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USE OF NATURAL FIBRES IN CONCRETE- A REVIEW

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ABSTRACT

Rapid increase in construction activities has resulted in shortage of construction materials. In the present scenario, high cost of conventional building materials is a major factor affecting housing system in the world. The effective housing techniques deal with reduction in cost of construction as well as providing strength to the buildings. The current review deals with the addition of natural fibres into concrete and to study the various strength properties. Natural inorganic fibres are basalt, asbestos etc. and the others are the natural organic fibres such as coconut, palm, jute, sisal, banana, pine, sugarcane, lime hemp, bamboo etc. The natural fibres are investigated by many researchers as construction materials that can be used in cement/paste/mortar concrete. For long lasting of natural construction materials including natural sand and aggregates, due importance should be given for sustainable development in the construction field. It is a well-known fact that concrete is hugely consumed by humans for construction activities, making concrete a sustainable material is unavoidable. Although concrete has enough flexibility to use in various materials in its production, understanding the performance of concrete with different materials is important for its end use. The inclusion of fibre reinforcement in concrete, mortar and cement paste, can enhance many of the engineering properties such as fracture, toughness, flexural strength and resistance to fatigue, impact, thermal shock and spalling. In recent years, a great deal of interest has been created worldwide on the potential applications of natural fibre reinforced, cement based composites. These fibres have always been considered promising as reinforcement of cement based matrices because of their availability, low cost and low consumption of energy. The use of above mentioned fibres in concrete production deals with providing social, economic and ecological benefits.

KEYWORDS :*Natural fibres, Light weight structural concrete, Pozzolanic material, Ligno-cellulosic material, Eco-friendliness.*

1.INTRODUCTION :

Concrete is a premier civil engineering material. Concrete manufacturing involves consumption of ingredients like cement, sand, aggregates, water and admixtures. Today's infrastructure development across the world has created demand for construction materials. Due to this, the non-availability of natural resources to future generations has also been realized. Concrete production is not only a source of societal development but also a significant source of employment. Although some fibres are traditionally considered as primitive and therefore inferior to more highly processes in terms of safety, durability, performance, occupant's health and comfort, consumption of environmental products and energy within the construction industry have created significant demand for these fibres as reinforcing agents in concrete production. The Portland cement concrete is a brittle material. It possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro-cracks are present in concrete alone and its poor tensile strength is due the propagation of such micro-cracks leading to brittle fraction of concrete. When load is applied, the internal cracks propagate and open up due to stress and additional cracks are formed. The development of these cracks is due to inelastic deformation of concrete. The addition of small closely spaced and uniformly dispersed fibres into concrete can act as crack arrester and improves its static and dynamic properties. This is known as Fibre Reinforced Concrete (FRC) which can also be defined as concrete containing fibrous material that increases its structural performance. It contains short discrete particles that are uniformly distributed and randomly oriented. The fibres can also reduce plastic and drying shrinkage. The development of steel has overcome the problem of poor tensile strength but it does not completely solve the problem of micro-cracks due to plastic and drying shrinkage owing to weathering conditions. It is therefore required to study on various methods for adopting fibres as reinforcements with different fibres. Addition of steel has reduced micro-cracks, but over a long period steel gets corroded due to various actions. This makes the enlightenment for usage of various organic and inorganic fibres which are eco-friendly and economic. According to natural fibres, compared to natural inorganic fibres, vegetable fibres (natural organic) are renewable and also the production cost is low.

2.REVIEW OF LITERATURES

The literatures regarding the potential utilities of natural fibres in concrete have been reviewed and are presented below.

Romildo Dias Toledo Filho et al (1999) have studied the use of sisal fibre as reinforcement in cement based composites and arrived at the following conclusions; cement based matrices reinforced with sisal fibres have brought new trends in composite materials, to make this a reality some conditions have to be satisfied like; efficient methods of fibre extraction, pre-treatment of fibres and conversion in usable forms (filaments, mats, fabrics, rovings), development of production techniques for manufacture keeping in view that it must be cost effective, since long term performance is one of the major limitations, durability must be properly assessed and process should be developed to minimize limitation, physical and mechanical properties; impact and abrasive resistance, water absorption, shrinkage, chemical resistance, acoustic requirement, thermal performance and durability of sisal fibres cement based products should be thoroughly evaluated so as to arrive at a series of composites to be used in rural and civil construction and lastly the design procedures must be standardized.

