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KIWALITE REFLECTIVE SHEETING

TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION

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Summary

Kiwalite reflective sheeting samples have been evaluated in the laboratory. Sheeting samples of white, red, orange, yellow, green, and blue, with both pressure sensitive and heat activated adhesive, were submitted by Sakai Trading New York, Inc. Tests applicable to Type 2 reflective sheeting in the 1979 MDOT Standard Specifications were performed; the results are discussed in this report and presented in tabular form. Testing showed some discrepancies but the manufacturer can produce sheeting conforming with specification requirements. Sign shop evaluation of handling and screening characteristics along with field evaluation of experimental signs is recommended.

Introduction

The Department has a policy of approving reflective sheeting products from manufacturers that can demonstrate an ability to conform with specifications. In the past, Kiwalite sheeting, as submitted through the Dale Metals Corp., had not shown satisfactory compliance with Department specifications. Subsequently, Sakai Trading requested the laboratory to test improved sheetings. Two sheets of white, orange, yellow, green, and blue with pressure sensitive and heat activated adhesive were received in June of 1980. A red sample was also received but only with pressure sensitive adhesive. Tests applicable to Type 2 reflective sheeting in the 1979 Standard Specifications were performed including the artificial weathering tests. Results of tests for adhesion, cold shock, flexibility, liner removal, luminance wet, impact, shrinkage, solvent resistance, peeling, initial luminance, water immersion, and initial reflectance showed compliance with specification requirements by all samples.

On some samples, results of the tests for color and artificial weathering showed discrepancies. Color test results are described below along with observations on post-water immersion and post-weathering surface appearance. Results of all tests are summarized in Table 1.

Color Test

Spectrophotometric evaluation of the samples before and after weathering gave the following results:

1) Hues of yellow samples with each adhesive were more green than the green limit. Lightness was satisfactory before and after weathering.

2) Hue of the red sample with pressure sensitive adhesive was more yellow than the yellow limit before weathering and more gray than the gray

limit after weathering. Lightness was satisfactory before and after weathering.

3) Orange samples with each adhesive had a satisfactory hue and lightness before artificial weathering but after weathering hue was more gray than the gray limit.

4) Green samples with each adhesive had a satisfactory hue and lightness both before and after artificial weathering.

5) White samples with pressure sensitive adhesive had a hue more yellow than the yellow limit after artificial weathering. White with heat activated adhesive was satisfactory.

6) Blue samples with each adhesive had a satisfactory hue and lightness before and after artificial weathering.

Surface Appearance

Appearance of samples after weathering was considered satisfactory. All samples showed water spotting.

Water Immersion

During water immersion the samples developed a roughened surface which returned to a smooth surface in approximately 72 hours.

Discussion

Color discrepancies noted on the red Kiwalite sample have been observed on samples from other sources. Red colors that are more yellow than the yellow limit before and after artificial weathering are typical of reds supplied by other manufacturers. Yellows that are more green than the green hue limit are also found with other sheeting manufacturers. The grayness after weathering of the red and orange samples was considered satisfactory. Yellowing of the white after weathering was also considered acceptable.

Specific luminance before and after artificial weathering was satisfactory except for the green pressure sensitive sample which was slightly low at the minus 4 degree entrance angle. Results for all samples are tabulated in Tables 2 and 3.

On the basis of laboratory tests, it does appear that the Kiwa Chemical Industry Co. has improved their reflective sheeting and can fabricate sheeting that conforms with Department specifications.

Recommendations

Since handling and application characteristics are not easily evaluated in the laboratory, it is recommended that sufficient sheeting be obtained to evaluate handling characteristics under sign shop conditions. Depending upon a satisfactory sign shop evaluation it is further recommended that signs be prepared and evaluated in the field for at least one year.

TABLE 1
TEST RESULTS SUMMARY

Test	Snow White		Yellow		Orange		Red		Green		Blue	
	80 RD-161 HA	80 RD-162 PS	80 RD-163 HA	80 RD-164 PS	80 RD-165 HA	80 RD-166 PS	No Sample	80 RD-168 PS	80 RD-169 HA	80 RD-170 PS	80 RD-171 HA	80 RD-172 PS
	2012*	2013	2042	2043	2052	2053	--	2063	2072	2073	2082	2083
Adhesion	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Cold shock	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Flexibility	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Liner removal	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Luminance wet	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Impact	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Shrinkage	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Solvent	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Peeling	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Initial luminance	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass
Initial color	Pass	Pass	Too green	Too green	Pass	Pass	--	Too yellow	Pass	Pass	Pass	Pass
Initial reflectance	57.4	57.3	40.4	39.2	26.7	26.3	--	12.1	7.87	8.25	3.51	3.28
1200 Hr. lum.	Pass	Pass	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass Fail 0.2, -4 0.5, -4	Pass	Pass
1200 Hr. color	Pass	Too yellow	Too green	Too green	Too gray	Too gray		Too gray	Pass	Pass	Pass	Pass
1200 Hr. reflec.	58.0	56.1	Pass	Pass	Pass	Pass	--	Pass	Pass	Pass	Pass	Pass

* Manufacturer's code no.

TABLE 2
INITIAL SPECIFIC LUMINANCE, cp per fc per sq ft

Sample No.	Divergence Angle 0.2°		Divergence Angle 0.5°	
	Entrance Angle -4°	30°	Entrance Angle -4°	30°
80 RD-161 HA Snow White	135.0	72.1	68.8	49.0
80 RD-162 PS Snow White	104.0	56.2	53.2	36.8
80 RD-163 HA Yellow	79.4	39.5	32.4	21.8
80 RD-164 PS Yellow	78.1	38.4	31.8	21.1
80 RD-165 HA Orange	40.0	20.0	19.0	12.2
80 RD-166 PS Orange	40.4	19.6	19.4	12.5
80 RD-167 (No Sample)				
80 RD-168 PS Red	26.1	12.9	13.1	8.3
80 RD-169 HA Green	25.5	9.7	10.0	5.7
80 RD-170 PS Green	20.9	9.3	9.9	5.8
80 RD-171 HA Blue	11.5	6.7	4.4	3.8
80 RD-172 PS Blue	11.8	7.1	4.5	4.4

TABLE 3
SPECIFIC LUMINANCE, cp per fc per sq ft
1200 Hour Weathering

Sample No.	Divergence Angle 0.2°		Divergence Angle 0.5°	
	Entrance Angle -4°	30°	-4°	30°
80 RD-161 HA Snow White	90.0	55.9	41.0	35.5
80 RD-162 PS Snow White	68.9	41.9	33.0	26.3
80 RD-163 HA Yellow	57.9	31.2	27.3	18.2
80 RD-164 PS Yellow	57.2	29.6	27.8	17.4
80 RD-165 HA Orange	25.6	14.8	12.0	9.3
80 RD-166 PS Orange	27.8	16.8	12.2	10.4
80 RD-167 (No Sample)				
80 RD-168 PS Red	18.4	9.8	9.0	6.1
80 RD-169 HA Green	16.3	9.0	7.1	5.4
80 RD-170 PS Green	4.2	2.3	2.0	1.4
80 RD-171 HA Blue	7.9	5.4	3.7	3.2
80 RD-172 PS Blue	5.5	5.3	3.1	3.3