International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL STUDY OF CONCRETE USING SEASHELL AND FLYASH

S. GOVINDHAN[1], S. THAMIZHA[2]

[1]*Head of the Department, Department of Civil Engineering, Sembodai R.V Engineering College, Sembodai, Nagappattinam, Tamilnadu-614820*
[2]*PG Scholar, M.E- Structural Engineering, Department of Civil Engineering, Sembodai R.V Engineering College, Sembodai, Nagappattinam, Tamilnadu-614820*

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Abstract - *In developing countries where concrete is widely used, the high and steadily increasing cost of concrete has made construction very expensive. This coupled with the deleterious effect of concrete production on the environment has led to studies on various materials which could be used as partial replacement for coarse aggregate and cement. This project is experimented to reduce the cost of concrete. In this research work experiments have been conducted with collection of materials required and the data required for mix design are obtained by sieve analysis and specific gravity test. Sieve analysis is carried out from various fine aggregates (FA) and coarse aggregates (CA) samples and the sample which suits the requirement is selected. Specific gravity tests are carried out for fine and coarse aggregate. In this project, cement is replaced with fly ash of about 5% along with the partial replacement of coarse aggregate with seashell. The coarse aggregate is replaced with 10%, 20%, and 30% by seashell. Further coarse aggregate is replaced with seashell of about 10% along with the partial replacement of cement with fly ash. The cement is replaced with 5%, 10%, and 15% by fly ash. The design mix used to execute this project is M20 grade concrete. This M20 grade concrete is designed as per Indian Standard Code for both the conventional concrete and seashell concrete. The water cement ratio is maintained for this mix design is 0.45. Preliminary test comprising sieve analysis, specific gravity, consistency, setting time and soundness were conducted .workability and strength test were also carried out on fresh and hardened concrete made from the study material. The strength obtained from seashell concrete is compared with the conventional concrete. Finally to compare the strength of both normal concrete and conventional concrete.*

Key Words: Cost of Concrete, Sea Shell, Fly Ash, Fine Aggregate, Coarse Aggregate, M20 Grade, Compressive strength.

1. INTRODUCTION

1.1 GENERAL

As concrete is ubiquitous and its history can be traced to ancient Egypt and Rome, it is often falsely perceived as a "simple" material. Actually, the microstructure of concrete tends to be highly complex. Moreover, the structure and the properties of this composite material can change over time. Most modern concrete structures are reinforced with steel, since concrete itself displays relatively low strength when loaded in tension. While steel reinforced concrete is obviously a widely used, cost effective construction material, degradation of such structures has become a major problem in many parts of the world. The basic constituents of concrete are cement, water and aggregate (and selected additives). Cement is produced by heating limestone and clay to very high temperatures in a rotating kiln. Cement is produced by grinding the resulting clinker to a fine powder. Water reacts chemically with cement to form the cement paste, which essentially acts as the "glue" (or binder) holding the aggregate together. The reaction is an exothermic hydration reaction. The water cement ratio is an important variable that needs to be "optimized". High ratios produce relatively porous concrete of low strength, whereas too low a ratio will tend to make the mix unworkable. Aggregates are usually described as inert "filler" material of either the fine (sand) or coarse (stone) variety. Aggregate tends to represent a relatively high volume percentage of concrete, to minimize costs of the material. Recent investigation of Indian sea shells has indicated greater scope for their utilization as a construction material. Greater utilization of sea shells will lead to not only saving such construction material but also assists in solving the problem of disposal of this waste product.

1.2 FLY ASH

Fly ash also known as “pulverized fuel ash” in the United Kingdom, is one of the coal combustion products, and is composed of the fine particles that are driven out of the boiler with the flue gases. Ash that falls in the bottom of the boiler is called bottom ash. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment before the flue gases reach the chimneys of coal-fired powdered plant and together with bottom ash removed from the bottom of the boiler is known as coal ash. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amount of silicon dioxide (SiO_2) (both amorphous and crystalline), aluminium oxide (Al_2O_3) and calcium oxide (CaO), the main mineral components in coal-bearing rock strata.

