EXPERIMENTAL STUDY OF CEMENT REPLACEMENT WITH TEA WASTE AND FLYASH

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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. The paper covers the element on how to pick waste materials for inexperienced concrete. It affords the feasibility of using by way of product substances like fly ash, tea waste as a replacement of cement in concrete. The use of fly ash in concrete contributes the discount of greenhouse emissions with terrible affects on the financial system. It has been found that tons of CO_2 is produced with cement manufacturing. Also, the composition of cement is 10% by weight in a cubic yard of concrete. Thus, through using green concrete it is viable to lessen the CO_2 emission in environment towards eco-friendly production method. 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.

Index Terms: Concrete, Eco-Friendly Concrete, Eco-Friendly Construction Material, Efficient Concrete, Green Concrete.

I. INTRODUCTION

The concrete that's made the use of wastes which is green is known as Green concrete. Green concrete is a progressive topic in the history of concrete industry. It turned into first invented in Denmark in the yr 1998. The CO_2 emission associated with concrete production, consisting of cement manufacturing, is between 0.1 and 0.2 ton per ton of produced concrete. Since concrete is the second maximum are up entity after water it accounts for round 5% of the sector's general CO_2 emission (Ernst Worrell, 2001). However, considering that the entire amount of concrete produced is so massive the absolute figures for the environmental effect are quite huge. The solution to this environmental trouble isn't always to alternative concrete for different substances but to reduce the environmental effect of concrete and cement. Usage of quarry rock dust at the side of fly ash and micro silica suggested quality residences. The ability environmental advantage to society of being able to construct with inexperienced concrete is large. It is realistic to anticipate that technology can be developed, which can have the CO_2 emission associated to concrete production. With the massive consumption of concrete this could potentially lessen the world's general CO_2 emission with the aid of 1.5 -2%. There is a huge ability in investigating the viable use of those products for concrete production. Well-recognized residual merchandise consisting of silica fume and fly ash may be mentioned.

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 one hundred percentage 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.

CO_2 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 Fly ash and tea waste on the environment.
B. To study the effectiveness of concrete by partial replacement of cement by fly ash and tea waste.
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 fly ash and tea waste in cement 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 al[1] 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 al[2] 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 al[3] 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 al[4] 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 al[5] 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 al[6] 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 al[7] 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 al[8] 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 4.1 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 (%)	9	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 4.2 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 4.3 Properties of Coarse aggregate

PROPERTIES	TEST RESULTS
Specific gravity	2.74
Fineness modulus	6

D. Tea waste

Tea is a famous beverage. Large amount of tea leaves are discarded, leading to the lack of treasured substances consisting of caffeine, catechin and melanin which can be still present inside the waste tea leaves. Waste tea leaves had been additionally effectively converted into black ink which can be used for portray and writings. Other approaches of recycling waste tea leaves were additionally explored.
The porous nature and excessive absorption capability of tea waste make it suitable materials for use as an imperative curing agent in excessive energy mortars to manipulate early age fast hydration and the leading indoors excessive temperature.

E. Fly Ash

Fly ash is a derivative of combustion of coal, composed of pleasant particles that are escaped out of the boiler at the side of the flue gases. Fly ash is commonly captured with the aid of electrostatic precipitators and the bottom ash is removed from the lowest of the boiler. Fly ash is normally stored at coal strength plant or dumped in landfills. Flyash which can be recycled is frequently used as pozzolano to supply hydraulic cement and as a alternative or partial replacement for Portland cement in manufacturing of concrete. Fly ash particles are commonly spherical in form and size ranges from 0.Five μm to three hundred μm. This study entails using fly ash as a partial alternative of cement with the 30% addition. A belonging of Fly Ash is listed.

Table 4.4 Properties of Fly ash

PROPERTIES	TEST RESULTS
Specific Gravity	2.07
Fineness Modulus	8%

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/mm^2)

Table 5.1 Materials required for replacement of cement with 5% and 10% of fly ash and tea waste

MATERIALS	QUANTITY
Cement replaced with tea waste + fly ash (5%)	1250 (31.25+31.25)
Cement replaced with tea waste + fly ash (10%)	1250(62.5+62.5)
Water	500 ml
Fine Aggregate (kg)	3200
Coarse Aggregate (kg)	4062

Table 5.2 Compressive strength test for replacement of cement with 5%, 10% mixture of tea waste and fly ash

Days	0% Replacement	5% Replacement	10% Replacement
7	32.45	32.89	32.30
14	42.23	42.67	40.23
28	50.23	51.12	49.77

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.

Split Tensile Strength = 2P/3.14DL

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

Table 5.3 Split tensile strength test for replacement of cement with 5%, 10% mixture of tea waste and fly ash

Days	0% Replacement	5% Replacement	10% Replacement
28	3.09	3.11	2.18

After getting the optimum result from compressive strength and split tensile strength test we can see that 5% of fly ash and tea waste as a replacement of cement gives more strength. Now we will perform the durability test with the optimum percentage of fly ash and tea waste.

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 mmx150 mm x150 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.

%water absorption = $w1-w2 / w2 \times 100$

$w1$= oven dried weight of specimen

$w2$ = very last weight of specimen

Table 5.4 Water Absorption test

Materials	Oven dried weight (Kg)	Weight of Specimen (kg)	Water Absorption (%)
5% replacement of cement (tea waste+fly ash)	8.599	8.581	0.256

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% fly ash and tea waste. 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 5.5 Carbonation test

Materials	Chemical Properties	Carbonation
5% replacement of cement (tea waste+fly ash)	Pink	Uncarbonized

Fig 5.1: Carbonation test

VI. CONCLUSION

In this, an experimental research has been carried out to discover that the fly ash and tea waste 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. Fly ash and tea waste changed partly with cement, in concrete improves the durability factors of concrete as compared with the nominal mix.
2. The water absorption decreases with boom in tea waste and fly ash content.
3. In compressive strength test combination percentage such as 5 % and 10% of fly ash and tea waste replaced with cement changed into satisfactory amongst all other mixtures.
4. In compressive strength test combination percentage such as 5 % and 10% of fly ash and tea waste replaced with cement have 51.12 kN/m^2 and 49.77 kN/m^2.
5. After undergoing mechanical properties, 5% tea waste and fly ash gave the optimum result.

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