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Effect of Natural Rubber Latex on Mechanical Properties of Concrete with Manufactured Sand as a Complete Replacement to River Sand

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Abstract – Construction industry development needs a better and durable concrete, ordinary Portland cement has satisfies the some of the requirements but it fails to satisfies all the requirements which construction industry especially ,concrete industry take care about the harden properties of the concrete since concrete withstand for various environment .of current production of ordinary concrete is insufficient to support the growth and need of the construction industry especially in the high rise building project and projects involving chemical attack. Therefore durable concrete is needed for the great understand about comparison the mechanical strength between river sand and M sand using rubber latex modified concrete, it is important to know the rubber latex on the fresh and hardened properties of the concrete. Latex modified concrete have good binding properties and good adhesion with aggregate. Rubber latex provides compressive, tensile, flexural strength to the concrete compare to the concrete without latex. This experimental study puts forward the applications of manufacture sand as an attempt towards sustainable development. It will help to find viable solution to the declining availability of natural sand to make eco balance. The present investigation is an attempt to study the strength of concrete with use of natural sand and 100% replacement of manufacture sand with varying percentage of rubber latex ranging from 0%-1.2% at an interval of 0.3% as an additive by the weight of cement. For the percent study M30 grade concrete is designed and mechanical properties of the concrete is studied in terms of compressive, flexural & split tensile.

***Key Words*: Compressive Strength, Compaction Factor Test, Concrete, Flexural Strength, Manufactured Sand, Natural Rubber Latex, Split Tensile Strength.**

1. INTRODUCTION

In India the annual consumption of cement is in the order of 22 million tons. Concrete is a site-made material unlike other materials of construction and as such can vary to a very great extent in its quality, properties and performance owing to the use of natural materials except cement.

Now a days sand is becoming a very scarce material, in this situation research began for inexpensive and easily available alternative material to natural sand. Some alternatives materials have already been used as a part of natural sand e.g. fly-ash, slag limestone and siliceous stone powder are used in concrete mixtures as a partial replacement of natural sand. However, scarcity in required quality is the major limitation in some of the above materials. Now a day's sustainable infrastructural growth demands the alternative material that should satisfy technical requisites of fine aggregate as well as it should be available abundantly. Thus, Manufactured Sand has been incorporated in concrete mix design by replacing sand in fixed proportions or completely for economic considerations. Latest studies have been conducted considering the possibility of using Manufactured Sand as a complete replacement of sand without impairing the strength and its durability.

The introduction of Natural Rubber Latex provides enhancement in Mechanical properties of Concrete in a long run. It substantially increases the Compressive Strengths, Flexural Strengths, Split Tensile strengths with a normal concrete.

2. LITERATURE REVIEW

VINAYA K L et al [1], Concrete designed as per IS:10262-2009 and its mix ratio were found to be 1:1.67:2.7:0.45. M70 grade was designed as per ACI method and its mix ratio was found to be 1:0.95:1.25:0.28:2. Then NRL was added at various percentage (0%,0.3%,0.6%,0.9%,1.2%,1.5%) for the both M30 and M70 grade concrete. This study illustrates the effect of NRL addition to the concrete in small increment in the strength. **DR.VAISHALI G et al [2],** In order to study the behavior of natural rubber latex modified fiber reinforced high performance concrete (NRLMFRHPC) in INDIA, and also to understand the effect of NRL on metakaoline based NRLMFRHPC, a total no of 81 mixes have been tried. The 28 days compressive strength of NRLMFRHPC mixes increases with increase in percentage of rubber latex up to 0.5%. It can further be observed that the maximum compressive strength of 103.67 mpa is achieved at 0.5% of NRL and 1% of steel fiber at water binder ratio of 0.325. **M.S. SHOBHA et al [3],** An experimental work has been planned to find the mechanical properties of metakaoline blended NRL modified high performance concrete. From this investigation the exact percentage of NRL and metakaloine to be added to concrete is found. From the experimental work it has been observed that optimum dosage of NRL is found to be 1% by the weight of cement in the concrete. The replacement of cement by metakaoline is found to be 10%. There is improvement in

