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Experimental Study on Strength of Quarry Dust with Chemical Admixture Using Nylon Fiber

Dr. A. Vijayakumar[1], Revathi K[2], Manojkumar R[3]

[1]Professor and Head of Civil Engineering, Coimbatore Institute of Engineering and Technology, Coimbatore, India
[2, 3]Assistant Professor in Civil Engineering, Coimbatore Institute of Engineering and Technology, Coimbatore, India

Abstract: ***Now a day's fibre reinforced concrete has many applications in concrete and construction industry. In this experimental study an attempt has been made to study the full replacement of fine aggregate by Quarry dust and addition of chemical admixture (SBR Latex) in the concrete to increase the strength. Nylon fibre in percentage of 0.5%, 1% and 1.5% is added to the concrete to overcome the very low tensile strength and resistance to cracking. The compressive strength, spilt tensile strength and flexural strength of conventional concrete and nylon fibre concrete of grade M30 with chemical admixture were studied.***

Keywords: Fibre reinforced concrete, chemical admixture, Quarry dust, Nylon Fibre, Quarry Dust

1. Introduction

Fibre reinforced polymer (FRP) composite materials have been successfully used in the construction of new structures and in rehabilitation of existing structures. Repair with externally bonded FRP reinforcement is a highly practical strengthening system, because of ease and speed of installation, efficiency of structural repair. Bonding of FRP to concrete is faster and less labour intensive. The most commonly used FRP types are NFRP, GFRP, and AFRP. FRP can apply for strengthening a variety of structural members like beams, columns, slabs and masonry wall. Concrete is a rigid material with high compressive strength and weak in tensile strength. Reinforcing bars are used to improve the tensile strength. In addition to that fibres can make the concrete more homogenous and can improve the tensile response, particularly the ductility.

In some developing countries, the needs on reinforcing the concrete bridges are also increased due to unpredictable traffic increase. After reinforcement by FRP, the weight increase and dimension change of the structure are very limited. On the other hand, unlike the conventional steel materials, the FRP has better corrosion resistant property.

Nylon Fibres

Nylon fibre's properties are impacted by the base polymer type, addition of different levels of additive, manufacturing conditions and fibre dimensions. Currently only two types of nylon fibre are marketed for concrete. Nylon is heat stable, hydrophilic, relatively inert and resistant to a wide variety of materials. Nylon is particularly effective in imparting impact resistance and flexural toughness and sustaining and increasing.

Figure 1: Nylon Fibre

2. Materials and Methods

2.1 Materials

2.2.1 Cement

Ordinary Portland Cement (OPC) of grade 53 with normal consistency of 29% conforming to IS: 8112-1989. The specific gravity and fineness modulus of cement are 3.15 and 5% respectively.

2.1.2 Coarse Aggregate

Coarse aggregate of size 20 mm has been selected for this study. The fineness modulus and specific gravity of coarse aggregate are 5.94% and 2.74 as per IS 2386 (part 1)-1963.

2.1.3 Fine Aggregate

River sand was used throughout the study as the fine aggregate conforming to grade zone III. The properties of sand by conducting tests according with IS 2386 (part-1) - 1963. The specific gravity, fineness modulus and moisture content were determined.

2.1.4 Quarry dust

Quarry dust is a waste material obtained from stone quarries while crushing stones, stone crusher dust, which is available abundantly from crusher units at a low cost in many areas, provides a viable alternative for river sand in concrete. Earlier investigation indicates that stone crusher dust has a good potential as fine aggregate in concrete construction. Crusher dust not only reduces the cost of construction but also helps to reduce the impact on environment by consuming the material generally considered as a waste product with few applications. Crusher dust has potential as fine aggregate in concrete structure with a reduction in cost of concrete by about 20 percent compared to conventional concrete.

2.1.5 Water

Water is an important ingredient of concrete and portable tap water available in the laboratory with pH value of 7.0 and conforming to the requirements of IS456-2000 is used for making concrete and curing the specimen.

