"COOL" CERAMIC TILES FOR FAÇADE CLADDING

Ana Gozalbo [1], María José Orts [1], Silvia Arrufat [1], Vicente Sanz [1], Miguel Angel Bengochea [2], Luis Guaita [2]

[1] Instituto de Tecnología Cerámica (ITC). Universitat Jaume I. Castellón, Spain

[2] KERABEN GRUPO, S.A. Nules, Spain

1. INTRODUCTION

Urban centres have significantly higher average temperatures than those of their surroundings, constituting so-called urban heat islands (UHI). Many construction materials have high solar radiation absorption and the absorbed heat is transformed into very high temperatures during the day, which can be re-radiated to the exterior, contributing to the UHI effect, and be transferred into the buildings by conduction, increasing the energy consumption required for cooling.

Solar radiation contains 3% of its energy in the UV region, 46% in the visible spectrum, and 52% in the NIR (near infrared) region. Consequently, dark materials, with low reflectance in the visible spectrum, absorb more radiation solar and therefore reach higher temperatures and contribute more to the UHI effect than materials with a light colour, which reflect the visible spectrum. When it is desired to use dark materials for aesthetic purposes, this effect can be alleviated by increasing the reflectance in the NIR region to obtain so-called "cool" materials, these being materials that, while maintaining the colour, reach a lower temperature than conventional materials.

COOL-Coverings (FP7-2010-NMP-ENV-ENERGY-ICT-EeB 260132) is a European project in which "cool" construction materials have been developed to cover building envelopes: asphalt membranes, paints, and ceramic tiles for façades.

2. TESTS CONDUCTED

"Cool" glazed porcelain stoneware tiles with a black colour were prepared for external wall cladding, and their performance with relation to solar radiation was compared with that of conventional black tiles with the same characteristics.

The solar absorptance of all tiles was measured using the solar irradiation of standard ASTM G-173-03. The chromatic coordinates CIEL*a*b*, using illuminant D65 and standard observer at 10°, were also measured.

Tile performance was compared, solar absorptance (ρ_{SOLAR}) and absorptance in the near-infrared region (ρ_{NIR}) being plotted versus lightness (L*).

3. RESULTS

The results obtained are shown in Figure 1. It may be observed that solar reflectance (ρ_{SOLAR}) and reflectance in the NIR region (ρ_{NIR}) were both much higher for the cool tiles. Comparison of the spectral reflectances (Figure 2) shows that, essentially, the reflectance in the infrared region was modified.

