Outdoor Environment & Water Aging of Millathane® CM & Millathane® 5004

Millathane® millable urethane compounds can have excellent resistance to ambient water and sunlight exposure, if they are compounded properly. This study shows the effects of 12 months of water exposure and 12 months of Florida sunlight on Millathane® CM and Millathane® 5004 compounds. The CM compound was sulfur cured while 5004 was peroxide cured. Both compounds in the study contained the same levels of N330 carbon black and DBEEA (TP-95) plasticizer. The 5004 compound contains Millstab® P, a carbodiimide hydrolysis stabilizer, to protect it from the hydrolyzing effect of water on polyester urethanes.

FORMULATIONS

Millathane at 100 phr	CM	5004
Stearic Acid		0.3
Zinc stearate	0.5	
N330	25	25
DBEEA (TP-95)	5	5
Struktol WB222	1	1
MBTS	4	
MBT	2	
Thanecure® ZM	1	
Sulfur	1.5	
Millstab P		5
DiCup 40C		6

PHYSICAL PROPERTIES

Press Cure, mins at 160	9		15	
Hardness, Shore A	70		70	
TSE-100*, psi / MPa	405	2.8	460	3.2
TSE-200*, psi / MPa	995	6.9	118	8.1
TSE-300*, psi / MPa	180	12.4	219	15.1
Tensile Strength, psi / MPa	382	26.3	410	28.3
Elongation, %	480		495	
Tear, Die C, lb/in / kN/m	269	47.1	284	49.7

**TSE-xxx = Tensile Stress at xxx% Elongation*

12 MONTH WATER AGING (AT ROOM TEMPERATURE)

The data below shows the physical properties after 12 months immersion in room temperature (approximately 72ºF/22ºC) deionized water. The results show minimal change in properties for both compounds. The Millathane® 5004 compound, with the relatively high level of Millstab P, actually had less change in properties than the CM compound.

Water Immersion 12 month/RT				
Millathane® Millable Urethane	**CM**		**5004**	
Hardness, Shore A	64		74	
Change	-6		+4	
TSE-100*, psi / MPa	340	2.3	495	3.4
% Change	-16		+8	
TSE-200*, psi / MPa	785	5.4	1190	8.2
% Change	-21		+1	
TSE-300*, psi / MPa	1420	9.8	2140	14.8
% Change	-21		-2	
Tensile Strength, psi / MPa	3480	24.0	3960	27.3
% Change	-9		-3	
Elongation, %	510		490	
% Change	+6		-1	
Tear, Die C, lb/in / kN/m	216	37.8	277	48.5
% Change	-20		-3	
Volume change, %	+10		+1	

**TSE-xxx = Tensile Stress at xxx%*

TSE INDUSTRIES
5180 113th Avenue North, Clearwater, FL 33760 USA
www.tseind.com
(800) 237-7634 | (727) 573-7676

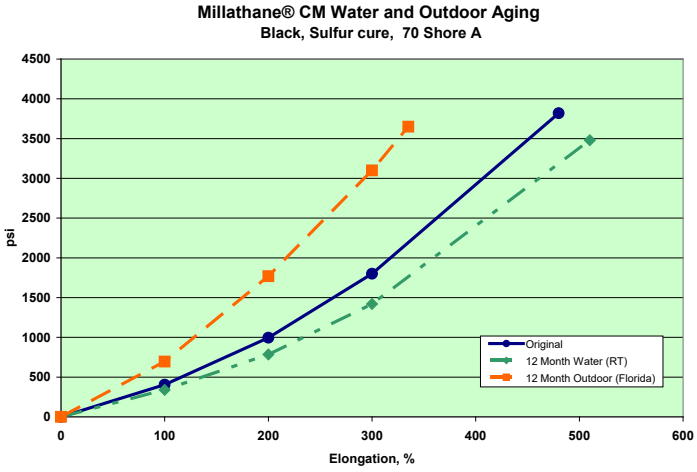
Outdoor Environment & Water Aging (cont.)

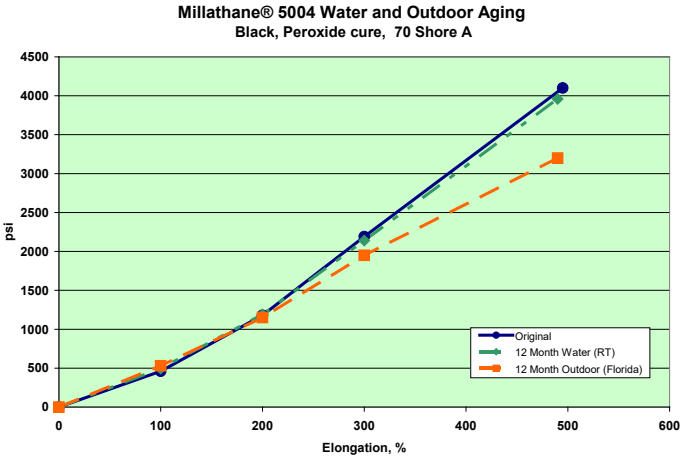
12 MONTH FLORIDA CLEARWATER, OUTDOOR AGING (April 2006-April 2007)

The data below shows the physical properties after 12 months outdoor exposure in Florida. Both compounds had minimal change in properties after this exposure and the cured samples didn't show any signs of cracking or crazing. The charts below show the stress/strain curves for the two compounds, with original data and after the two 12-month exposures.

Outdoor FL Exposure 12 months				
Millathane® Millable Urethane	**CM**		**5004**	
Hardness, Shore A	75		68	
Change	5		-2	
TSE-100*, psi / MPa	695	72	530	3.7
% Change	72		15	
TSE-200*, psi / MPa	1770	12.2	1150	7.9
% Change	78		-3	
TSE-300*, psi / MPa	3100	21.4	1950	13.4
% Change	72		-11	
Tensile Strength, psi / MPa	3650	25.2	3200	22.1
% Change	-4		-22	
Elongation, %	335		490	
% Change	-30		-1	
Tear, Die C, lb/in / kN/m	211	36.9	302	52.9

**TSE-xxx = Tensile Stress at xxx%*





SUMMARY Properly compounded Millathane® millable urethane compounds can withstand water and outdoor exposures, as the data above shows. Polyester urethanes, not known for their resistance to water, can perform well for extended periods in water if a carbodiimide water stabilizer like Millstab® P is used. The level of Millstab P used in the 5004 compound (5 parts) is higher than normally seen (typically 2-3 parts), and can be varied depending on the conditions the cured part will see in service or storage.

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