*International Journal of Research in Engineering and Science (IJRES)*
*ISSN (Online): 2320-9364, ISSN (Print): 2320-9356*
*www.ijres.org Volume 10 Issue 8 ǁ August 2022 ǁ PP. 304-309*

# Investigation on Locust Bean Podash withSilica Fume as Partial Replacement of Cement in Concrete Structures

Govandan.A[1] , Ellakkiya.RS[2] , Mathumitha.A[3] , Prapalya.S[4]
[1]*Professor, Department of Civil Engineering, Parisutham Institute of Technology and science, Thanjavur, Tamilnadu, India*
[2]*B.E. student, Department of Civil Engineering, Parisutham Institute of Technology and science, Thanjavur, Tamilnadu, India*
[3]*B.E. student, Department of Civil Engineering, Parisutham Institute of Technology and science, Thanjavur, Tamilnadu, India*
[4]*B.E. student, Department of Civil Engineering, Parisutham Institute of Technology and science, Thanjavur, Tamilnadu, India*

***Abstract:*** *This project aimed at the investigation of compressive strength using Locust Bean Pod Ash (LBPA) and Silica fume as a partial replacement for cement in concrete. The Locust Bean Pod Ash (LBPA) and Silica fume is a good pozzolana and an excellent admixture for concrete. LBPA was obtained by the burning of Locust Bean Pod. The solid residue after the combustion process was sieved using a set IS Standard sieves which the sieved sample was analysed chemically to determined its constituents. The cement causing large amount of environment problems, also it isone of the depletion of natural resource. This led to the use of industrial by product as supplementary cementation material in the concrete. The concrete cube cast control; LBPA of 0%, 10%, 20%, 30%, 40%,50% and Silica fume of 0%, 5%,*
*10%, 15%, 20% and 25% respectively. The Cube will be cured for 7 days, 14 days and 28 days. This pozzolonic reactivity of Locust Bean Pod Ash and the Silica fume increases the compressive strength of the concrete with time.*

***Keywords*** *– locust bean ash, silica fume andcompressive strength*

---

Date of Submission: 01-08-2022 Date of acceptance: 15-08-2022

---

## I. INTRODUCTION

Concrete is the most widely used building material in construction industry. Concrete is a mixture of cement, fine aggregate and coarse aggregate. Increasing population, expanding urbanization, climbing way of life due to technological innovations has demanded a huge amount of natural resources in the construction industry, which has resulted in scarcity of resources. Reuse of agricultural wastes as sustainable construction materials take care of the issue of contamination, as well as the issue of areafilling and the expense of building materials. LBPA was obtained by the burning of Locust Bean husk. Those husk were completely burnt under certain atmospheric condition. The solid residue after the combustion process was sieved using a set IS Standard sieves which the sieved sample wasanalysed chemically to determined its constituents.

The silica fume is an amorphous (non- crystalline) polymorph of silica dioxide, also known as micro-silica is derived from the production of Silicon Steel. It is highly reactive and an excellent admixture for concrete. It reduces thermal cracking, improves durability. This pozzolonic reactivity of Locust Bean Pod Ash increases the compressive strength.

### MATERIAL USED

The ingredients of concrete consist of Cement, Fine aggregate, Coarse aggregate and Water. Also the cement is replaced by LBPA of 0%, 10%, 20%, 30%,
40%, 50% and Silica fume of 0%, 5%, 10%, 15%, 20%, 25%. The are described in details with their properties are as follows:

### CEMENT

Cement is manufactured through a closely controlled chemical combination of calcium, silicon, aluminum, iron and other ingrediants. The common materials used to manufactured cement includes limestone, shells, and chalk or marl. Cement is an extremely fine materialhaving adhesive and cohesive properties which provides a binding medium for the discrete ingredients.