2.1.6 SBR Latex

SBR Latex is a Styrene Butadiene Copolymer Latex mixed in concrete to improve adhesion and abrasion resistance. SBR Latex is added to the concrete by weight of cement as a chemical admixture. SBR Latex improves the chemical, water resistance of cementitious mixes and improves the bond strength of concrete.

2.2 Concrete Mix Design

In the present study, M30 grade with nominal mix as per IS 456-2000 was used.

Table 1: Mix proportions for M30

S.No	*Cement*	*Fine Aggregate*	*Quarry Dust*	*Coarse Aggregate*	*Water*
1.	1	1.74	--	2.29	0.44
2.	1	--	1.375	2.54	0.44

2.3 Casting and Testing

Quarry dust was added in the concrete as full replacement of fine aggregate. Nylon Fibre was added into the concrete in percentage of 0.5%, 1% and 1.5% for both mixes. Totally 84 cubes, 42 cylinders and 42 beam specimens were casted. Final strength of cube and cylinder are tested for 7 days and 28 days, flexural strength of beam is tested for 28 days. The average compressive strength, split tensile strength and flexural strength are determined for each mix proportions. The final test results are compared with conventional concrete and maximum result of various percentage of nylon fiber with chemical admixture.

3. Results and Discussions

3.1 Test results of Compressive test

The cube specimens are tested for compressive strength at the end of 7 days and 28 days. The compressive strength f_c, of the specimen was calculated using the formula:

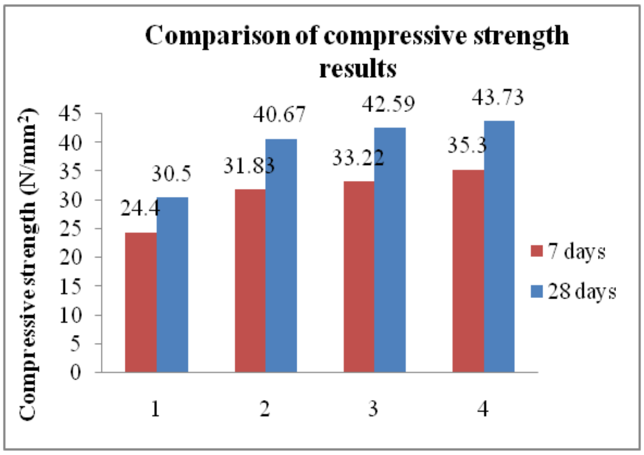
$$f_c = P/A \ \ N/mm^2$$

Where, P = maximum load applied in Newton, A = cross-sectional area calculated from the mean dimensions of the section in mm^2.

The results of the compressive strength tests on concrete cubes are shown in Table 3 (a).

Table 3 (a): Test result of Compressive Strength

S. No	*Percentage of Nylon Fibre*	*Average Compressive Strength (N/mm²)*	
		7 Days	*28 Days*
1.	0%	24.4	30.5
2.	0.5%	31.83	40.67
3.	1%	33.22	42.59
4.	1.5%	35.30	43.73



3.2 Test results of tensile test

The cylinder specimens were tested for tensile strength at the end of 7 days and 28 days. The split tensile strength (f_{ct}) of the specimens was calculated by using the formula

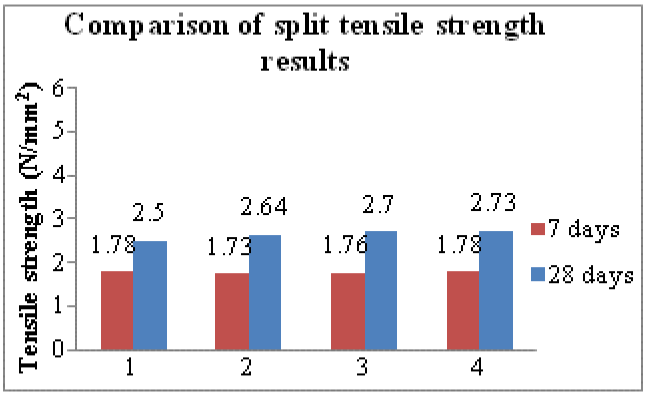
$$f_{ct} = 2P/(\pi LD)$$

Where, P = maximum load applied in Newton L = length of the specimen (in mm) D = cross sectional dimension of the specimen. The results of the tensile strength tests on cylinders are shown in Table 3 (b).