England et al (1997) have studied about various natural fibres and its use in concrete. The conclusions drawn were as follows; Fibres can be added to cement based matrices as primary or secondary reinforcement. Fibres work as primary reinforcement in thin products in which conventional reinforcing bars cannot be used. The fibres act to increase both the toughness and strength of composite. In components such as slabs and pavements, fibres are added to control cracking induced by humidity or temperature variations and in these applications they work as secondary reinforcement. In cement –based composites, the two major roles played by the fibres are to improve the toughness and post cracking performance of the matrices. There are also some changes created to the pre-cracking behaviour of the hardened matrices which help to define the composite action. Fibre content (% by volume), ratio of fibre modulus (Ef) to the matric modulus (Em) and the ratio of the fibre strength to the matrix strength, all influence the performance of the composite before cracking.

Nilson L. (1975) in his studies observed that there is an improvement in the tensile strength as well as bending for fibre reinforced specimens for sisal fibres which was cut to a length 10-30 mm. It was found that toughness increased markedly when continuous fibres were used

Coutts et al (1992) have analysed about the sisal fibre reinforced cement mortar and hence studied the variation of various properties of concrete composites with and without sisal pulp. Kraft and Soda process were used to determine the magnitude of various properties like flexural strength, fracture toughness, flexural modulus, water absorption and density. The physical and mechanical properties of the composites were evaluated with a view to make use of these materials as building products.

Nataraja M.C. (1999) has experimented on Fibre Reinforced Concrete and analysed their behaviour, properties and applications. Some of his conclusions were; the growth of the amount of research and applications of SFRC (Steel Fibre Reinforced Concrete) and HPC (High Performance Concrete) has been phenomenal in the past seven or eight years. HPC concrete has become widely accepted practically on all continents. Much of the applications of HP-SFRC remain in the areas of long span bridges in Europe and Japan, while more buildings than bridges used HPC in U.S. Increasing emphasis is being placed on concrete durability than its strength. In many applications high strength concrete is used only because of its durability, quality rather the need for its strength. Much researches must be carried out on mechanical properties of high and very high strength concretes with and without fibres and their structural applications. The Slurry Infiltrated Mat Concrete (SIMCON) and the delivery system for non-metallic fibres are two significant recent developments in the areas of high performance FRC. Compact Reinforced Concrete and Reactive Powder Concrete (Ductal) have gained popularity in western countries. Use of High Performance new generation fibre concrete in India is only in laboratories and in research centres. It may take many years to popularize in actual practice.

Meeravali et al (2014) et al have experimented on replacement of cement in concrete with sugarcane baggase ash behaviour in Hcl solution and found out that; as the percentage of SCBA (sugarcane Baggase Ash) increased, the compressive strength of concrete tends to increase up to certain percentage and then started decreasing with increase of ash content; SCBA concrete performed better when compared to ordinary concrete upto 10% replacement of SCBA; compressive strength is decreased for concrete used in 5% Hcl solution when compared to concrete cured in normal water; compressive strength is increased for 7, 28, 60 days curing in normal water, but compressive strength is reduced very slight acid attack after immersion of 28 and 60 days in acid solutions; compressive strength is reduced if the curing duration is increased more than 60 days in 5 % Hcl solution; concrete is affected when it is exposed to Hcl solution for longer duration; utilization of waste materials SCBA can be advantageously used as replacement of cement in preparation of concrete when it is exposed to 5 % Hcl solution only.

Morton et al (2006) have studied the performance of slash pine fibres in fibre cement products and made the following inferences; Fibres manufactured from the slash pine trees (Pinus elliottii) by the wrapping paper method have shown wonderful performance in fibre cement composites made by each aircured(naturally aged) and autoclaved processes. These fibres square measure compared to different softwood fibres usually used for fibre cement applications. CF-16 could be a totally bleached pulp with a special coating to reinforce base-forming stability that's supposed primarily for uses in air-cured fibre cement merchandise ,though it are often homogenized with undyed fibres to be used in each and autoclaved air- curedapplications. The improved base-forming stability will increase the sturdiness and strength in a very cementious matrix.Bleached slash pine fibres with a special coating to reinforce base-forming stability give strength, durability , process and dimensional stability advantages for air-cured merchandise. Both bleached and undyed slash pine fibres give improved beating response versus different usually used fibres and may be co-refined with acceptable brown stock fibres to produce each filter and reinforcing fibres in a very single pass.

