The Effect of Surface Roughness on the Performance of Finishes

In this study, the relationship between the morphological structure of the outside wood layer expressed as surface roughness, and the performance of coatings was analyzed. The surface roughness of five roughness categories (processed by planing,sanding, and bandsawing) on three wood substrates (vertical- and flat-grained western redcedar and flat-grained southern yellow pine) was determined by stylus tracer measurements. Several surface parameters were calculated to characterize the five roughness grades. Surface sanding proved to be an advantageous processing step prior to paint application. Sanded surfaces needed a relatively low quantity of paint for coverage and showed best paint performances even on low-grade wood.

The table presents the results of surface characterization and the performance of stained samples in accelerated weathering.

		Erosion after (hr.)				Discoloration after (hr)			
	Spreading Rate								-
Samples	(ft²/Gal)	600	1,200	1,800	2,400	600	1,200	1,800	2,400
SYP, RC1, SR 1	442	8.7	5.0	4.0	3.3	7.7	4.0	4.0	3.3
SYP, RC2, SR 1	268	9.0	6.7	5.7	5.0	8.3	5.7	5.7	5.0
SYP, RC4, SR 1	220	9.3	7.3	5.3	4.0	8.3	6.3	5.3	4.0
SYP, RC5, SR 1	158	9.0	7.7	5.7	5.0	8.7	6.7	5.7	5.0
SYP, RC4, SR 2	453	5.3	3.7	2.0	1.0	5.3	3.7	2.0	4.0
SYP, RC5, SR 2	355	6.0	5.0	3.0	2.0	6.0	5.0	3.0	4.0
WRC-F, RC1, SR1	430	5.3	3.7	3.0	2.0	6.0	5.0	3.0	2.0
WRC-F, RC2, SR1	371	9.7	8.7	7.0	6.3	9.3	8.7	6.7	6.0
WRC-F, RC3, SR1	219	9.0	7.3	6.3	5.7	9.0	7.3	6.3	5.7
WRC-F, RC4, SR1	207	9.7	7.0	6.0	4.7	9.7	7.0	5.0	4.7
WRC-F, RC5, SR1	155	9.0	6.3	5.3	4.3	8.3	6.3	5.3	4.3
WRC-F, RC3, SR2	464	4.3	3.0	2.0	1.0	4.3	3.0	1.0	2.0
WRC-F, RC4, SR2	446	4.7	3.0	2.0	2.0	4.7	3.0	1.0	1.0
WRC-F, RC5, SR2	396	3.3	2.0	2.0	2.0	3.3	2.0	1.0	1.0
WRC-V, RC1, SR1	437	9.7	7.0	6.0	5.0	9.0	6.3	5.3	5.0
WRC-V, RC2, SR1	376	9.7	8.7	7.0	7.0	8.7	8.0	7.0	7.0
WRC-V, RC3, SR1	200	9.0	7.0	6.0	5.0	7.7	7.0	5.3	5.0
WRC-V, RC4, SR1	193	9.0	7.0	6.0	5.7	8.0	7.0	6.0	5.7
WRC-V, RC5, SR1	177	8.0	6.0	5.0	5.0	8.0	6.0	5.0	5.0
WRC-V, RC3, SR2	462	4.7	2.3	1.7	1.0	4.7	2.3	1.0	1.0
WRC-V, RC4, SR2	449	4.7	3.0	2.0	1.0	4.7	3.0	2.0	1.0
WRC-V, RC5, SR2	418	4.3	2.7	2.0	1.0	4.3	2.0	1.0	1.0

Roughness and Spreading Rate

The sanding process reveals the best possible individual characteristics of the substrates as they refer to the ability to accept coatings. All boards finished with a reduced spreading rate (SR2) showed significantly lower ratings in both stain erosion and discoloration as compared to the normally finished boards.

Accelerated Weathering

On normally finished wood, the sanded surfaces (RC2) showed similar (SYP) or better performance than roughsawn specimens. Sanded vertica grain WRC had superior rating (7.0 for both erosion and discoloration), but the differences in the low-quality flat grained SRC were surprisingly small (6.3 and 6.0 respectively).

Sanding would make stain application more efficient, not only economically (less material use), but also from an ecological standpoint (fewer volatile organic chemical emissions).

The reason for the improved stain performance on sanded boards is that the stain uniformly covered the sanded specimens

Conclusion:

Surface roughness produced by sanding or sawing can affect the performance of finishes in several ways. It has been quantified that finish spreading rates and surface roughness are related and that rough surface substrates need more finish coverage per area than smooth surface substrates. Very rough stained wood performed well in long term exposure mainily because of the high spread necessary to cover the surface, whereas rough wood finished with the same amount of stain applied to smooth surfaces (limited amounts) failed completely after only short-time weathering.

The best stain performance was found on sanded surfaces, with performance ratings even better than those found for very rough wood, but with less than half the amount of finish applied.

Sanding seems to be a perfect surface preparation for coatings because it levels off inherent differences in wood surface properties resulting in an equal and homogeneous finish spread. The light roughening allows sufficient finish penetration in dense latewood zones and avoices an over penetation in early wood tissue, areas that are usually severe failure zones on planed wood.

Sanded surfaces needed a relatively low quantity of paint for coverage and showed best paint performances even on low-grade wood.

SYP - Southern Yellow Pine WRC - Western Red Cedar

RC1-Smooth RC2-Sanded double belt sander (50 grit) RC3-Rough as Received RC4-Roughed with Bandsaw (normal set) RC5-Roughed with Bandsaw (High set) **RC**-Roughness Category **SR**-Spreading Rate

SR1-Normal Spreading Rate SR2-Reduced Spreading Rate

F-Flat Grained V-Vertical Grained

Ratings Erosion/Discoloration 10 = original condition 1 = total failure