Figure 3: Split Tensile Strength on cylinder

Table 3 (b): Test result of Tensile Strength

S.No	Percentage of Nylon Fibre	Average Tensile Strength (N/mm²)	
		7 Days	28 Days
1	0%	1.78	2.5
2	0.5%	1.73	2.64
3	1%	1.76	2.7
4	1.5	1.78	2.73



3.3 Test results of Flexural Test

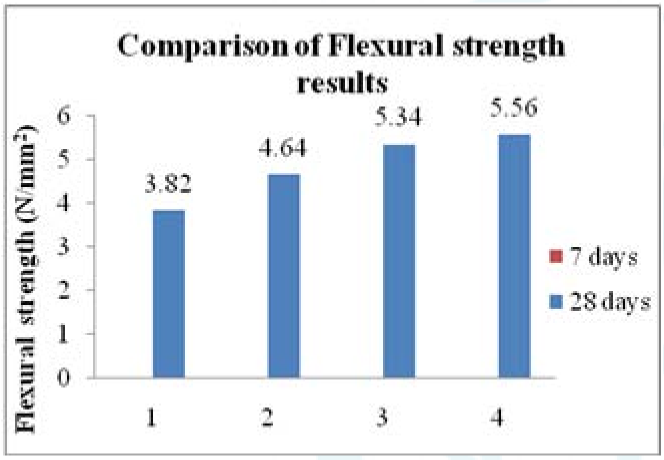
The beams specimens were tested for flexural strength at the end of 28 days. The flexural strength (f_b) of the specimens can be expressed as the modulus of rupture and calculated by using the formula

$$F_b = PL / BD^2$$

Where, F_{cr} = Flexural strength in N/mm^2, P = ultimate load applied to the specimen in N, L = the measured length of specimen in mm, B = the measured width of specimen in mm, D = the measured depth of specimen in mm.

Table 3 (c): Test result of Flexural Strength

S.No	Percentage of Nylon Fibre	Average 28 Days Flexural Strength (N/mm^2)
1	0%	3.82
2	0.5%	4.64
3	1%	5.34
4	1.5%	5.56



4. Conclusions

Based on the experimental study governing the compressive strength, split tensile strength and flexural strength of concrete, the followings conclusion are arrived.

- While comparing the result with conventional concrete with quarry dust replacing fully the fine aggregate result shows that by adding 0.5%, 1% and 1.5% of nylon fiber for M30 grade with chemical admixture (SBR latex) the strength found to be increases than the conventional concrete.
- It is found that at the age of 28 days strength, 30% increase in strength is observed with the conventional concrete.
- Also it is observed that the split tensile strength by adding 1.5% of nylon fiber at 28 days for M30 grade concrete with chemical admixture the strength is increased than the conventional concrete.
- The flexural strength result shows that adding 1.5% of nylon fiber at 28 days for M30 grade concrete with chemical admixture the strength is increased by 8% than the conventional concrete.
- Hence by adding 1.5% of nylon fiber with quarry dust replacing fine aggregate can be used for construction purpose.

