



Millathane® 26 Blends with High Styrene Resin & Liquid Polybutadiene

Millathane® 26 is the only millable polyurethane rubber that complies with the FDA regulation 21CFR177.2600 and has found use in various applications involving food contact. As some applications, including rollers and gaskets, require relatively high hardness, several formulation ingredients were evaluated to achieve a higher hardness. This report examines compounding of Millathane® 26 with Pliolite S6B (a high styrene resin) and Ricon 154 (a polybutadiene resin). These materials, as well as the other ingredients in the formulations, comply with the FDA regulation 21CFR177.2600*.

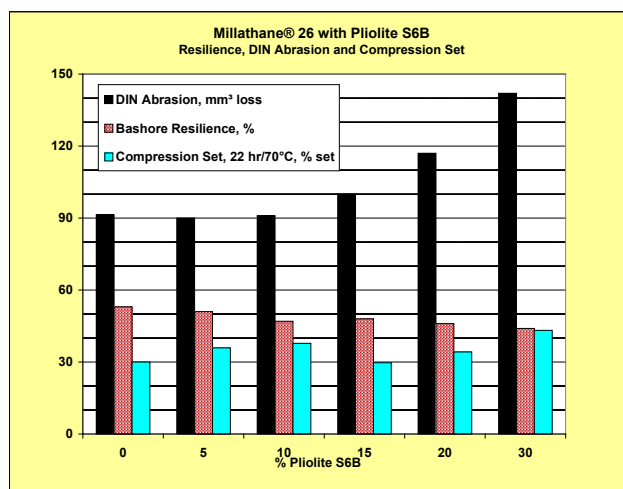
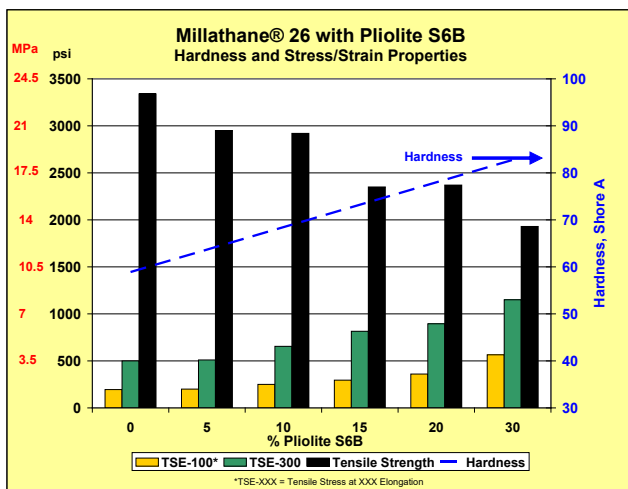
HIGH STYRENE RESIN (PLIOLITE S6B) BLENDS

Pliolite S6B is an emulsion polymerized high styrene resin with a typical styrene/butadiene ratio of 82.5/17.5. It is commonly used to increase hardness and stiffness in rubber compounds that are used for applications including shoe soles and rollers. As a means to achieve high hardness compounds, Pliolite S6B was blended with Millathane® 26 in ratios from 100/0 to 70/30 Millathane® 26/Pliolite S6B. The non-black, silica reinforced formula is shown.

Millathane® 26	100 – 70
Pliolite S6B	0 – 30
Stearic Acid	0.3
Ultrasil VN3	25
TP-95 (DBEEA)	2
Struktol WB222	1
AC 617A	2
Dicumyl Peroxide 40%	5

The data, shown in the following two charts, show the following trends:

- Hardness and tensile stress (aka, modulus) increased as the level of Pliolite S6B increased. The hardness increased approximately 8 Shore A points per 10 parts Pliolite S6B. The highest hardness of these compounds tested 86 Shore A.
- Tensile strength decreased somewhat with increasing Pliolite S6B, approximately 400 psi (2.7 MPa) per 10 parts Pliolite S6B.
- Abrasion resistance was not affected up to 10 phr Pliolite S6B but was poorer at higher levels.
- Resilience decreased and compression set increased slightly as the Pliolite S6B level increased.