Constituents depend upon the specific coal bed makeup, but may include one or more of the following elements or substance found in trace concentrations (up to 100 ppm) arsenic, beryllium, boron, cadmium, chromium, hexavalent chromium, cobalt, lead, manganese, mercury, molybdenum, selenium, strontium, thallium and vanadium along with very small concentrations of dioxins and PAH compounds.

In the past, fly ash was generally released into the atmosphere, but air pollution control standards now require that it can be captured prior to release by fitting pollution control equipment. In the US, fly ash is generally stored at coal power plants or placed in landfills. About 43% is recycled, often used as a pozzolan to produce hydraulic cement or hydraulic plaster and a replacement and partial replacement for Portland cement in concrete production. Pozzolans ensure the setting of concrete and plaster and provide concrete with more protection from wet condition and chemicals attack.

After a long regulatory process, the EPA published a final ruling in December 2014, which establishes that coal fly ash does not have to be classified as a hazardous waste under the Resource Conservation and Recovery Act (RCRA).

In the case that fly or bottom ash is not produced from coal, for example when solid waste is used to produce electricity in an incinerator, this kind of ash may contain higher levels of contaminants than coal ash. In the case the ash produced is often classified as hazardous waste.

Fig -1: Fly Ash

Fly ash material solidifies while suspended in the exhaust gases and is collected by electrostatic precipitators or filters bags. Since the particles solidify rapidly while suspended in the exhaust gases, fly ash particles are generally spherical in shape and range in size from 0.5 μm to 300 μm. The major consequence of the rapid cooling is that few minerals have time to crystalize, and that mainly amorphous, quenched glass remains. Nevertheless, some refractory phases in the pulverized coal do not melt (entirely), and remain crystalline. In consequence, fly ash id a heterogeneous material. SiO_2, Al_2O_3, Fe_2O_3 and occasionally CaO are the main chemical compound present in fly ashes. The mineralogy of fly ashes is very diverse. The main phases encountered are a glass phases, together with quartz, mullite and the iron oxides hematite, magnetite and other phases often identified are cristobalite, anhydrite, free lime, periclase, calcite, sylvite, halite, Portlandite, rutile, and anatase. The Ca^- bearing minerals anorthite, gehlenite, akermanite, and various calcium silicates and calcium aluminates identical to those found in Portland cement can be identified in Ca^- rich fly ashes. The mercury content can reach 1ppm, but is generally included in the range 0.01 – 1 ppm for bituminous coal. The concentrations of other trace elements vary as well according to the kind of coal combusted to from it. In fact, in the case of bituminous coal, with the notable exception of boron, trace element concentrations are generally similar to trace elemeconcentrations in unpolluted soils.

1.3 SEA SHELL

A sea shell also known simply as a shell, is a hard, protective outer layer created by an animal that lives in the sea. The shell is part of the body of the animal. Empty sea shells are often found washed up on beaches by beachcombers. The shells are empty because the animal has died and the soft parts have been eaten by other animal or have rotted out.. The term sea shell usually refers to the exoskeleton of an invertebrate (an animal without a backbone). Most sea shell that are found on beaches are the shells or marine mollusks, partly because many of these shells endure better than other seashells.

Apart from mollusk seashell, other shells that can be found on beaches are those of barnacles, horseshoe crabs and brachiopods. Marine annelid worms in the family serpulidae create shells which are tubes made of calcium carbonate that are cemented onto other surfaces. The shells of sea urchins are called tests, and the moulted shells of crabs and lobsters are called exuviae. While most sea shells are external, some cephalopods have internal shells. Seashells have been used for many different purposes throughout history and pre-history. However, seashells are not the only kind of shells in various habitats, there are shells from freshwater animal such as freshwater mussels and freshwater snail, and shells of land snails.

