PARTIAL REPLACEMENT OF CEMENT WITH FLY ASH IN CONCRETE AND FINE AGGREGATE WITH CRUMB RUBBER

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Abstract: *The focus area in the present situation period is the solid waste operations of used and waste accoutrements . External solid scrap, plastic waste, and tire waste are among the numerous waste accoutrements that should be taken veritably seriously. The purpose of this design is to help in the solid waste operation of tire trash and explore fine aggregate backups as a way to lower structure costs and lower pollution situations in the terrain. There could be a detriment to the terrain from the periodic increase of nearly three crore waste tires. Chancing a different kind of total for structure is the topmost option to break this issue. By diff. the volume of scruple rubber, the proposed work offers an experimental disquisition of the goods of using this solid waste material in concrete. colorful combinations of The advance of concrete can reduce the consumption of natural resources and energy sources and lessen the burden of pollutants on environment. Presently large amounts of fly ash are generated in thermal industries with an important impact on environment and humans. In recent decade, many researchers have used of supplementary Cement material (SCMs) like fly ash (FA), blast furnace slag, silica fume, metakaolin (MK), and rice husk ash (RHA), hypo sludge etc. can, not only enhance the various properties of concrete- both in its fresh and hardened states, but also can contribute to economy in construction costs. This research work describes the feasibility of using the thermal industry waste in concrete production as partial replacement of cement crumb rubber with traditional fine aggregate were evaluated based on workability were conducted according to Indian standards.*

M30 grade concrete with a w/c ratio of 0.45 is used for the job, and fly ash replaces fine aggregate in rages of 0% to 15% with 5% increments by weight of cement, fine aggregate, and coarse aggregate. For each mix, the compressive strengths are measured at 7, 14, and 28 days into the curing process.

1. INTRODUCTION

1.1 GENERAL:

Every year, millions of tires are useless worldwide. Tires are non-biodegradable and having a lengthy lifespan, making waste tire disposal difficult. The conventional approaches to managing waste tires have included land filling, unlawful disposal, and stockpiling; they are all temporary fixes. environmental issues arising from growth and recycling In this instance, tire is an inventive concept or method. Reusing Tyre is the car recycling procedure. tires that have sustained irreversible damage, including punctures, or are too worn to be used on automobiles. Tyre rubber is broken up or made smaller using the cracker mill method, which involves transferring the material between corrugated steel drums that rotate. Through this procedure, a shattered, unevenly shaped particle with vast surface area are produced and this particles are commonly known as crumb rubber.

Fig 1.1: Crumb Rubber

Lightweight concrete composite has gained popularity as a building material in recent years due to its low density, ability to reduce dead load, and affordable handling costs. The qualities of the constituents, the size and mix proportions, the compaction and curing process, and other factors all affect the strength, longevity, and other features of concrete. The use of lightweight concrete allows industrial waste—such as scrap rubber tires, flash, clinkers, etc.—to be disposed of, which would otherwise be problematic. Two of the main industrial wastes that are growing greatly each year are flash and scrap tire rubber. Because of the severe environmental issues, disposing of these organic and inorganic wastes is a big problem. Technology advancements have made it possible for the construction sector to handle these industrial wastes

The last product of coal, which is primarily produced in large amounts by thermal power plants, is fly ash. Because fly ash is a long-lasting and environmentally friendly solution for a range of concrete applications, its use in the construction industry has grown in popularity. Fly ash is most frequently used in the cement industry because it reduces water usage, hydration heat, and cement's long-term strength. Over the past few years, there have been numerous attempts to use recycled tire rubber in composite concrete materials such membrane liners, water proofing systems, and asphalt pavement after minor processing. The leftover tire rubber is recycled into either fine or coarse rubber particles and then mixed with cement-based substance. The concrete that has been rubberized compositely has a lower

.Fly ash, especially class C fly ashes, can be used in place of some Portland cement in construction projects. Concrete's resistance to freeze-thaw damage may be diminished if Class F fly ashes have volatile effects on the entrained air content of the material. Although fly ash can be used in higher dosages in some applications, it typically substitutes up to 30% of the mass of Portland cement. Fly ash has the potential to improve the ultimate strength, chemical resistance, and durability of concrete in certain situations.

