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Sustainable Pavements with Reflective and Photoluminescent Properties

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Abstract : An alternative to mitigate the heat island effect is to pave streets and sidewalks with pavements that reflect incident solar energy, keeping their surface temperature lower than conventional pavements. The “Heat island mitigation to prevent global warming by designing sustainable pavements with reflective and photoluminescent properties (RELUM) Project” has been carried out with this intention in mind. Its objective has been to develop bituminous mixtures for urban pavements that help in the fight against global warming and climate change, while improving the quality of life of citizens. The technology employed has focused on the use of reflective pavements, using bituminous mixes made with synthetic bitumens and light pigments that provide high solar reflectance. In addition to this advantage, the light surface colour achieved with these mixes can improve visibility, especially at night. In parallel and following the latter approach, an appropriate type of treatment has also been developed on bituminous mixtures to make them capable of illuminating at night, giving rise to photoluminescent applications, which can reduce energy consumption and increase road safety due to improved night-time visibility. The work carried out consisted of designing different bituminous mixtures in which the nature of the aggregate was varied (porphyry, granite and limestone) and also the colour of the mixture, which was lightened by adding pigments (titanium dioxide and iron oxide). The reflectance of each of these mixtures was measured, as well as the temperatures recorded throughout the day, at different times of the year. The results obtained make it possible to propose bituminous mixtures whose characteristics can contribute to the reduction of urban heat islands. Among the most outstanding results is the mixture made with synthetic bitumen, white limestone aggregate and a small percentage of titanium dioxide, which would be the most suitable for urban surfaces without road traffic, given its high reflectance and the greater temperature reduction it offers. With this solution, a surface temperature reduction of 9.7°C is achieved at the beginning of the night in the summer season with the highest radiation. As for luminescent pavements, paints with different contents of strontium aluminate and glass microspheres have been applied to asphalt mixtures, and the luminance of all the applications designed has been measured by exciting them with electric bulbs that simulate the effect of sunlight. The results obtained at this stage confirm the ability of all the designed dosages to emit light for a certain time, varying according to the proportions used. Not only the effect of the strontium aluminate and microsphere content has been observed, but also the influence of the colour of the base on which the paint is applied; the lighter the base, the higher the luminance. Ongoing studies are focusing on the evaluation of the durability of the designed solutions in order to determine their lifetime.

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