = 2P/3.14DL$$

Where, P = Applied Load D = Diameter of the Specimen L = Length of the Specimen.

Table 7 Split tensile strength test for replacement of CA with 5%, 10% mixture of coconut shell and scrap tyres

Days	0% Replacement	5% Replacement	10% Replacement
28	3.09	3.56	3.32

After getting the optimum result from compressive strength and split tensile strength test we can see that 5% of coconut shell and scrap tyres as a replacement of CA gives more strength. Now we will perform the durability test with the optimum percentage of coconut shell and scrap tyres.

DURABILITY TEST

1. WATER ABSORPTION TEST:

Moisture penetration is one of the factors affecting the sturdiness of concrete. Concrete as a porous fabric which can permit water to migrate via it, corroding metal reinforcement, bringing in harmful chemical substances. So it's far a primary thing to be decided to evaluate the first-rate of concrete. For water absorption take a look at, dice specimen of length of 150 mm x150 mm x 150 mm become casted and immersed in water for 28 days. The specimens are oven dried for twenty-four hours at the temperature of 110°C till the mass will become consistent and once more weighed at room temperature.

$$\% \text{ water absorption} = w_1 - w_2 / w_2 \times 100$$

w₁ = oven dried weight of specimen

w₂ = very last weight of specimen

Table 8 Water Absorption test

Materials	Oven dried weight (Kg)	Weight of Specimen (kg)	Water Absorption (%)
5% replacement of CA (coconut shell and scrap tyres)	8.551	8.572	0.244

2. CARBONATION TEST

Carbonation immediately relates with the corrosion of metal reinforcement and shrinkage. To keep away from the future corrosion of metal reinforcement and the improvement of shrinkage cracks, carbonation take a look at may be very essential. This take a look at entails measuring the depth of carbonation of concrete. Specimen with size 150 mm x150 mm x150 mm cube was casted with 5% coconut shell and scrap tyres. Phenolphthalein is used as a trademark and specimen tester turns pink color it turned into denoted as Un Carbonated and if it colorless means that the specimen is carbonated.

Table 9 Carbonation test

Materials	Chemical Properties	Carbonation
5% replacement of CA (coconut shell and scrap tyres)	Pink	Un-carbonized



Fig 1: Carbonation test

VI. CONCLUSION

In this, an experimental research has been carried out to discover that the coconut shell and scrap tyres along with concrete specimens and compressive strength, tensile strength test were evaluated. After that mechanical test we have undergone durability test viz. carbonation test and water absorption test.

The following conclusions had been drawn from experiments performed at the specimens are as follows:

1. Coconut shell and scrap tyres changed partly with CA, in concrete improves the durability factors of concrete as compared with the nominal mix.
2. The water absorption decreases with boom in Coconut shell and scrap tyres content.
3. In compressive strength test combination percentage such as 5 % and 10% of coconut shell and scrap tyres replaced with CA changed into satisfactory amongst all other mixtures.
4. In compressive strength test combination percentage such as 5 % and 10% of Coconut shell and scrap tyres replaced with CA have 51.56 kN/m² and 49.78 kN/m².
5. After undergoing mechanical properties, 5% Coconut shell and scrap tyres gave the optimum result.

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