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NATURAL FIBER COMPOSITES FOR STRUCTURAL APPLICATIONS

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Summary. *In the recent times, there is a growing interest on the use of various natural fibers in structural applications due to their light weight, low cost and sustainability. This paper reports the recent developments in the field of natural fiber reinforced polymeric and cementitious composites for structural applications. Different techniques to improve fiber/matrix interface as well as the durability of natural fiber reinforced composites have been discussed.*

1 INTRODUCTION

Natural fibers present cheap and sustainable alternative to the metallic and synthetic fibers used as building materials. Light weight, low environmental impact and bio-degradability are other important advantages of natural fibers. There are mainly two strategies explored till date for the use of natural fibers in structural applications. In the first approach, natural fiber reinforced polymeric composites have been developed for the different parts of building [1], whereas the second approach explores the use of natural fibers for concrete reinforcement [2].

2 NATURAL FIBER REINFORCED POLYMERIC COMPOSITES

Polymeric composites based on natural fibers such as sisal, jute, etc. have been developed to construct different parts of buildings such as beams, roofs, floors, balcony, fire doors, etc. Most of these composites have sandwich structures in order to reduce weight and to achieve better flexural properties. Mechanical performance of these composite structures have been characterized and the results explored their potential for building construction.

3 NATURAL FIBER BASED CEMENTITIOUS COMPOSITES

Due to the corrosion problem of steel, there is an increasing need for concrete reinforcing materials which can replace steel rebars. Concrete has been reinforced with various natural fibers such as bamboo, coconut, sisal, etc. for developing cost-effective and sustainable building constructions. Addition of these natural fibers to concrete was found helpful to improve various mechanical performances including flexural properties, impact resistance,

fracture toughness, etc. and in some cases, even found better than glass and carbon fibers.

3 LIMITATIONS AND SOLUTIONS

Natural fibers possess some disadvantages when considered as building materials such as variability in properties, less durability due to high moisture and chemical absorption, generation of concrete cracks due to swelling and volume changes, weakening due to alkaline environment of cement and poor interface between natural fibers and polymeric or cementitious matrices.

Besides using low alkaline cement, some other approaches based on fiber modification have been reported to overcome the drawbacks of natural fiber such as treatment with alkali, silane and various water repelling agents. There are also very recent reports on the plasma modification of natural fibers. These techniques usually reduces the water absorption of natural fiber either by removing hemicellulose and lignin or by imparting hydrophobicity. These fiber modification techniques were also found advantageous to improve the interface between natural fiber and various matrices.

4 CONCLUSIONS

In spite of several existing solutions to overcome the shortcomings of natural fiber, the major concern till date is the durability issue of natural fiber based composites and therefore, a great deal of research efforts is necessary for successful implementation of natural fiber in structural applications.

REFERENCES

[1] A. Ticoalu, T. Aravinthan and F. Cardona, “A review of current development in natural fiber composites for structural and infrastructure applications”, Southern region engineering conference, Toowoomba, Australia, 11-12 November (2010).

[2] F. Torgal and Said Jalali, “Vegetable Fibre Reinforced Concrete Composites: A Review”, International Materials Symposium, Lisboa, Portugal (2009).