Other data not shown above indicated that as the level of Pliolite S6B increased the viscosity was relatively constant and the tear resistance of both Die C and Die B was improved.



Millathane® 26 Blends with High Styrene Resin & Liquid Polybutadiene (cont.)

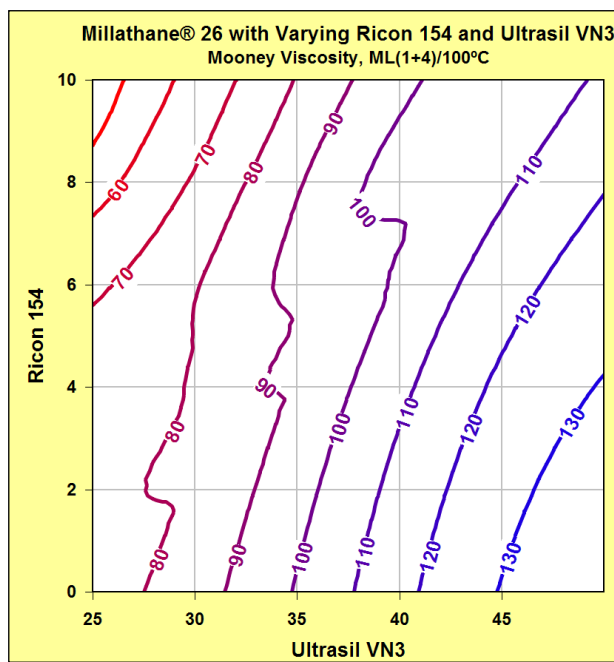
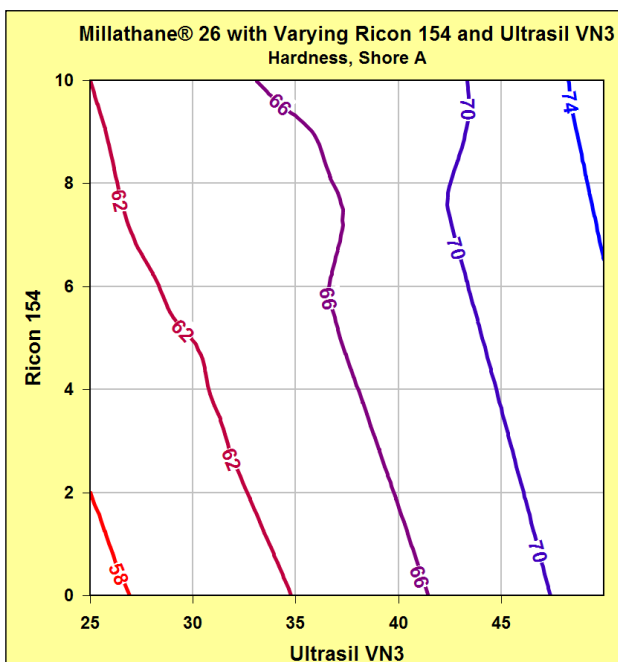
LIQUID POLYBUTADIENE RESIN IN MILLATHANE® 26

Liquid polybutadiene resins, such as Ricon 154 from Sartomer Company, can be used as vulcanizable coagents in Millathane® 26. Ricon 154 is a butadiene homopolymer with 1,2-Vinyl content of 90%. An experimental design was run, varying the precipitated silica (Ultrasil VN3) from 25 to 50 parts while varying the polybutadiene resin (Ricon 154) from 0 to 10 parts.

