ISSN 2348 – 7968

Compressive Strength of Concrete using abundantly available desecrate resources as Fine Aggregates

Gowtham.P[1], Sutha.A[2] and Dr.D. Vijayalakshmi[3]

[1] Civil Department, SNS College of Engineering,
Coimbatore, Tamilnadu, India

[2] Civil Department, SNS College of Engineering,
Coimbatore, Tamilnadu, India

[3] Civil Department, SNS College of Engineering,
Coimbatore, Tamilnadu, India

Abstract

Concrete is one of the most popular construction materials. Due to this fact, the construction industry is always trying to increase its uses and applications and improving its properties, while reducing cost. This paper is part of a research investigating the structural characteristics of concrete using various combinations of lateritic sand and lime stone filler as complete replacement for conventional river sand fine aggregate and junk tyres as partial replacement for coarse aggregate in the production of conventional concrete. This experimental study is conducted to analyze the behavior and failure characteristics of concrete where copiously accessible desecrate resources are used as fine coarse aggregates. The first type of concrete are made using varying contents of laterite and lime stone filler as fine aggregate. The quantity of laterite was varied from 0% to 100% against lime stone filler at intervals of 25%. The second type of concrete was made using recycled rubber from automotive tyres is used as a partial aggregate. The replacement of coarse aggregate by junk rubber in concrete has resulted in reduced compressive strengths and densities. The reductions in compressive strength and density depended on the amount of rubber added.

Keywords: Laterite, Limestone filler, Junk tyre, Compressive Strength, Replacement.

1. Introduction

The huge quantity of concrete is consumed by construction industry all over the world. In India, the conventional concrete is produced using natural sand from river beds as fine aggregate. Coarse aggregate, which is one of the constituent used in the production of conventional concrete, has become highly expensive and also scarce. Decreasing natural resources poses the environmental problem and hence government restriction on sand quarrying resulted in scarcity and significant increase in its cost. Digging sand, from river bed in excess quantity is hazardous to environment. The deep pits dug in the river bed, affects the ground water level. In order to fulfill the requirement of fine aggregate, some alternative material must be found. The cheapest and the easiest way of getting substitute for natural sand is obtained from limestone quarries, lateritic sand and crushing natural stone quarries is known as manufactured sand. Waste tyre dumping or disposal of these materials causes environmental and health problems. Waste tyre management is a serious global concern. Millions of waste tyres are generated and stock piled every year, often in an uncontrolled manner, causing a major environmental problem. The public, governments and industry are all greatly interested in green design and engineering approaches towards better environmental quality and sustainable development. At the same time, these studies can help producers to take conservative action aimed at making the environmental impact less harmful and as an emerging use is the production of concrete. Concrete made with lateritic sand and lime stone filler as complete replacement for conventional river sand fine aggregate in concrete can attain more or less same compressive strength, tensile strength, permeability, modulus of rupture and lower degree of shrinkage as the control concrete. Millions of waste tyres are generated and stock piled every year, often in an uncontrolled manner, causing a major environmental problem. As tyres are durable and not naturally biodegradable, they remain in dump sites with little degradation overtime, presenting a continuing environmental hazard. Therefore, recycling of copiously accessible materials plays a vital role in concrete.

2. Aim of the Study

Fully replacement of lateritic sand and lime stone filler by natural sand and junk tyres as coarse aggregate. The study is mainly done to find the compression strength, corrosion resistance, tensile strength and economy in practice.

ISSN 2348 – 7968

3. Properties of Junk tyres

3.1 Physical properties

Table 1: Physical properties of Junk tyres

S. No	*Physical property*	*Typical values*
1	Angle of friction	19^0-26^0
2	Bulk density	350-500 kg/m
3	Compacted density	600-700 kg/m
4	Cohesion(kpa)	5-1
5	Compressibility	20-50%
6	Loose Bulk density	3.3-4.8 kN/m^3
7	Particle size	12.5 – 20mm
8	Poisson's ratio	0.2 – 0.35
9	Resilient modulus	1 – 2 Mpa
10	Specific gravity	1.09
11	Abrasion	0%
12	Water absorption	0%