The finely split mineral residue left behind after ground or powered coal is burned in a thermal power station to produce electricity is called fly ash. An advantageous mineral to add to concrete is fly ash. It affects a number of concrete's characteristics in both its fresh and hardened states. Additionally, using waste materials in the cement and concrete sector lowers the environmental issues power plants face as well as the cost of producing electricity.

Fig 1.2: Fly Ash

1.2 ECONOMY:

Fly ash is less expensive than cement and fine aggregate, thus we can gain economy by using it in place of those materials in place of crumb rubber. We can lessen the pollution in the environment by employing these items. Rubber can be utilized in construction instead of being wasted because it decomposes slowly. As a result, less pollution enters the environment. Cement is a somewhat expensive material that can be replaced with fly ash from thermal plants.

2. LITERATURE REVIEW

[1]. Abhijitsinh Parmar, Chahil Joshi, Aditi Parmar, Urvish Patel, Avadh Vaghasiya " Use of Crumb Rubber as a Partial Replacement of Fine Aggregate in Conventional concrete", this project involves investigating alternatives to fine aggregate to lower the cost of construction and lessen environmental pollution, as well as helping to solve the problem of tire waste disposal. In accordance with Indian norms, various blends of traditional fine aggregate and crumb rubber were assessed for workability. This study found that the workability of concrete decreases as the quantity of crumb rubber increases.

[2]. M. Priyadharshini, M. Naveen kumar " Experimental study on Crumb Rubber with partial replacement of Fine Aggregate", the proposed work includes an experimental investigation of the effects of using crumb rubber, a solid waste material, in concrete by varying the volume of crumb rubber. Particles in crumb rubber typically have a size range of 0.075mm. Particles with sizes ranging from 0.6 to 0.15 mm are used in the majority of operations that use crumb rubber as an asphalt modifier. The mixture's overall percentage (5%), fine aggregate replacement (20%), and acceptable qualities were demonstrated for real-world applications. The purpose of this research project is to investigate the potential of rubber as a fine aggregate substitute and to reduce global warming by using recycled rubber tires in concrete.

[3]. Pitisukontasukkul "Use of Crumb Rubber to improve thermal and sound properties of precast concrete panel", this study looked into the crumb rubber concrete panel's thermal and acoustic characteristics. A nearby recycling facility provided tire crumb rubber, which was substituted for fine aggregate at percentages of 10%, 20%, and 30%. Investigations were done on properties such noise reduction, heat transfer, conductivity value, thermal resistance, and absorption of sound at various frequencies. The findings showed that the crumb rubber concrete panel was superior to the convectional concrete panel in terms of heat transmission qualities, sound absorption, and weight.

[4]. Safiuddin M, Raman S N and Zain M.F.M " Utilization of quarry waste fine aggregate in concrete mixtures", In both their fresh and hardened states, four different types of concrete mixtures were combined and assessed. All concrete mixes included quarry waste fine aggregate in place of some of the natural sand, with the exception of the control concrete. We investigated the effects of the quarry waste-derived fine aggregate on a number of the concrete's fresh and hardened properties. It was found that the newly mixed concrete's slump and slump flow were enhanced by the addition of fine aggregate made from quarry waste. The unit weight and air content of the concretes did not alter, though. Hardened concretes' compressive strength was decreased when fine aggregate from quarry waste was added. Moreover, the dynamic modulus of elasticity and initial surface absorption showed a minor increase However, the ultrasonic pulse velocity remained unchanged. But the use of fine aggregate made from quarry waste produced the most notable results when silica fume was present. Overall test findings demonstrated that natural sand in concrete compositions can be effectively substituted with fine aggregate made from quarry refuse.

