



BACTIBLOCK® ANTIMICROBIAL DURABILITY

BactiBlock® is an antimicrobial additive compatible with many polymeric systems and coatings. High effectiveness has been proven according to international Antimicrobial Standards such as JIS Z 2801, JIS Z 1902, ASTM G21 and others. However, BactiBlock® antimicrobial durability and its influence on applications and systems are sometimes a concern for our customers.

BactiBlock® Aging Tests Research

This research gives an answer to the following questions and concerns:

1. Does BactiBlock® have an influence on the materials' shelf life?

Answer 1. Adding BactiBlock® does not affect the Ultraviolet resistance in Polymers.

2. How long does BactiBlock®'s antimicrobial effectiveness last?

Answer 2. At usual BactiBlock® dosages, antimicrobial effectiveness lasts during a time period longer than the life cycle of the material.

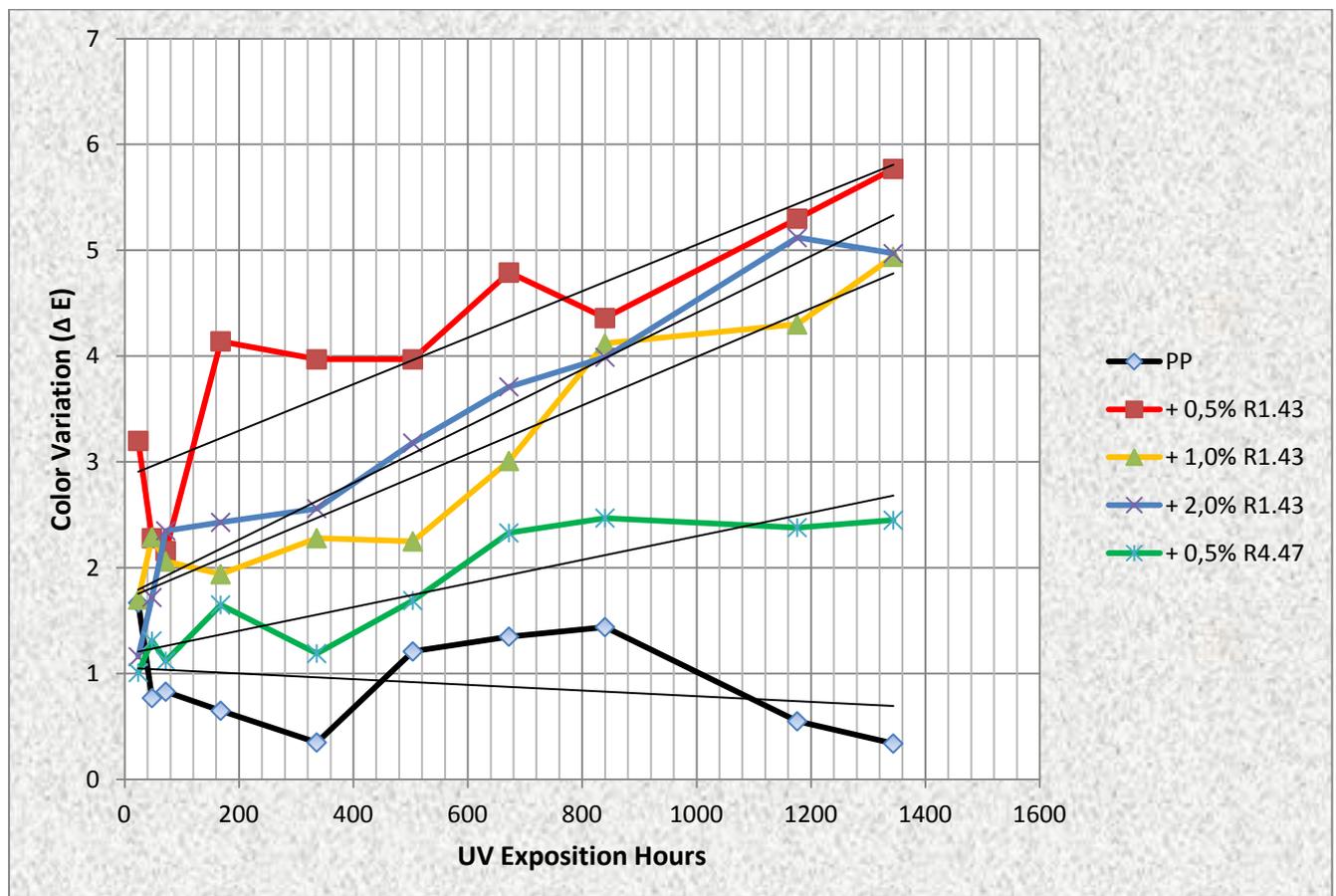
In order to answer these questions, NanoBioMatters has developed a Method which results and developments are reported through the following analysis.

1. Ultraviolet Resistance

One of the most usual aging tests for thermoplastics (Polyolefin, Polyester or Polyamide), thermosetting materials and coatings measures the materials' aging behavior with respect to the UV light. In order to test the Ultraviolet Resistance in materials with BactiBlock®, NanoBioMatters laboratory used PP sheets with 0.2 mm thickness containing 1% Ultramarine Blue (Color Index PB 29). PP sheets were additivated at several BactiBlock® dosages. Ultramarine Blue pigment was selected due to its high sensibility to UV light.