Yalley and Kwan have created experimental investigations on fibre in concrete preparation and got wind of the subsequent conclusions; the addition of coconut fibres(coir) considerably improved the numerous of the engineering properties of concrete, notably torsion, toughness and durability. the power to resist cracking and spalling were additionally increased. but the addition of fibres adversely affected the compressive strength, evidently attributable to difficulties in compaction that consequently junction rectifier to extend in voids. Despite its wonderful properties, coconut fibre as Associate in Nursing improvement of concrete is unlikely to interchange steel for the overwhelming majority of structures. Experiments and demonstration projects around the world have shown that natural fibre enhancement is a viable and cost effective alternative to conventional building materials. However the construction industries are extremely conservative and so the most likely development route is the use of the new materials in non-structural applications or in ones where the consequences of failure are not too severe. The various disadvantages identified in using the natural fibres are high water absorption causing unstable volume, low cohesion between fibre and matrix, rapid decomposition in alkaline environment etc. Given the variety of fibre materials, the number of mix constituent and method of production, it is evident that product development should be the prime future research objective. Economic methods of natural fibre extraction, handling and automated methods of fibre dispersion at batching plants are needed if large amount of fibres are going to be used. Application for coconut fibre enhanced concrete and mortar composite for housing need to be expanded. Since cement- based materials are well known insulators, another avenue for future research and product development would be the use of coconut fibre-cement composites for sound and heat insulation. Such products might be composed wholly of fibre-cement or using fibre-cement as one component in an insulating member. Studies show that aerated concrete would be better, cheaper and easier than the proposed coconut fibre composite insulator; however it could be a replacement where aerated concrete might not be available or comparatively expensive to produce.

Mohammed A. Ismail and Huzaifa Bin Hashim (2008) have experimented on palm oil fibre in concrete and observed that; Palm oil fibre with good physical properties has shown some encouraging results when used as an additive material in concrete. From this study, it has been found that the optimum length of fibre that yields the maximum strength is 5 cm for 0.25% of fibre content and 3 cm fibre length for 0.50% of fibre content. More research is still required in the durability aspect before the concrete can be used in the building industries. The concrete specimens were subjected to SEM (Scanning Electron Microscope) analysis which showed that there is evidence of the surface roughness between hydrated cement pastes with fibres surface contributing to the interlocking between both materials. This certainly could give a strong effect to the compressive strength of concrete made with normal aggregates and might also affect the hardening process of concrete.

Mukhopadhay et al (2006) have analysed the variability and fracture behaviour of banana fibres and concluded that; there is a wide range of variation of fibres ranging from 0.08 mm to 0.32 mm. The diameter of fibres ranging from 0.17-0.19 mm were used for tensile strength test. Results of tensile testing revealed that strain rates played an important role in the nature of the stress-strain curves, the strength of the fibres and the nature of failure. The tenacity increased when the strain rate is increased to 0.5 min-1 but ultimately decreased with an increment in speed. At higher strain rates of 1 min-1, a failure in tensile strength is observed which may be a result of the presence of imperfections in fibre causing immediate failure. SEM micrographs showed a fall in tensile strength as the strain rates increased. In some fibres there is reorientation of micro fibrils. Stress-strain curves for higher strain rates resulted in higher apparent modulus values. In lower strain rates, the fibres behave in a partial ductile fashion. The fibres behave as a stiffer elastic body with increased strain rates, i.e. the crystalline region shares the major applied load resulting in high values of mechanical properties. At 0.5 min-1, the fracture surface demonstrates a more brittle-ductile nature of fracture. However the fibres are conspicuous by their absence.