[5]. Abdulhalin Karasin and Murat Dogruyol "An experimental study on strength and durability for utilization of fly ash in concrete mix", this study aims to address the variations in strength and durability of concrete subjected to high sulfate environments in a particular region. The second goal is to talk about the potential for using less cement while building concrete structures. In order to do this, laboratory tests were carried out utilizing 20% fly ash—a waste product—in lieu of cement to examine the compressive strength and sulfate-resisting capacity of concrete. In order to conduct a case study, soil samples from high-sulfate regions in Siirt Province were compared to sulfate standard parametersConcrete deterioration is a danger in certain areas when subsurface water seeps into hardened concrete substructures. According to ASTM C 112, the samples were rested in a Na2SO4 solution for the testing in order to ascertain the variation in strength and durability for concrete subjected to such a hostile environment. This experimental study's findings indicate that the compressive strength of concrete remains unchanged over time when 20% fly ash is used in place of cement.

[6]. Jayesh Pitroda, L B Zala, F S Umoigar " Experimental investigation on partial replacement of cement with fly ash in design mix concrete", the use of supplementary cementitious materials (SCMs) such as fly ash (FA), blast furnace slag, silica fume, metakaolin (MK), rice husk ash (RHA), hypo sludge, etc. has been shown by numerous researchers in recent years to not only improve the various properties of concrete in both its fresh and hardened states, but also to reduce construction costs. The viability of partially replacing cement in the manufacturing of concrete with thermal industry waste is discussed in this research study. As an alternative to conventional concrete, the use of fly ash as an additional cementitious ingredient in concrete formation has been tested. In the range of 0%, 10%, 20%, 30%, and 40% by weight of cement for M-25 and M-40 mix, fly ash has been substituted for cement. Compressive and split strengths of concrete mixtures were created, evaluated, and contrasted with normal concrete. These tests were performed in order to assess the mechanical characteristics of the split strength and compressive strength values for a period of 56 days and 28 days, respectively.

[7]. Satish H Sathawane, Vikrant S Vairagade, Kavita Skene " Combine effect of rice husk ash and fly ash on concrete by 30% cement replacement", In this research, a thorough experimental examination was conducted to examine the effects of gradually increasing the RHA by 2.5% while replacing cement in concrete with a blend of fly ash and rice husk ash. The blend proportion started at 30% FA and 0% RHA. The final percentage was 15% FA and 15% RHA. The destructive tests conducted on hardened concrete included the split tensile strength on a cylinder at 28 days of curing according to IS: 5816 1999, the flexural strength on a beam at 28 days of curing according to IS: 516 1959, and the compressive test on a cube at 7, 14, 28, 56, and 90 days of curing according to IS: 516 1959. This paper presents research on the behavior of concrete made from cement containing varying amounts of FA and RHA. The mechanical properties of the concrete, including its compressive strength, flexural strength, and split tensile strength, are examined. The results of the investigation showed that split tensile strength decreased by 9.58% compared to control concrete at 28 days, flexural strength increased by 4.57% compared to control concrete at 28 days, and compressive strength increased by 30.15% compared to targeted strength and decreased by 8.73%. These results came out to a combined 22.5%. Concrete made using FA and RHA is affordable, environmentally friendly, and has less of an impact on the environment.

[8]. Amit mittal, M B Kaisare, Rajendra Kumar Shetti. " Experimental study on use of fly ash in concrete", Concrete offers many benefits for the environment, which is why fly ash is being used more and more to partially replace cement in concrete. Modern thermal power plants and fly ash collection systems have benefited from technological improvements that have raised fly ash consistency. Studying the effects of partially replacing cement with fly ash has involved conducting a great deal of study on concrete mixes that contain 300 to 500 kg/cum cementitious material at 20%, 30%, 40%, and 50% replacement levels. The present research investigates the impact of fly ash on the subsequent parameters: permeability as determined by the rapid chloride permeability test (RCPT), workability, setting time, density, air content, modulus of elasticity, shrinkage. There are light-colored curves representing compressive strength vs. W/Cm of this investigation. so that concrete mixes of grade M15 to M45 with different percentage of fly ash can be directly designed.

