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COMPARITIVE STUDY ON STRENGTH PROPERTIES OF CONCRETE DUE TO PARTIAL REPLACEMENT OF CEMENT BY ARECANUT HUSK ASH AND FLY ASH

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Abstract - *The primary objective of the project is to investigate the strength behavior of concrete due to the replacement of cement by arecanut husk ash and compare the results with that by replacement by fly ash. Basic material testing are carried out and the mix design for M30 grade is made. Strength properties like compressive, split tensile and flexure are carried. The mixes are prepared with five percentages (0, 5,10,15 and 20) of arecanut husk ash and fly ash as partial replacement of Portland cement. The results are compared and the conclusions are drawn.*

***Key Words*: Arecanut husk ash, Fly ash, M30, Cement replacement.**

1.INTRODUCTION

Concrete is one of the regularly used and durable building material. Concrete is a composite material consisting mixture of cement, fine aggregate, coarse aggregate, water and chemical compounds if required. Aggregate are the most important constituents in concrete. In concrete nearly 75-80% of the volume is occupied by aggregates, aggregates gives adequate strength and stiffness to the concrete. Cement is used as a binding material, cement reacts chemically with the water to form a hard matrix which binds all the materials together. Generally OPC [Ordinary Portland cement] cement is the most commonly used type as a building material around the world.

As we know at present India is one of the leading developing countries that have undergone rapid industrialisation. At present India is among first ten industrialised countries of the world. After the steel and power, cement production in India is recognised as the one of the most important industries. The consumption pattern of the cement often indicates the economic growth of the any country. India is the second largest producer of cement after China.OPC [Ordinary Portland cement] is the regularly utilised cement in common as a structural material around the world because of its high compressive strength. Although the raw material for making OPC are readily available in most countries, search for new and alternative is important for conservation of natural resources, in the manufacturing cost and environmental burden as OPC production is still causes 7-10% of global CO_2 emission.

The increase in demand of cement increases the number of factories in recent years. The cement industries has been recognised to be playing vital role in the imbalance of the environment and environmental pollution.

Another major industry in discussion is the power production using coal. After the production there is lot of production of coal ash which is has the capacity to fly and called as fly slag. The disposal of fly slag is a major problem. Large quantity of fly slag is a matter of concern for the disposal.

The arecanut is the seed of areca palm and is cultivated more in India. India is ranked number one the production of arecanut in the world. Major states growing areca nut are Karnataka, Kerala, Assam, Tamil Nadu and West Bengal. Karnataka tops in the list in arecanut growing state in India. Before using the nut, the husk is removed and the disposal of this husk is a problem. The production rate of arecanut is increasing every year leading to increase in the disposal. In some areas it is used as a alternative for fire wood.

In this project arecanut husk ash and fly ash as used for fractional substitution of cement in all concrete mix. The primary objective of the project is to investigate the strength behaviour of concrete due to the addition of a small quantity of arecanut husk slag and compare the results with fly slag.

2. OBJECTIVES

The principal goal of this project investigation are as per the following:

1. To study and compare the strength properties of concrete due to replacement of cement by fly ash and arecanut husk ash.
2. To identify the percentage level of replacement of cement by both fly ash and arecanut husk ash

3. EXPERIMENTAL PROGRAMME

3.1 CEMENT

Most widely utilised cement is OPC. In this project locally available Coromandel OPC cement belongs to 43 grade is used. Cement should be free from lumps and grey in colour.

Some of the chemical and physical properties of the OPC cement is tabulated in table below.

Table1: Physical characteristics of Cement (OPC 43 Grade).

Serial number	Material properties	Result obtained	From Code IS 8112-1989
1	Specific gravity	3.10	3.15
2	Fineness	5.10%	Not greater than 10%
3	Normal consistency	30%	Not greater than 35%
4	Initial setting time	55 minutes	Not under 30 minutes
5	Final setting time	355 minutes	Not over 600 minutes

3.2 FINE AGGREGATE

In this work local river sand belonging to the zone II range conforming by IS 383-1970 is utilised. The sieve analysis results and some of basic test of fine aggregate results are tabulated below.

