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Waterborne wood coatings: the effects of UV absorbers and light stabilizers on color and gloss

André Chaperon[(1)], Sangjoon Park[(2)], Rosanna Telesca[(1)]

[(1)] Songwon International, Switzerland, [(2)]Songwon Industrial, Korea

Stabilizing additives are an essential component of wood-coating formulations.

Thanks to its attractive and natural appearance and its sustainability as a raw material, wood is becoming more and more popular for all sorts of applications. Coatings serve to enhance the durability of wooden articles, especially those used outdoors. Stabilizing additives are an essential component of wood-coating formulations: they protect both the coating binders and, in clear coats, the underlying wood structures from degradation caused by weathering. UV protective additives fall into two categories: absorbers and stabilizers. UV absorbers dissipate the energy in a less damaging form, while UV stabilizers act as scavengers, reducing the reactivity of any free radicals formed within the coating.

SONGWON is committed to helping improve sustainability throughout the coatings value chain and to this end works continuously on enhancing the environmental acceptability of its products. Company experts have developed new water-based additives and stabilization packages that combine the efficiency of conventional products, including easy dosing and handling, with the benefits of water miscibility, notably low-to-zero VOC generation.

In a recent study, the efficacy of a range of these additives was tested in waterborne exterior wood-coating formulations based on three different types of binder chemistry: acrylic, alkyd and polyurethane.

Scope of study and test conditions

To ascertain the effect of the additives on the color and gloss of coatings, five SONGWON UV protective additives (Table 1) were tested, alone and in combination with each other, and compared with a competitive product. The samples were exposed to 2,909 hours of accelerated weathering in accordance with QUV method EN 927-6.

Table 1: Additives used in the test program

Name	Type
SONGSORB® CS 1130	Benzotriazole UV absorber
SONGSORB® CS 384-2	Benzotriazole UV absorber
SONGSORB® CS 400 WB	Triazine UV absorber
SONGSORB® CS AQ01	Hindered amine light stabilizer (HALS)
SONGSORB® CS 292	HALS
Water-soluble commercial benchmark product	Benzotriazole UV absorber

Table 2: Additives used in each formulation

Formulation	UV absorber	HALS
A	No additives	
B	SONGSORB® CS 1130	None
C	SONGSORB® CS 1130	SONGSORB® CS AQ01
D	SONGSORB® CS 384-2 and SONGSORB® CS 400 WB	SONGSORB® CS AQ01
E	SONGSORB® CS 400 WB	None
F	SONGSORB® CS 400 WB	SONGSORB® CS AQ01
G	SONGSORB® CS 400 WB	SONGSORB® CS 292
H	Water-soluble commercial benchmark product (benzotriazole UVA)	

Results: effects on color and gloss

QUV assessment

With the **acrylic** and **polyurethane** formulations, color change and yellowness in most cases increased as a function of ageing time. As expected, the formulations without UV absorbers or stabilizers (A) showed the fastest change in color and increase in yellowness.

The **alkyd** formulations tended to give the best results. Here, too, color change and yellowness increased as a function of ageing time. The formulations based on both a UV absorber and a HALS performed better than those containing only a UV absorber.

Visual assessment

As expected, formulation A (without UV stabilization additives) showed the greatest discoloration and yellowing.

In terms of appearance and resistance to development of defects, the best-performing additive packages based on the **acrylic** binder were those containing SONGSORB® CS 400 WB and a HALS. Formulations D (SONGSORB® CS 384-2/SONGSORB® CS 400 WB and SONGSORB® CS AQ01) and G (SONGSORB® CS 400 WB and SONGSORB® CS 292) gave similar results to those obtained with the commercial benchmark. The waterborne additive SONGSORB® CS 400 WB performed better than the 100% solids additive SONGSORB® CS 1130.

Figure 1: Non-stabilized acrylic formulation (no UVA and no HALS) before and after 2,909 hours of exposure

Figure 2: Formulation stabilized with SONGSORB® CS 400 WB and a HALS before and after 2,909 hours of exposure

With the **alkyd** formulation, significant yellowing of the coating occurred in sections of the panels exposed to heat but not UV radiation: the color in areas exposed to UV was quite different from that of the masked parts of the panels.

All formulations except A (which contained no stabilizers) performed well in the test, formulation D (SONGSORB® CS 384-2/ SONGSORB® CS 400 WB and SONGSORB® CS AQ01) giving the best results. Most of the test formulations performed better than the commercial benchmark (H) as regards prevention of coating-defect formation.

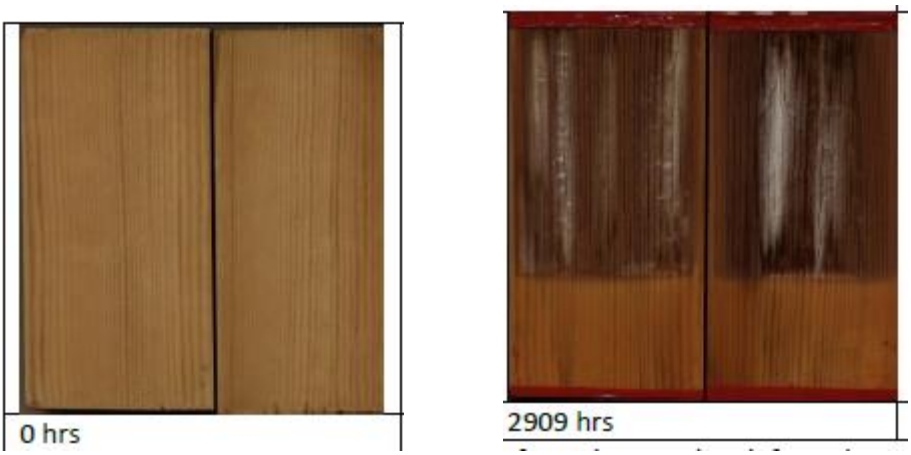

Figure 3: Non-stabilized alkyd formulation before and after 2,909 hours of exposure

