Fungal deterioration control in outdoor environments by nano-additivated waterborne paint

Erasmo Gámez-Espinosa[1], Cecilia Deyá[1,2], Natalia Bellotti[1,3]
(1) Centro de Investigación y Desarrollo en Tecnología de Pinturas (CIDEPINT) (CONICET-UNLP-CICPBA), Buenos Aires, Argentina
(2) Facultad de Ingeniería, Universidad Nacional de La Plata, Buenos Aires, Argentina
(3) Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, Buenos Aires, Argentina

Biodeterioration of facades in building constructions causes economic damage. Filamentous fungi by their presence cause aesthetic damage to structural materials. In addition, its invasive growth through hyphae generates physical deterioration and due to its nutrition and excretion, they release enzymes, acids and pigments that cause chemical deterioration.To control fungal deterioration, paint additives with nanostructured biocides can be applied on facades.In addition, it is important that the nanoadditive maintains its long-term antimicrobial activity to delay fungal deterioration.The aim of this research was to assess the antifungal activity of a waterborne paint additivated with ZnO nanoparticles (ZnONPs) after 4 years exposed to the outdoor environment.Control paint without biocides (PC), was prepared following the corresponding composition, % by weight. Following also this formulation, paints additivated with the ZnONPs were prepared replacing, by weight, the natural calcium carbonate by the corresponding NPs (PZnO). The nanoparticles were supplied courtesy of Dr. Facundo Ruiz, Universidad Autónoma de San Luis Potosí, San Luis Potosí, México. Paints films were exposed to the natural weather conditions of La Plata city (34º54'S and 57º55'W). Biodeterioration observed on the coatings was evaluated taking into account ASTM D 5590 standard. The mycobiota of the samples was studied after 4 years of exposition to the outdoor environment. The paints were swabbed and the fungi were isolated following conventional microbiological techniques. In addition, relative density (RD) and apparition relative frequency (RF) of the isolate were calculated.Samples paints exposed to natural weathering were evaluated in relation to biodeterioration. Visual inspection and the use of the stereoscopic microscope were used to rate the performance in each case. At the end of the test, the biodeterioration increase in the samples with PC being the heavy growth. The PZnO samples maintained a notable difference with the control samples with trace to light biofilm growth being. PC the RF of the isolated were Rhodotorula sp. (95%), Cladosporium sp. (90%), Alternaria sp. (75%), Epicoccum nigrum (69%) and Mucor sp. (55%). Therefore, Rhodotorula sp. (Basidiomycota) and Cladosporium sp. (Ascomycota) are abundant; Alternaria sp. (Ascomycota) and E. nigrum (Ascomycota) are common and Mucor sp. (Mucoromycota) is moderate. Also to the strains mentioned previously, Penicillium sp. was isolated only from the PZnO. In PZnO the fungi had less FR and DR with respect to PC due to the presence of ZnONPs. In this study, it was possible to formulate a waterborne paint containing ZnPNOs as additive to control the biodegradation of facades and can be used to prevent fungal deterioration in hospitals and buildings.

Financing: Acknowledgments Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Comisión de Investigaciones Científicas de la provincia de Buenos Aires (CICPBA), Agencia Nacional de Promoción Científica y Tecnológica (ANPCyT) and Universidad Nacional de La Plata (UNLP), Argentina.