3.2 Chemical properties

Tyres are complex combination of metals, minerals and hydrocarbons. Car and van tyres made of artificial rubber (styrene and butadiene). Lorry tyres mostly made of natural rubber. They made of vulcanized (cross linked polymer chains). Most commonly used tyre rubber is styrene-butadiene co-polymer- SBR containing 25% styrene. However this may be virgin rubber, synthetic rubber or recycled tyre rubber. Rubber constitutes approximately 30% of a tyre by weight with the remainder made up from other constituents including steel, nylon, rayon, carbon black, fiber glass, agamid and brass. In this process we have taken to find chemical components in the shredded pieces tyres.

4. Experimental Procedure

Portland Pozzolana Cement of 53 grades conforming to IS: 1489-1991(Part 1) was used in this process which contains 23% fly ash. Averagely the proportion of fly ash used as Pozzolana can vary between 15% to 35% by weight of cement as stipulated by code. Coarse aggregates has been substituted by 10% and 15% of Junk tyre rubber of size vary into 12.5-20mm.The mix ratio for the replacement of fine aggregate is prepared for 1:2:4, 1:1.5:3 and 1:1:2, for both conventional and also lateritic and lime stone filler. The fine aggregate portion of the mix was achieved by combining lateritic and lime stone filler in ratio with 25%-75%, 50%-50% and 75%-25%. The materials were then mixed thoroughly before adding the prescribed quantity of water and then mixed further to produced fresh concrete. Water cements ratios of 0.55 were adopted. The mix proportion to be used for experimental study was arrived by doing a detailed. Concrete mix design and the method used is Indian Standards recommended method of concrete mix design IS: 10262-1982. Water cement ratio required for the target mean strength from the IS: 10262-1982 is 0.48. Nominal mix and rubberized concrete mix has prepared. Dimensions of 150*150*150mm moulds were used to prepare cubes for compressive strength tests and 150mm diameter and 300mm length cylindrical specimens were used for split tensile strength tests. Compressive strength, split tensile strength was measured in concrete specimens. The cube specimens were tested for compressive strength at the end of 3,7,14 & 28 days. The specimens stored in water were tested after drying the specimen's code conforming to (IS: 516-1959). Placing a cylindrical specimen horizontally between the loading surfaces of a Universal testing machine carries out this test and the load is applied until failure of the cylinder, along the vertical diameter. Split tensile strength test code conforming to IS: 5816-1999.

5. Results and Discussion

The results of the present investigation are presented in tabular form. In order to facilitate the analysis, interpretation of the results is carried out at each phase of the experimental work.

It was found that 0.48 water/cement ratio produced higher compressive strengths and better workability for M20 mix, proportion. Specifically compressive strength ranged from 21.06 -35.2 N/mm^2 for the mixes considered.

Test results of 28 days rubberized concrete shown 10%,15% replacement of junk tyre rubber gives low compressive strength than conventional concrete specimens. Rubberized concrete gives less compressive strength is not required.

TABLE 2 - Compressive Strength of Conventional Concrete and LAT & LSF Concrete

Type of Concrete	*Mix ratio*	*Compressive strength for various mix ratio's*		
		7 days	*14 days*	*28 days*
Normal concrete	1:2:4	16.64	19.16	21.06
	1:1.5:3	22.12	27.12	33.12
	1:1:2	22.43	27.26	34.43
25% LAT:75lime stone filler	1:2:4	20.14	21.26	26.01
	1:1.5:3	26.72	30.12	36.12
	1:1:2	25.43	28.26	35.03
50% LAT :50lime stone filler	1:2:4	15.34	19.06	20.06
	1:1.5:3	20.42	26.72	35.12
	1:1:2	21.63	27.06	34.53
75% LAT :25lime stone filler	1:2:4	13.64	15.16	19.06
	1:1.5:3	18.12	20.12	23.12
	1:1:2	17.43	21.26	23.43

TABLE 3 - Compressive Strength of Conventional Concrete and Rubberized Concrete with 10% and 15% replacement

