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The Use of Cementitious Materials as Biological Substrate



The construction sector increasingly incorporates photosynthetic organisms on the outside of building elements, for aesthetic, environmental and economic reasons. This research compares the results of building materials with improved physical and chemical properties promoting colonisation, development and reproduction of organisms when submitted to three different environments. The results show that biological growth depends on weather conditions and climate.

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Incorporation of photosynthetic organisms on the structure envelope, traditionally as vertical gardens, has gained attention and has become a priority in the area of architecture and construction. The above is not only consequence of aesthetics but also consequence of environmental and economic benefits. There are several typologies ranging from plant boxes to systems more complex such as hydroponic ones and they have several benefits including local absorptions of CO₂, thermal improvement of buildings, purification of the local air and others.

Nonetheless, recent research of the Polytechnic University of Catalonia (UPC) is centred in the development of cementitious materials with an enhanced bioreceptivity to stimulate biological growth. The term bioreceptivity refers to the physical and chemical properties of a material involved in the promotion of the colonisation, development and reproduction of living organisms.

This propitiates more sustainable constructions and with a higher level of integration in the natural environment, imitating what naturally happens on rocks in natural and rural areas.

Natural colonisation of living organisms under environmental conditions is very time-consuming since the current materials have properties, which hinder this process. Moreover, common tests carried out in this research topic are based on accelerated laboratory tests. However, those tests have limitations by not considering weather conditions as well as environmental biodiversity.



Figure 1: Exposure of experimental samples in the area of Montseny.

The article, which has been published in the peer-reviewed journal *Science of the Total Environment*, investigates the possible correlation between laboratory and field-scale experiments in the evaluation of high bioreceptive cementitious materials. In this regard, a one-year duration experiment has been carried out, in which the samples were exposed to 3 different environments, which differed in weather and/or air quality. The three selected areas were Barcelona city, the Natural Park of Montseny and Ghent city (Belgium). The first two locations differ in the air quality while the two urban locations differ in weather conditions.

Results obtained show significant differences in the biodiversity and quantification of fungi and bacteria, which are the common pioneer microorganisms of the colonisation process of cementitious materials, for the three locations. The study aimed to be a first approach of the joint analysis of the biological and natural colonisation, and the weather conditions and air quality. The research demonstrates biological growth is heavily dependent of the environmental conditions (weather conditions and air quality), which justifies the fact that laboratory and field-scale tests presented different results. Moreover, it is necessary to carry out longer experimental programs for natural colonisation analysis.

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References

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