Fig -2: Sea Shell

Terminology

When the word “seashells” refers only to the shells on marine mollusk, then studying seashells is part of conchology. Conchologists or serious collectors who have a scientific bias are in general careful not to disturb living populations and habitats; even though they may a few live animal, most responsible collectors do not often over-collect or otherwise disturb ecosystems.

The study of the entire Mollusca animal (as well as the shell) is known as malacology; a person who studies mollusks is known as a malacologist.

Occurrence

Sea shells are commonly found on beach drift, which is natural detritus deposited along strandlines on beaches by the waves and the tides. Shells are very often washed up onto a beach empty and clean, the animal having already died, and the soft parts having rotted away or having been eaten by either predators or scavengers.

Empty sea shells often picked up by beachcombers. However majority of seashells which are offered for sale commercially have been collected alive (often on bulk) and then killed and cleaned, specifically for the commercial trade. This type of large scale exploitation can sometimes have a strong negative impact on local ecosystems, and sometime can significantly reduce the distribution of rare species.

1.4 SCOPE

The scope of the work includes the studies on the following aspects of cement mortar and cement concrete.

- Evaluation of fly ash and sea shell based on cement mortar in brick masonry construction.
- Partial replacement of cement and coarse aggregate by fly ash and seashell respectively.
- In this project, cement is replaced with fly ash of about 5% along with the partial replacement of coarse aggregate with seashell. The coarse aggregate is replaced with 10%, 20%, and 30% by seashell.
- Further coarse aggregate is replaced with seashell of about 10% along with the partial replacement of cement with fly ash. The cement is replaced with 5%, 10%, and 15% by fly ash.

Cement sand mortar joint thickness of 10 and 15mm.

1.5 OBJECTIVES

- Fly ash and seashell has also gained popularity in the building industry for use as a fill material.
- Used fly ash in place of cement and seashell in place of coarse aggregate during concrete construction.
- Fly ash and seashell can also use as a building material formed into blocks.
- It is widely used in the sand blasting industry and it has been used in the manufacture of abrasive tools.

Fly ash and seashell is used as an abrasive media to remove rust, old coating and other impurities in dry abrasive blasting due to its high hardness.

2. MATERIAL, METHODOLOGY AND TESTING

2.1 MATERIALS

2.1.1 CEMENT

Cement is a well-known building material has occupied an indispensable place in construction works. Cement is an extremely ground material having adhesive ingredients. It is obtained by burning together, in a definite proportion, a mixture of ingredients. It is obtained by burning together in a definite proportion, a mixture of naturally occurring argillaceous and calcareous, cooled and ground to the required the required fineness to produce material known as cement.

In general cement is a binder a substance that sets and hardens independently and can bind other materials together. The word `cement` is used to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder.

Ordinary Portland Cement was used for casing concrete. This cement is the most widely used one in the construction industry in India. The Ordinary Portland Cement of 53 grade conforming to IS: 12269- 1987 is been used. The specific gravity of cement is 3.15. The initial time and final setting time were found to be 30min and 600min respectively.

Table -1: Properties Cement

S.no	Property	Test result
1	Normal consistency	28%
2	Specific gravity	3.15
3	Initial setting time	30min
4	Final setting time	600min

2.1.2 AGGREGATE

These are chemically inert, solid bodies held together by the cement. Aggregates come in various shapes, sizes and material ranging from fine particle of sand to large rocks. Because cement is the most expensive ingredients in making concrete, it is desirable to minimize the amount of cement used 70%-80% of the volume of concrete is aggregate keeping the cost of the concrete low. Generally flat and elongated particles are avoided or are limited to about 15% by weight of the total aggregate. Unit weight measures the volume that graded aggregate and the voids between them will occupy in concrete. The void content between particles affects the amount of cement paste required for the mix.

