INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 4 – www.ijrmmae.in – Pages 17-25

EXPERIMENTAL STUDY ON HEMPFIBER REINFORCED POLYMER MODIFIED M-SAND CONCRETE

DR. S. CHARLES RUSKIN KUMAR
IES College of Engineering, Thrissur, Kerala, India

Abstract:

This paper discusses the development of hemp fiber reinforced polymer modified m-sand concrete to improve the resistant of reinforced concrete. In this hemp fiber is not only very absorbent but are also uncommonly rich in silica which is added as 1 to 5% in concrete mix Manufactured fine aggregates are products created from rocks are crushed using mechanical crusher(fully replaced). Polymer improves mechanical properties of binders which is added (maximum 15 to 20 %) based on cement When these combinations of these three products will perform in the well manner.

INTRODUCTION

The use of hemp fibre, reinforced polymers, M-sand as a confinement for structures is gaining life time of the concrete. This is due to many advantages these material afford when compared to conventional steel reinforcement. The main aim of the research on sustainable materials is to investigate the use of natural fibers with cement/concrete mixes to improve the performance of construction components and reduce the depletion in natural resources.

The demand for the agricultural fibers for concrete production would to be a major incentive to Lebanese farmers to benefits from the social impact on the habitat level of living. In the preliminary program reported in this paper, cubes and standard flexural beams were tested to evaluate the structural and physical performance of concrete mixes prepared with different volumetric ratio of added fibers and different proportions of aggregate. Test result indicates that the use of industrial hemp fibers resulted in reducing the coarse aggregate quantity without affecting the flexural performance of concrete. when we use the hemp fiber which increases the tensile strength in concrete at the same time durability also increased. Polymer will resist the corrosion when compared to conventional concrete. Replacing the M sand instead of river sand , natural resources will be saved. These combinations in concrete will be also well suited for seismic zones. And it will arrest the cracking. We use the M20 concrete for our project. In this paper the results of the behavior of 42cubes, 42 cylinders, 42 beams specimens confined by hemp fibre reinforced polymer modified concrete are presented. The specimens are confined with relatively volumetric ratios of 1%,2%,3% of hemp fibre & epoxy resin is 0.2%,0.3% so as to examine their confining effect when used in concrete. The satisfactory correlation of experimental and analytical results is observed.

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 4 – www.ijrmmae.in – Pages 17-25

MATERIALS

Cement, M-sand, coarse aggregate, were used in casting of concrete and natural fiber hemp is used. Epoxy is used as polymer to arrest the corrosion. The specifications and properties of these materials are given below.

CEMENT

Cement is a fine grey powder. It is mixed with water and materials such as sand, gravel, and crushed stone to make concrete. Cement and water form a paste that binds the other materials together as the concrete hardens. Ordinary Portland cement (53 grade) is a higher strength cement to meet the needs of the consumer for the higher strength concrete.

MANUFACTURED SAND

Fine aggregate is fully replaced by the M-sand. Manufactured fine aggregates (MFA) are products created from rocks are crushed using mechanical crusher. The strength of the M-sand is equal to the fine aggregate of concrete.

COARSE AGGREGATE

The material which was retained on BIS test sieve 4.75 mm was termed as coarse aggregate. The broken stone is generally used as coarse aggregate. The nature of work decides the maximum size of coarse aggregate. Locally available coarse aggregate having the maximum size of 20mm was used in the work. The aggregate was washed to remove dust and dirt and was dried to surface dry condition. The aggregate was tested as per Indian standard specifications IS2386-1963. Consisted 31% calcium and 17% magnesium as its major contributed chemicals.

HEMP FIBRE

Hemp fibre is one of the strongest and most durable of all natural fibers. An fine Materials with size less then 40 micrometer in diameter, the average being about 10-50 micrometer. It is well known that the addition of fibre to concrete matrix substantially enhances the toughness, energy adsorption capacity and cracks resistance of the plane concrete. Fibres bridging the guarantee stress transfer between both faces of crack, providing in such a way post crack toughness. The addition of industrial hemp fibers and hurds into concrete masonry blocks would result in the reduction of the aggregate material used and the improvement of thermal properties, similarly to hemp-fiber- reinforced concrete. It is worth noting that in the current research, the hemp material is added as raw material, without any treatment, in order to simplify the manufacturing process. The use of hemp as an agricultural waste material in concrete masonry blocks would promote a wide market for industrial hemp usage.