Table -2 Physical properties of fine aggregate.

S No.	Material Properties	Result obtained
1	Specific Gravity	2.78
2	Fineness modulus	3.35
3	Water absorption	0.8%
4	Bulk density	1128.9 kg/m^3

3.3 COARSE AGGREGATE

In this work locally crushed Coarse aggregate belonging to 20mm down conforming by IS 383-1970 is utilised. The sieve analysis data and some of the basic test results of Coarse aggregate are below.

Table -2 Physical properties coarse aggregate.

Serial No.	Material Properties	Result obtained
1	Specific Gravity	2.76
2	Water absorption	0.6%

3.4 ARECANUT HUSK ASH

In this project work locally available Areca nut husk is collected and the husk is cleaned with water, dried in sun and burned. After burning process is completed, the ash was left to cool down to room temperature. In order to achieve fineness comparable to OPC, the burned Areca nut husk ash is grounded in a ball mills for 30 minutes and screened through 150µ strainer. The strainer cinder is stored immediately in air tight container to restrict pre-hydration.

Fig 1: Steps of Arecanut husk ash preparation.

Table 3: Physical properties of Areca nut husk ash.

Serial No.	Material Properties	Result obtained
1	Specific Gravity	2.97
2	Fineness	6.5%

3.5 FLY ASH

Fly slag utilised in this anticipation is collected from Bellary thermal power plant, fly slag collected falls under the category of Class C fly ash because calcium oxide content is more than 20%. Fly ash physical and chemical characteristics are tabulated below.

Fig 2: Fly slag.

Table 4: Physical characteristics of Fly cinder.

Serial No.	Material characteristics	Result obtained
1	Specific Gravity	2.65
2	Fineness	8.5%

3.6 WATER

Ordinary potable water is used in this project for both mixing and curing process. Water is imperative element of

the concrete it helps for the chemical reaction of cement and workability of concrete depends on water content. Caution should be taken to add water to concrete because addition of more water leads to increasing in workability but strength property of the concrete decreases and addition of less amount of water leads to decrease of workability.

1). The water used should be free from Alkali material.
2). pH value of water should be 6-10.
3). water should be free from organic matters.
4). water should be free from chemicals or should be within the limits because it will effect setting time and chemical reaction of the concrete.

4. RESULTS AND DISSCUSSION

4.1 Compression Strength Results:

Table 5: Comparison of replacement of 5% cement by areca nut husk ash and Fly ash Compressive strength of M-30 mix.

Days	Compressive strength of arecanut husk ash.	Compressive strength of Fly slag.
7	30.22	26.66
14	33.62	31.85
28	35.25	33.62

Graph1: Compressive strength comparison of 5% ANA & FA.

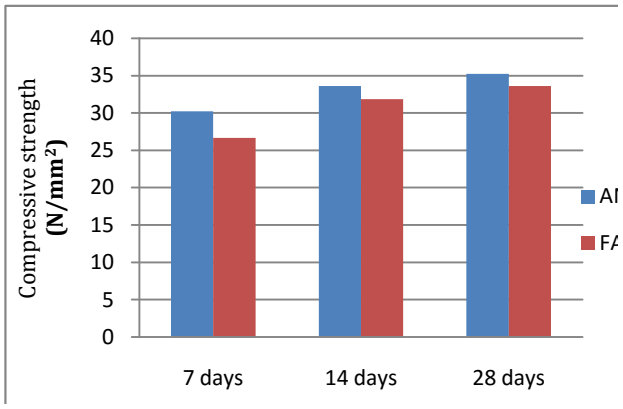


Table 6: Comparison of replacement of 10% cement by Areca nut husk ash and Fly ash Compressive strength of M-30 mix.

Days	Compressive strength of arecanut husk ash.	Compressive strength of Fly slag.
7	25.77	28.44
14	29.92	32.3
28	31.70	38.52

Graph2: Compressive strength comparison of 10% ANA & FA.