[9]. Alvin Harison, Vikas Srivastava and Arpan Herbert " Effect of fly ash on compressive strength of Portland Pozzolana Cement Concrete", this study is a component of an experimental program designed to investigate the use of fly ash, an unconventional building material, to create novel materials that can meet the demands of the construction industry in a variety of contexts. Fly ash has been substituted for cement in this study in the following weight ranges: 0% (fly ash-free), 10%, 20%, 30%, 40%, 50%, and 60% by weight of cement for M-25 grade of mix with 0.45 water cement ratio. Compressive strength tests of comparisons, and production of concrete mixtures were conducted. Fly ash strength was shown to slightly increase the 20% replacement Portland pozzolana cement (PPC) at 28 and 56 days, from 1.9% to 3.2%, respectively. Additionally, it was noted that PPC might be replaced by up to 30% After 56 days, the fly ash strength is about similar to that of the recommendation concrete. Because the hydration process was delayed, PPC gained strength after 56 days of curing. thus that direct design of concrete mixtures of grades M15 to M45 with varying fly ash percentages is possible.

[10]. Hussein et al. (2013) In his research, fly ash was used in place of OPC in amounts ranging from 5 to 50%. He found that while 10% fly ash had the maximum compressive strength across all age groups, using 15%–30% fly ash greatly boosted the compressive strength at 90 and 180 days.

[11]. Mukherjee et al. (2013) revealed that the compressive strength of the zero slump concrete was higher than that of the workable concrete with fly ash replaced up to 60% in place of the super plasticizer. At every cement replacement level with fly ash, the strength gain over time is greater than that of OPC concrete; the maximum strength gain was seen at 70% replacement at 28 days.

3. METHODOLOGY

3.1.1 Cement:

Cement of Ultratech OPC 53 grade was utilized. Table 3.1 displays cement made from a single source, the qualities of which are examined in a lab.Table 3.1: Properties of cement

SL.No	Cement properties	Results	Value as per [IS: 12269-1987]
1	Specific gravity	3.3	3.1-3.5
2	Normal consistency	33%	26%-33%

3	Fineness	5%	Should not exceed 10%
4	Initial setting time	30 minutes	Should not be less than30 minutes
5	Final setting time	150 minutes	Should not exceed 600 minutes

3.1.2 Fine Aggregate (F.A):

High-quality zone-II fine aggregate was utilized; table 3.2 lists the fine aggregate's physical characteristics and the results of its sieve examination.

3.1.3 Coarse aggregate (C.A):

The gravel utilized in this experiment came from a nearby crusher. There were two size fractions utilized, namely 20mm and 25mm down size ballast coarse aggregate. For ballast coarse aggregate, many laboratory tests were conducted, including bulk density and specific gravity. Table 3.3 presents the findings.

3.1.4 Fly Ash (F.L.A):

High-grade fly ash is utilized. Fly ash of class F is utilized. Table 3.4 lists the properties of fly ash.

3.1.5 Crumb Rubber (C.R):

The rubber industry supplied the crumb rubber. The tire rubber is sent into the cutting device, where it is chopped into tiny fragments. It is produced in various sizes. In this experiment, thirty-grade rubber crumb is used. In table 3.5, the characteristics of crumb rubber are listed...