S. No	*Duration*	*Conventional concrete (N/mm^2)*	*Rubberized concrete 10% replacement (N/mm^2)*	*Rubberized concrete 15% replacement (N/mm^2)*
1.	3 Days	12.75	18.04	16.21
2.	7 Days	16.45	19.43	17.70
3.	14 Days	22.09	20.25	19.29
4.	28 Days	24.30	22.41	20.08

The 7days compressive strength of conventional concrete, 50%-50% (Lat & LSF)and 75% - 25%(Lat & LSF) concrete 21.03% ,31.29% and47.6% of compressive strength is reduced when compared to the 25% - 75%(Lat & LSF) concrete which is found that 1:2:4 mix ratio. The compressive strength of conventional concrete, 50%-50% (Lat & LSF) and 75% - 25%(Lat & LSF) more or less same having M20 and M25grade of concrete. The Results of this test are show in table .1

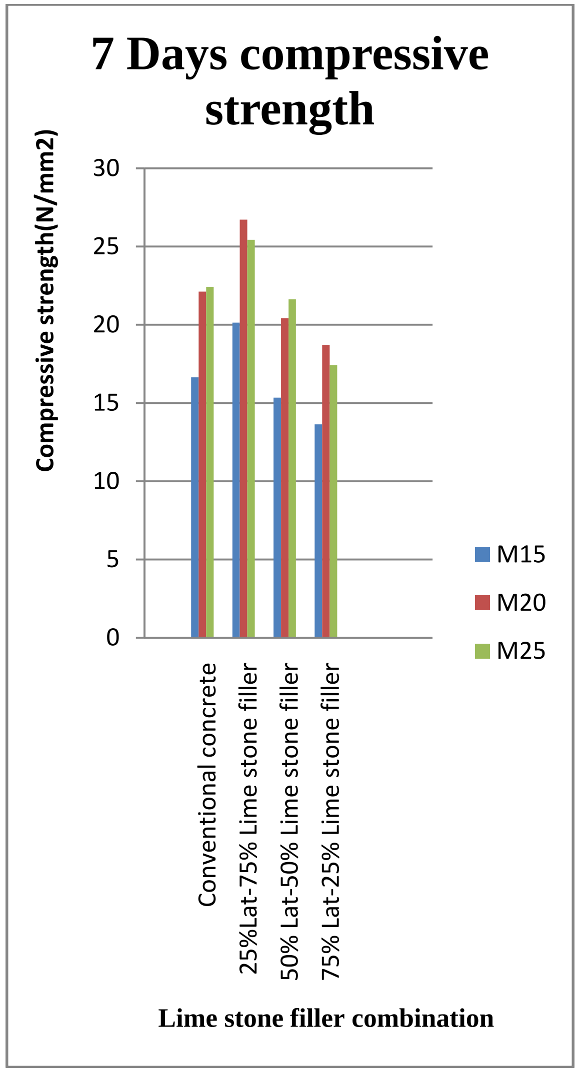

Fig. 1: 7 Days Compressive strength results..

The 14 days compressive strength of conventional concrete, 50%-50% (Lat & LSF)and 75% - 25%(Lat & LSF) concrete 10.96 % ,11.54 % and40.23% of compressive strength is reduced when compared to the 25% - 75%(Lat & LSF) concrete which is found that 1:2:4 mix ratio. The compressive strength of conventional concrete, 50%-50% (Lat & LSF)and 75% - 25%(Lat & LSF) more or less same having M20 and M25 grade of cocrete. The Results of this test are show in table .1