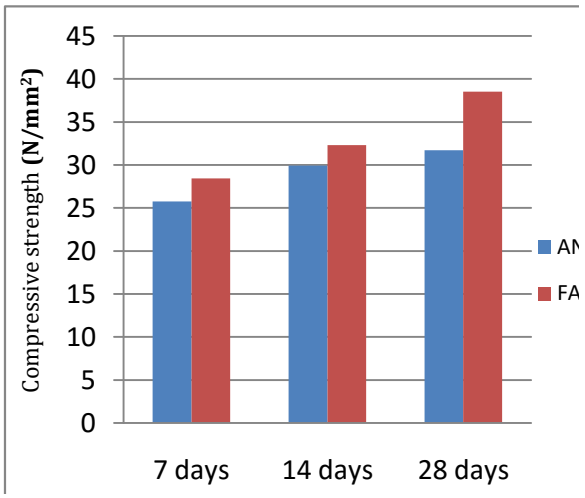


Table 7: Comparison of replacement of 15% cement by Areca nut husk ash and Fly ash compressive strength of M-30 mix.

Days	Compressive strength of arecanut husk ash.	Compressive strength of Fly slag.
7	18.66	26.96
14	19.40	31.4
28	25.03	37.47

Graph3: Compressive strength comparison of 15% ANA & FA.

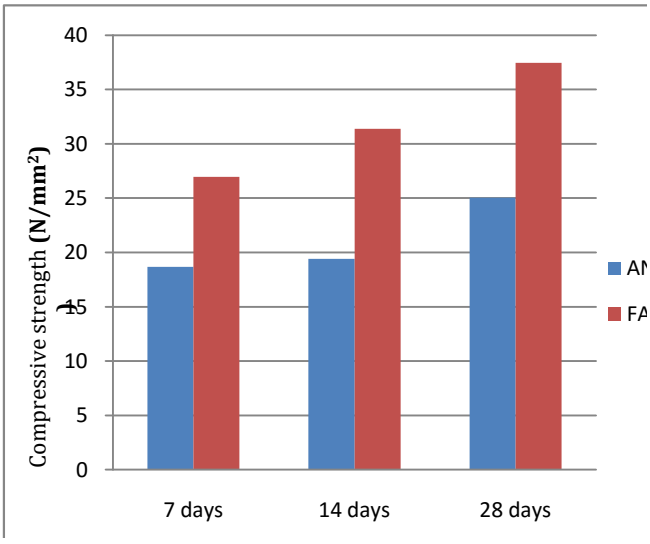
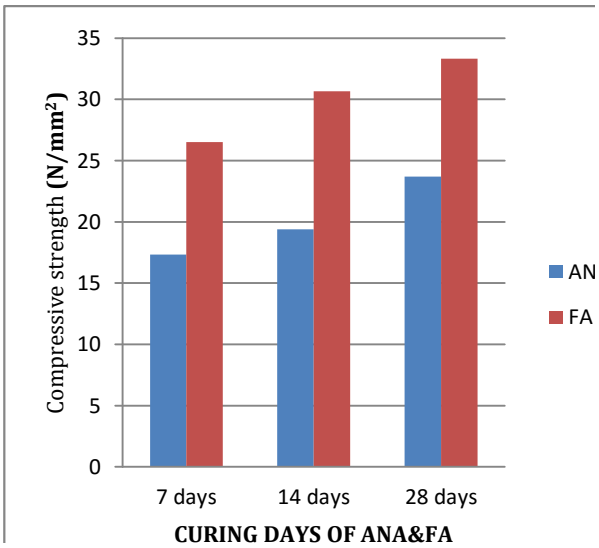


Table 8: Comparison of replacement of 20% cement by Areca nut husk ash and Fly slag compressive strength of M-30 mix.

Days	Compressive strength of arecanut husk ash.	Compressive strength of Fly slag.
7	17.32	26.51
14	19.40	30.67
28	23.7	33.33

Graph4: Compressive strength comparison of 20% ANA & FA.

