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*RESEARCH ARTICLE*

# EXPERIMENTAL STUDY OF PARTIAL REPLACEMENT OF CEMENT USING EUCALYPTUS DIE LEAVES ASH

**T.J. Vishnu Pathy[1], M. Vijayapandian[1], K. Hemanth Kumar[1], N. Mohammed Aashik[1] and Mr. B. Palanikumar[2]**

1. Students,DepartmentofCivilEngineering,SethuInstituteofTechnology,Pullor,Kariapatti.
2. AssistantProfessor,DepartmentofCivilEngineering,SethuInstituteofTechnology,Pullor,Kariapatti.

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## *Abstract*

In this research, Cement composites have become an inevitable part of construction industry. Concrete is the most utilized material on earth next to the water. With the advent of urbanization and increase in infrastructure activities, consumption of cement concrete has escalated. The production process of one ton of cement emits about 0.7 tons of carbon dioxide into atmosphere.. Few of such products have been identified like eucalyptus die leaves ash. Thereby, the mechanical properties such as compressive strength, split-tensile strength were determined for M30 grade concrete and by varying percentage of ash content from 5%, 10% and 15% by Cement is replaced by EUCALYPTUS DIE LEAVES ASH. The mechanical properties such as compressive strength with % ashes were compared with conventional concrete properties of M30 grade. From the results it is observed that increasing % of ash in concrete increases the compressive strength of concrete.



## Introduction:-

In the global pursuit of sustainable development and environmental conservation, the construction industry stands at a critical crossroads. With growing concerns over the environmental impact of conventional building materials and practices, researchers, engineers, and policymakers are increasingly turning their attention towards innovative solutions that minimize resource depletion, reduce carbon emissions, and promote ecological balance. Within this context, the exploration of alternative materials for concrete production has emerged as a promising frontier, offering a pathway towards greener, more sustainable construction practices.

Among the myriad of potential alternatives, agricultural and industrial byproducts have garnered considerable interest for their abundance, renewability, and potential utility in enhancing the performance and environmental footprint of concrete. One such byproduct that has recently captured the attention of researchers is the ash derived from eucalyptus die leaves—a material often overlooked but imbued with significant potential for sustainable construction applications.

**Propertiesofmaterial:**

Cement, fine aggregate, coarse aggregate, Eucalyptusdie leaves ash and water are the various material used in this project.Before casting the specimen various materials has been conductedandastudy onthemis presentedinthisjournal.

**Corresponding Author:- Mr. B. Palanikumar**
Address:- Department of Civil Engineering, Sethu Institute of Technology, Pulloor, Kariapatti, Virudhunagar.

**Materials Used:**

**Cement:**

The cement used was OPC 53 grade cement. The differenttests were conducted as per Indian Standards to determine theproperties of this cement. For initial & final setting time IS: 8112-1989isusedandforstandardconsistencyofcementIS:4031(part-4)1988.Forspecificgravityofcement(IS: 2720-part3)is used.

**PhysicalPropertiesofCement**

| S.No | CharacteristicsExperimentalValve | ExperimentalValve |
|---|---|---|
| 1. | SpecificGravity | 3.15 |
| 2. | Standardconsistency | 30% |
| 3 | (i) Initialsettingtime | 35minutes |
| | (ii)Finalsettingtime | 7hrs |

**Fineaggregate:**

Fine aggregate should be properly graded to giveminimum void ratio and be free from deleterious materials likeclay, silt content and chloride contamination etc.,Hence it isdesirabletousethecoarservarietyoffineaggregatehavingahighfinenessmodulusformakingworkableandstrongconcrete.

Locallyavailablefreeofdebrisandnearlyriverbedsandis used as fine aggregate.The sand particles should also pack togiveminimumvoidratio,highervoidscontentleadstorequirement of more mixing water.

In the present study the sandconforms to Zone II as per the Indian standards.Those fractionsfrom4.75mmto150μaretermedas fineaggregate.

**TestonFineAggregate**

| S.NO | CHARACTERISTICSEXPERIMENTALVALVE | EXPERIMENTALVALVE |
|---|---|---|
| 1. | Specificgravity | 2.60 |
| 2. | Percentageofvoids | 24.5% |
| 3. | Finenessmodulus | 4.0 |
| 4. | Bulk density | 1.780 kg/m3 |
| 5. | Water absorption | 1% |

**Coarseaggregate:**

Coarseaggregateconsistsoflargerthanfineaggregatelargerthandineaggregateandtheirsizevaryfrom20 to4.75mm.Theretendtoimprovequalityandbondcharacteristicandgenerally result in a higher flexural strength of concrete. It alsohelps in reducing shrinkage. These aggregates occupy 70-80% ofvolumeoftheconcrete.

**TestonCoarseAggregate**

| | | |
|---|---|---|
| 1. | Specificgravity | 2.74 |
| 2. | Finenessmodulus | 4.63 |

| | | |
|---|---|---|
| 3. | Bulkdensity | 1.780kg/$m^3$ |
| 4. | Waterabsorption | 0.8% |

**Eucalyptus Die Leaves Ash:**

Eucalyptus trees, like many other plants, contain organic materials that can combust when subjected to high temperatures. When leaves or branches of eucalyptus trees die and dry out, they can become very flammable due to the oils they contain. In regions prone to wildfires, such as parts of Australia where eucalyptus trees are common, this can contribute to the spread and intensity of fires.The high oil content in eucalyptus leaves is a natural adaptation that helps the tree conserve water and deter pests, but it also makes them highly combustible. During a fire, the leaves can burn intensely, sometimes even explosively, contributing to the spread of the fire. However, it's important to note that not all eucalyptus leaves will turn to ash when they die.