Concrete masonry blocks are mainly used, as non-load bearing members, for partitioning and external façade, in any construction job. When the thermal properties of the masonry units are improved, the result is mainly reflected in improving the insulation potential of the building units. Consequently, the demand for air conditioning would be decreased resulting in major savings with respect to fuel demand and consumption. Specifically, nowadays fuel crisis have been reflected in the sharp increase in the fuel prices worldwide and locally, which has exhausted the economical status of developing countries, affecting

ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 4 – www.ijrmmae.in – Pages 17-25

mostly the poor community. Besides, the addition of hemp material to the masonry units may result in light-weight masonry units, which are sought for and favored as non-load bearing units in the construction field; for example with high-rise buildings where the load is very crucial in designing concrete structural elements.

Synthetic fibers and natural fibers have been investigated and tried in both cement and concrete mixes. The advantage of using natural fibers, like jute, sisal, coconut, banana, hemp, and others in fiber-reinforced concrete is the saving on natural resources. Natural fibers are in most cases classified as waste materials compared to industrial or synthetic fibers that are produced from other raw materials. Due to their large availability, low cost, and renewable resources, natural fibers were considered in fiber-reinforced cements.

EPOXY

The mechanical properties of constituents material, both concrete and epoxy, were measured under the influence of accelerated moisture ingress. Interfacial property was quantified using the concept of interface fracture toughness. Moisture acceleration is facilitated through continuous conditioning under water bath at elevated temperature. Test results reveal that moisture effect on the deterioration is accompanied by a shifting in failure mode from concrete delamination to interface separation under mode I loading condition. Epoxy resins, also known as poly-epoxides are a class of reactive pre-polymer and polymers which contain epoxide groups. Epoxy resins may be reacted (cross-linked) either with themselves through catalytic homo-polymerization or with a wide range of co-reactants including poly- functional amines, acids anhydrides, phenols, alcohols, and thiols. These co-reactants are often referred to as hardeners and the cross- linking reaction is commonly referred to as curing. Reaction of poly-epoxides with themselves or with poly- functional hardeners forms a thermosetting polymer, often with strong mechanical properties as well as high temperature and chemical resistance. Epoxy has a wide range of industrial applications, including metal coating, use in electronic and electrical components, high tension electrical insulators, fibre-reinforced plastics materials, and structural adhesives commonly used in boat building. Epoxy resin is employed to bind gutta percha in some root canal procedures. Polymer- modified Concrete (PMC) has also been called polymer-Portland cement-concrete (PPCC) and latex-modified concrete

(LMC). It is defined as Portland cement and aggregate combined at the time of mixing with organic polymers that are dispersed or redispersed in water. This dispersion is called latex; the organic polymer is a substance composed of thousands of simple molecules combined into large molecules. The simple molecules are known as monomers, and the reaction that combine them is called polymerization. The polymer may be a homo-polymer if it is made by the polymerization of one monomer, or a copolymer when two or more monomers are polymerized various polymer-modified mortar and concrete, latex-modified mortar and concrete have superior properties, such as high tensile and flexural strength, excellent adhesion, high waterproofness, high abrasion resistance and good chemical resistance, to ordinary cement mortar and concrete. Accordingly they are widely used in many specialized applications in which ordinary cement mortar and concrete have been employed to a lesser extent till now. In these applications, the latex-modified mortars are widely used rather than the latex-modified concrete. Generally the modified mortar can be recommended for thickness of 30 mm or less, and the modified concrete for

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 4 – www.ijrmmae.in – Pages 17-25

the thickness exceeding 30 mm. Floor/screeds/toppings upto 100 mm thick have been successfully used.

METHODOLOGY

From the literature reviewed it is clear that paucity of information exists in the hemp fiber, polymer and M-sand concrete literature. Hence an attempt has been made to study the properties of hemp fiber reinforced polymer modified M-sand concrete.

MIX PROPORTION

S.No.	Cement	M-Sand	Coarse aggregate
1.	1	1.62	2.95
2.	394	642	1163

TESTING OF SPECIMEN

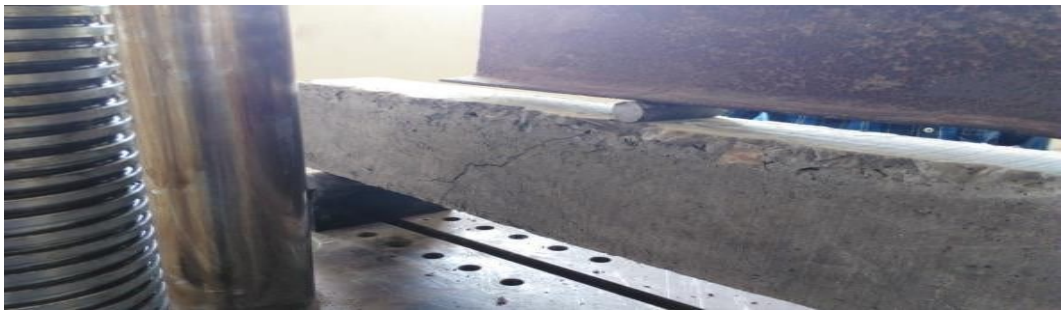
42 cubes, 42 cylinder and 42 beam where tested. Compressive strength of cubes were found using compression testing machine. Split tensile strength was found for cylinders and flexural strength of beam was found using universal testing machine. The specimens was left for 7days and 28days curing in the curing tank. Then they were tested on the 7th day and 28th day. The specimen were taken out from the curing tanks morning and left for drying. They were tested on the evening after drying.