strength at this percentage replacement by metakaoline. Replacing the cement by MK and inclusion of NRL not only improves mechanical properties but also makes the construction economical. **MANIKANDHAN K.U. et al [4]** In this experiment cubes and cylinder of M70 grade concrete have been cast with reverse sand as fine aggregate and tested for cubes compressive strength and split tensile strength. Cubes and cylinders M70 grade concrete have been cast with M sand as fine aggregate and tested for cube compressive strength and split tensile strength. Based on the experimental investigation 7days and 14 days strength of concrete with river sand is higher when compared with the strength of concrete with M sand. 28 days strength of concrete with m sand is higher than that of river sand. Also due to the superior gradation of M sand gave good plasticity to mortar providing excellent workability. **PRIYANKA A, et al [5],** The main objective of the present work has to be systematically study the effect of water cement ratio and percentage of replacement of manufacture sand by natural sand as 0.4,0.45,0.5and 0%, 20% ,40%, 60%, 80%, and 100% respectively on the strength properties of concrete. The compressive, split, tensile and flexural strength of concrete with 60% replacement of natural sand by manufacture sand reveals higher strengths compared to reference mix. These results were compared with previous work then found that, present study gives better strength and higher water cement ratio gives better workability. Based on the existing literature reviews there has not been much work done on effect of rubber latex on mechanical properties of concrete with M sand as a replacement to natural sand. Hence this experimental study is an attempt to known the behavior of M sand concrete due to addition of rubber latex on mechanical properties of concrete.

3. MATERIALS USED

3.1 Material Properties

3.1.1 Cement

Ordinary Portland cement of Birla super of grade 53 conforming to IS 12269:1987 was used. The properties of cement are given in the table 1.

Table 1: Properties of Cement

SL.NO	PROPERTIES	RESULTS
1	Specific gravity	3.15
2	Standard consistency	33%
3	Initial setting time	90 minutes
4	Final setting time	300 minutes
5	Fineness of cement	4%

3.1.2 Fine Aggregate and Coarse Aggregate

M-sand, clear from organic impurities conform to IS 4031: 1988 and crushed stones of 20mm, 12.5mm and 6mm sizes conform to IS 2386: 1963 part 3 were used Properties of fine (M Sand & Natural Sand) and coarse aggregate are shown in Table 2, Table 3 & Table 4 respectively.

Table 2: Properties of Fine Aggregate (Manufactured Sand)

SL NO.	Properties	Results
1	Specific gravity	2.64
2	Sieve analysis	Zone II Table 4 of IS 383 (1970)
3	Water absorption	0.52%

Table 3: Properties of Fine Aggregate (Natural Sand)

SL NO.	Properties	Results
1	Specific gravity	2.62
2	Sieve analysis	Zone II Table 4 of IS 383 (1970)
3	Water absorption	0.52%

Table 4: Properties of Coarse Aggregate

SL NO.	Properties	Results
1	Specific gravity	2.56
2	Sieve analysis	20mm Downsize Zone I Table 2 of IS 383 (1970)
3	Water absorption	nil
4	Aggregate Impact Value	24.86%

3.1.3 NATURAL RUBBER LATEX

The Natural Rubber latex is collected from ASSOCIATED LATEX (INDIA) LIMITED having its Administrative Office at P.B. NO.1117, Beach Road, Calicut. The properties of Natural Rubber Latex are presented in Table 5.

