

# Technical Information for Performance Solutions

## Outdoor (FL) and Water Aging of MILLATHANE® CM and 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 Millathane CM compound was sulfur cured while Millathane 5004 was peroxide cured. Both compounds in the study contained the same levels of N330 carbon black and DBEEA (TP-95) plasticizer. The Millathane 5004 compound contains Millstab® P, a carbodiimide hydrolysis stabilizer, to protect it from the hydrolyzing effect of water on polyester urethanes.

### Topics:

- Formulation
- Physical Properties
- 12 Month Water Aging
- 12 Month FL Clearwater Outdoor Aging
- Summary
- ASK Doctor Millathane

| Millathane Millable Urethane 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, minutes at 160 °C | 9    | 15   |
| Hardness, Shore A             | 70   | 70   |
| TSE-100*, psi                 | 405  | 460  |
| MPa                           | 2.8  | 3.2  |
| TSE-200, psi                  | 995  | 1180 |
| MPa                           | 6.9  | 8.1  |
| TSE-300, psi                  | 1800 | 2190 |
| MPa                           | 12.4 | 15.1 |
| Tensile Strength, psi         | 3820 | 4100 |
| MPa                           | 26.3 | 28.3 |
| Elongation, %                 | 480  | 495  |
| Tear, Die C, lb/in            | 269  | 284  |
| kN/m                          | 47.1 | 49.7 |

\*TSExxx=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 72°F/22°C) 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 Millathane CM compound.

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

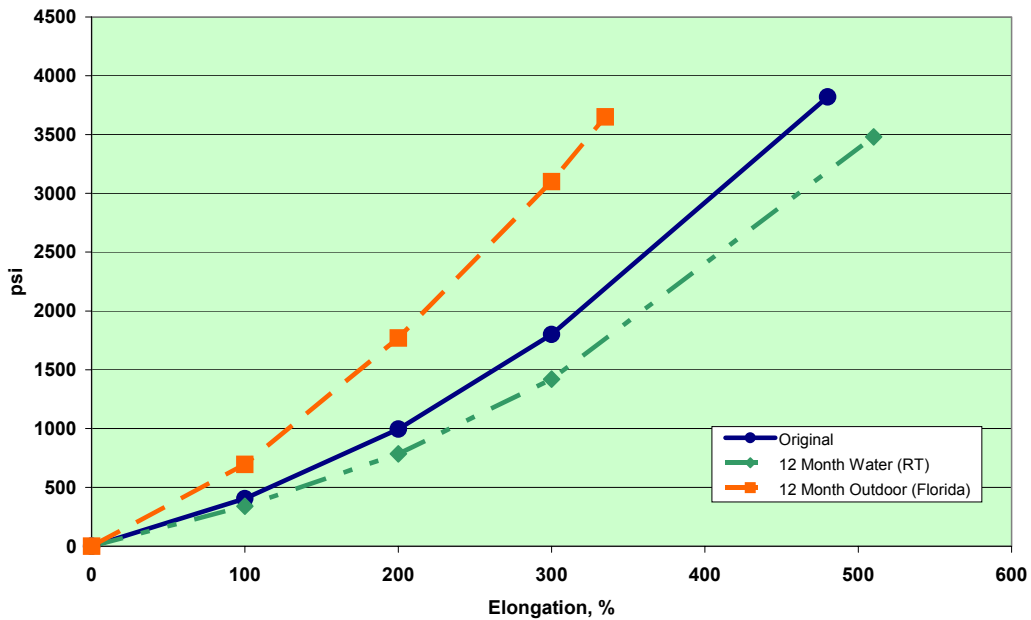
## 12 Month Florida Clearwater, Outdoor Aging (April 2006-April 2007)

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.