COMPRESSIVE STRENGTH OF CUBE

SPLIT TENSILE STRENGTH OF CYLINDER

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 4 – www.ijrmmae.in – Pages 17-25

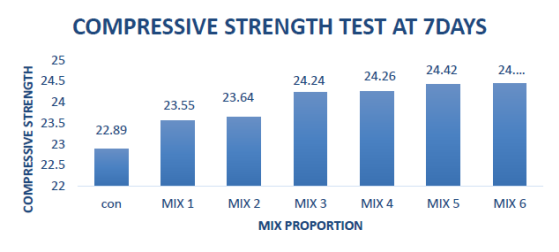
FLEXURAL STRENGTH OF BEAM



RESULTS AND DISCUSSION

S.NO	DESCRIPTION	TRAIL 1	TRAIL 2	TRAIL 3	AVERAGE
1	MIX 1	22.2	28.6	20.13	23.64
2	MIX 2	26.12	16.8	27.73	23.55
3	MIX 3	22.68	21.65	22.81	24.34
4	MIX 4	23.16	24.65	21.68	23.16
5	MIX 5	24.00	25.11	23.51	24.20
6	MIX 6	25.02	23.76	24.02	24.27

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 4 – www.ijrmmae.in – Pages 17-25



Compressive Strength Test at 28 days

S.NO	DESCRIPTION	TRAIL 1	TRAIL 2	TRAIL 3	AVERAGE
1	MIX 1	26.1	29.25	24.12	26.49
2	MIX 2	27.13	25.51	27.32	26.65
3	MIX 3	26.33	27.47	27.71	27.71
4	MIX 4	26.39	28.21	29.68	28.32
5	MIX 5	27.51	29.01	28.92	28.48
6	MIX 6	29.59	27.83	28.87	28.76

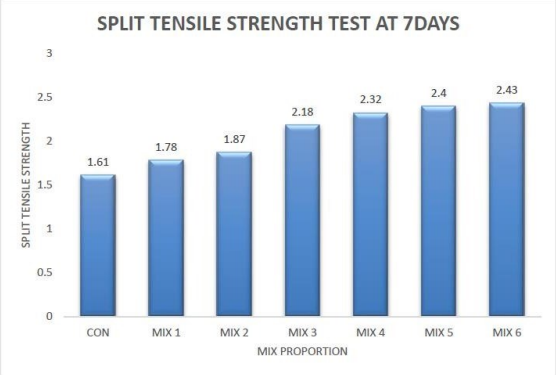
Graph

Split Tensile Strength Test at 7 days

S.NO	DESCRIPTION	TRAIL 1	TRAIL 2	TRAIL 3	AVERAGE
1	MIX 1	2.37	2.78	2.45	2.53
2	MIX 2	2.10	2.12	1.84	2.02
3	MIX 3	2.26	2.01	2.16	2.14
4	MIX 4	1.79	1.92	1.77	1.82
5	MIX 5	2.45	2.26	2.31	2.32
6	MIX 6	1.89	1.62	1.83	1.78

Graph

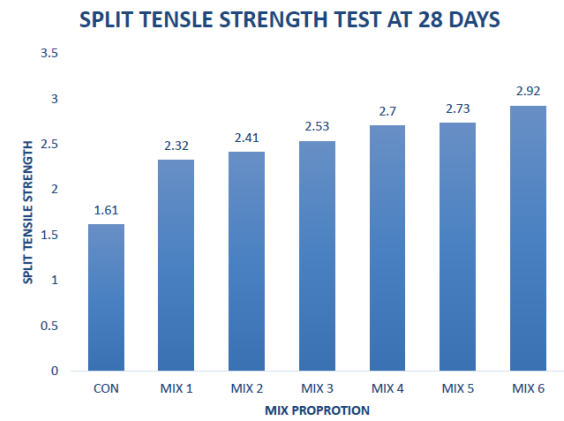
INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 4 – www.ijrmmae.in – Pages 17-25