Table 5 Physical properties of Rubber latex

S.No	**Property**	**Rubber latex**
1	Color	White
2	Total Solid Content (% By Weight)	61.5 Max
3	Dry Rubber Content (% By Weight)	60 Min
4	Non Rubber solid content	1.50 Max
5	KOH Number	0.55 Max
6	Ammonia content , NH3 %	0.70 Max
7	Mechanical stability time	600 TO 1200
8	Volatile Fatty Acid Number	0.10 Max
9	Magnesium Content	8
10	P_H	10.4 Min
11	Coagulum Content , % By Mass	0.01 Max
12	Sludge Content, % By Mass	0.01 Max

13	Copper content As PPM	5
14	IRON content As ppm	8
15	Particle size of Rubber latex	0.2 m
16	Specific Gravity of Rubber latex	0.94

4. EXPERIMENTAL INVESTIGATION

4.1 Concrete Mix Design

Concrete mix design was done as per IS 456:2000 and IS 10262:2009. Mix proportion for M30 mix is given in table 6.

Table 6: Mix Proportion for fine Aggregate (for both manufactured Sand & natural sand)

SL. NO	Materials	Quantity(kg/m^3)
1	Cement	437.77 kg/m^3
2	Fine Aggregate	649.57 kg/m^3
3	Coarse Aggregate	1072.51 kg/m^3
4	Water	197 kg/m^3
5	Water cement ratio	
Mix Proportion(C:FA:CA:W)		1:1.5:2.5:0.45

