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A Preliminary Study on Biopolymerised Concrete with Sawdust as an Admixture

Shobana K .S*, Gobinath R., Saravanan S. P., Sivakumar V., Dinesh J., Krishnaviraj S., Sangeetha
Department of Civil Engineering, Jay Shriram Group of Institutions, Avinashipalayam, Tirupur, Tamilnadu, India

Abstract

In this study bio polymer obtained from Tapioca starch and sawdust in fine form were assessed for the use as partial replacement of cement materials for an application in lightweight concrete. Physical and chemical characteristics of bio polymer and sawdust were analyzed initially. Properties of concrete that has been investigated were compressive, tensile and flexural strength. The cement has been replaced by bio polymer and saw dust accordingly in the range of 1 and 2–5%, respectively for M-20 concrete mix. The concrete specimens were tested in three series as compression test, split tensile test and flexural test. These tests were carried out to evaluate the mechanical properties of concrete after 28 days curing.

Keywords: *Bio polymer saw dust, Compression test, Replacement*

**Author for Correspondence* E-mail: shobabecivil@gmail.com

INTRODUCTION

The cement partially replaced with quarry dust. Quarry dust, a waste from the stone crushing unit accounts 25% of the final product from stone crushing unit. Water to powder ratios of 0.5, 0.4, 0.35 for M_{20}, M_{30}, $M_{40,}$ respectively were maintained for all the percentage replacements for workability. The quarry dust was replaced up to 25% of concrete. The compression strength of the concrete was increased when adding the quarry dust between 20–25% [1].

The coconut shell was used to partially replace the ordinary portland cement for increasing the compressive strength of the concrete. They said that this concrete mix showed some promise for use in reinforce concrete as well as mass concrete structures in building construction. The study reveals that 10 to 15% partial replacement of ordinary Portland cement with coconut shell ash using water cement ratio of 0.5 were suitable for production of both heavy weight and light weight concrete [2]. In this study the replacement of cement by using of ceramic waste for sustainable development and increase the compressive strength of the concrete. Ceramic waste is one of the most active research areas that encompass a number of disciplines including civil engineering and construction materials. They said that the compressive strength of M_{20} grade concrete increases when the cement was replaced with the ceramic powder up to 30% and further replacement of cement with ceramic powder decreases the compressive strength. The compressive strength obtained on 30% replacement of cement with ceramic powder was 22.98 N/mm^2 and the cost of the cement was reduced up to 12.67% in M_{20} grade concrete and hence it becomes technically and economically feasible and viable [3].

In this study it was said that the replacement of the bambara groundnut shell ash as ordinary portland cement for increasing the compressive strength of the concrete. They said that, there exists a high possibility for partial replacement of cement with bambara groundnut ash. Partial replacement of Ordinary Portland Cement with about 10% Bambara Groundnut Shell ash in concrete is acceptable. Though the strength of ordinary Portland cement /the bambara groundnut shell ash concrete was lower than that of 100%

cement, it can be used for light load bearing elements [3].

In this study, saw dust ash is partially replaced by cement in the concrete for increasing the strength of the concrete. The possibility of using sawdust ash as a construction material was experimentally investigated. Saw dust was burnt and the ash sieved using a 90 micron sieve. They said important oxides content was 65.45% by weight of SDA and has a pH value of 11.12, which shows that it's alkaline in nature. This shows that sawdust ash has a significant physical and chemical property that encourages its uses as a pozzolanas. Setting time increased in all the grades of OPC upon the addition of sawdust ash but is in the range recommended for pure cement. They also said compressive strength of concrete increases with grade of cement [4].

This study utilized the paper-mill pulp to be used as a partially replacement of the cement in the concrete. The use of paper-mill pulp in concrete formulations was investigated as an alternative to landfill disposal. They said that the cement has been replaced by waste paper sludge accordingly in the range of 5 to 20% by weight for M-20 and M-30 mix. The slump increased up to 5% replacement of cement, above 5% the slump decreased as the paper pulp content in the concrete mixtures was increased [5].