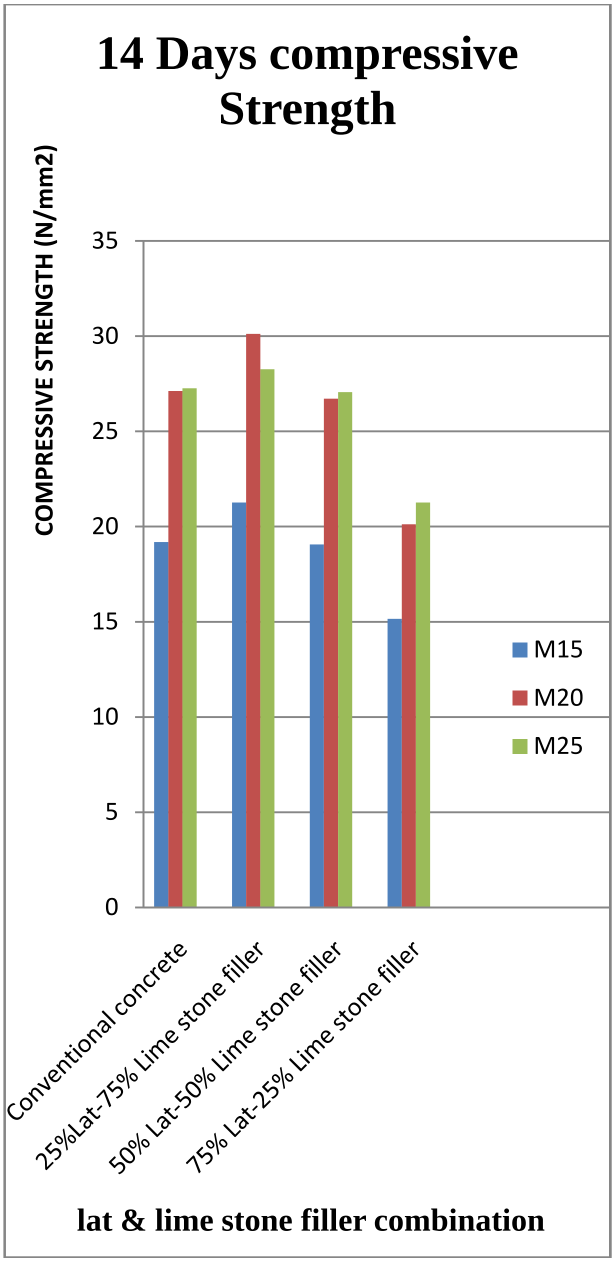

Fig. 2: 14 Days Compressive strength results.