Gore Ketan R. and Suhasini M. Kulkarni (2012-13) in their research about basalt fibre in concrete have noted the following points; the strength of basalt fibre have gained more than the design mix after 28 days of curing, basalt rock fibres have no toxic reactions with air or water,they are non-combustible and explosion proof . once in-tuned with alternative chemicals they turn out no chemical reactions which can harm health or surroundings.Basalt base composites will replace steel and far-famed bolstered plastics (1 metric weight unit of volcanic rock reinforces equals nine.6 metric weight unit of steel). volcanic rock will replace the majority applications of amphibole and has 3 times its heat insulating properties. it's a really renowned as a rock found in just about each country around the world. Basalt rock is more in India (especially in Maharashtra) and the cost of basalt is 10 times lower than the raw materials for fibre glass. Also the melting and energy consumption of these fibres is lower.

Bhratiraja et al (2014) have made concrete using manufactured sand, sisal and steel fibres and made the following inferences; from the result it was found that the manufactured sand can be used as partial replacement for fine aggregates which will reduce the cost and also the scar of natural resources. From the 28 days split tensile strength result it was found that due to increase in manufactured sand content from 0%, 20%, 40%, 60%, 80%, 100% as fine aggregate partial replacement with steel and sisal fibres which induces crack development at later stage also increases the split tensile strength. Also due to presence of low and high modulus fibre, the split tensile strength also increases with partial replacement of fine aggregate.

Sivaraja et al (2010) on their studies regarding natural fibre concrete composites concluded that; at all the curing ages, both the natural fibres such as coir and sugarcane fibres enhance all the three mechanical properties such as compressive strength, split tensile strength, modulus of rupture and flexural performance. Though the natural fibres enhance the strength properties at early curing ages, the rate of increments are lower than conventional concrete specimens at later curing ages. The flexural performance of the natural fibre reinforced concrete beam specimens do not yield much difference at the three curing ages such as 28 days, 1 year and 2 years, they possess a little bit difference at the yielding stage only. SEM and EDS analysis confirmed that the boundary of the fibre-matrix transition zone have excellent adhesion. The impregnation of calcium content on the fibre walls showed better strength enhancement. Application of natural fibre reinforced concrete would be limited to marine areas. Although effect of freezing and thawing on natural fibre reinforced concrete was higher than conventional concrete, the difference in mass loss and relative modulus of elasticity between fibre reinforced and conventional concrete was acceptable.

Ali Majid (2011) has reviewed a paper regarding coconut fibre and reported that; coconut fibres are most ductile and energy absorbent material. They have the potential to be used in composites for various purposes. Various aspects of coconut fibre reinforced composites have already been investigated and economical and better results were achieved as concluded by many researchers. Since the use of coconut fibres has given some marvellous products, there is still possibility of the invention of new products containing coconut fibres with improved results. In civil engineering, coconut fibres have been used as reinforcement in composites for non-structural components. There is a need of investigating the behaviour of coconut fibre reinforced concrete to be used in main structural components like beams, columns and walls.

Krishna Vamshi K. and Rao Venkateswara J. (2014) have studied behaviour of fibre reinforced concrete in rigid pavements and arrived at the following inferences; Compressive strength enhancement ranges from 8.38% to 16.37% when % of fibres increased from 0.1%-0.3% for PFRC (Polypropylene Fibre Reinforced Concrete) compared to conventional concrete at 28 days. As the fibre content is increased from 0.1%-0.3% in weight of cement, there is an increase in the split tensile strength from 12.44%-37.78% compared to the conventional concrete at 28 days. There is a significant improvement in flexural strength with the addition of fibres at 28 days. Addition of polyester fibres in concrete, the pavement thickness is decreased by 20% and which is economical when compared to plain cement concrete.

3.CONCLUSION

Hence it can be well concluded that, there is a vast application of natural fibres in concrete preparation as stated above. Fibres act as primary or secondary type reinforcement in concrete matrix so as to provide strength in addition to steel rods. They are also durable and resistant against chemical attack, where as in conventional concrete blocks the steel rods are subjected to corrosion due to penetration of chloride ions and other environmental factors. Besides use in concrete, these fibres have a wide application in manufacturing of various products having a very high market value. Some fibres are also available locally whereas some are expensive due to their unavailability. They are also economical, eco-friendly and consume less energy during various processes starting from fibre extraction to Fibre Reinforced Concrete Product. Innovative ideas regarding Green Buildings may merge with utilization of natural fibres effectively. They help in preventing micro-cracks and spalling in concrete. Also indirectly develops the tensile strength of concrete (without rebars) to a small extent. Some fibres can withstand very high temperatures and show very outstanding results as compared to conventional or ordinary concrete. Now-a-days HPC (High Performance Concrete) are prepared using some percentages of fibres in the mix. So, fibres are a gift of nature and our motive should be to use it in a proper way in building construction apart from its uses in other sectors.