Selecting equal sizes of well graded aggregates reduce the void content. Absorption and surface moisture of aggregate are measured while selecting aggregate because the internal structure of aggregate is made up of solid material and voids that may affect the water cement ratio.

2.1.2.1 FINE AGGREGATE

Fine aggregate used for concrete should be properly graded to give minimum void ratio and be free from deleterious material like clay, slit content and chloride contamination etc. Hence grading of fine aggregate is relatively different from that in normal concrete. Grading of fine aggregate should be such that it does not cause increase in water demand for the concrete and should give maximum voids so that the fine cementitious particles to fill the voids. Hence it is desirable to use the coarser variety of fine aggregate having a high fineness modulus for making workable and strong concrete. The fine aggregate having are taken in saturated surface dry condition.

2.1.2.2 COARSE AGGREGATE

Local aggregate comprising 20mm, and less than 20mm coarse aggregates in saturated surface dry condition, were used. The coarse aggregates were crushed granite type aggregates. Coarse aggregate were obtained in crushed from majority of the particles were of granite type. The quality is tested using impact test.

2.1.2.3 FLY ASH

Fly ash is a finely divided residue resulting from the combustion of powdered coal and transported by the flue gases and collected by the electrostatic precipitator. In recent time the importance and use of fly ash in concrete has grown so much that it has almost become the common ingredient in concrete particularly for making high strength and high performance concrete. Specific gravity of fly ash is 2.2

Table -2: Chemical composition and classification of fly ash

Component	Bituminous	Subbituminous	Lignite
SiO_2	20-60	40-60	15-40
Al_2O_3	5-35	20-30	20-25
Fe_2O_3	10-40	4-10	4-15
CaO	1-12	5-30	15-40
LOI	0-15	0-3	0-5

2.1.2.4 SEA SHELL

Seashell is a waste obtained near the seashore area as the result of disintegration of dead animals. Seashell consists of three layers outer, intermediate and inner layer .Outer layer is made up of calcite material whereas inner layer is otherwise known as nacre which is made up of calcium carbonate. Since 95% of calcium carbonate present in seashell, it has the strength nearly equal to coarse aggregate.

2.1.4 WATER

It is the key ingredient mixed with cement, forms a paste that binds the aggregate together. The water causes the hardening of concrete through a process called hydration. Hydration is a chemical reaction in which the major compound in cement form chemical bonds with molecules because the water to cement ratio is the most critical factor in the design of perfect concrete. Excess of water reduces strength and workability of concrete.

Portable tap water available in the plant conforming to the requirements of IS456-2000 was used for casting concrete & curing the specimens.

2.2 METHODOLOGY FLOW CHART

Chart -1: Flow chart

2.3 TESTS

2.3.1 TESTS ON FINE AGGREGATE

In this project, the river sand, which was available in saturated surface dry condition was used as fine aggregate and the following tests were carried out on sand as per IS:2386-1968(iii):

- Sieve analysis
- Density
- Specific gravity
- Water absorption

2.3.2 TESTS ON COARSE AGGREGATE

The coarse aggregate are tested for the following

- Impact value
- Sieve analysis
- Density
- Specific gravity
- Water absorption

2.3.3 TESTS ON SEA SHELL

The coarse aggregate are tested for the following

- Impact value
- Sieve analysis
- Density
- Specific gravity
- Water absorption

SIEVE ANALYSIS TEST

Sieve analysis helps to determine the particle size distribution of the coarse and fine aggregate. This is done by sieving the aggregates as per IS: 2386 (part I) 1963. In this we use different sieves as standardized by the IS code and then pass aggregate through them and collect different sized particles left over different sieves.

DENSITY

The density of both fresh and hardened concrete is of interest to the parties involved for numerous reasons including its effect on durability, strength and resistance to permeability. Hardened concrete density is determined either by simple dimensional check followed by weighing and calculation or by weight in air water buoyancy method.

