RheoLight™ Crystal Glass Pigments

RHEOLIGHT™ COOL-COLORS FOR THERMAL COMFORT IMPROVEMENT

A Revolutionary Heat Reflector for High-End Aesthetic Applications

Objects left in the sun will warm up differently depending on their color. Studies[1] have shown that dark-colored objects warm up significantly faster and more than light-colored objects. This is because white coatings reflect up to 60% of sun rays compared to only 5% for black-colored objects[1]. Consequently, the darker the object's color, the more radiation it absorbs from the sun, which leads to increased interior temperatures.
RheoLight's mode of action is based on reflection of sunlight, therefore potentially decreasing the object's interior temperature. This has several benefits, including a cooler car interior on a hot day, resulting in a reduced load on the air conditioning. Optimizing color choices can result in up to 2% savings in fuel consumption and a smaller environmental impact[1].

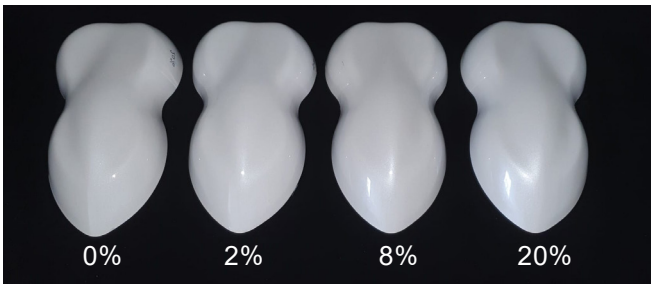
> Tune any color with RheoLight™ for thermal comfort, energy savings, and personal style.

With RheoLight, you can choose any color and increase solar reflectance by adding RheoLight and turning your styling into a '*cool color*'. Indicative in-house performed study test results have shown that RheoLight could help to keep the inside of objects cooler when exposed to a heat source. This makes it a valuable tool for various commercial and industrial applications where people want a high-end look and thermal comfort, such as automotive coatings, helmets, window blinds, roof painting and wall decorations.

In an in-house developed experimental setup, the thermal behavior of four white plastic car models was evaluated after coating them with a commercial car refinishing system with and without RheoLight in different concentrations. On all the cars, first a primer was applied and then a single coat of Syrox Suzuki Arctic White (waterbased). A second Syrox Suzuki Arctic White paint-layer was applied with 0, 2, 8 and 20 weight percent of RheoLight CSTL. Finally, a high-gloss 2K topcoat was added.

Proof of concept study design:

- Simulating (extreme) exposure to direct sunlight a shortwave-infrared heat-source (3x 1100W) was used (LD3P – MW tools), set to emit at 60°C
- Calibrated Thermocouples positioned in the interior's center of the four car models logging temperatures
- Data analysis shows, that under these conditions, a 2.5°C cooling effect was reproducably attained
- Further validiation and controlled testing is planned to provide confirmation of this effect in real-life situations



Picture 1. Car models with various percentage of RheoLight.

Picture 2. MW LD3P Shortwave Infrared Curing System

[1] Levinson, R., Pan, H., Ban-Weiss, G., Rosado, P., Paolini, R., & Akbari, H. (2011). Potential benefits of solar reflective car shells: cooler cabins, fuel savings and emission reductions. Applied Energy, 88(12), 4343–4357. https://doi.org/10.1016/j.apenergy.2011.05.006

A significant clear, steady-state cooling effect is obtained with RheoLight™

The calculated difference in interior temperature of the car-shaped models with 0% and 20% RheoLight is visualized in Figure 1. The 0% RheoLight is represented by the black (top) line and follows a steeper heating-curve which is also higher than the blue (lower) 20% RheoLight line. As a result, this formulation's clear, steady-state cooling effect of 2.5°C is observed under these circumstances.

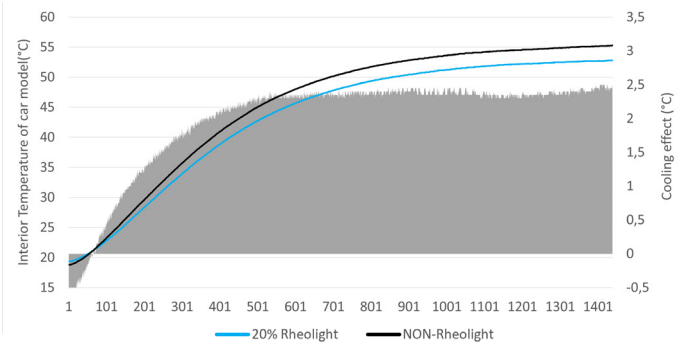


Figure 1. Comparison of heating curves for a 0% and 20% RheoLight™ coating and steady-state temperature

Besides the measurements performed for this white color range, the effect has demonstrated to also be reproducible using the same setup for other colors, such as metallic blue and fluor orange, strongly confirmative of a systemic improvement of the addition of RheoLight to a decreasing interior temperature.

Combined results of the four white car-shapes with the different RheoLight percentages, show an increasing heat reduction effect when increasing the RheoLight concentration. The following graph shows the correlation of the cooling effect of RheoLight as a function of its concentration in the coating, see Figure 2.

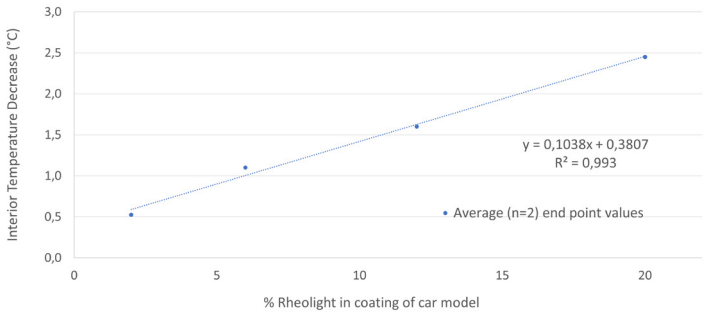


Figure 2. Graph describing near-linear temperature decrease effect of increasing %'s of RheoLight™.

Scientific Validity of the test results

The positive effect of RheoLight on the heating profile of interior temperatures under the proof-of-concept conditions applied confirm reproduceability over the whole range of optimized RheoLight colors. Additional research and confirmatory testing for real-life situations is initiated for new RheoLight colors.

When drawing conclusions about the RheoLight Effect based on measurement of the external temperature of objects, caution is advised as the results have shown a low correlation between the external temperature and the consistent lower interior temperature of the car models. Further research is going to be conducted under more controlled conditions to validate the positive effect in real-life situations.