FLEXURAL BEHAVIOUR OF REINFORCED CONCRETE BEAM USING TAMARIND KERNEL POWDER AS AN ADMIXTURE

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ABSTRACT

The quality of the construction material is required to be improved in order to enhance the structure more stable. From the earlier days, admixture plays a vital role in concrete to improve the structural properties. In this work, an attempt has been made to study the possibilities of using tamarind kernel powder as an admixture in concrete. The addition of tamarind kernel powder is varied from 0% to 3% at 0.5% intervals. The flexural strength test was carried out on prisms and beams. The Tamarind kernel powder admixed reinforced concrete beam has higher load carrying capacity than conventional reinforced concrete beam.

Keywords: tamarind kernel powder; stiffness; strength; crack width; deflection

INTRODUCTION

Admixtures are added to concrete during its preparation, to alter the properties of fresh concrete or enhance the properties of the hardened concrete. Even though several advancements have been made in concrete technology, it still suffers from several drawbacks, viz poor workability, high shrinkage cracks, poor performance against chemicals, high permeability and low strength. Concrete also possess problems in extreme cold or hot weather conditions. In order to overcome this draw back, the use of admixture in concrete is essential. Improvement of concrete by adding chemicals areexpensive and therefore require an economic replacement. Tamarind tree grows in more than fifty countries of the world. The major areas of production are in Asian countries like India, Bangladesh, Sri Lanka, Thailand, Indonesia, and in the African and the American continents. Tamarind trees are more abundantly available in Tamil Nadu. Hence a huge amount of tamarind seed wastes are produced every year. In the absence of an effective waste disposal, the utilization of tamarind seed for concrete improvement will be a welcome development.

REVIEW OF LITERATURES

The addition of cassava flour and maize starch increased the strength of concrete [1].The reduced slump and increased strength was obtained in concrete with the addition of corn starch [2]. The tamarind seed gum has good sag resistance [3] and tamarind kernel powder (TKP) has good water resistance [7]. The effect of agro-climatic influence on preparation of TKP and seed gum has studied. In the processing of Tamarind kernel powder, Roasting and Dehulling methods were found to be more significant than wet processing [6].

OBJECTIVES OF THIS STUDY

The main objective of this work was to study the flexural behaviour of concrete prisms and beams with the addition of tamarind kernel powder. The addition of Tamarind Kernel Powder varies from 0% to 3% at 0.5% intervals.

MATERIALS

Cement

The most popular Ordinary Portland cement (OPC-53) was used in this study. The physical properties of the cement were determined and tabulated in table I

Table I. Properties of Cement

SI.No	*Properties*	*Result*
1	Specific Gravity	3.12
2	Fineness Modulus	2 %
3	Standard Consistency	31 %
4	Initial Setting Time	36 minutes
5	Final Setting Time	300 minutes

Fine Aggregate

Ordinary river sand conforming IS 383-1970 was used in this project. Some of the properties of fine aggregate were shown in table II.

Coarse Aggregate

In this project, 20 mm size coarse aggregate was used. Table II shows the various properties of fine and coarse aggregate.

Table II. Properties of Fine and Coarse Aggregate

SI. No	*Properties*		*Fine Aggregate*	*Coarse Aggregate*
1	Specific Gravity		2.47	2.74
2	Fineness Modulus		2.99	7.34
3	Bulk densit y	Loose State	1542	1426
		Compac	1701	1706

	(Kg/m ^{3})	ted state		
4	Water absorption (%)		1	0.5
5	Moisture content		NIL	NIL

Tamarind Kernel Powder

Tamarind Kernel Powder (TKP) is the by-product of Tamarind pulp industry and seed gum isa polysaccharide present in TKP. Removal of testa from the seed is a difficult process. There arethree methods to separate the kernel from seed. These are as follows.

1. Wet process
2. Roasting process
3. Dehulling process

The separated kernels are milled to get the TKP. In this project, we had chosen the roasting process for separating the kernel from seed. Because the roasting process will give the maximum quantity of TKP.

Specific Gravity of TKP = 1.33

Water

Water used for mixing and curing shall be clean and free from oils, acids, alkalis, salts etc. The water should conform to IS 456-2000 standards. The water inside the college campus is used for this study.

Steel

Fe500HYSD grade steel bars are used in this study.

MIX DESIGN

In this experimental work, M25 grade concrete with w/c ratio of 0.45 was used. In this experimental study, totally 23 numbers of specimen were cast. The specimen consisted of 21 numbers of 500x100x100 mm size prisms and 2 numbers of 1500x150x300 mm size reinforced concrete beams. The TKP was added to concrete by percentage weight of cement. Table III shows the arrived values of mix ratio for conventional concrete.