SPECIFIC GRAVITY TEST

Purpose

This test is performed to determined specific gravity of material by using a pycnometer. Specific gravity is the ratio of the mass of unit volume of material at stated temperature to the mass of same volume of gas free distilled water at the stated temperature.

Standard reference

IS: 2720 (part 3) 1980, first revision – standard test for specific gravity of material is used as reference for testing.

Significance

The specific gravity of a material is used in the phase relationship of air water and solid in the given volume of material.

Specific gravity $= \frac{W_0}{[W_0+(Wa-Wb)]}$

W_0 = weight of sample material, g=Wps-Wp

WA = weight of pycnometer filled with water

WB = weight of pycnometer filled with water and material.

WATER ABSORPTION

This process is particularly important on concrete for durability. Absorption capacity is a measure of porosity of a material. It is also used as a correlation factor in determination of free moisture by oven dry method. The absorption capacity is determined by finding the weight of surface dry sample after it has been soaked for 24 hours and again finding the weight after sample has been dried in an oven. The difference in weight expressed as a percentage of dry sample weight.

Water absorption = (increased weight in kg/weight of specimen in kg) ×100

3. TEST RESULTS

3.1 SPECIFIC GRAVITY TEST

3.1.1 SEA SHELL

Instrument used = Pycnometer

Material used = Sea shell

Observations:

1. Weight of pycnometer (W1) = 630 g
2. Weight of pycnometer + Sea Shell (W2) = 1105 g
3. Weight of pycnometer + full water + Sea Shell (W3) = 1845 g
4. Weight of pycnometer + full water (W4) = 1560 g

Specific gravity $= \frac{W2-W1}{[(W2-W1)-(W3-W4)]}$

$= \frac{1330-630}{[(1330-630)-(2070-1560)]}$

G = 3.68

3.1.2 FINE AGGREGATE

Instrument used = Pycnometer

Material used = Fine aggregate

Observations:

1. Weight of pycnometer (W1) = 630 g
2. Weight of pycnometer + Fine aggregate (W2) = 950 g
3. Weight of pycnometer + full water + Fine aggregate (W3) = 1560 g
4. Weight of pycnometer + full water (W4) = 1360 g

Specific gravity $= \frac{W2-W1}{[(W2-W1)-(W3-W4)]}$

$= \frac{950-630}{[(950-630)-(1560-1360)]}$

G = 2.68

3.1.3 COARSE AGGREGATE

Instrument used = Pycnometer

Material used = Coarse aggregate

Observations:

1. Weight of pycnometer (W1) = 630 g
2. Weight of pycnometer + Coarse aggregate (W2) = 1010 g
3. Weight of pycnometer + fullwater+Coarse aggregate (W3) = 1640 g
4. Weight of pycnometer + full water (W4) = 1395 g

Specific gravity $= \frac{W2-W1}{[(W2-W1)-(W3-W4)]}$

$= \frac{1010-630}{[(1010-630)-(1640-1395)]}$

G = 2.80

3.1.4 CEMENT

Instrument used = Pycnometer

Material used = Cement

Observations:

1. Weight of pycnometer (W1) = 630 g
2. Weight of pycnometer + Cement (W2) = 1080 g
3. Weight of pycnometer + kerosene + Cement (W3) = 1600 g
4. Weight of pycnometer + kerosene (W4) = 1263 g
5. Specific gravity of kerosene = 0.79

Specific gravity $= \left\{\frac{W2-W1}{[(W2-W1)-(W3-W4)]}\right\} \times 0.79$

$= \left\{\frac{1330-630}{[(1330-630)-(2070-1560)]}\right\} \times 0.79$

G = 3.15

3.1.5 FLY ASH

Instrument used = Pycnometer

Material used = Fly ash

Observations:

1. Weight of pycnometer (W1) = 630 g
2. Weight of pycnometer + Fly ash (W2) = 1467 g
3. Weight of pycnometer + kerosene + Fly ash (W3) = 2097 g
4. Weight of pycnometer + kerosene (W4) = 1560 g
5. Specific gravity of kerosene = 0.79