5. EXPERIMENTAL TEST RESULTS & DISCUSSIONS

5.1 Workability Test

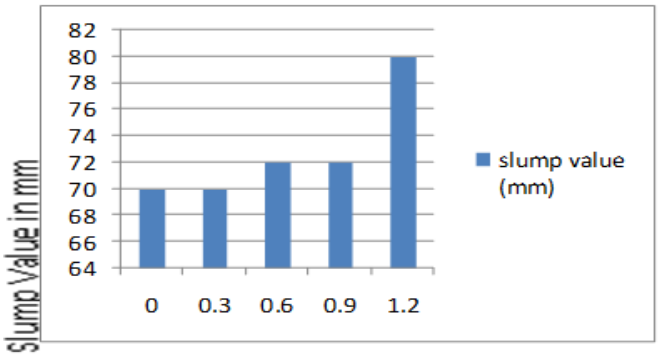

Chart- 1. Slump Value (in mm) vs. % NRL for M sand for 0.45 water cement ratio

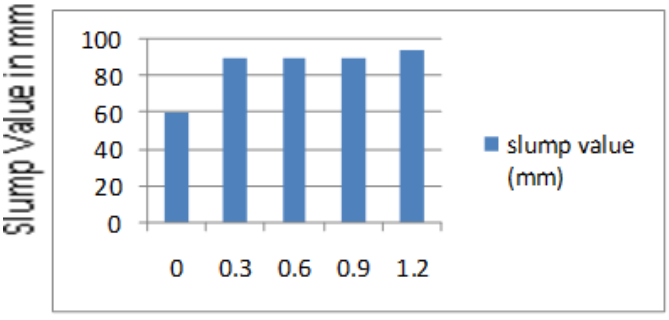

Chart- 2. Slump Value (in mm) vs. % NRL for R sand for 0.45 water cement ratio

5.2 Compressive Strength Test

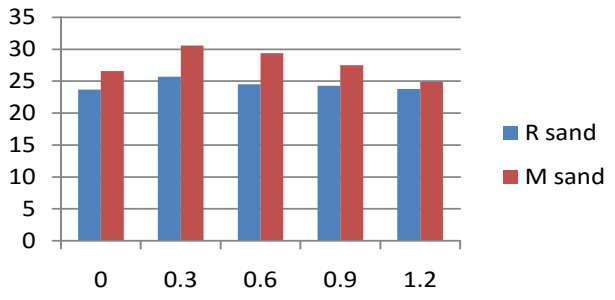

Chart- 3. Compressive Strength (in Mpa) for 7 days vs. % of NRL

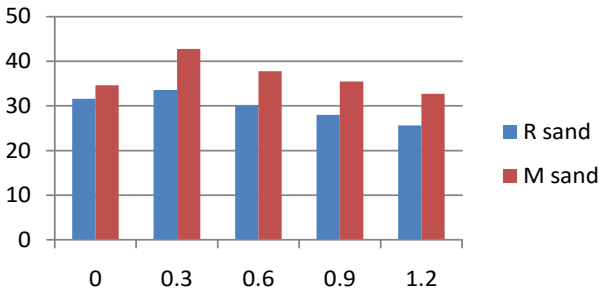

Chart- 4. Compressive Strength (in Mpa) for 14 days vs. % of NRL

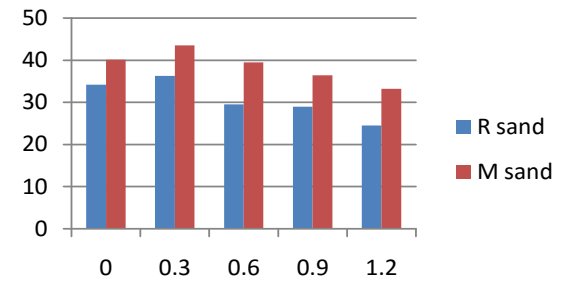

Chart- 5. Compressive Strength (in Mpa) for 21 days vs. % of NRL

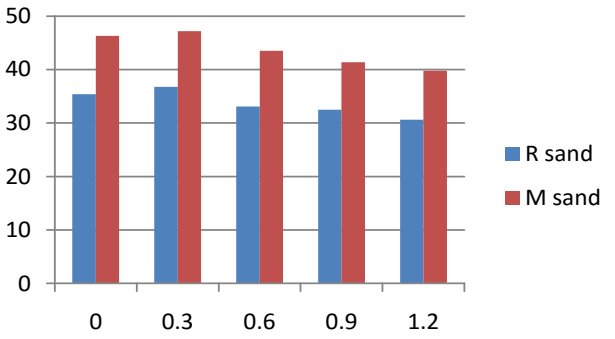

Chart- 6. Compressive Strength (in Mpa) for 28 days vs. % of NRL

5.3 Tensile Strength Test

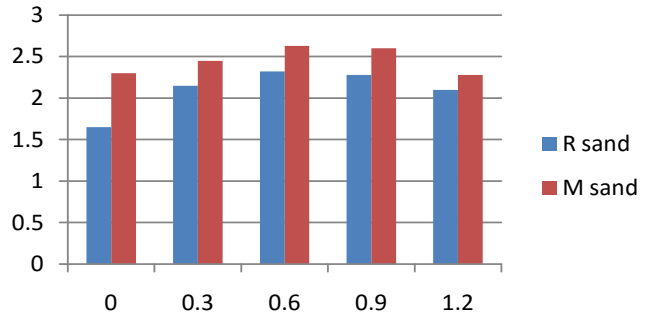