Table 3.2: Results of sieve analysis and physical properties of fine aggregate

SL.No.	IS sieve size	Cumulative e% passing	Value as per IS 383-1970	
1	4.75mm	99.200	90-100	**F.A belongs to ZoneII**
2	2.36mm	91.800	75-100	
3	1.18mm	76.800	55-90	
4	600µ	35.300	35-59	
5	300µ	8.300	8-30	
6	150µ	2.400	0-10	
7	Specific gravity= 2.64			
8	Bulk density=1710 Kg/m^3			

Table 3.3: Results of sieve analysis and physical properties of coarse aggregate

SL.No.	Size of sieve's	Cumulative % passing finer for ballast aggregate	Value as per IS 383-1970
1	40mm	100	100
2	20mm	82.50	85-100
3	12.5mm	21.80	25-700
4	10mm	7.25	0-20

5	4.75mm	3.06	0-5
6	Specific gravity=2.84		
7	Bulk density=1480 Kg/m^3		

3.1.6 Water:

Both casting and curing of the specimens were done in the current experiment using portable water.

Table3.4: Chemical composition of cement and Fly Ash

Constituents	Cement in %	Fly Ash in %
Silica	21.25	59.94
Aluminum oxide	4.33	22.87
Iron oxide	1.87	4.67
Titanium dioxide	0.13	0.94
Calcium oxide	64.30	3.08
Magnesium oxide	1.81	1.55
Sulfur trioxide	3.70	0.35
Potassium oxide	0.71	2.19
Sodium oxide	0.17	0.62
l.o.i	1.50	3.34

Table3.5: Properties of crumb rubber

Parameters	Unit	Standard Specs
Acetone Extraction	%	5-10
Ash content	%	4 max
Bulk Density	gm/cc	0.30-0.45
Sieve analysis passing through 4mm sieve	%	99
Sieve analysis passing through 2mm sieve	%	1

DESIGN OF CONCRETE MIX

3.2 Concrete Mix Design by IS Method: A mix design technique, mostly based on work conducted at national laboratories and covered by IS 10262-2009, has been released by an Indian standard institute. Both medium strength and high strength can be achieved with this procedure. The IS technique of mix design was used to design the M30 grade of concrete mix.

3.2.1 Mix design procedure for M30 grade concrete:

1) Target mean strength

fck' = fck +1.65 × SD =30 + 1.65 × 5 =38.25N/mm^2

fck'= Target average or mean compressive strength at 28 days after casting
fck= Characteristic compressive strength of concrete at 28 days after casting
S= Standard deviation assumed in N/mm^2 = 5 (as per table-1 of IS 10262-2009)

2) Water / Cement Ratio

Maximum water/cement ratio = 0.45 (from table 5 of IS 456-2000)

3) Water Content selection

For 20mm aggregate Max. water = 186 Liters (from IS 10262:2009)
We are targeting a slump of 100mm; we need to increase water content by 3% for every 25mm above 50mm i.e. increase 6% for 100mm slump.
For 100mm slump estimated water content = 186 + 6 / 120 × 186 = 197.16 liters.

4) Cement content Calculation

Water/cement ratio = 0.45
Cement Content = Water Content/Water Cement Ratio= 197.16 / 0.45
=483.13kg/m^3>450Kg/m^3 Cement taken = 450kg/m^3

5) Proportion of Coarse Aggregate and Fine Aggregate volume content.

From IS 10262-2009 of table 3, coarse aggregate of volume corresponding to 20mm size and fine aggregate of Zone II = 0.62
At present water-cement ratio is 0.45, So there will be change in coarse aggregate volume i.e. 0.62 + 0.01=0.63
Pump able concrete = 0.63 X 0.9= 0.567 (coarse aggregate),
1 - 0.567 = 0.433 (fine aggregate)

6) Estimation of concrete mix calculations for 1m3

The mix calculations per unit volume of concrete shall be as follows:
Volume of cement = (mass of cement/specific gravity of cement) × (1/100)
= (450/3.15)× (1/1000) = 0.142m^3
Volume of water = (mass of cement/specific gravity of cement) × (1/100)