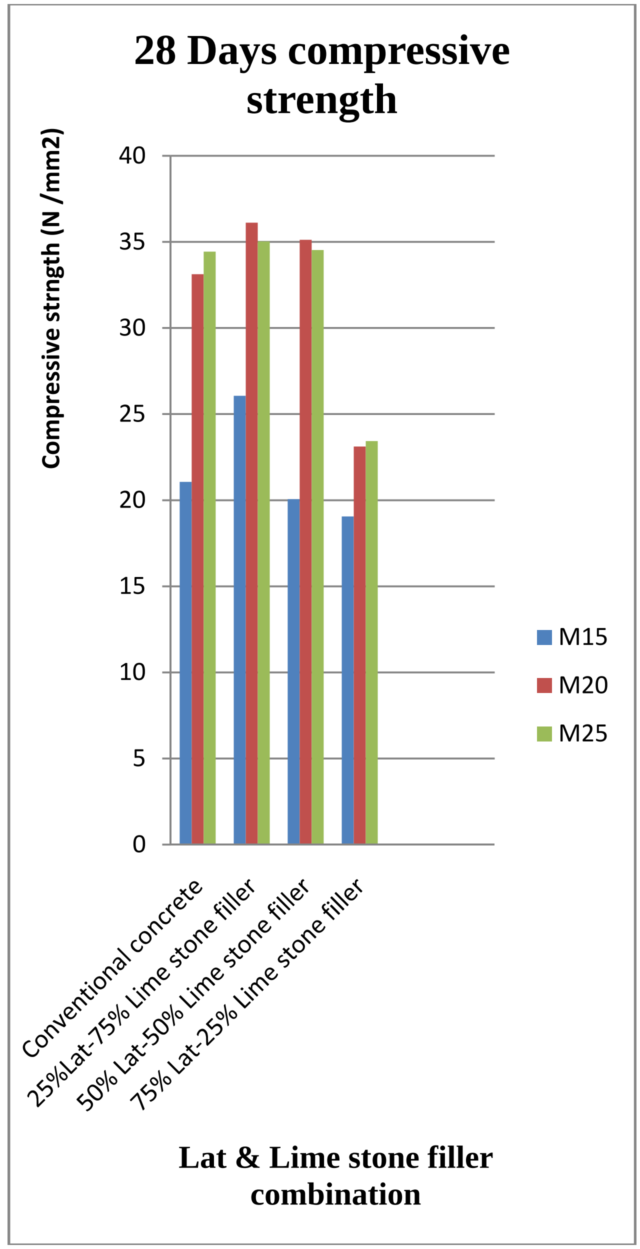

Fig. 3: 28 Days Compressive strength results.

The 28 days compressive strength of conventional concrete, 50%-50% (Lat & LSF) and 75% - 25% (Lat & LSF) concrete 23.30 % ,22.74 % and 36.64 % of compressive strength is reduced when compared to the 25% - 75%(Lat & LSF) concrete which is found that 1:2:4 mix ratio. The compressive strength of conventional concrete, 50%-50% (Lat & LSF) and 75% - 25% (Lat & LSF) more or less same having M20 and M25 grade of concrete. The Results of this test are show in table .1

6. Conclusion

- It can be seen from the results of this study that the combination of laterite and lime stone filler replaces the conventional river sand in the production of concrete for construction industry.
- The compressive strength of concrete using lateritic sand lime stone filler was measured in the laboratory.

Compressive strength was found to increase with age as for normal concrete.

- The 28 – day compressive strength was found 21.06 - 35.2 N/mm2. for different mixes. the above strength properties the proportion of 25% laterite to 75% lime stone filler produced higher values of compressive strength. Further work is required to get data for other structural properties of the experimental concrete.
- Utilization of waste tyres in the study process has been focus to reduce tyre wastes ,economic, environmental management.
- Test results of 28 days rubberized concrete shown 10%, 15% replacement of junk tyre rubber gives low compressive strength than conventional concrete specimens.
- Rubberized concrete is also a Light Weight Concrete.
- Fast growing world motor vehicle usage is increasing in every year, Promotable future product for replacement of coarse aggregates.
- Alternative to coarse aggregate to recycle tyres helping the conservation of the environment. Reduce the natural source utilization ,improve to use modified materials,
- Rubberized concrete give low compressive strength which cannot be used in conventional concrete, where as this can be used where high compressive strength not required.

Acknowledgments

The authors like to thank the Management for the Infrastructural Support for the successful execution of the project and also the faculty members of the Department of civil engineering for their moral Technical support.

References

[1] Joseph O. Ukpata, Maurice E.Ephraim and GodwinA. Akeke.(2012). “Compressive strength of Concrete using Lateritic Sand and Quarry Dust as Fine Aggregate.”Arpn Journal of Engineering and Applied Sciences, Junuary 2012.Volume 7,No.1.

[2] M.R.F.Goncalves, C.P.Bergmann,(2012). “ Thermal insulators made with rice husk ashes Production and correlation between properties and microstructure.” Constr. Build. Mater. 21 (2007) pp.2059-2065.

[3] K. Ganesan, K. Rajagopal, K. Thangavel,(2008). “ Rice husk ash blended cement: Assessment of optimal level of replacement for strength and permeability properties of concrete.” Constr. Build. Mater., **22** (8) (2008) pp.1675-1683.

[4] Mohammad Reza Zamani Abyaneh, Seyed Mahdi Mousavi, Alireza Mehran, Seyed Mohammad, Mahdi Hoseini, Soroosh Naderi, Farhad Mesbah Irandoost,(2013). “Effects of Nano silica on Permeability of concrete and steel Bars Reinforcement Corrosion.”Australian Journal of Basic and Applied Science,7(2):464-467, 2013.

[5]Prince Arulraj.G, Jemimah Carmichael.M,(2011). “Effect of Nano –Flyash on Concrete.” International Jouranal of civil and structural Engineering ,November 2011.Volume 2, No 2, 2011.