Chart- 7. Tensile Strength (in Mpa) for 7 days vs. % of NRL

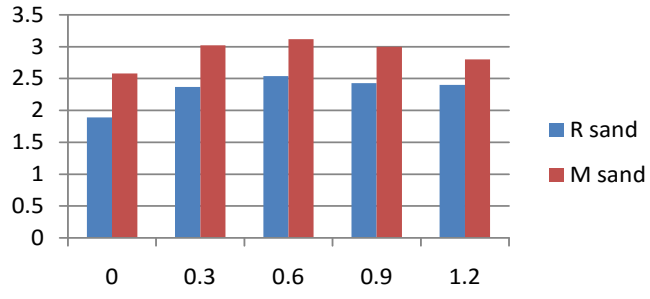

Chart- 8. Tensile Strength (in Mpa) for 14 days vs. % of NRL

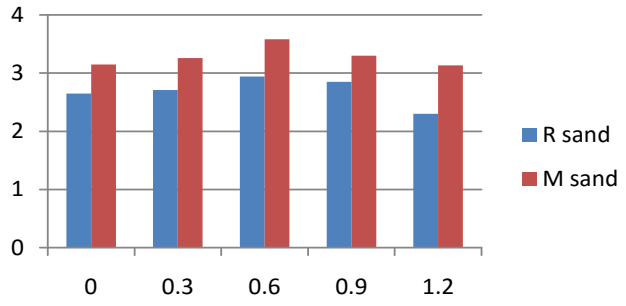

Chart- 9. Tensile Strength (in Mpa) for 21 days vs. % of NRL

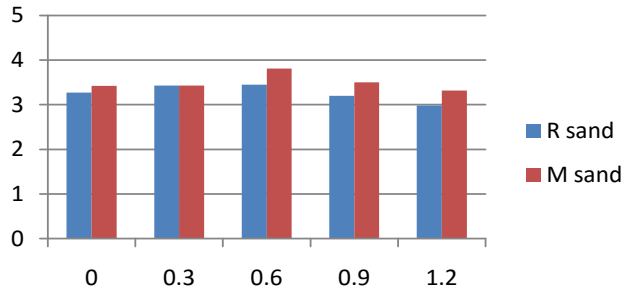

Chart- 10. Tensile Strength (in Mpa) for 28 days vs. % of NRL

5.4 Flexural Strength Test

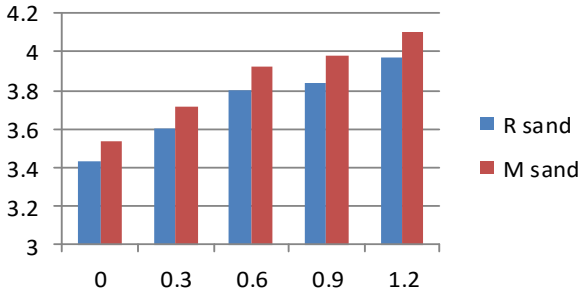

Chart- 11. Flexural Strength (in Mpa) for 7 days vs. % of NRL

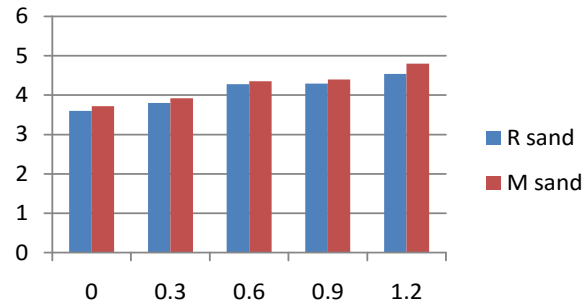

Chart- 12. Flexural Strength (in Mpa) for 14 days vs. % of NRL

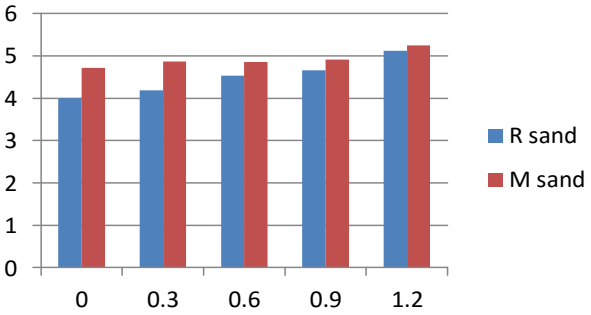

Chart- 13. Flexural Strength (in Mpa) for 21 days vs. % of NRL

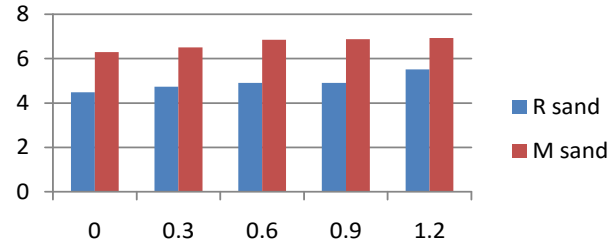

Chart- 14. Flexural Strength (in Mpa) for 28 days vs. % of NRL

6 CONCLUSIONS

Following conclusion were drawn from this experimental work.