Specific gravity $= \left\{\frac{W2-W1}{[(W2-W1)-(W3-W4)]}\right\} \times 0.79$

$= \left\{\frac{1467-630}{[(1467-630)-(2097-1560)]}\right\} \times 0.79$

G = 2.2

3.2 SIEVE ANALYSIS

3.2.1 SEA SHELL

Instrument used = Sieve

Material used = Sea Shell

Weight of material = 2000 g

Table -3: Sieve analysis on Sea Shell

IS Sieve Size	Weight retained (g)	% of weight retained	Cumulative % retained	% of passing
125	1060	53	53	47
100	940	47	100	0
75	0	0	100	0
50	0	0	100	0

40	0	0	100	0
25	0	0	100	0
12.5	0	0	100	0

Fineness modulus = 753/100

= 7.53

3.2.2 FINE AGGREGATE

Instrument used = Sieve

Material used = Fine aggregate

Weight of material = 1000 g

Table -4: Sieve analysis on Fine aggregate

IS Sieve Size	Weight retained (g)	% of weight retained	Cumulative % retained	% of passing
4.75 mm	0.01	10	1	99
2.36 mm	0.06	70	7	93
1.18 mm	0.36	430	43	57
600 µ	0.27	700	70	30
300 µ	0.19	890	89	11
150 µ	0.09	980	98	2
Pan	0.02	1000	100	0

Fineness modulus = 408/100

= 4.08

3.2.3 COARSE AGGREGATE

Instrument used = Sieve

Material used = coarse aggregate

Weight of material = 2000 g

Table -5: Sieve analysis on Coarse aggregate

IS Sieve Size	Weight retained (g)	% of weight retained	Cumulative % retained	% of passing
125	**0**	**100**	**0**	**100**
100	0	100	0	100
75	0	100	0	100
50	0	100	0	100
40	0	100	0	100
25	730	63.5	36.5	63.5
12.5	2000	0	100	0
10	2000	0	100	0

Fineness modulus = 236.5 / 100

= 2.365

3.3 WATER ABSORPTION TEST

3.3.1 FINE AGGREGATE

Table -6: water absorption of fine aggregates

Sample no.	Weight of oven dried specimen (W1) Kg	Weight of saturated specimen (W2) Kg	Weight of absorbed water W3=W2-W1 Kg	% of water absorption =(W3/W1)×100
1	0.995	1.01	0.015	1.5

3.3.2 COARSE AGGREGATE

Table -7: water absorption of Coarse aggregates

Sample no.	Weight of oven dried specimen (W1)Kg	Weight of saturated specimen (W2)Kg	Weight of absorbed water W3=W2-(W1)Kg	% of water absorption =(W3/W1)×100
1	1.166	1.172	0.006	0.51

3.3.3 SEA SHELL

Table -8: Water absorption of Sea Shell

Sample no.	Weight of oven dried specimen (W1) Kg	Weight of saturated specimen (W2) Kg	Weight of absorbed water W3=W2-W1 Kg	% of water absorption =(W3/W1) ×100
1	0.1	0.103	0.003	3

3.4 COMPRESSIVE STRENGHT TEST ON CONCRETE CUBE (M20)

FORMULA USED

Compressive strength = (load/area) N/mm^2

3.4.1 Compressive strength for 7 days

Table -9: Compressive strength after 7 days

TRIAL	CONCRETE TRIAL	LOAD IN (KN)	COMPRESSION STRENGTH (N / mm^2)	AVERAGE COMPRESSION STRENGTH (N / mm^2)
1	Conventional concrete	467 470 467	20.77 20.89 20.74	20.80
2	5% fly ash & 10%	470	20.88	20.92

	seashell	471 471	20.94 20.94	
3	5% fly ash & 20% seashell	480 482 485	21.32 21.40 21.54	21.42
4	5% fly ash & 30% seashell	513 522 513	22.80 23.18 22.80	22.92
5	10% seashell & 5% fly ash	482 485 484	21.40 21.54 21.50	22.48
6	10% seashell & 10% fly ash	461 462 465	20.48 20.54 20.66	20.56
7	10% seashell & 15% fly ash	440 438 442	19.48 19.54 19.66	19.56