Millathane® 26	100
Stearic Acid	0.3
Ultrasil VN3	25 – 50
TP-95 (DBEEA)	2
Struktol WB222	1
Ricon 154	0 – 10
Dicumyl Peroxide 40%	5

The data plotted in the contour charts below and on page 3 show:

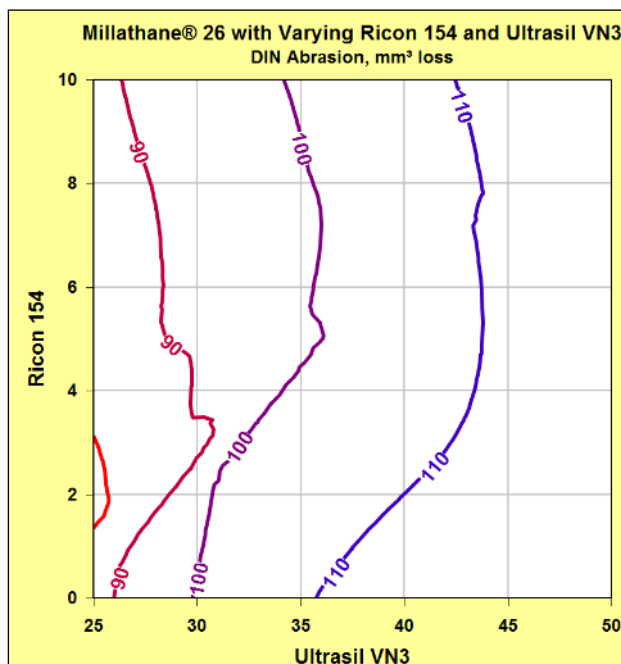
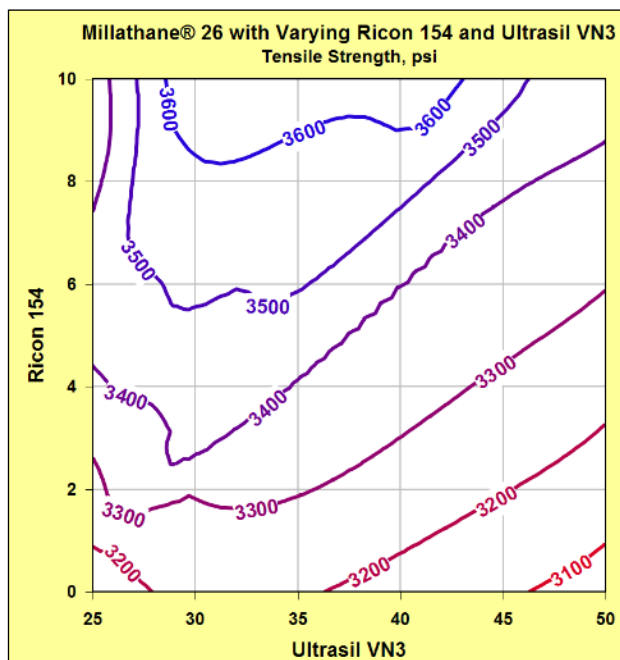
- The **hardness** is primarily affected by the silica level, increasing approximately 4 Shore A points for each 7-8 parts of silica. The polybutadiene resin also increased the hardness, about 4 Shore A points per 10 parts of resin.
- The **compound viscosity** is significantly affected by both the silica and the polybutadiene resin, increasing with increasing silica, and decreasing with increasing polybutadiene resin.





Millathane® 26 Blends with High Styrene Resin & Liquid Polybutadiene (cont.)

- The **tensile strength** is not significantly affected by either ingredient, with all compounds in this experimental design testing between 3140 and 3650 psi (21.7 to 25.2 MPa) tensile strength.
- **Abrasion resistance** was not significantly affected by the polybutadiene resin levels, but did diminish somewhat as the silica level increased, giving higher DIN abrasion losses.



SUMMARY

High hardness compounds based upon Millathane® 26 can be achieved by increasing the silica or carbon black level in the compound. This by itself tend to give high viscosity compounds. The addition of high styrene resin (Pliolite S6B) or liquid polybutadiene resin (Ricon 154), along with the reinforcing filler, will give better processing (lower viscosity) compounds than just using reinforcing filler to increase hardness.

**with information as provided by suppliers of the ingredients as of November 2009. You should check with the suppliers of your raw materials to confirm that they are (still) FDA-compliant.*

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