

Titre : Approches micro-macroscopiques pour l' valuation des m canismes fongiques impliqu s dans la d gradation des mortiers biosourc s : impact sur les propri t s hygrothermiques

Mots cl s : mat riaux biosourc s, b ton de chanvre, durabilit , cycles de vieillissement, biod terioration, contamination microbienne

R sum  : L'objectif principal de ce travail de th se  tait l' tude de la durabilit  de mat riaux biosourc s tel que le mortier de chanvre dans le sens large. La prise en compte des aspects de vieillissement et de diff rents facteurs influant sur la performance de mortier de chanvre au cours de son p riode d'utilisation a  t  faite.

L'originalit  de ce travail r side dans plusieurs aspects. D'une part, il s'agit d'une  tude du vieillissement du mortier de chanvre. Pour ce faire, il est n cessaire   la fois d'adopter un protocole de vieillissement repr sentatif des conditions d'utilisation du mortier de chanvre et d'utiliser diff rentes m thodes exp rimentales de suivi de l' volution des caract ristiques et propri t s. L'ensemble de ces travaux a conduit   la mise en place de montages sp cifiques pour l'application des cycles de vieillissement.

D'autre part, l' tude approfondie de la prolif ration microbienne est n cessaire pour pallier le fait que le mortier de chanvre repr sente un grand risque de croissance microbienne en raison de sa nature organique.

Dans ce but, l'utilisation de m thodes analytiques rarement utilis es dans le milieu du g nie civil a  t  adopt e (extraction et s quen age de l'ADN).

Premi rement, le protocole de vieillissement acc l r  a  t  propos  qui visait   mieux repr senter les conditions d'utilisation compte tenu des informations constructives de l'installation de mortier de chanvre. Pour analyser l'influence du vieillissement, plusieurs dispositifs exp rimentaux ont  t  adopt s. Cela a permis d' tudier l' volution de la microstructure, de la composition chimique et des propri t s hygrothermiques.

Ensuite, la contamination microbienne a  t   tudi e de diff rents points de vue. Tout d'abord, l'influence de la prolif ration fongique sur la composition chimique a  t   tudi e. Ce travail a n cessit  l' tude des conditions de croissance des moisissures et la mise en place d'un protocole exp rimental permettant l'analyse et la comparaison de l' volution de la composition des mortiers bruts et contamin s. Ensuite, diff rentes m thodes d'identification ont  t  propos es pour comprendre la nature de la contamination fongique. Dans un premier temps, l'identification ph notypique a  t  appliqu e pour l'analyse de la contamination fongique. Ensuite, une autre m thode, proposant une technique de criblage fin de la contamination fongique et bact rienne, a  t  utilis e pour obtenir les r sultats les plus fiables.

Title : Micro-macroscopic approaches for evaluation of fungal mechanisms involved in the degradation of bio-sourced mortars: the impact on hygrothermal properties

Keywords : bio-based materials, hemp mortar, durability, aging cycles, biodeterioration, microbial contamination

Abstract : The main objective of this thesis work was the study of the durability of bio-based materials such as hemp mortar in the broad sense. The aspects of aging and different factors influencing the performance of hemp mortar during its period of use were taken into account. The originality of this work lies in several aspects. On the one hand, it is a study of the aging of hemp mortar. To do this, it is necessary both to adopt an aging protocol representative of the conditions of use of hemp mortar and to use different experimental methods to monitor the evolution of characteristics and properties. All this work has led to the implementation of specific setups for the application of aging cycles.

On the other hand, the in-depth study of the microbial proliferation is necessary to palliate the fact that the hemp mortar represents a great risk of microbial growth because of its organic nature. For this purpose, the use of analytical methods rarely used in the civil engineering environment was adopted (DNA extraction and sequencing).

First, the accelerated aging protocol was proposed which aimed to better represent the usage conditions considering the constructive information of the hemp mortar installation. To analyze the influence of aging, several experimental devices were adopted. This allowed to study the evolution of microstructure, chemical composition and hygrothermal properties.

Then, the microbial contamination was studied from different points of view. First, the influence of fungal growth on the chemical composition was studied. This work required the study of the conditions of growth of moulds and the implementation of an experimental protocol allowing the analysis and the comparison of the evolution of the composition of raw and contaminated mortars. Then, different identification methods were proposed to understand the nature of the fungal contamination. First, phenotypic identification was applied to analyze the fungal contamination. Then, another method, proposing a fine screening technique of fungal and bacterial contamination, was used to obtain the most reliable results.