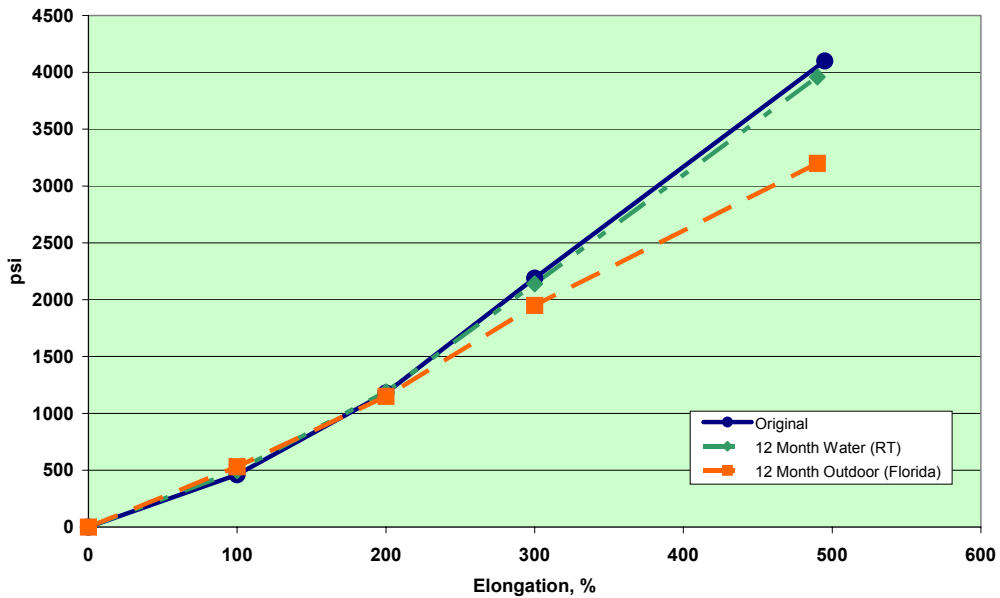
The charts below show the stress/strain curves for the two compounds, with original data and after the two 12 month exposures.

| <b>Outdoor FL Exposure 12 months</b> |           |             |
|--------------------------------------|-----------|-------------|
| <b>Millathane® Millable Urethane</b> | <b>CM</b> | <b>5004</b> |
| Hardness, Shore A                    | 75        | 68          |
| Change                               | 5         | -2          |
| TSE-100*, psi                        | 695       | 530         |
| MPa                                  | 4.8       | 3.7         |
| % Change                             | 72        | 15          |
| TSE-200, psi                         | 1770      | 1150        |
| MPa                                  | 12.2      | 7.9         |
| % Change                             | 78        | -3          |
| TSE-300, psi                         | 3100      | 1950        |
| MPa                                  | 21.4      | 13.4        |
| % Change                             | 72        | -11         |
| Tensile Strength, psi                | 3650      | 3200        |
| MPa                                  | 25.2      | 22.1        |
| % Change                             | -4        | -22         |
| Elongation, %                        | 335       | 490         |
| % Change                             | -30       | -1          |
| Tear, Die C, lb/in                   | 211       | 302         |
| kN/m                                 | 36.9      | 52.9        |

**Millathane® CM Water and Outdoor Aging**  
 Black, Sulfur cure, 70 Shore A



**Millathane® 5004 Water and Outdoor Aging**  
 Black, Peroxide cure, 70 Shore A



### Summary

Properly compounded Millathane millable urethane compounds can withstand water and outdoor exposures, as the data on the Millathane CM and Millathane 5004 compounds show. Polyester urethanes, not known for their resistance to water, can perform well for extended periods in water if a carbodiimide water stabilizer such as Millstab® P is used. The level of Millstab P used in the Millathane 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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*We are here to serve you:*

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**ASK Doctor Millathane®**

Dear Dr. Millathane,

I have a soft compound based upon Millathane 76, soft both in hardness and viscosity, and it tends to give blisters in the cured parts. A side issue is that the uncured stock has low green strength and wants to cold flow. Can you help?  
*Perplexed*

Dear Perplexed,

The blistering may be due to moisture in the compound, excessive air in the compound, or low compound green strength.

If the problem is related to moisture, if the compound is passed through a water dip tank to cool after mixing, perhaps the rubber wasn't sufficiently dry before it was stacked. Also, compounds can pick up moisture from the air, especially compounds with significant amounts of non-black fillers, so they should be stored protected from ambient humidity. Mixing the compound to a higher temperature may help get rid of moisture that may be present in the raw materials.

If the compound has excessive air in the preforms that are being molded, you can try resheeting or preforming the compound to get rid of the air. If the compound contains primarily small particle sized filler, such as silica, adding some larger particle size filler such as calcium carbonate or N990 black (reducing the amount of small particle size filler, if necessary) may be beneficial.

If the problem is green strength-related, increasing the viscosity of the compound can help minimize blistering. This can be accomplished by using a higher viscosity polymer or by blending with a higher viscosity polymer. Millathane 76 comes in several viscosity grades, so try using a higher viscosity Millathane 76. Also, substituting a minor proportion of a high viscosity, high green strength polymer like Millathane CM can help reduce blisters as well as reduce cold flow of the compound. Changing the polymer from 100% Millathane 76 to 70:30 Millathane 76:Millathane CM helped a customer solve this same problem. The customer found that the compound hardness increased slightly, so several additional parts of plasticizer were added to the compound, but the result was greatly reduced molding defects due to blistering.

Dr. Millathane

If you have any Millathane millable urethane questions you'd like answered, please send an email to [millathaneinfo@tse-industries.com](mailto:millathaneinfo@tse-industries.com).