Experimental Study on The Behaviour of Concrete: Made By Partial Replacement of Cement with Senegalia Rugata and Fly Ash

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***Abstract*— Cement is the most essential component widely utilized in the building industry around the world, but it has a higher carbon footprint during manufacture. To minimize this, some materials are partially replaced with cement in the production of concrete while maintaining its strength. In India, organic substances such as myrobalan, jaggery, and eggs were frequently utilized as construction materials in concrete because they provided greater structural strength and allowed buildings to last longer. This novel material "Senegalia Rugata", a herb which is traditionally used in India as a shampoo powder which doesn't have carbon-foot print and fly ash, a waste product of thermal power plants, can be utilized as a partial replacement of cement during the production of concrete in such a way to reduce carbon footprint and retain the strength of concrete. In this project, M30 grade concrete is casted in the form of Cubes, Prisms, and Cylinders with 15% Fly Ash and 15% Senegalia Rugata are used as partial replacement of cement in concrete, and tested for Compressive, Flexural, Split Tensile Strengths along with conventional concrete and results are compared. The results of this project are consistent and standard, similar to those achieved on normal conventional concrete (here M30 grade concrete) at the end of Compressive, Flexural and Split tensile strength tests. Hence "Senegalia Rugata" can be used as a construction material, similarly there is a chance of introducing a new type of Indianized variety of cement called "Senegalia Rugata-based cement" (as Senegalia Rugata is mostly and widely used in India / by Indians globally) similar to PPC which is a Fly Ash Based Cement.**

Keywords — Senegalia Rugata, Fly Ash, Compressive strength, Flexural Strength, Split tensile strength test

I. INTRODUCTION

In this fast-developing universe it is necessary to look after the environment as well by reducing carbon footprint therefore this project helps in doing the same by including Senegalia Rugata along with Fly Ash in concrete production. By incorporating Senegalia Rugata and Fly Ash not only the carbon foot print reduces but also the strength is slightly enhanced. The bonding capacity of the material when partially replaced with cement should not be affected and also it should combine well with all the materials of concrete.

The Compressive strength of concrete made by partially replacement of cement with Senegalia Rugata and Fly Ash is tested on Day 7 and Day 28 and the results are compared with conventional concrete. The Flexural and Split Tensile tests of concrete made of partial replacement of cement with Senegalia Rugata and Fly Ash are conducted on Day 28 and the results are compared with conventional concrete.

I. MATERIALS USED

A. CEMENT:

Ordinary Portland cement of grade 43 was used in the project work, as it was readily available in local market. The cement used in the project has specific gravity was 3.15.

B. SENEGALIA RUGATA:

Senegalia Rugata was used as a partial replacement of cement in mix 2. The Senegalia Rugata used in the project has specific gravity was 2.64.

C. FLY ASH:

Fly ash in powdered form obtained from Ennore Thermal Power Station is used as a partial replacement of cement in Mix 2. The Fly ash used in the project has specific gravity was 2.61.

D. COARSE AGGREGATE:

Crushed angular coarse aggregate were used as coarse aggregate in the project work passes through standard IS Sieve 20 mm down grade. The specific gravity was 2.72.

E. FINE AGGREGATE:

River sand used as fine aggregate in the project work passes through standard IS Sieve 4.75 mm down grade. The specific gravity was 2.73.

F. CHEMICAL ADMIXTURES:

Super plasticizers, also known as high range water reducers, were chemical admixtures used where well-dispersed particle suspension was required. These polymers were used as dispersants to avoid particle segregation (gravel, coarse and fine sands), and to improve the flow characteristics of suspensions such as in concrete applications. The specific gravity was 1.18 @ 25° C (given by Manufacturer).

II. METHODOLOGY

WORKABILITY*:*

The workability tests were performed using standard sizes of Slump Moulds.

A. COMPRESSIVE STRENGTH:

The cube specimens of size 150 x 150 x 150 mm are casted and tested on 7th and 28th days.

B. FLEXURAL STRENGTH:

The prism specimens of size 700 x 150 x 150 mm are casted and tested on 28th day.

C. SPLIT TENSILE STRENGTH:

The cylindrical specimens of size 150 mm in diameter and 300 mm long are casted and tested on 28th day.

III. RESULTS AND DISCUSSIONS

A. WORKABILITY:

The workability of M-30 grades of concrete with various proportions of Cement partial replaced with Senegalia Rugata and Fly Ash was estimated in terms of Slump test. The Slump test was conducted as per IS: 1199-1999. The results of Slump test M-25 grades of concrete outcomes that there is a slump loss for every increase in silica fume and fly ash when compared with conventional concrete.

