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Enhancing the optical properties of black conventional colorants by TiO2 incorporation

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In Europe, buildings are responsible for over 40% of energy consumption and greenhouse gas emissions, so that improving their sustainability is a much-needed demand for the construction sector. To reduce energy use and CO2 emissions, it is necessary to contain as much as possible the energy requirements of a building [1]. Among the several solutions studied, the development of materials with high reflectance of the solar energy for roofs and envelope systems has been shown to be effective in reducing the thermal gains and overheating in buildings [2]. A cool material is a material that contains highly near-infrared reflective pigments and that can be applied onto a surface exposed to solar radiation to reduce its radiation absorption. Thus, the use of coatings containing such reflective materials that reflects a large part of solar radiation is decisive to reduce the thermal gains and overheating of buildings [3]. Our study targeted the development of innovative envelope systems by increasing their solar reflectance through new material formulations with the inclusion of nanoparticles. For that, it is necessary to develop and optimize nanoparticles formulations to achieve a high NIR reflectance. We studied the reflectance and colour properties by doping a standard black coating with different sizes of TiO2 nanoparticles, in an acrylic substrate. In particular, titanium dioxide rutile nanoparticles were used with the concentration in the coating being varied (1%, 3%, 5% and 8%). The inclusion of the TiO2 nanoparticles in these coatings led to an increase in the spectral reflectance in the acrylic substrate, with the most promising results obtained for composites containing TiO2 with 30 nm and with 20% concentration (with a 0.23 reflection compared to 0.13 for the standard colorant). Our results indicate that, with increasing nanosized particles content, the thermal insulation properties for the coating are improved.

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