# UV STABILITY OF THERMOCHROMIC MICROCAPSULES FOR SMART POLYMER COMPOSITE STRUCTURES

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By incorporation of stimuli-responsive microcapsules into a composite structure, the application possibilities of its could be extended. Such a smart structure is not only a part of the construction but also implements an integrated function of sensors. Encapsulated thermochromic dyes could be relatively simply mixed into a polymer structure and they can perform the function of detecting an increase in ambient temperature where it is important for the structure as a whole. The ability of thermochromic material to alter its light absorption and emission parameters upon the crystalline phase (liquid crystal dye) or chemical form (leuco dye) change induced by a change in temperature is applied. A dramatic visual colour change of the material will occur when the temperature reaches a certain threshold value set by the thermochromic material manufacturing process. Dyes are known victims of intense ultraviolet degradation in the form of colour fade and colour change due to chromophore chemical bond damage. Despite the fact that the thermochromic dye is encapsulated to protect it from the effects of environmental factors, even encapsulated it still remains sensitive to UV. Thermochromic microcapsule colours are visible with the naked eye due to their capsule shells being transparent, exposing the thermochromic core and letting light interact with chromophores through absorption and emission. This naturally raises the question of whether these microcapsules are viable for use under direct sunlight as ultraviolet radiation is part of the total terrestrial insolation spectrum.

The aim of the work is to evaluate the effect of UV light on the service-life of thermochromic microcapsules. To achieve the aim several tasks were outlined:

1. Define the method of colour change control and quantitative evaluation.
2. Experimentally define colour changes of thermochromic microcapsules integrated into the polymer structure under UV exposure.
3. Define the critical time of UV exposure for thermochromic microcapsules integrated into the polymer structure.

Thermochromic microcapsules with a colour change at temperatures 31, 40, and 50 °C were mixed into acrylic paint as a polymer matrix. Samples as thin films were prepared. Samples were exposed by UV (radiation energy 24.6 W for wavelength 240 - 320 nm) for the time interval from some minutes to 72 hours. The difference in colour change, as well as the ability to change colour after the increase of temperature, was evaluated vs. the time of UV exposure. The trend of experimental results indicates that there is a certain time of UV exposure where thermochromic pigment in microcapsules has degraded to the point of not showing the colour difference after the increase of temperature.

Colour change of samples was evaluated by images made in the photo light box (thus excluding the influence of ambient lighting in the room) and treated in Adobe® Photoshop® software. Images were converted to grayscale and Info tool was used to obtain K value from grayscale images. K is a value in 8 bit CMYK colour scheme graded from white (255 = 0%) to black (0 = 100%) in percent.

In the result of the work it was defined that for microcapsules with different colour change temperatures, time of UV exposure leading to pigment degradation is not the same. The pigments in microcapsules used for colour change at 40 °C, and 50 °C are more stable to UV compared to the pigment used for colour change at 30 °C.