- Present experimental study shows that the strength in concrete by adding various percentage of NRL on both river sand and m sand, gives the optimum percentage of NRL as 0.3% by the weight of cement for compressive strength, and further increase in NRL percentage resulted in decrease of strength.
- The behavior of concrete under split tensile strength resulted that there is considerable gain in strength with increase in NRL % up to 0.6% and further increase in NRL percentage resulted in decrease of strength.
- But in flexure, the strength goes on increases as the % of NRL increases in both River and M sand.
- In 100% Replacement of Natural sand by M sand, the Compressive strength increases by 28.26%, which is maximum.
- In 100% Replacement of Natural sand by M sand, the Split Tensile strength increases by 10.43%, which is maximum.
- In 100% Replacement of Natural sand by M sand, the Flexural strength increases by 20.34% which is maximum.
- In workability test, the slump value increases as increase in percentage of NRL on both M sand and river sand.
- As observed in the above experimental work NRL increases the strength of normal strength concrete linearly up to 0.3% for Compression and 0.6% for Split tensile strength. But in flexure strength is increases as the percentage of NRL increases.
- Results show that the river sand can be fully replaced by manufacture sand.

REFERENCES

[1] Vinaya K L, Sanjth J, Ranjith A, Kiran B M (2014), "Effect of natural rubber latex on normal and heigh strength concrete", Post Graduate Student, Assistant professor, Civil Engineering, AIT Chikmangaluru,

[2] Dr.Vaishali.G.Ghorapade, Sri. K. Munirathnam, Dr. H. Sudarsana Rao / International Journal of Engineering Research and Applications (IJERA) ISSN:2248-9622,Vol.3,Issue 3, May-June 2013, pp.827-831."Efffect of NRL on strength and workability of fiber reinforced high performance-concrete with metakaoline admixture."

[3] M.S. Shobha (2014), "Mechanical properties of latex modified high performance concrete", IOSR Journal of mechanical and civil Engineering (IOSR-JMCE) e-ISSN:2278-1684, p-ISSN:2320-334X, Volume 11,Issue 1 Ver. 111(jan.2014), PP 13-19

[4] Mani kandhan. K. U, Sathya Kumar. N,Sakthivel. R, "Effect of replacement of river sand by M sand in high strength concrete", Department of civil Enagineering, Bannari Amman Institute of Technology, International Journal of Modern Trends in Engineering and Research.

[5] Priyanka A, Jadhav, Dilip K. Kulkarni, (2013) "Effect of replacement of natural sand by manufactured sand on the properties of cement mortar", Research Scholar, Civil Engineering Department, India Institute of technology, Bombay, Maharashtra, India-400 076.

[6] V. Syam Prakash (2007) "Ready mixed concrete using manufactured sand as fine aggregate", College of Engineering, Trivandrum, Kerala, India, 32nd Conference on OUR WORLD IN CONCRETE & STRUCTURES: 28-29 August 2007,Singapore

[7] Nimitha Vijayaraghavan and A S Wayal (2013) "Effect of manufacture sand on compressive strength and workability of concrete", ISSN 2319-6009, BOL. 2, No.4, November 2013

[8] M. ADAMS JOE, et.al. , "Experimental investigation on the effect of M sand in high performance concrete" American Journal of Engineering Research (AJER), e-ISSN:2320-0847 P-ISSN:2320-0936 Volume-02, Issue-12, pp-46-51

[9] Properties of Concrete - Neville, A.M. – ELBS Edition, Longman ltd, London.

[10] Concrete Technology – M.S. Shetty, A.R. Santhakumar, - Oxford University Press.

BIOGRAPHIES

Suman Luitel received the BE in civil Engineering degree from Visveswaraya Technological University. He has a keen interest on Research on Concrete, Alternative Building Materials, Prestress Concrete, and Structures & Material Science, Seismic Design, Geotechnical Engineering, Structural Health Monitoring & Finite Element Analysis.

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