= (197.16/1) × (1/1000) = 0.197.16m^3

Total volume of aggregates = 1 - (0.142 + 0.197.16) = 0.660m^3

Mass of coarse aggregates = 0.6608 × 0.567 × 2.67 × 1000 = 1000.38kg/m^3 Mass of fine aggregates = 0.6608 × 0.433 × 2.65 × 1000 = 758.23kg/m^3

7) Concrete mix proportions

Cement = 450kg/m^3
Water = 197.16 liters
Fine aggregates = 758.26kg/m^3 Coarse aggregate = 1000.38kg/m^3 Water – cement ratio = 0.45

Table 3.6: Proportions of ingredients for M30 grade

Water	Cement	F.A	C.A
197.16	450	758.26	1000.38
0.45	1	1.68	2.22

3.2.2 Procedure for Mix Design

For cube compressive strength testing required ingredients as follows For

0% Concrete block

- For M30 grade concrete

Cement required=0.003375 × 450

=1.52kg (for one cube) For 4 cubes cement required is 6.08 kg.

- For M30 grade concrete

Water required=0.003375 × 197.16

=0.66kg (for one cube) For 4 cubes water required is 2.64 kg.

- For M30 grade concrete

Fine aggregate required=0.003375 × 758.23

=2.55kg (for one cube) For 4 cubes fine aggregate required is 10.2 kg.

- For M30 grade concrete

Coarse aggregate required=0.003375 × 1000.38

=3.376kg (for one cube) For 4 cubes coarse aggregate required is 13.504 kg.

For 5% partial replacement crumb rubber & 15% partial replacement of fly ash in concrete block

- For M30 grade concrete

Cement required= (0.003375 × 450) - (0.15 × 0.003375 × 450)

=1.292kg (for one cube) For 4 cubes cement required is 5.168 kg.

- For M30 grade concrete

Fly ash required=0.15 × 0.003375 × 450

=0.228kg (for one cube) For 4 cubes fly ash required is 1.152 kg.

- For M30 grade concrete

Water required=0.003375 × 197.16

=0.66kg (for one cube) For 4 cubes water required is 2.64 kg.

- For M30 grade concrete

Fine aggregate required= (0.003375 × 758.23) - (0.05 × 0.003375 × 758.23)

=2.42kg (for one cube) For 4 cubes fine aggregate required is 9.68 kg.

- For M30 grade concrete

Crumb rubber required= (0.003375 × 758.23 × 0.05)

=0.1275kg (for one cube) For 4 cubes crumb rubber required is 0.51 kg.

- For M30 grade concrete

Coarse aggregate required= (0.003375 × 1000.38)

=3.376kg (for one cube) For 4 cubes coarse aggregate required is 13.504 kg.

For 10% partial replacement crumb rubber & 15% partial replacement of fly ash in concrete block

- For M30 grade concrete

Cement required= (0.003375 × 450) - (0.15 × 0.003375 × 450)

=1.292kg (for one cube) For 4 cubes cement required is 5.168 kg.

- For M30 grade concrete

Fly ash required=0.15 × 0.003375 × 450

=0.228kg (for one cube)

For 4 cubes fly ash required is 1.152 kg.

- For M30 grade concrete

Water required=0.003375 × 197.16

=0.66kg (for one cube) For 4 cubes water required is 2.64 kg.

- For M30 grade concrete

Fine aggregate required= (0.003375 × 758.23) - (0.1 × 0.003375 × 758.23)

=2.295 (for one cube) For 4 cubes fine aggregate required is 9.18 kg.

- For M30 grade concrete

Crumb rubber required= (0.003375 × 758.23 × 0.1)

=0.255kg (for one cube) For 4 cubes crumb rubber required is 1.02 kg.

- For M30 grade concrete

Coarse aggregate required= (0.003375 × 1000.38)

=3.376kg (for one cube) For 4 cubes coarse aggregate required is 13.504 kg.

For 15% partial replacement crumb rubber & 15% partial replacement of fly ash in concrete block

- For M30 grade concrete

Cement required= (0.003375 × 450) - (0.15 × 0.003375 × 450)

=1.292kg (for one cube) For 4 cubes cement required is 5.168 kg.