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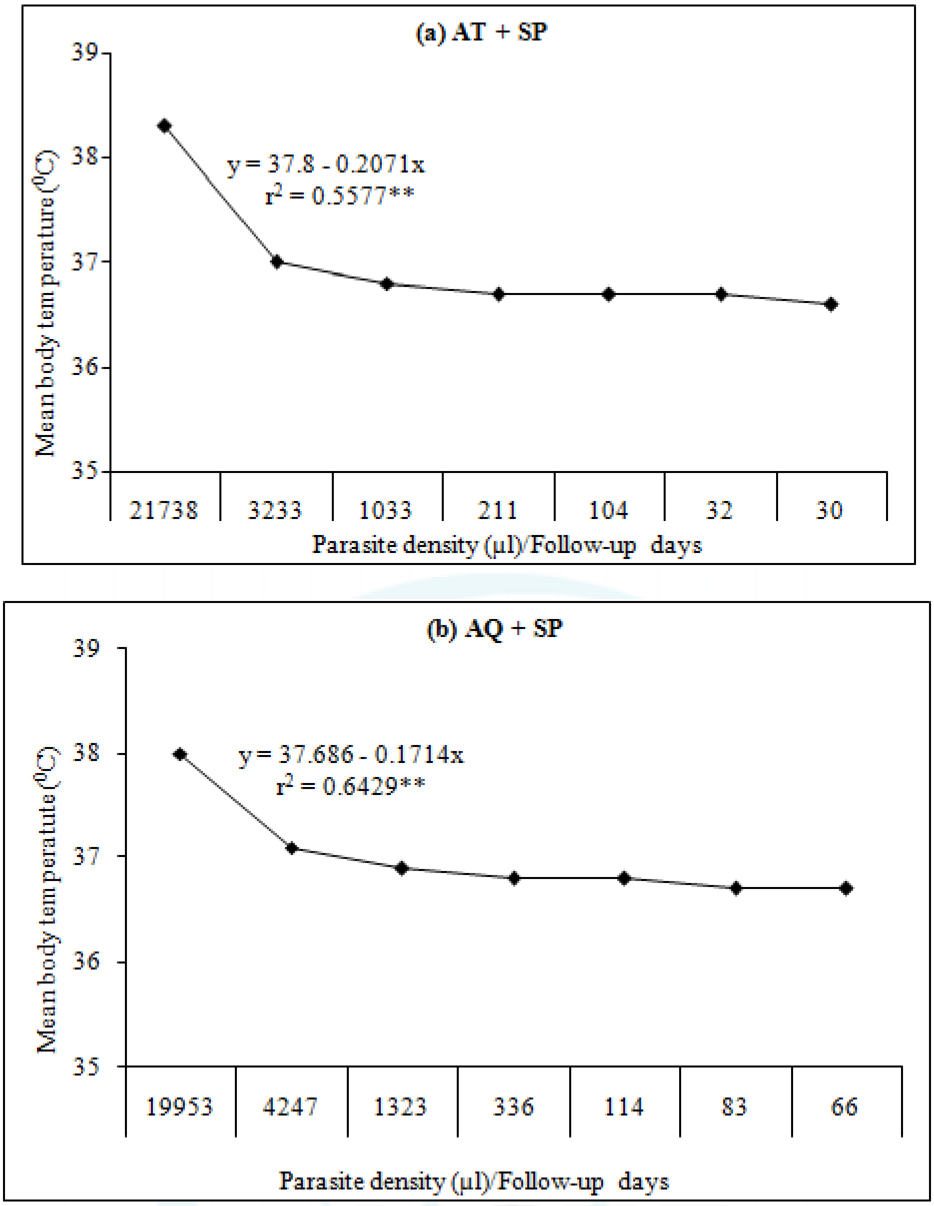

Figure 1: Relationship between parasite densities and body temperature pattern in children administered (a) AT+SP and (b) AQ+SP in *P. falcifarum* treated at Lake-Alau, North Eastern Nigeria