METHODOLOGY

Materials used in this study include bio polymer obtained from local supplier and saw dust received from a local saw mill. River sand confirming to grading zone-III as per IS: 383-1970, having specific gravity of 2.61 and fineness modulus of 2.9 has been used as fine aggregate for this study. Coarse aggregate obtained from local quarry units has been used for this study. Maximum size of aggregate used is 20 mm with specific gravity of 2.73. Portland pozzolana cement conforming to IS: 269:1976 and IS: 4031-1967 was used in this study which is of 53 grade. Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water are required to be looked into very carefully. A M_{20} grade mix was designed as per Indian Standard method (IS 10262-2009) and the same was used to prepare the test samples.

Sawdust is an organic waste resulting from the mechanical milling or processing of timber (wood) into various shapes and sizes. The dust is usually used as domestic fuel. The resulting ash known as SDA (saw-dust ash) is a form of pozzolana. Dry sawdust concrete weighs only 30% as much as normal weight concrete and its insulating properties approximate those of wood. With proper cement to sawdust ratios, it is not flammable. As a basic construction material, sawdust concrete does indeed have its functions. Sawdust is in abundance in North Eastern India (Meghalaya) and other parts of the world. An experimental study is done to evaluate the behavior concrete properties.

Experimental Test Setup

Concrete cubes confirming to IS: 516:1964 of size 150 x 150 x 150 mm were cast. Total 12 cubes were cast for determination of compressive strength, flexural strength, tensile strength. After 24 h the moulds were de-moulded and subjected to water curing. Before testing, the cubes were air dried for 2 h. Crushing loads were noted and average compressive strength of 3 specimens was determined after seven days and 28 days shown in Table 1 of various mix proportions [6–8].

Table: 1 *Test Results of the Bio Polymerized Saw Dust Concrete after 28 Days Curing.*

S. No.	% of Bio polymer	% of Saw Dust	Compressive Strength (N/mm^2)	Tensile Strength (N/mm^2)	Flexural Strength (N/mm^2)
1	1	2	13	2.9	1.8
2	1	3	16	3.4	2.4
3	1	4	18	3.7	2.8
4	1	5	22	4.6	3.9

RESULT AND DISCUSSION

The compressive strength, splitting tensile strength and flexural strength test results are given in Table 1 and shown in Figures 1, 2 and 3. The compressive strength tests were carried out in 28 days.