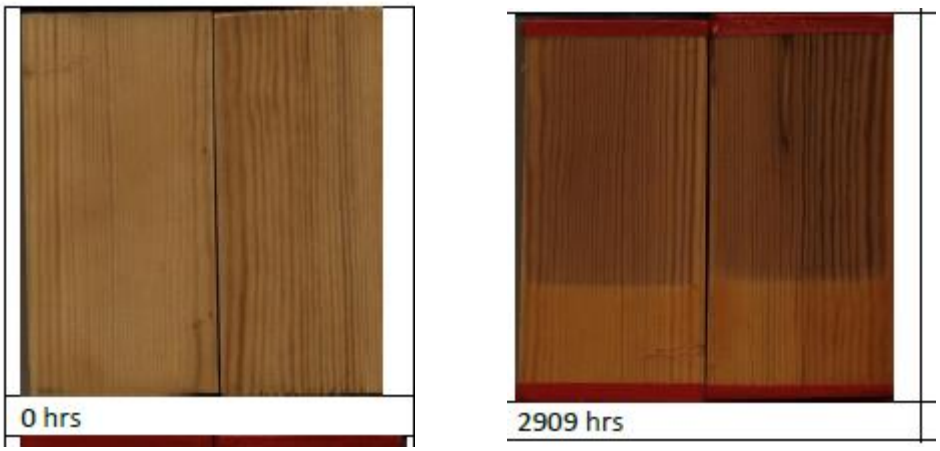

Figure 4: Stabilized alkyd formulation before and after 2,909 hours of exposure

With the **polyurethane** binder, formulations D (SONGSORB® 384-2/SONGSORB® CS 400 WB and SONGSORB® CS AQ01) and E (SONGSORB® CS 400 WB) gave the best results. SONGSORB® CS 400 WB performed better than SONGSORB® CS 1130 as regards prevention of coating-defect development.

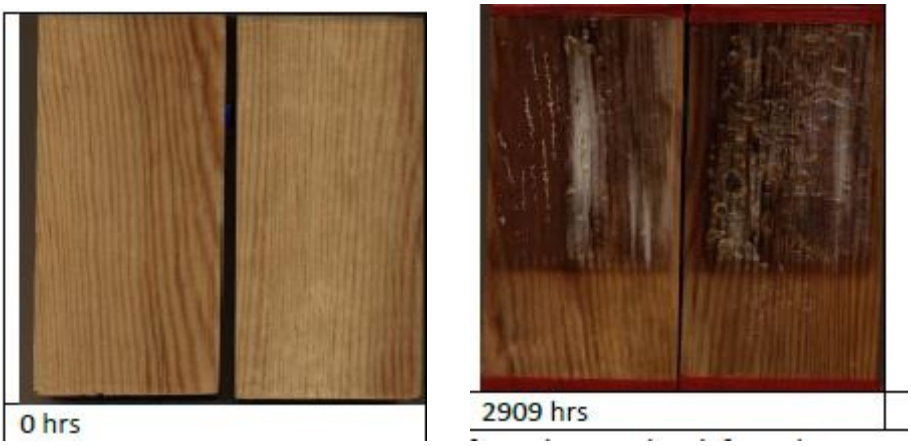

Figure 5: Non-stabilized PUR formulation before and after 2,909 hours of exposure

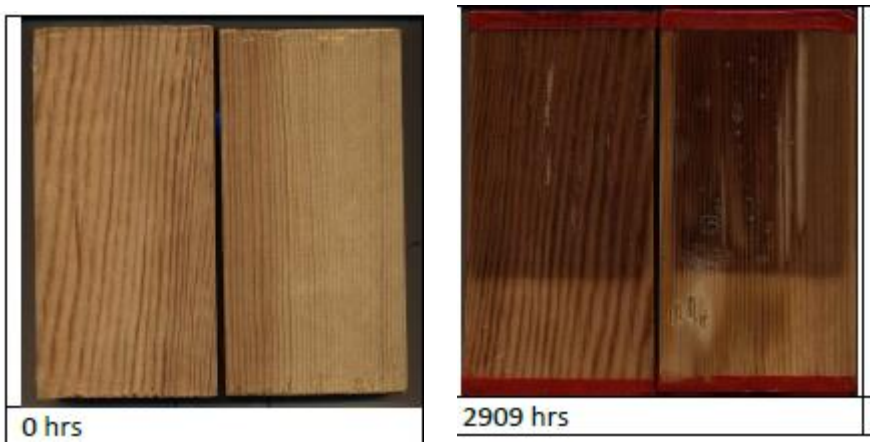

Figure 6: Stabilized PUR formulation before and after 2,909 hours of exposure

Conclusions

The baseline formulations containing no stabilizers or UV absorbers underwent the greatest alterations during the exposure period. These included increased yellowness and color changes as well as gloss reduction and the development of defects such as whitening, blistering, cracking and flaking on all tested panels.

Performance depended both on the base coating formulation and on the parameter being tested. Generally, but not in all cases, the formulations containing a combination of UV absorber and HALS gave the best results. Formulations containing SONGSORB® CS 400 WB performed better than those based on SONGSORB® CS 1130.

As part of its drive for greater sustainability throughout the wood-processing value chain, SONGWON continues to develop, test and market additives suitable for waterborne coatings.

For detailed results of the study, please contact specialtychemicals@songwon.com.