- For M30 grade concrete

Fly ash required=0.15 × 0.003375 × 450

=0.228kg (for one cube) For 4 cubes fly ash required is 1.152 kg.

- For M30 grade concrete

Water required=0.003375 × 197.16

=0.66kg (for one cube) For 4 cubes water required is 2.64 kg.

- For M30 grade concrete

Fine aggregate required= (0.003375 × 758.23) - (0.15 × 0.003375 × 758.23)

=2.1675kg (for one cube) For 4 cubes fine aggregate required is 8.67 kg.

- For M30 grade concrete

Crumb rubber required= (0.003375 × 758.23 × 0.15)

=0.3825kg (for one cube) For 4 cubes crumb rubber required is 1.53 kg.

- For M30 grade concrete

Coarse aggregate required= (0.003375 × 1000.38)

=3.376kg (for one cube) For 4 cubes coarse aggregate required is 13.504 kg.

Table 3.9: Results of slump test

% Replacement of cement with fly ash and fine aggregate with crumb rubber	**Slump value for M30 grade concrete in mm**
0%	20
5%	10
10%	5
15%	4

3.3 Calculation of quantity of materials required:

Table 3.10 below displays the computed mineral quantities for M30 grade concrete with fly ash and crumb rubber substitution at 0%, 5%, 10%, and 15% by weight of cement.

Table 3.10: Quantity of materials required for M30 grade of concrete for fly ash and crumb rubber replacement

Grade of concrete	**specimen**	**% age of replacement**	**Cement in Kg**	**Fly ash in Kg**	**F.A in Kg**	**Crumb rubber in Kg**	**C.A in Kg**	**water**
M30	9cubes	0%	6.08	0	10.2	0	13.504	2.64
	9cubes	5%	5.168	1.152	9.68	0.51	13.504	2.64
	9cubes	10%	5.168	1.152	9.18	1.02	13.504	2.64
	9cubes	15%	5.168	1.152	8.67	1.53	13.504	2.64

4. RESULTS AND DISCUSSIONS

.1 Compressive strength

According to the results of the compressive strength test for concrete of the M30 grade, the strength of the concrete decreased after fly ash and crumb rubber were added in amounts of up to 5%. The best percentage of fly ash and crumb rubber to use in M30 grade concrete is discovered to be 5%, which results in the highest compressive strength.

Table 4.1 displays the M30 grade compressive strength findings for varying fly ash and crumb rubber % dosages. Figure 4.1 also displays the same results.

Table 4.1: Test results of compressive strength

Mix	7Days "Mpa"		14Days "Mpa"		28Days "Mpa"	
	3Cubes	Avg. Value	3Cubes	Avg. Value	3Cubes	Avg. Value
FA-0% & CR 0%	20.1	21	26.01	26	32	31.92
	21.0		25.9		32.7	
	22		26.3		31.05	
FA-5% & CR 5%	13.9	13.6	17.2	16.8	24.05	24.3
	13.5		16.3		24.8	
	13.5		16.95		24.19	
FA-10% & CR 10%	8.75	8.7	12.35	12.6	16.02	16.2
	8.4		12.6		16.2	
	8.9		12.9		16.5	
FA-15% & CR 15%	6.2	6.3	7.6	7.7	9.8	10.0
	6.3		7.9		10.3	
	6.45		7.7		10	

.2 Specimens tests for replacements in M30 grade concrete

- • After 7 days of curing for 5% of replacement, it was discovered that the compressive strength of M30 grade concrete had decreased by 35.24%.
- • After 14 days of curing for 5% of replacement, it was discovered that the M30 grade concrete had a 35.38% reduction in compressive strength.
- • After 28 days of curing for 5% of replacement, it was discovered that the compressive strength of M30 grade concrete had decreased by 22.0%.
- • After 7 days of curing for 10% of replacement, it was discovered that the M30 grade concrete's compressive strength had decreased by 58.57%.
- It is found that there was 51.57% decrement in compressive strength for M30 grade concrete at 14 days of curing for 10% of replacement.