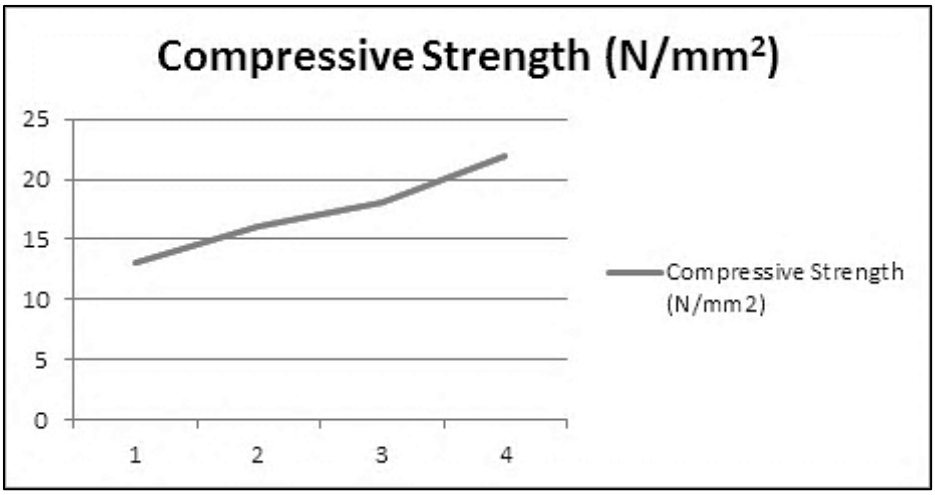

Fig. 1: *Compressive Strength of a Bio Polymerized Saw Dust Concrete.*

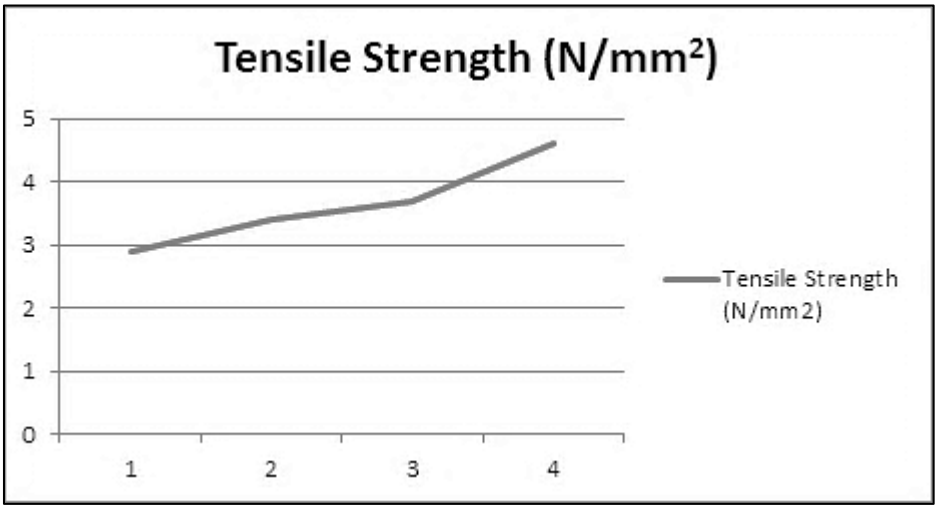

Fig. 2: *Tensile Strength of a Bio Polymerized Saw Dust Concrete.*

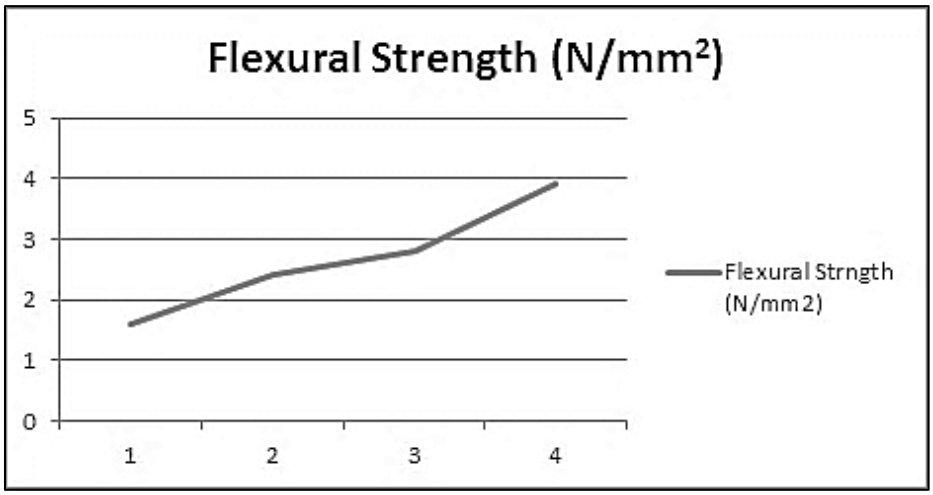

Fig. 3: *Flexural Strength of a Bio Polymerized Saw Dust Concrete.*

CONCLUSION

Based on experimental investigations concerning the compressive strength of concrete, the following observations are made:

(a) The compressive strength of M_{20} grade concrete increases when the replacement of cement with saw dust up to 5% replaces and further replacement of cement with saw dust and bio polymer decreases the compressive strength.

(b) Concrete on 5% replacement of cement with saw dust and 1% replacement of cement with bio polymer, compressive strength obtained is 22 N/mm^2 and vice-versa the cost of the cement usage is reduced up to 12.67% in M_{20} grade and hence it becomes more economical without compromising concrete strength than the standard concrete. It becomes technically and economically feasible and viable.

(c) Utilization of saw dust and bio polymer and its application are used for the development of construction industry and material sciences.

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