

Polyurethane Specialty Products Group

VERSALINK® P-1000 OLIGOMERIC DIAMINE

Polytetramethyleneoxide-di-p-aminobenzoate

Description

Oligomeric diamine
 TSCA Registry No.: 54677-43-5
 CAS Registry No.: 54667-43-5

Versalink P-1000 oligomeric diamine is a liquid at room temperature. Table 1 outlines this product's physical properties.

Applications

Versalink P-1000 oligomeric diamine is a liquid at ambient temperatures so it can be mixed, cast and cured at room temperature. It can be used as a curative for diisocyanates (MDI, TDI) and as an amine- and anhydride-cured epoxy modifier (to enhance flexibility). Applications include cast prototypes and elastomers, coatings, adhesives, sealants and spray systems. Due to its ease of processing Versalink P-1000 oligomeric diamine is excellent for field repair.

Properties

Table 2 outlines typical properties when using Versalink P-1000 oligomeric diamine cured with three MDI variants, processed at room temperature. All of the systems shown here were mixed, cast and cured at ambient conditions.

Versalink P-1000/MDI room temperature-cured systems generate physical properties similar to those of conventional heat-cured prepolymer systems and superior to those of MDI/diol heat-cured elastomers. In addition, Versalink P-1000 systems are easier to process than heat-cured systems.

When processed at ambient conditions, Versalink P-1000-

Table 1 - Typical Properties of VERSALINK P-1000 Oligomeric Diamine

$\text{H}_2\text{N}-\text{C}_6\text{H}_4-\text{C}(=\text{O})-\text{O}-(\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{O})_n-\text{C}(=\text{O})-\text{C}_6\text{H}_4-\text{NH}_2$	
Color	Amber Liquid
Viscosity	Maximum 3,000 cPs @ 40 °C
Specific Gravity	1.01 - 1.06 @ 20 °C
Melting Range, °C (°F):	18 - 21 (64 - 70)
Equivalent Weight	575 - 625
Molecular Weight	1,238
n =	13 - 14

Table 2 - Versalink P-1000/MDI Systems

Processing Conditions			
MDI	RUBINATE® PBA 2225	ISONATE® 2143L	ISONATE 181 ²
NCO, %	31	29	23
MDI Level, pph	23	24	30
Stoichiometry, %	95	95	95
Mix Temp., °C	25	25	25
Cure Temp., °C	25	25	25
Pot Life, min.	30	20	20
Demold Time, hr.	2 - 3	2 - 3	2 - 3
Cure Times, days	14	14	14
Physical Properties			
Hardness, Shore A	95	95	95
Modulus, psi			
100%	900	1,000	900
300%	1,200	1,400	1,000
Tensile Strength, psi	4,500	4,500	5,200
Elongation, %	460	460	690
Tear Strength, pli			
Die C	370	420	410
Split	110	150	120
Rebound, %	53	49	55

¹ Comparable results should be obtained with Mondur® CD, Lupranate® MM-103, and Rubinate LF-168.

² Comparable results should be obtained with Lupranate MP-102, Mondur PF, and Rubinate LF-179

based elastomers have a low shrinkage factor. Linear shrinkage is only 0.3% when processed at room temperature, versus 1.6% when cured at 100 °C.

Hardness Variations

Versalink P-1000 oligomeric diamine can also be formulated using other MDI prepolymers and MDI quasi-prepolymers to produce different hardness elastomers. Table 3 shows three formulations producing elastomers with a hardness range of 75 Shore A to 95 Shore A.

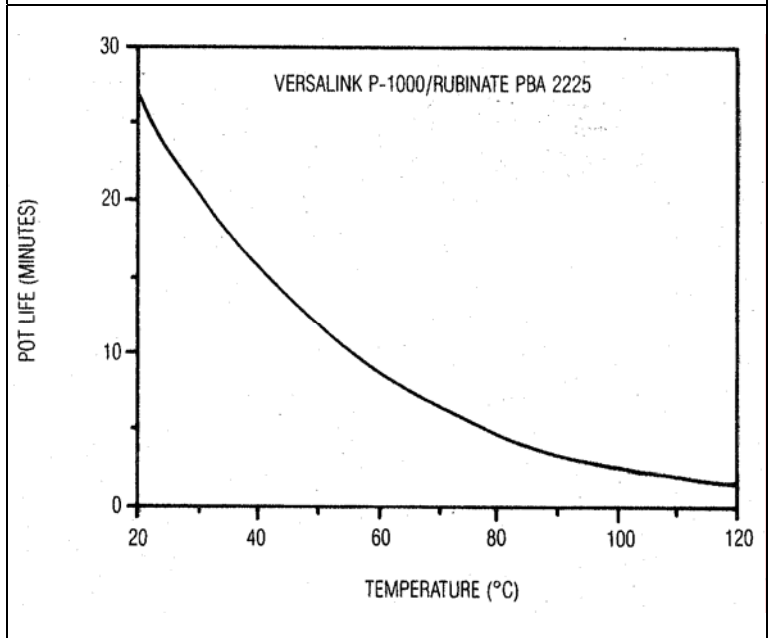
**Table 3 - VERSALINK P-1000/MDI Systems
Hardness Variations**

Processing Conditions			
MDI	BAYTEC MP-090	MONDUR MRS-2	RUBINATE PBA 2225
NCO, %	9	32	31
MDI Level, php	76	21	23
Stoichiometry, %	95	95	95
Mix Temp., °C	25	25	25
Cure Temp., °C	25	25	25
Pot Life, min.	30	30	30
Demold Time, hr.	3	3	3
Cure Times, days	14	14	14
Physical Properties			
Hardness, Shore A	75	90	95
Modulus, psi			
100%	500	1,200	900
300%	800	2,000	1,200
Tensile Strength, psi	3,000	3,000	4,500
Elongation, %	525	360	460
Tear Strength, pli			
Die C	200	280	370
Split	40	85	110
Rebound, %	30	50	53

Reaction Control

Versalink P-1000 oligomeric diamine can be processed at higher temperatures in order to decrease pot life and customize the reaction profile. Figure 1 shows pot life versus temperature for a Versalink P-1000/ Rubinate PBA 2225 system. Physical properties are not significantly affected when the processing conditions are changed.