3.4.2 Compressive strength for 28 days

Table -10: Compressive strength after 28 days

TRIAL	CONCRETE TRIAL	LOAD IN (KN)	COMPRESSION STRENGTH (N / mm^2)	AVERAGE COMPRESSION STRENGTH (N / mm^2)
1	Conventional concrete	628 644 649	27.92 28.64 28.86	28.47
2	5% fly ash & 10% seashell	663 665 686	29.46 29.54 30.57	29.83
3	5% fly ash & 20% seashell	739 746 739	32.84 33.15 32.84	32.94
4	5% fly ash & 30% seashell	768 779 764	34.15 34.64 33.96	34.25
5	10% seashell & 5% fly ash	753 768 748	33.46 34.15 33.24	33.62
6	10% seashell & 10% fly ash	663 665 655	29.46 29.54 29.12	29.37
7	10% seashell & 15% fly ash	611 640 617	27.15 28.46 27.40	27.64

3.4.3 RESULTS FOR COMPRESSION TEST

Table -11: Compression test results After 7 & 28 days

Mix	7 Days	28Days
Conventional concrete	20.80	28.47
5% fly ash & 10% seashell	20.92	29.83
5% fly ash & 20% seashell	21.42	32.94
5% fly ash & 30% seashell	22.92	34.25
10% seashell & 5% fly ash	22.48	33.62
10% seashell & 10% fly ash	20.56	29.37
10% seashell & 15% fly ash	19.56	27.64

3.4.4 COMPRESSION STRENGTH AFTER 7 DAYS 7& 28 DAYS

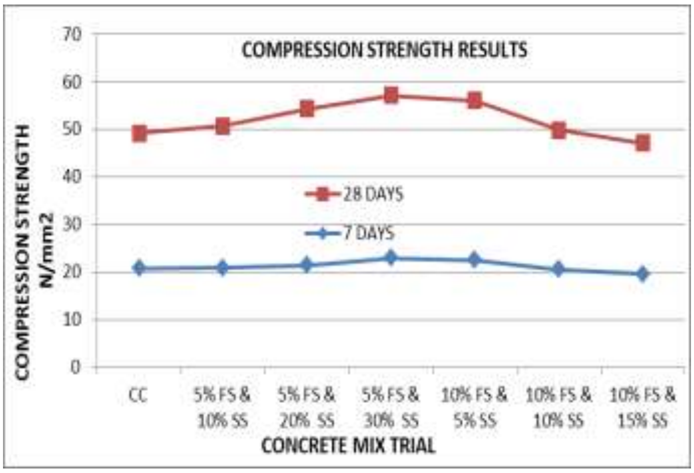

Chart-2: Compression strength results

4. CONCLUSION

In this project, cement is partially replaced with fly ash of about 5% along with the partial replacement of coarse aggregate with seashell. The coarse aggregate is partially replaced with 10%, 20%, and 30% by seashell. Further coarse aggregate is partially replaced with seashell of about 10% along with the partial replacement of cement with fly ash. The cement is replaced with 5%, 10%, and 15% by fly ash. The design mix used to execute this project is M20 grade concrete. This M20 grade concrete is designed as per Indian Standard Code for both the conventional concrete and seashell concrete. So we conclude that the cement and coarse aggregate replaced with fly ash at 5% and sea shell at 30% in concrete is suitable for construction. Moreover it reduces the construction cost by reducing the cost of cement and coarse aggregate and it also reduces the environmental pollution due to fly ash and seashell.

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