

TECHNICAL REPORT

PROPERTIES CHARACTERIZATION OF ECOCOAT TITAN

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R&D
IGL COATINGS
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Introduction

Widespread awareness and the resulting need for sanitization have been at an all-time high in the age of a global pandemic. The push to a new normal will see surface sanitization being at the forefront of the battle against infectious pathogens. The need for a new technology to supplement constant cleaning, both at home and in commercial areas, will introduce new type of ever-increasing labor cost. Thus, reducing the need for constant sanitizing in commercial areas can be done with an active self-cleaning surface that can survive the rigors of high-touch commercial areas.

IGL Coatings Ecocoat Titan has been specifically designed for high-traffic bacterial hotspots such as door handles, hand railings, glass surfaces, laminated wood tabletops, atm machines and others. The bound TiO_2 photocatalyst responsible for the antimicrobial activity of the coating ensures its long-lasting effects. The TiO_2 photocatalyst has also been tested in different conditions of light and has proven to work in both indoor and outdoor settings. The wide variety of surfaces and resistance to most surface sanitizers makes ecocoat titan the solution to the ever-increasing need for surface sanitization.

Product Details

Ecocoat Titan is a waterborne sol-gel coating system that contains TiO_2 photocatalyst as an antimicrobial agent.

Advantages:

- Waterborne, low VOC formulation
- Forms thin, clear coating
- Good adhesion on a wide variety of substrates (metals, glass, plastic, cloth, etc)
- Great scrub resistance for high-traffic surfaces
- Can be applied by wiping or spray method

Properties:

- Dry-to-touch: 4-6 hours
- Thorough dry: 12 hours
- Resistant to most household cleaners
- Low curing temperature (20 - 80 °C)

Summary

| Test | Values | Standard Method |
|---|--|-----------------|
| Chemical Resistance, Spot Test, Covered | 1 hour exposure to ecoclean multi, absolute and 35% citric acid may damage the coating | ASTM D 1308 |
| Scrub test | >10 000 soap scrub >1000 IPA scrub | ASTM D 4213 |
| Accelerated stability test, 50 °C | Stable for at least 2 months | In-house |
| Antibacterial activity of photocatalytic coatings | 7log reduction or 99.9999% bacterial reduction in 30 mins | ASTM E 2180 |

Results

Chemical Resistance, Spot Test

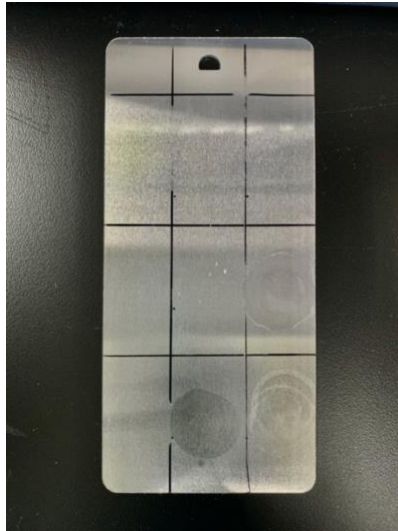
The chemical resistance spot test was done on an aluminium panel coated ecocoat titan with <1 µm thickness. An area of 9 separated spots was created. The spots had an approximate dimension of 32.5 – by 22 mm each. A couple of drops of a variety of regular household cleaners was applied to a spot and was immediately covered. The chemicals were in contact with the panel for the duration of 1 hour. The following chemicals were used:

| | | |
|--------------------------------|-------------------------------|---|
| I - 70% isopropyl alcohol | II - 1:50 bleach dilution | III - glass cleaner |
| IV - 20% acetic acid (vinegar) | V - ecoclean wash (detergent) | VI - ecoclean absolute (peroxide-based cleaner with silver ion) |
| VII - enzyme-based cleaner | VIII - 35% citric acid | IX - ecoclean multi (multi-purpose cleaner) |

| Panel | | |
|-------|---|---|
| O | O | O |
| O | O | X |
| O | X | X |

Result of chemical resistance spot test (O =No effect, X = Not recommended)

The test showed resistance to most mild household cleaners. 35% citric acid, ecoclean absolute and ecoclean multi were able to remove the coating to varying degree. Ecoclean multi is known to be able to remove some silicone-based coatings due to its good degreasing ability. Ecoclean absolute is a concentrated version of commercially available peroxide-based cleaners, thus has significantly more robust cleaning power.



Scrub Resistance Test

The scrub resistance test was done on 2 panels; one with a freshly-mixed finished formulation and the other after storage at 50 °C for 2 months (equivalent to one-year stability at room temperature). The tests were commenced using BGD 528 Wet Abrasion Scrub Tester using abrasion head of sponge holder with a weight of $1\ 000 \pm 10$ g and sponges with approximately 15 ml of scrub medium. No abrasive pads were used. The coating was left to cure for one day before subjected to scrub resistance test.

The rate of thinning of the coating were measured by visual assessment of the coating film and weight loss at interval of 1 000 scrubs. The test was stopped at 10 000 and 1 000 scrubs with detergent and isopropyl alcohol respectively. No visible film loss was observed on both panels and the weight of the coated plates were constant throughout the testing period.



Visual appearance of plate after scrub resistance test. L: Freshly mixed product; M: After 2 months at 50 °C; R: Example of plate with film loss.

Accelerated Stability Test

The finished product of ecocoat titan in its intended packaging was subjected to long term storage in a 50 °C oven for over 2 months to simulate an accelerated stability test. A standard test in the cosmetics industry states that 2 months emulsion stability at elevated temperature should translate into 1-year shelf life at room temperature. After the testing period of 2 months, the formulation was checked for its adhesion and performance.

Some settling of the nanoparticles was observed at the end of the testing period but was easily reconstituted back by shaking the bottle. A small amount of yellowing was observed, however surface coated with it was still clear and transparent. Scrub resistance test and ATP testing were done, and the result was comparable to newly mixed product.

Antibacterial Activity of Photocatalytic Coatings.

The antibacterial activity test was done on coated panels and subjected to 3 different conditions; UV light (2 hours irradiation), ambient light and darkness. Two gram negative bacteria (*E. coli* and *P.aeruginosa*), two gram positive bacteria (*B. subtilis* and *S.aureus*), two positive controls and a negative control was subjected to each set of conditions. 100 µl of each treatment was pipetted on the plate and spread evenly before it was left for incubation for 24 hours at 30 °C. Every 30 minutes within the first 2 hours, plates were swabbed and streaked onto sterile Nutrient Agar before incubated for 24 hours. Colony number was obtained at the end of the testing period and recorded in CFU/ml.

After 2 hours of pre-activation by UV light, gram positive bacteria *B. subtilis* showed total inhibition while *S.aureus* showed steady decrease over 2 hours and no traceable growth after 24h (**see attached official report**). Both ambient and dark conditions exhibited similar behavior for the two gram positive bacteria within the first 2 hours. At 24 hours however, the *B.subtilis* showed increase in population while *S.aureus* was completely eradicated. More data points will be taken to confirm if regrowth occurs for *B.subtilis* after 24 h of incubation. With initial concentration of bacteria of approximately 150 000 000, both *B.subtilis* and *S.aureus* showed reduction of over 7log reduction, which is equal to over 99.9999% reduction of bacteria. In gram negative bacteria, total inhibition was observed for both species of bacteria at 30 mins.

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