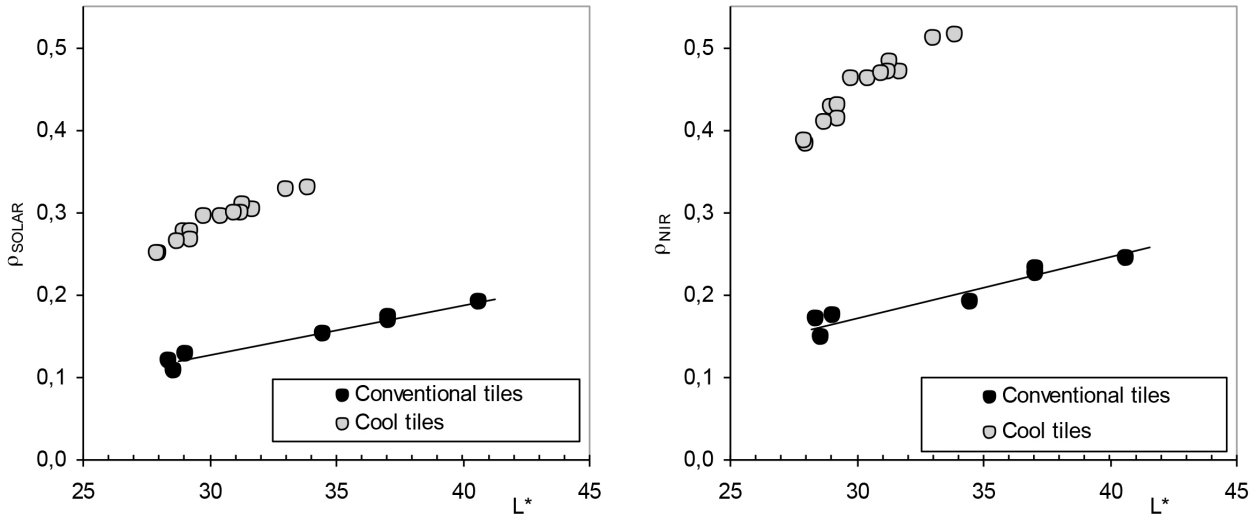

Figure 1. Variation of solar reflectance and reflectance in the NIR region with lightness (L).*

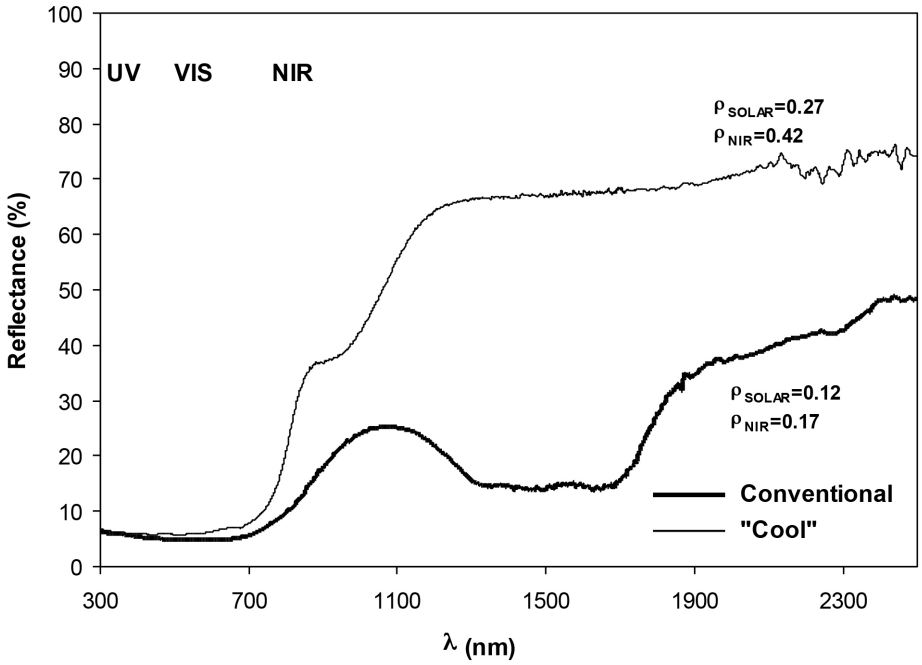

Figure 2. Spectral reflectance of one of the cool tiles and of a conventional tile.

The tiles were obtained industrially and a demo park was built in Algete (Madrid), in which "cool" and conventional tiles with the same colour were used to clad two buildings with exactly the same characteristics. Tile surface temperature and the heat flux into the buildings were continuously recorded. A reduction in temperature of about 5°C and a decrease in heat flux density of 10 to 12W/m^2 were observed.

5 REFERENCES

[1] A. Synnefa, M. Santamouris and K. Apostolakis. On the development, optical properties and thermal performance of cool colored coatings for the urban environment. Solar Energy 81 (2007) 488–497.

[2] R. Levinson, H. Akbari, P. Berdahl. Measuring solar reflectance—Part II: Review of practical methods Solar Energy 84 (2010) 1745–1759.

[3] J.M. Revel, M. Martarelli, M.A.Bengochea, A. Gozalbo, M.J. Orts, A. Gaki, M. Gregou, M. Taxiarchou, A. Bianchin and M. Emiliani. Nanobased coatings with improved NIR reflecting properties for building envelope materials: Development and natural aging effect measurement. Cement and Concrete Composites.36 (2013) 128-135.