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Abstract for an oral presentation (session 7: Building and Housing)

**Effect of woody hemp core on the setting
of cementitious binders in lightweight concrete**

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Woody hemp core (also called hemp hurds) constitutes the central part of hemp stalk (*Cannabis Sativa*). It can be considered as a by-product of the long fibers and seed production and so far, it has been used mostly as animal bedding or mulch. Regarding the chemical composition, woody hemp core can be compared to wood but it presents a much lower density. Due to this low density, woody hemp core can be used as a natural aggregate to produce hemp lightweight concretes (HLC), characterized by good thermal and acoustic insulation properties. Whereas the functional properties and environmental advantages of HLC are clearly established, some questions remain on their formulation and setting up. In particular, like the most of the lignocellulosic residues, woody hemp core develops complex interactions with cement during setting reactions, which are at the origin of various technical problems during curing and further performances.

The aim of this study is then to delineate in an integrated way the complex interaction that take place during the setting and curing of HLC.

Firstly, we demonstrated that water extractives from hemp hurds, representing only 3-4 wt % of sample, can delay the setting of cement by more than five hours, according to the Vicat test. The production of hydrates and their formation rates were also shown to be lowered by the presence of water extractives in the cement paste. Moreover, mechanical tests have revealed that water extractives reduced compression properties of the material obtained after 28 days of curing.

Further insight into the mechanisms at the origin of this effect led us to identify the extractives composition and therefore, the potential effective molecules interfering with cement during the setting and curing. We also designed an original test allowing the visualization of the effect on cement of a single particle of hemp. Thanks to this test, we observed, a very well defined zone (2-3mm) of non-hydrated cement surrounding the hemp particle, as confirmed by infrared spectroscopy and thermogravimetric analysis. These

findings highlight the fact that the formation of the interface is a key point for hemp/cement composites, depending on local physic-chemical conditions and on the dynamics of the reactive systems. Comparing different types of lignocellulosic residues and different sizes of particle, we also noticed that the morphology/porosity of the aggregates influences greatly their cement setting inhibition capacity.

To conclude, the multi-scale approach presented here appears to be useful to better understand the interaction of two complex systems, i.e., plant aggregates and mineral binder.