**TABLE -1 CHEMICAL COMPOSITION OFORDINARY PORTLAND CEMENT**

| **Constituent** | **Percentage(%)** |
|---|---|
| Lime (CaO) | 60-67 |
| Silica ($SiO_2$) | 17-25 |
| Alumina ($Al_2O_3$) | 3-8 |
| Iron oxide ($Fe_2O_3$) | 0.5-6 |
| Magnesia (MgO) | 0.1-4 |
| Sulphur trioxide ($SO_3$) | 1-3 |
| Soda/Potash ($Na_2O+K_2O$) | 0.5-1.3 |

**FINE AGGREGATE**

Fine aggregates are usually sand or crushed stone. Aggregates less than 4.75 mm insize are called fine aggregates; sand falls under the fine aggregate.

**COARSE AGGREGATE**

The most common size of aggregate used in construction is 20mm. Aggregate which has a size bigger than 4.75 mm or which retrainedon 4.75 mm IS Sieve are known as Coarse aggregate.

**WATER**

Portable tap water available in the laboratory with pH value of 7.0±1 and confirming to the requirements of IS: 456- 2000 was used for mixing concrete and also for curing the specimens.

**LOCUST BEAB POD ASH**

Locust Bean Pod Ash was obtained by the burning of Locust Bean husk. Those husk were completely burnt under certain atmospheric condition. The solid residue after the combustion process was sieved using a set IS Standard sieves which the sievedsample was analysed chemically to determined its constituents.

Fig-1 Locust bean pod ash

**SILICA FUME**

The silica fume is an amorphous (non- crystalline) polymorph of silicon dioxide, also known as micro-silica is derived from the production of Silicon Steel. It is highly reactive and an excellent admixture for concrete. It reduces thermal cracking, improves durability.

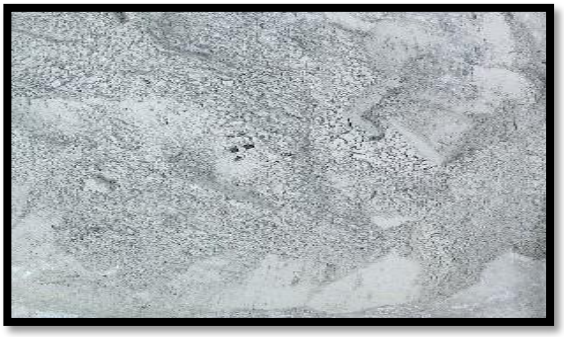

Fig-2 Silica fume

**TABLE -2 CHEMICAL COMPOSITION OFSILICA FUME & LOCUST BEAN PODASH**

| CONSTITUENT | SILICA% | LBPA% |
|---|---|---|
| Lime (CaO) | 0.2 | 15.71 |
| Silica ($SiO_2$) | 97 | 39.01 |
| Alumina ($Al_2O_3$) | 0.2 | 13.5 |
| Iron oxide($Fe_2O_3$) | 0.5 | 11.51 |
| Magnesia (MgO) | 0.5 | 2.01 |
| Sodium oxide($Na_2O$) | - | 1.21 |
| Potash ($K_2O$) | 0.5 | 5.62 |
| Nitrous oxide | 0.2 | - |
| Sulphur trioxide($SO_3$) | 0.15 | - |
| Carbon ($C_1$) | 0.01 | - |
| Water ($H_2O$) | 0.5 | - |

**EXPERIMENTAL WORKGENERAL**

The aim of experimental work is to replacement of cement, preparation of concreteand test on concrete.

**REPLACEMENT OF CEMENT**

The production of Portland cement is not only costly and energy intensive, but it also produces large amount of carbon emission. The cement has been replaced by locust bean pod ash and silica fume in the percentage of 0,10,20,30,40,50 and 0,5,10,15,20,25.

**PREPARATION OF CONCRETE**

Concrete has been prepared for the Grade of M30with the following mix proportion of 1:2:3.16.