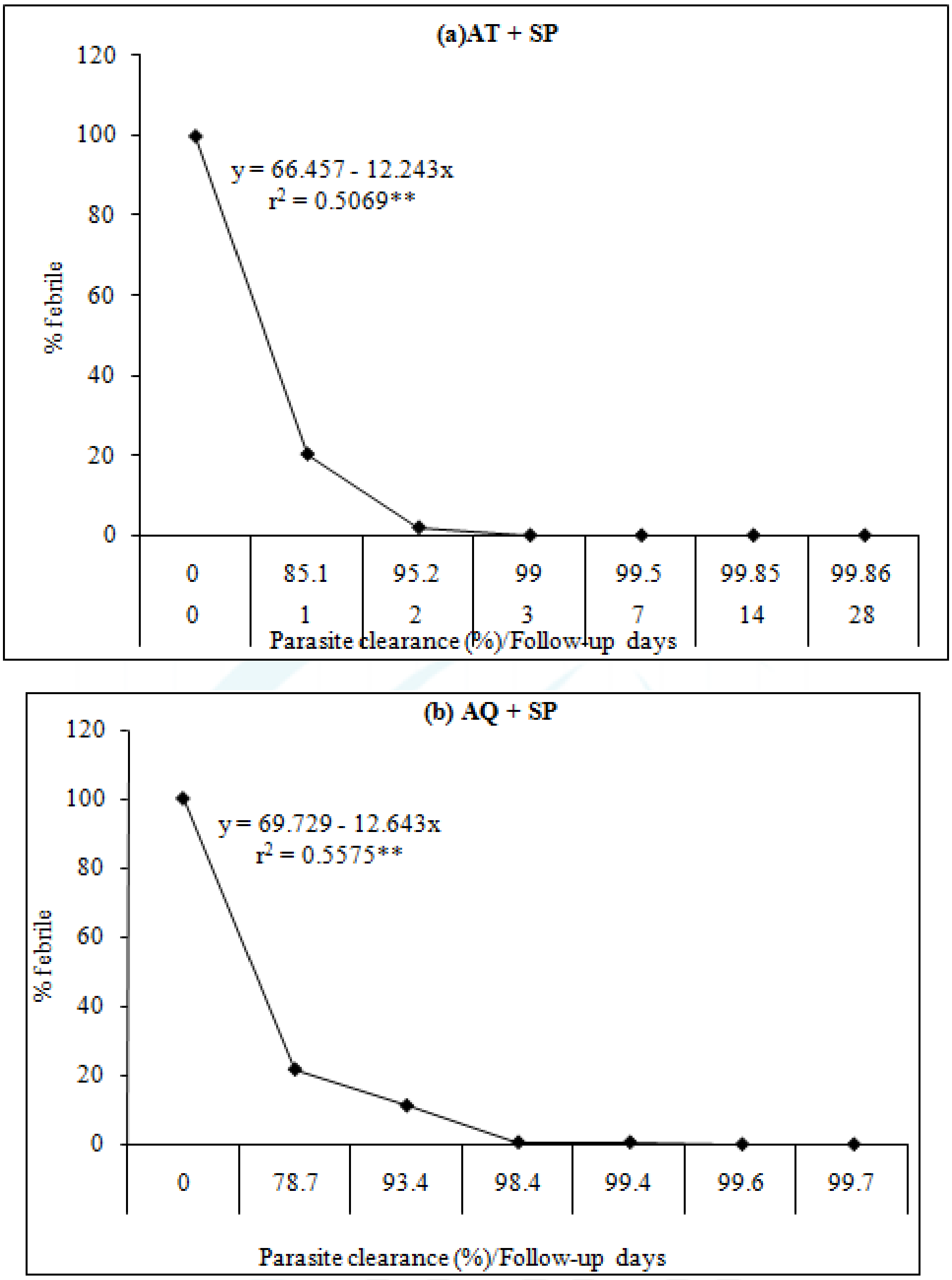

Figure 2: Relationship between parasite clearance and percentage febrile in children administered (a) AT+SP and (b) AQ+SP in P. falcifarum treated at Lake-Alau, North Eastern Nigeria