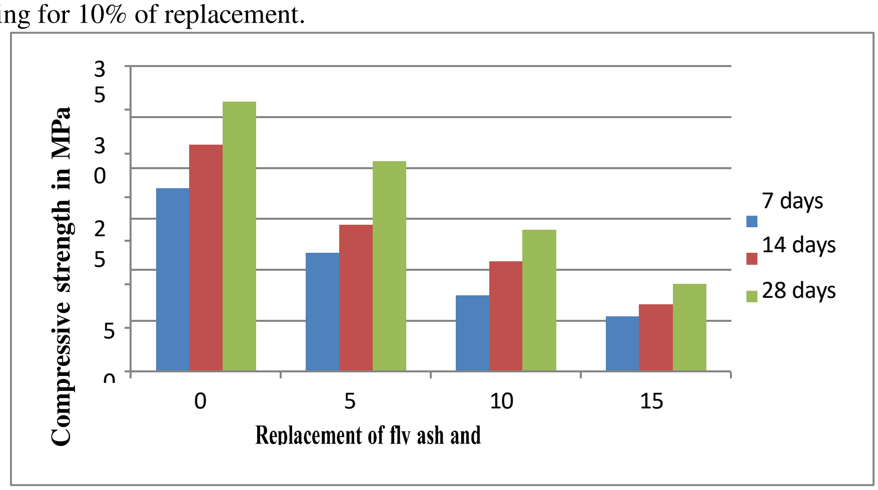

Fig 4.1 Compressive strength of M30 grade concrete

- After 28 days of curing for 10% of replacement, it was discovered that the M30 grade concrete's compressive strength had decreased by 60.19%.
- After 7 days of curing for 15% of replacement, it was discovered that the compressive strength of M30 grade concrete had decreased by 70.0%.
- After 14 days of curing for 15% of replacement, it was discovered that the compressive strength of M30 grade concrete had decreased by 70.38%.
- After 28 days of curing for 15% of replacement, it was discovered that the compressive strength of M30 grade concrete had decreased by 67.64%.
- A substitute concrete with a 5% replacement could be utilized instead of the concrete used in the building of secondary structural components.
- • There won't be any steel corrosion if this concrete is utilized in RCC.
- • Because of a rise in water demand, the workability of concrete reduced as the amount of crumb rubber increased..
- The mechanical qualities of concrete were significantly reduced when crumb rubber was added, but the durability was boosted. The impact of substituting crumb rubber for the mixture is greater than the impact of substituting fine aggregate.
- By pretreating crumb rubber with modifiers, the detrimental effects of crumb rubber on mechanical strength could be reduced and even eliminated.
- As the amount of rubber in concrete increases, its density drops.
- Rubberized concrete's low density lowers the structure's dead load and self weight.
- Adding fly ash in place of cement is far more cost-effective.
- The cost study shows that a percentage of cement reduction lowers the construction cost, but strength also drops.
- The use of fly ash in concrete can save coal and thermal industry disposal expenses and generate a greener concrete for construction. In extremely tiny amounts, adding fly ash in place of cement reduces the density.
- The amended concrete with crap rubber had much higher toughness than the control mix. Rubberized concrete can absorb more energy when loaded since rubber is stretchy.

Fig 4.2: Performing Compression test for 10% replacement concrete cube

4. CONCLUSION

- For replacing cement by fly ash and fine aggregate with crumb rubber the optimum value is 5%.
- The workability of concrete reduced with increase in replacement of cement by fly ash and fine aggregate by crumb rubber.
- The compressive strength for 28 days of testing after curing is 24.1MPa which is maximum at 5% of dosage.
- The dosage of 5% which got maximum strength is used for secondary structural components construction

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