- Mass of cement = 422 kg/m3
- Mass of coarse aggregate = 1170 Kg /m3
- Mass of fine aggregate = 685 Kg /m3
- Water =192 kg/m3
- W/C ratio = 0.45

## II. RESULTS AND DISCUSSION

In this research locust bean pod ash and silica fume as the admixture is used as replacement of conventional building materials such as cement in partial in various proportions. The Replacementsare done for a ratio of 10%, 20%, 30%, 40% & 50% and 0%, 5%, 10%, 15%, 20%& 25% respectively. The grade of concrete mixed is M30 grade with a water cement ratio of 0.45. The optimum strength obtained at a replacement of 30% of silica fume and locust bean ash pod ash by cement. The strength of the locust bean pod ash with silica fume concrete at an age of 7 days 14 days and 28 days are more than the conventional concrete.

**COMPRESSIVE STRENGTH OF CONCRETE**

**IN N/MM $^2$**

Cube specimen shall be of size not less thanfour times the maximum size of the coarse aggregate and not less than 150 mm Compressive strength of concrete made with 15cm x 15cm x15cm cubes are made with M30 grade of concrete.

Compressive strength = Failure load (KN) /Area of cube ($mm^2$)

**TABLE – 3 COMPRESSIVE STRENGTH OF CONVENTIONAL CONCRETE (N/MM)**

| DESCRIPTION | DURATION(Days) | | |
|---|---|---|---|
| | 7 ($N/mm^2$) | 14 ($N/mm^2$) | 28 ($N/mm^2$) |
| Compressive strength of concrete | 15.555 | 22.666 | 35.555 |

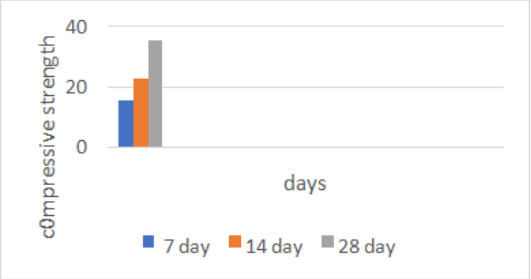


Fig-3

**TABLE - 4 COMPRESSIVE STRENGTH OF LOCUST BEAN POD ASH FOR REPLACEMENT OF CEMENT ($N/MM^2$)**

| REPLACEMENT(%) | DURATION(Days) | | |
|---|---|---|---|
| | 7 ($N/mm^2$) | 14 ($N/mm^2$) | 28 ($N/mm^2$) |
| 0 | 25.02 | 30.8 | 38.05 |
| 10 | 25.28 | 31.12 | 38.9 |
| 20 | 25.87 | 31.84 | 39.8 |
| 30 | 24.83 | 30.56 | 38.2 |
| 40 | 24.44 | 30.08 | 37.6 |
| 50 | 21.88 | 28.16 | 35.2 |

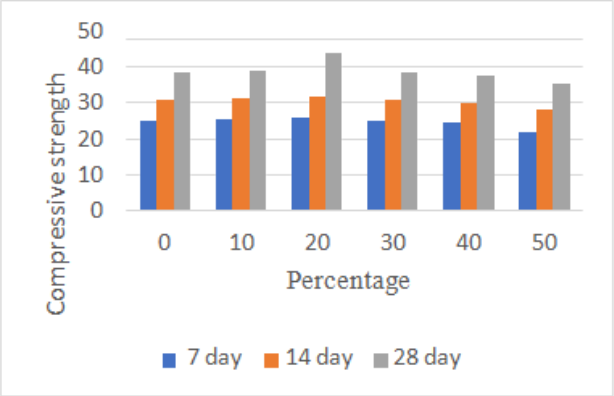


Fig – 4

**TABLE - 5 COMPRESSIVE STRENGTH OF SILICA FUME FOR REPLACEMENT OF CEMENT ($N/MM^2$)**

| REPLACEMENT (%) | DURATION(Days) | | |
|---|---|---|---|
| | 7 ($N/mm^2$) | 14 ($N/mm^2$) | 28 ($N/mm^2$) |
| 0 | 25.02 | 30.8 | 38.5 |
| 5 | 26.19 | 32.24 | 40.3 |
| 10 | 27.62 | 34 | 42.5 |
| 15 | 25.87 | 31.84 | 39.8 |
| 20 | 23.79 | 29.28 | 36.6 |
| 25 | 20.86 | 25.68 | 32.1 |

