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To cite this version:

Vincent Placet, Lamine Boubakar. Mechanical behavior of hemp fibres : a review of recent works. 1st International Conference on Natural Fibers (1st ICNF), Jan 2013, France. pp.1 - 2. hal-00993417

HAL Id: hal-00993417

https://hal.science/hal-00993417v1

Submitted on 20 May 2014

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MECHANICAL BEHAVIOUR OF HEMP FIBRES: STATE-OF-THE-ART

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ABSTRACT

This work proposes a review of literature on the mechanical behaviour of hemp fibres. The paper is focused both on experimental results and modelling.

STATE-OF-THE-ART

Cellulosic fibres originating from annual plant stems represent an interesting alternative to man-made fibres in composite applications and can be competitive with glass fibres in particular. Many types of natural fibre have been identified as having appropriate mechanical properties for structural applications. Sisal, flax and hemp fibres are examples of plants with such fibres, however many other suitable fibres exist, especially in emerging countries.

This work is focused on hemp fibres. Hemp has been cultivated and used by many civilizations for over thousand years. The possible use of the stem fibres in engineering materials, and particularly as reinforcement in organic matrices, goes back only a few years. Fig. 1, showing the evolution of the number of scientific papers from the seventies to this day, illustrates the recent and remarkable interest of the scientific community in hemp fibres for composite applications.

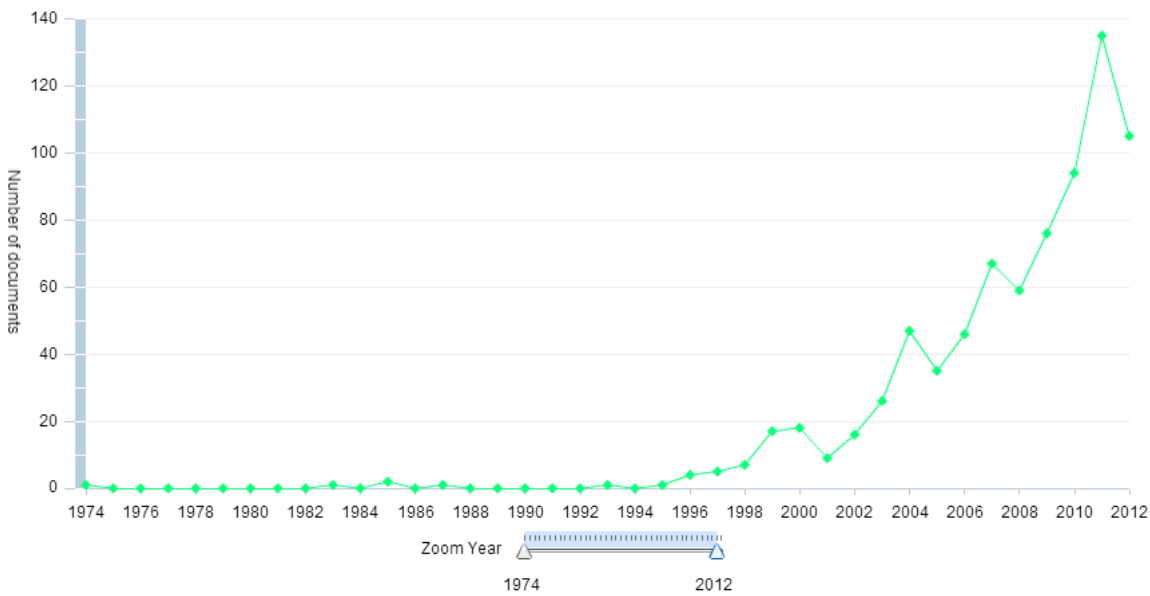

Fig.1 Number of scientific papers per year in peer-reviewed journal referenced in the SCOPUS database. Query words: “composite” and “hemp fibres”.

At the present time, hemp fibres are used mainly in low performance applications, in the construction and automotive industries. Their specific mechanical properties, and full potential in composite applications, thus appear to be poorly exploited. However, before such fibres can be used for the reinforcement of organic matrices in high performance applications, it is essential to gain an accurate understanding of their micro-mechanical behaviour. This paper reviews the main knowledge about the mechanical behaviour of hemp fibres and emphasises the scientific and technological bottlenecks to overpass before achieving a massive and sustainable use.

The origin of the variability and of the non-linear behaviour (Placet et al., 2013) the relationship between the morphology, structure/ultrastructure and the mechanical properties Duval et al., 2011; Schäfer & Hornermeier, 2006; Nilsson & Gustafsson, 2007; Thygesen et al., 2007; Thygesen, 2006; Crônier et al., 2005; Placet et al., 2012; 2011), the influence of temperature and environmental relative-humiditiy on tensile and rotational properties (Placet et al. 2012; Placet 2009) are reviewed in this work.

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