

Influence of Controlled Retting on the Quality of the Hemp Fibres Harvested at the Seed Maturity by Using a Designed Lab-Scale Pilot Unit

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Abstract : Hemp fibers are increasingly used as reinforcements in polymer matrix composites due to their competitive performance (low density, mechanical properties and biodegradability) compared to conventional fibres such as glass fibers. However, the huge variation of their biochemical, physical and mechanical properties limits the use of these natural fibres in structural applications when high consistency and homogeneity are required. In the hemp industry, traditional processes termed field retting are commonly used to facilitate the extraction and separation of stem fibers. This retting treatment consists to spread out the stems on the ground for a duration ranging from a few days to several weeks. Microorganisms (fungi and bacteria) grow on the stem surface and produce enzymes that degrade pectinolytic substances in the middle lamellae surrounding the fibers. This operation depends on the weather conditions and is currently carried out very empirically in the fields so that a large variability in the hemp fibers quality (mechanical properties, color, morphology, chemical composition...) is resulting. Nonetheless, if controlled, retting might be favorable for good properties of hemp fibers and then of hemp fibers reinforced composites. Therefore, the present study aims to investigate the influence of controlled retting within a designed environmental chamber (lab-scale pilot unit) on the quality of the hemp fibres harvested at the seed maturity growth stage. Various assessments were applied directly on fibers: color observations, morphological (optical microscope), surface (ESEM), biochemical (gravimetry) analysis, spectrophotometric measurements (pectins content), thermogravimetric analysis (TGA) and tensile testing. The results reveal that controlled retting leads to a rapid change of color from yellow to dark grey due to development of microbial communities (fungi and bacteria) at the stem surface. An increase of thermal stability of fibres due to the removal of non-cellulosic components along retting is also observed. A separation of bast fibers to elementary fibers occurred with an evolution of chemical composition (degradation of pectins) and a rapid decrease in tensile properties (380MPa to 170MPa after 3 weeks) due to accelerated retting process. The influence of controlled retting on the biocomposite material (PP / hemp fibers) properties is under investigation.

Keywords : controlled retting, hemp fibre, mechanical properties, thermal stability

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