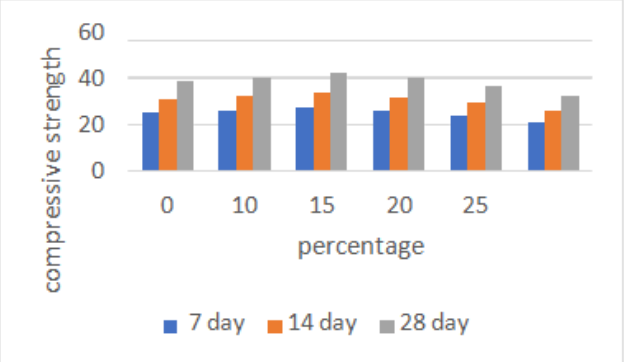


Fig-5

**TABLE – 6 COMPRESSIVE STRENGTH OF10%OF SILICA FUME WITH LOCUST BEAN POD ASH OF CEMENT**

| REPLACEMENT(%) | DURATION(Days) | | |
|---|---|---|---|
| | 7 ($N/mm^2$) | 14 ($N/mm^2$) | 28 ($N/mm^2$) |
| 0 | 25.02 | 30.8 | 38.5 |
| 10 | 26.78 | 32.96 | 34.1 |
| 20 | 28.47 | 35.04 | 43.8 |
| 30 | 26.05 | 32.08 | 40.1 |
| 40 | 24.375 | 30 | 37.5 |
| 50 | 22.49 | 27.68 | 34.6 |

Odey Ade Osha (2020) “Effect of Locust Bean Pod Ash and Eggshell Ash on the Mortar Compressive and Flexural Strengthsof Cement Blends” ISSN 2413- 9009.

- Andrew Y. Adama1 , Yinusa A. Jimoh 2 and Stephen S. Kolo3 (January 2013) “Effect of Locust Bean Pod Ash on Compaction Characteristics of Weak Sub Grade Soils” ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726.
- S Bhanja, B Sengupta (2005) “Influence of silica fume on the tensile strength of concrete” Volume 35, Issue 4, April 2005, Pages 743-747.
- K Ganesh Babu, PV Surya Prakas (1995) “Efficiency of silica fume in concrete”.

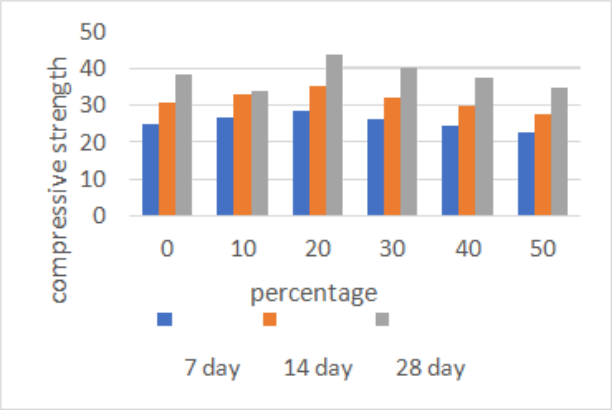


**Fig – 6**

## III. CONCLUSION

- Locust bean pod ash is a eco-friendly material, therefore the strength of concrete is less for that we are adding Silica fume as anadmixture.
- The colour of our concrete is black due to addition of Locust bean pod ash.
- For locust bean pod ash the strength has beenincreased upto 20% the strength will be 39.8N/mm$^2$.
- Locust bean pod ash concrete strength gradually increases and at after certain percentage it starts decreasing.
- For silica fume the strength has been increased upto 10%.
- By the test results of replacement in cement, we have analysed that the silica fume can be effectively replaced. The optimum strength attain in 10% of cement is 425%. With the 10% of silica fume the LBPA is replaced and the strength has been increased upto 20% for7days, 14days, 28days respectively.

## REFERENCE

[1]. Samuel Mahuta Auta, Kabiru Adebayo (July 2018) "the effect of locust bean podepicarp ash(lbpea) on the compressive strength of revibrated concrete" ISSN 2304-6295.

[2]. Olumide Olu Olubajo1, Abubakar Jibril1,