Split Tensile Strength Test at 28 days

S.NO	DESCRIPTION	TRAIL 1	TRAIL 2	TRAIL 3	AVERAGE
1	MIX 1	2.26	2.45	2.31	2.32
2	MIX 2	2.29	2.51	2.40	2.41
3	MIX 3	2.32	2.61	2.58	2.53
4	MIX 4	2.37	2.98	2.77	2.70
5	MIX 5	2.27	3.1	2.89	2.73
6	MIX 6	2.99	2.92	2.87	2.92

Graph

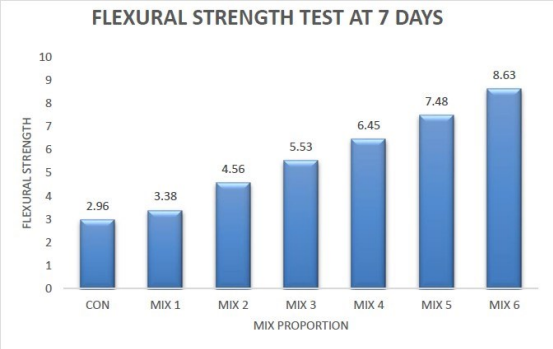


Flexural strength at 7days

S.NO	DESCRIPTION	TRAIL 1	TRAIL 2	TRAIL 3	AVERAGE
1	MIX 1	3.15	3.4	3.6	3.38
2	MIX 2	4.2	4.6	4.9	4.56
3	MIX 3	5.3	5.5	5.8	5.53
4	MIX 4	6.13	6.53	6.72	6.45
5	MIX 5	7.2	7.48	7.78	7.47
6	MIX 6	8.4	8.62	8.88	8.63

INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 4 – www.ijrmmae.in – Pages 17-25

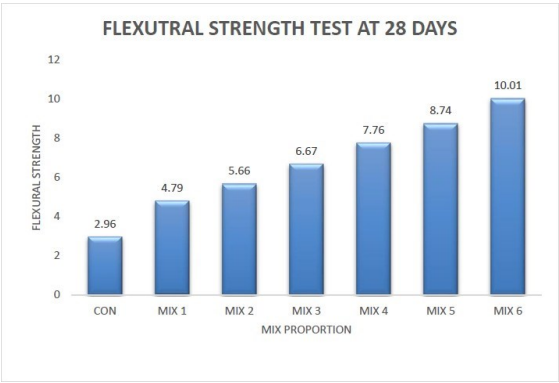
Graph



Flexural strength at 28 days

S.NO	DESCRIPTION	TRAIL 1	TRAIL 2	TRAIL 3	AVERAGE
1	MIX 1	4.88	4.69	4.82	4.79
2	MIX 2	5.92	5.77	5.29	5.66
3	MIX 3	6.28	6.75	6.99	6.67
4	MIX 4	7.65	7.82	7.77	7.76
5	MIX 5	8.83	8.46	8.91	8.74
6	MIX 6	9.54	10.32	10.18	10.01

Graph



CONCLUSION

Following are the conclusions drawn based on the analytical investigations carried out to study the Hemp Fibre Reinforced Polymer Modified M-sand Concrete.

It is noticed that the specimen exhibited higher strength, compared to the conventional concrete. The strength obtained after 7days and 28days is higher than the other concretes with only hemp fibre, epoxy resins and M-sand. Thus cracks can be arrested by the addition of hemp fibre can rest the corrosion of steel by epoxy polymer and

ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 4 – www.ijrmmae.in – Pages 17-25

provide the M-sand of concrete to safe of the alternative resources. Thus they can be used to meet the demand of concrete technology by various applications.

REFERENCES

[1] Awwad, E., Mabsout, M., Hamad, B., Farran, M., and Khatib, H. (2012). "Studies on Fiber-Reinforced Concrete using Industrial Hemp Fibers." The Construction and Building Materials Journal, Elsevier, Vol. 35, October 2012, pp.710-717.

[2] Awwad, E., Hamad, B., Mabsout, M., and Khatib, H. (2012). "Sustainable Concrete using Hemp Fibers." Institution of Civil Engineers - Construction Materials Journal, DOI: 10.1680/coma.11.00006.

[3] Colville, J., A.M. Amde and M. Miltenberger, "Tensile Bond Strength of Polymer Modified Mortar," Journal of Materials in Civil Engineering, ASCE, Vol. II, No. 1, pp. 1-5, February 1999.

[4] Hamad, B.S., Harajli, M., and Jumaa, G. (2001). "Effect of Steel Fibers on Bond Strength of Tension Lap Splices in High Strength Concrete." ACI Structural Journal, Volume 98, No. 5, September-October 2001, pp. 638–647.

[5] Kulkarni D., and Jadhav P., (2009), Role of manufactured sand on the strength properties of concrete, New Building Materials & Construction World (NBM & CW), pp 202-206