Table III. Mix Ratio

Cement	***Fine Aggregate***	***Coarse Aggregate***	***Water***
1	1.51	2.85	0..45

DESIGN OF BEAM

The beams are designed using limit state method for M25 grade concrete and Fe500 HYSD steel bars. The size of the beam specimen is 1500mm x 150mm x 300mm. The effective depth of beam is calculated as 269 mm by taking 25mm clear cover. The reinforcement detail of the beam is shown in figure 1.

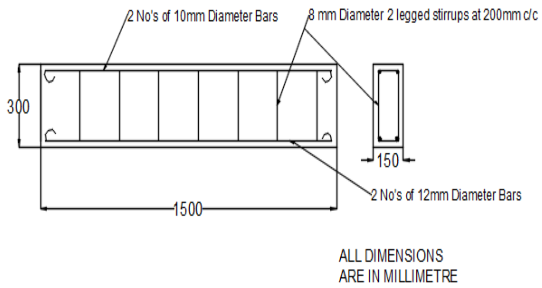

Figure 1. Reinforcement Details of Beam

RESULTS AND DISCUSSION

Flexural Strength of Prism

Flexural strength of concrete prisms with varying percentage of tamarind kernel powder is obtained by carrying out a flexural test in the flexural testing machine.

Table IV. Flexural Strength of Concrete Prisms at 28th Day

SI.NO	*ADDITION OF TKP (%)*	*FLEXURAL STRENGTH (N/mm^2)*
1	0	5.92
2	0.5	6.83
3	1	7.83
4	1.5	8.03
5	2	8.14
6	2.5	8.25
7	3	7.62

Table IV depicts the variation of flexural strength of concrete at 28th day. From the table, it is observed that the flexural strength of concrete is increased with the addition of TKP upto 2.5%, further addition of TKP leads to the decrease of strength. However, the flexural strength of 3% TKP admixed concrete is higher than the conventional concrete. The result of flexural strength test shows that the TKP admixed concrete has higher strength than the control concrete. The maximum strength is obtained for concrete with 2.5% addition of TKP. The strength increment of TKP admixed concrete is 39.4% higher than the control concrete. The strength increment may be due to the higher degree of polymerization of TKP which results in the greater binding force. The lower strength after 2.5% addition of TKP may be due to the prolonged retarding action of TKP high dosage levels.

Flexural Behaviour of Reinforced Concrete Beam

The flexural test is carried to study the flexural behavior of concrete. Two simply supported reinforced concrete beams (Conventional concrete and 2.5% TKP admixed concrete) are tested after 28 days curing and ultimate load carrying capacity is noted.Deflection at the midpoint of beam is measured using dial gauge.

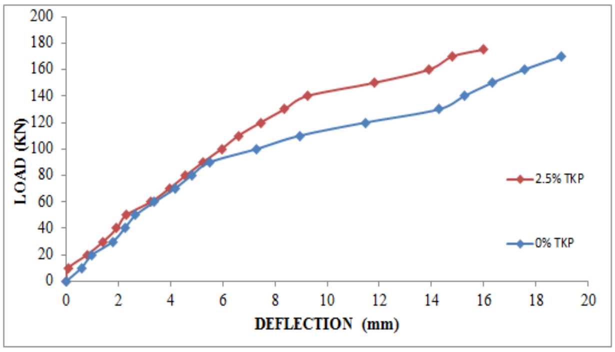

Figure 2. Load Vs Deflection curve for reinforced concrete beams

Figure 2 shows the relation between load and deflection for conventional and TKP admixed reinforced concrete beams. Load deflection behavior of TKP admixed reinforced concrete beam is similar to conventional reinforced concrete beams. The deflection of TKP admixed concrete beams is lower than the conventional concrete.

Table V shows the variation of load, deflection and stiffness value at cracking and ultimate stage with the addition of 2.5% TKP. Stiffness value of concrete is increased with the addition of TKP. The initial crack is observed at 65 kN load for conventional concrete beam whereas initial crack is observed at 70 kN load for TKP admixed reinforced concrete beam. The ultimate load carrying capacity of TKP admixed reinforced concrete beam is 175 KN which is higher than the ultimate load carrying capacity of conventional reinforced concrete beam.

The initial crack width is 0.1 mm for both the beams whereas final crack width is 8 mm for TKP admixed concrete beam and 10 mm for conventional reinforced concrete beam. The crack is propagated from bottom to top in both the beams.

Table V. Variation of Load, Deflection and Stiffness Value at Cracking and Ultimate stage

SI.No	***Addition of TKP (%)***	***Load***		***Deflection***		***Stiffness***	
		Cracking	***Ultimate***	***Cracking***	***Ultimate***	***Cracking***	***Ultimate***
1	0	65	170	3.84	18.99	16.93	8.95
2	2.5	70	175	3.95	15.98	17.72	10.95

CONCLUSIONS

The following are the conclusions made from this experimental study.

- The flexural strength of concrete prisms are increased with the addition of TKP.
- The load carrying capacity of reinforced concrete beam is increased with the addition of TKP.
- Stiffness value is increased for TKP admixed concrete than the conventional concrete.

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