B. COMPRESSIVE STRENGTH TEST:

The Compressive Strength test was conducted as IS: 516-1979. The results of Compressive Strength tests conducted on M30 grade of Conventional concrete vs Concrete made of Cement partial replaced with Senegalia Rugata and Fly Ash and the results are tabulated below:

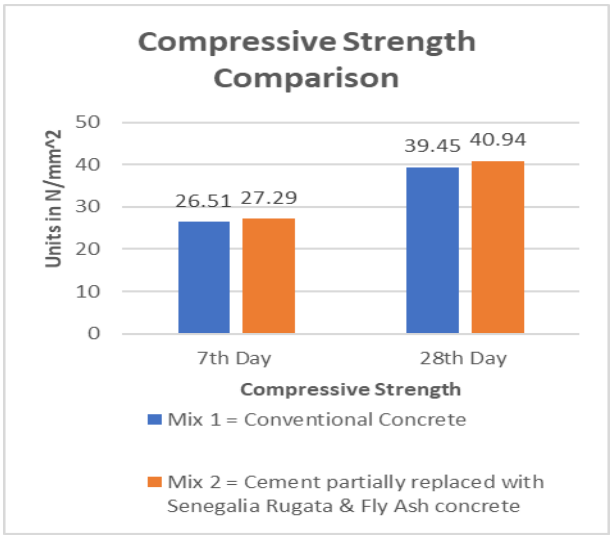

Fig.1 -Variation of Compressive Strength of Conventional Concrete vs Fly Ash and Senegalia Rugata partially replaced with cement Concrete in N/mm^2.

C. FLEXURAL STRENGTH TEST

The Flexural Strength test was conducted as per IS 5816-1999. The results of Flexural Strength test conducted on M30 grade of Conventional concrete vs Concrete made of Cement partial replaced with Senegalia Rugata and Fly Ash and the results are tabulated below:

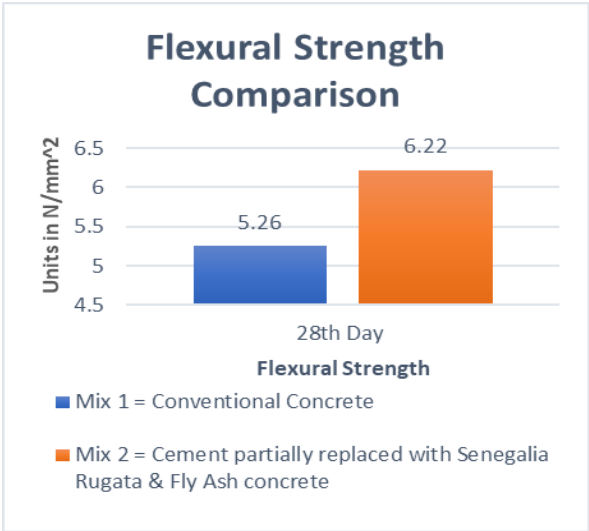

Fig.2 - Variation of Flexural Strength of Conventional Concrete vs Fly Ash and Senegalia Rugata partially replaced with cement Concrete in N/mm^2.

D. SPLIT TENSILE TEST:

The Split Tensile Strength test was conducted as per IS 5816-1999. The results of Split Tensile Strength tests conducted on different grades of concrete are tabulated below:

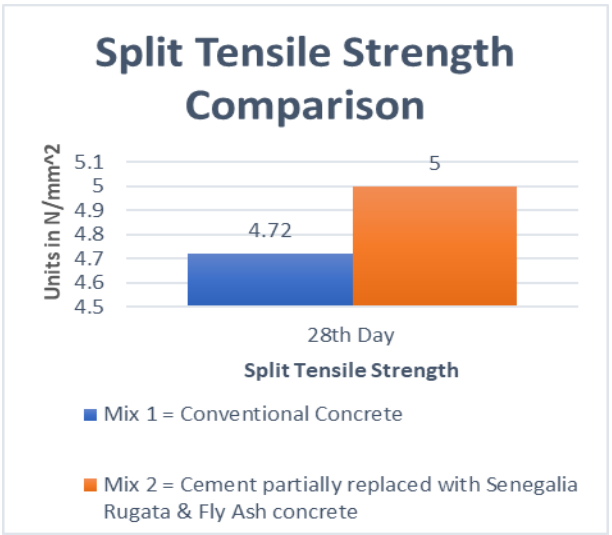

Fig.3 - Variation of Split Tensile Strength of Conventional Concrete vs Fly Ash and Senegalia Rugata partially replaced with cement Concrete in N/mm^2.

V. CONCLUSION

1. The results obtained shows that the partial replacement of cement with a combination of 15% Senegalia Rugata and 15% Fly Ash proves to be a successful combination for replacement of cement.
2. The Result shows that the Senegalia Rugata and Fly Replacement mix gives Higher Compressive, Flexural and Split Tensile Strengths compared to conventional concrete.
3. Thereby this project paves way for further research to be carried out in finding the best proportion of Senegalia Rugata as partial replacement with cement as this is a novel material for construction industry this project leads to be a successfully tested trial to prove that this organic material can be used as a construction material as this gives better strength to concrete in terms of compression, flexure and tension.
4. Hence our fellow engineers can confidently use this material as cement replacement material saving time without any doubt there won't be a wastage of money in the future attempts by fellow engineers while finding the best combination in a scenario where the doubts of using Senegalia Rugata as a construction material or not is eliminated as this material now becomes a successful tested material.
5. In terms of Environmental aspect carbon footprint due to constructions can be partly reduced.
6. The cultivation of Senegalia Rugata can spread all over the world from a particular zone of India to the entire world and this material will also be considered as a construction material apart from only being used as a cosmetic material.
7. This will make Senegalia Rugata as a global plantation which will surely reduce its cost very low due to its global availability in the future as its new to everyone as construction material future research will make this material get its recognition.

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