Sample	% of BactiBlock 101 R1.43	% of BactiBlock 101 R4.47
1	0.5	--
2	1.0	--
3	2.0	--
4	--	0.5
Control	--	--

In the following graph is depicted the **Color Variation (ΔE)** versus Time Exposure of the different samples with respect to themselves at zero exposure time.



CONCLUSIONS:

1. The Control Sample behavior is linear, with a tendency to stabilize over time.
2. The behavior of the sample containing 0.5% of BactiBlock® R4.47 is better than the samples containing BactiBlock® R1.43. It only achieves a color difference higher than 3 over 1,500 hours of exposure.
3. Samples containing R1.43 have a major discoloration at relatively low exposure times and stabilize over ΔE superior to 5 CIELAB units.

NOTE. Tests have been performed and verified using the following equipment:

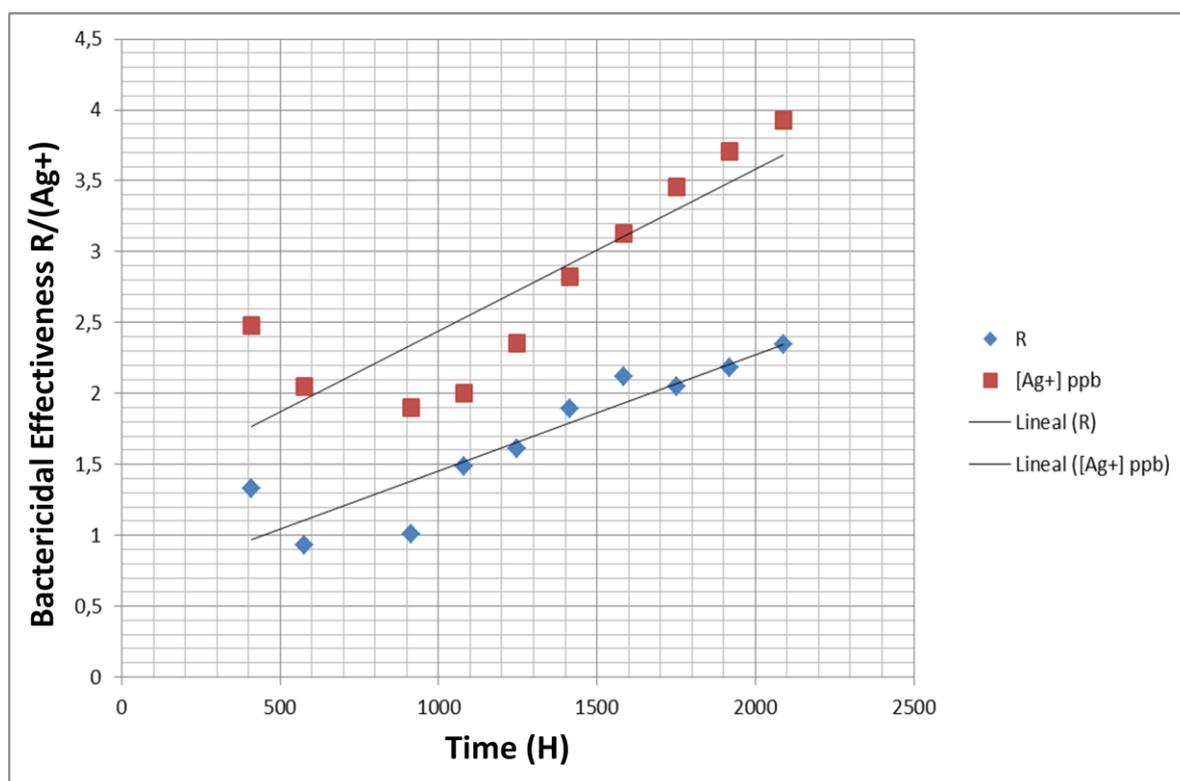
- Bulb 300W Ultra-Vitalux. Mixture of radiation similar to the sun.
- Black box of dimensions (60 cm highx 80cm wide x40.5cm depth).

Colorimeter for measurements: Konica Minolta



2. Silver release and antimicrobial activity in aqueous or high humidity conditions

With the objective of establishing a relationship between the silver release and the bacterial activity of BactiBlock®, PP films of 60 microns thickness were prepared containing 1% wt. BactiBlock® 101 R1.43. Then, 0.5 grams of sample were quartered and placed in aqueous immersion at a stable temperature of 40°C. The immersion time varies depending on the attached graph, which determines the extraction of Ag⁺ from each of the samples prepared at the times described and R antimicrobial activity of each of the solutions prepared as described above.



CONCLUSIONS

1. The release of Ag⁺, measured by atomic absorption, is maintained between 2 and 4 ppb. Silver release stabilizes after 2,000 hours. Considering that the concentration of Ag⁺ in the sample is 0.5% Ag⁺, or 5,000 ppm (or ppb 5,000,000); with 4 ppb release after more than 2,000 hours, **the durability of BactiBlock® lasts hundreds of years in the polymer.**
2. Regarding the evolution of antibacterial activity parameter R, the first activity appears in the samples over 400 hours, reaching R > 2 in the vicinity of 1,500 hours. From this value, all samples achieve R > 2 with tendency to stabilize.