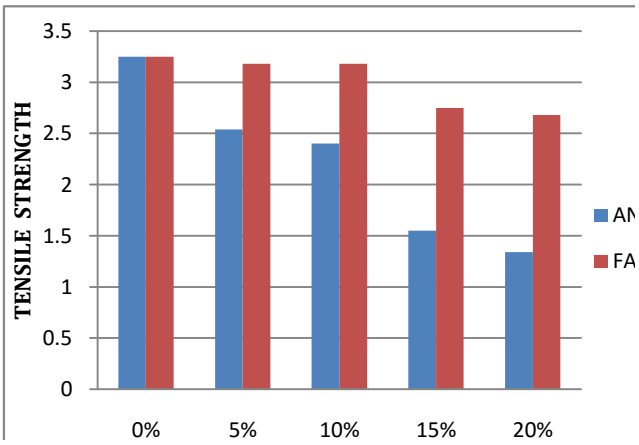


4.2 TENSILE STRENGTH RESULTS

Table 9: Comparison of Tensile strength of Arecanut husk ash and Fly ash.

Percentage replacement of materials.	Tensile strength of Arecanut husk ash.	Tensile strength of Fly slag.
0%	3.25	3.25
5%	2.54	3.18
10%	2.40	3.18
15%	1.55	2.75
20%	1.34	2.68

Graph 5: Comparison of tensile strength of ANA & FA

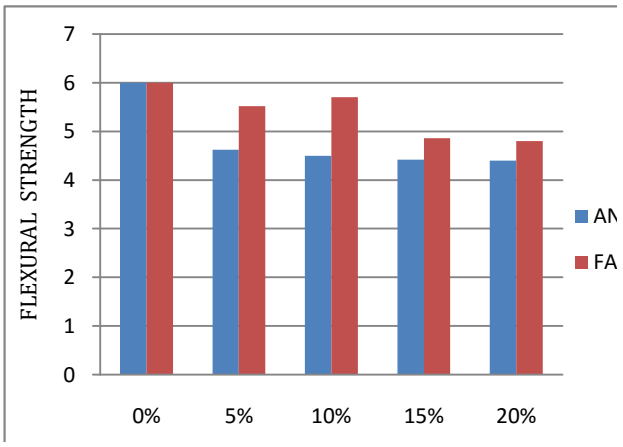


4.3 FLEXURAL STRENGTH RESULTS

Table 10: Comparison of flexural strength of Arecanut husk ash and Fly ash.

Percentage replacement of materials.	Flexural strength of Arecanut husk ash.	Flexural strength of Fly slag.
0%	6.0	6.0
5%	4.62	5.52
10%	4.5	5.7
15%	4.42	4.86
20%	4.4	4.8

Graph 6: Comparison of flexural strength of ANA & FA



5. OBSERVATIONS AND CONCLUSION:

1. There is an increase in compressive strength by 24.77% at 5% addition and later it is observed that the strength decreases with increase in percentage replacement. Similar observation is found in 14 days strength. Whereas the strength goes on decreasing after 28 days.

2.There is an increase in strength up to 10% replacement of cement by fly ash and later the strength goes on decreasing. Similar observations are found for second and fourth week test. It is observed that the strength of concrete increases by 24.4% after fourth week due to 10% replacement of cement by fly ash.000.
3.Tensile strength of concrete after fourth week goes on decreasing due to replacement of cement by arecanut ash. However the decrease is minimum upto 10 %. Similar observations are made in the replacement by fly ash
4.There is no satisfactory improvement in flexural strength of concrete in replacement by both the materials.
With the above observations following conclusions are drawn Cement in concrete of M30 grade can be replaced effectively by flyash. Replacement by arecanut husk ash can also be made where only compressive stress is predominate.
However it is suggested that an improvement in tensile and flexural strength can be achieved by adding either steel reinforcement or fibres.

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BIOGRAPHIES

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