4.REFERENCES

[1] Romildo Dias Toledo Filho, Kuruvilla,Joseph, Khosrow Ghavani and George Leslie England (1999), The use of sisal fibre as reinforcement in cement based composites. Journal- Revista Brasileira de Engenharia Agricolae Ambiental,volume-3, no.2, pp: 245-256. Camplina Grande, PB, DEAG/UFPB.

[2]England, G.L and Toledo Filho, R.D. (1997). Natural Fibre Reinforced Concrete in Asia-Pacific Speciality Conference On Fibre Reinforced Concrete, Singapore, pp: 55-70.

[3]Nilson, L (1975). Reinforcement of concrete with sisal and other vegetable fibres, Stocholm: Swedish Council for Building Research, 68p, Document No. D-14.

[4]Coutts, R.S.P and Warden, P.G. (1992), Sisal Pulp Reinforcement Cement Mortar. Cement and Concrete Composites; volume-14, pp; 17-21.

[5] Natraja M.C. and Chamarajendra Sri Jaya.(1999). Fibre Reinforced Concrete- Behaviour, Properties and Applications. Annual Report, College of Engineering, Mysore- 570066, nataraja96@yahoocom,

[6]K Meeravali, KVGD Balaji, T. Santosh Kumar (2014), Partial Replacement of Cement in Concrete with Sugarcane Baggase Ash behaviour in Hcl Solution, International Journal of Advanced Research in

Science and Engineering, Vol. no. 3, pp: 368-373.
[7] J.H. Morton, S.A.S. Akers and T. Cooke (2006), Performance of Slashpine Fibres in Fibre Cement Products, International Inorganic-Bonded Fibre Composite Conference. Nov.15-18, Sao Paulo- Brazil, pp: 168-177
[8]Yalley P.P. (School of Engineering, Takoradi Polytechnic,Ghana) and Kwan A.S.K.(School of Engineering, Cardiff University,U.K.), Use of Coconut Fibres as an Enhancement of Concrete, pp: 54-73.
[9]Mohammed A. Ismail (Associate Professor) and Huzaifa Bin Hashim (Graduate Student), Department of Structures and Materials, Civil Engineering, Malaysia, Palm Oil Fibre Concrete, The 3rdACF International Conference-ACF/VCA 2008
[10]Mukhopadhay S., Vijay G., Talwade R, Dhake J.D and Pegoretti A. (2006). Some studies on banana fibres, International Conference On Advances in Fibrous Materials, Nonwoven and Technical Textiles, 7-9 August2006, Coimbatore, India.
[11]Gore Ketan R and Suhasini M. Kulkarni (Nov 2012 – Oct 2013), The Performance of Basalt Fibre In High Strength Concrete, Vol. 2, Issue 2, ISSN 0975-6744, pp: 117-124.
[12]Bharatiraja P., Vinothkumar M., Manikandan R.K., Kumar Arun M and Shiva,Mathiraja C. (2014). A concrete made using manufactured sand, steel and sisal fibres, International Journal Of Latest Trends In Engineering And Technology, vol.3, Issue 3 pp: 83-85.
[13]Sivaraja M, Kandasamy, Velmani N and Pillai Sudhkaran M (2010), 'Study on durability of natural fibre concrete composites using mechanical strength and microstructural properties, Vol.33, No.6,pp: 719-729.
[14]Ali Majid (2011), 'Coconut Fibre: A Versatile Material and Its Applications In Engineering', Journal of Civil Engineering and Construction Technology, Vol.2 (9), pp: 189-197
[15]Krishna Vamshi K. and Rao Venkateswara J. (2014), 'Experimental study on behaviour of fibre reinforced concrete for rigid pavements', Journal of Mechanical and Civil Engineering, Vol.11, Issue 4, pp:49-53

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