**Eucalyptus Die Leaves Ash**

**Mix Design Of Concrete**

Design of concrete mixes involves determination of the proportions of the given constituents namely cement, water, coarse aggregates and fine aggregates it should produce concrete possessing specified properties both in fresh and hardened states with the economy.

Design mix of concrete for M30 grade are made as per IS 10262:2000. Size of nominal maximum of aggregate is 20mm is used .minimum water content as per IS 10262:2000 proportion of mix design is given below.

**Specimen Preparation**

**Mix Proportion of Cubes**

| MIX ID | CEMENT (KG) | EDLA (KG) | FINE AGGREGATE (KG) | COARSE AGGREGATE (KG) |
|---|---|---|---|---|
| Control(100% Cement) | 5.355.35 5.35 | 0.00 | 5.355.35 | 16. 16.0505 |
| Mix 1 (5% EDLA) | 5.09 | 0.26 | 5.35 | 16.05 |
| Mix 2 (10% EDLA) | 4.81 | 0.53 | 5.35 | 16.05 |
| Mix 3 (15% EDLA) | 4.54 | 0.80 | 5.35 | 16.05 |

**Mix Proportion of Cylinders**

| **MIX ID** | **CEMENT (KG)** | **EDLA (KG)** | **FINE AGGREGATE (KG)** | **COARSE AGGREGATE (KG)** |
|---|---|---|---|---|
| **Control(100% Cement)** | **5.355.35** 3.15 | 0.00 | 3.15 | **16.**9.45**05** |
| **Mix 1 (5% EDLA)** | 3.00 | 0.15 | 3.15 | 9.45 |
| **Mix 2 (10% EDLA)** | 2.83 | 0.32 | 3.15 | 9.45 |
| **Mix 3 (15% EDLA)** | 2.68 | 0.47 | 3.15 | 9.45 |

**Compressive Strength**

The compressive strength test was carried out as per IS 516 -1968 (Methods of Tests for Strength of Concrete) on 150mm x 150mm of cube specimens to find the strength of the developed concrete mix. Compressive strength of cube was found at the age of 7 days & 28days. Totally 3 mix proportion of specimens were tested. Compression Testing Machine of capacity 1000kN was used for the test. Test was continued and the failure load was noted.

The cubes of size 150mmx150mmx150mm are prepared with 3 control specimens and 3 specimens each with addition of Eucalyptus Die Leaves Ash by various proportions such as 0%, 5%, 10%,15%, by weight of cement for each type at the age of 7 days and 28 days.

**Compressive Strength of Cube (N/mm$^2$)**

| S.No - EDLA% | % EDLA | No of sample tested | Load KN | Area mm$^2$ | 7days strength N/mm$^2$ | Load KN | Area mm$^2$ | 28 days strength N/mm$^2$ |
|---|---|---|---|---|---|---|---|---|
| C -0 | 0 | 3 | 500 | 22500 | 22.22 | 700 | 22500 | 31.11 |
| M1 - 05 | 05 | 3 | 513 | 22500 | 22.80 | 720 | 22500 | 32.00 |
| M2 - 10 | 10 | 3 | 539 | 22500 | 23.95 | 750 | 22500 | 33.33 |
| M3 - 15 | 15 | 3 | 550 | 22500 | 24.44 | 785 | 22500 | 34.88 |

**Tensile Strength**

For cylinder specimen, tensile strength test was conducted to find out the strength development of concrete containing 0%, 05%, 10%, 15% by weight of cement for each type at the age of 28days.

**Tensile Strength of Cylinders (N/mm$^2$)**

| S.No - EDLA% | % EDLA | No of sample tested | Load KN | 28 days strength N/mm$^2$ |
|---|---|---|---|---|
| C -0 | 0 | 3 | 170.9 | 2.42 |
| M1 - 05 | 05 | 3 | 183.1 | 2.59 |

| | | | | |
|---|---|---|---|---|
| M2 - 10 | 10 | 3 | 164.2 | 2.32 |
| M3 - 15 | 15 | 3 | 185.9 | 2.63 |

## Conclusions:-

Replacement of cement with eucalyptus die leaves ash is found to improve the strength of concrete.

- The Compressive strength of Cubes are increased with addition of eucalyptus die leaves ash up to 20% replace by weight of cement and further any addition of both ashes the compressive strength decreases.
- Thus we found out the optimum percentage for replacement of eucalyptus die leaves ash with cement and it is almost 20% of the total cement for cubes.
- The concrete specimens cast with ash as cement at various percentages like 05%, 10%, 15%. Among the above six 20% eucalyptus die leaves ash replaced concrete produced better result than others, based on the compressive strength values.
- Concrete containing 20% eucalyptus die leaves ash as cement the values shows maximum improvement in the compressive strength, split tensile strength, flexural strength and when compared to the control specimen.
- To minimize the costs for construction with usage of eucalyptus die leaves ash which is freely or cheaply available and more importantly.
- To saving the environmental pollution by cement production; being our main objective as Civil Engineers.

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