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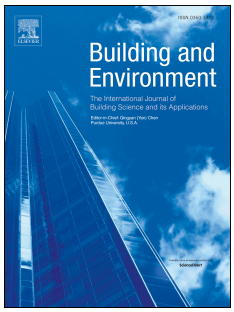

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Manuel Nuño, Giovanni L. Pesce, Chris R. Bowen, Panayiotis Xenophontos, Richard J. Ball

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Environmental performance of nano-structured $Ca(OH)_2/TiO_2$ photocatalytic coatings for buildings

Manuel Nuño[1], Giovanni L. Pesce[1], Chris R. Bowen[2], Panayiotis Xenophontos[1], Richard J. Ball[1]*

[1]BRE Centre for Innovative Construction Materials, Department of Architecture and Civil Engineering, University of Bath, Claverton Down, BA2 7AY

[2]Department of Mechanical Engineering, University of Bath, Claverton Down, BA2 7AY

* Corresponding author

Email: m.nuno@bath.ac.uk

Abstract

This paper describes the environmental performance of a mixed phase coating (photocatalytic nanolime) manufactured from a colloidal nano-structured calcium hydroxide in alcohol (nanolime) combined with titanium dioxide. While nanolime is used as a consolidant in the field of cultural heritage and titanium dioxide is used as a photocatalytic material for self-cleaning coatings and environmental pollution control within the construction industry both materials are often used separately. We report in this paper an approach to combine both materials for the development of a photocatalytic nanolime coating. The photocatalytic effect of titanium dioxide on the carbonation of nanolime and its influence on the degradation processes in polluted environments is explored. A suspension of 25g/l of nanolime in ethanol and 7.4% wt/vol titanium dioxide was applied to specimens of Bath stone. For comparison, additional specimens were treated only with the nanolime. The specimens were exposed to oxides of nitrogen and sulphur under 30% relative humidity (RH) for 120 hours. Exposure was carried out under both, UV and daylight. After exposure, the effect of titanium dioxide on the carbonation of nanolime and on the degradation processes was investigated using scanning electron microscopy (SEM), energy dispersive X-ray analysis (EDS) and X-ray photo electron spectroscopy (XPS). Results were evaluated considering the dissolution processes of the two oxides in water, and modelled using PHREEQC. Results show that the nanolime and the photocatalytic nanolime coatings promote the reaction of SO_2. In addition, the photocatalytic effect of the anatase form of titanium dioxide promotes the formation of a surface layer of calcium sulphate and inhibits carbonation of calcium hydroxide. That was attributed to the oxidation of sulphur dioxide to sulphur trioxide by hydroxyl radicals which led to the formation of sulphuric acid.