Figure 1 - Pot Life vs. Temperature



Versalink P-1000 oligomeric diamine systems can also employ standard catalysis methods to customize the reaction profile. Figure 2 shows the variation in pot life versus DABCO 33-LV[®] catalyst level. Adipic acid could also be used and would give similar results. Physical properties are not significantly affected by the use of a catalyst.

Processing

The recommended stoichiometry for processing Versalink P-1000 oligomeric diamine is 95% theory. Under ambient conditions and in a well-ventilated area, mix the required amount of MDI with Versalink P-1000. Degassing is optional, but recommended. Although the viscosity of Versalink P-1000 oligomeric diamine is somewhat high at room temperature, the diluent effect of the MDI sufficiently lowers the viscosity to allow easy mixing by hand and complete degassing prior to casting.

The mixture is now ready for application—casting, coating, spraying, etc. The pot life will range between 15–30 minutes at ambient conditions depending upon the type of MDI utilized. A cast part can be demolded in 2–3 hours at room temperature or as quickly as 15 minutes when cured at 100 °C.

Two weeks are required to achieve complete cure at ambient conditions. However, 75% of the ultimate physical properties are realized within 24 hours at ambient temperatures.

Table 4 shows the negligible effect that changing the curing temperature has on the ultimate physical properties. The largest advantage that curing the material in a heated mold provides is to significantly reduce the demold time.

Figure 2 - Pot Life vs Catalyst Concentration

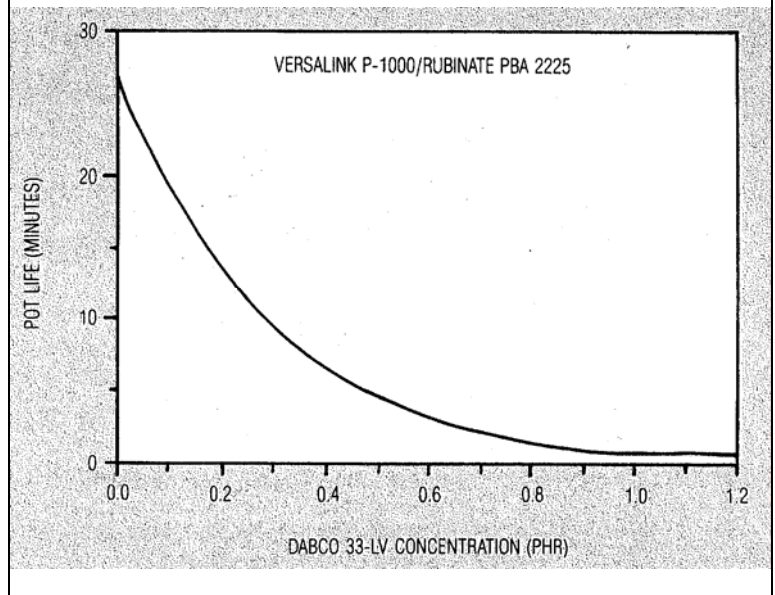


Table 4 - Effect of Cure Temperature

Processing Conditions				
MDI	RUBINATE PBA 2225		ISONATE 2143L	
NCO, %	31		29	
MDI Level, php	23		25	
Stoichiometry, %	95		95	
Mix Temp., °C	25		25	
Cure Temp., °C	25	100	25	100
Demold Time, min.	150	15	150	15
Cure Time	14 days	6 hrs.	14 days	6 hrs.
Physical Properties				
Hardness, Shore A	95	95	95	95
Modulus, psi				
100%	900	800	900	1,000
300%	1,200	1,800	1,400	3,000
Tensile Strength, psi	4,500	3,900	4,500	4,300
Elongation, %	460	380	450	360
Tear Strength, pli				
Die C	370	350	380	360
Split	110	90	120	100
Rebound, %	53	47	52	48

Hydrolytic Stability

Polyether urethane-urea systems are often employed in applications where hydrolytic stability is an important issue. Polyurea and polyurethane-urea systems based on Versalink oligomeric diamines can be included in this class of materials and will offer many advantages in a number of high-performance applications. However, the presence of the ester linkage in the Versalink oligomeric diamine structure has led to questions concerning the hydrolytic stability of the resulting coatings, adhesives and elastomers. As a result, a study was undertaken to compare the hydrolytic stability of cast elastomers based on Versalink P-1000 oligomeric diamine and liquid MDI with that of a standard TDI-ether prepolymer cured with MBOCA. The study results are provided in Table 5. The data indicates that after four weeks at 80°C in pH 3 water, there is no difference in the hydrolytic stability of the Versalink/MDI and conventional TDI-ether/MBOCA systems.

This confirms that the ester groups in a Versalink oligomeric diamine do not contribute unduly to the hydrolytic degradation of a Versalink-based elastomer. The most likely site of hydrolysis is the urea linkage which is common to both the VERSALINK/MDI and TDI-ether/MBOCA systems.

Handling

Versalink P-1000 oligomeric diamine is an amber liquid under ambient conditions. If it should become a solid due to exposure to lower temperatures while in transit or storage, gentle warming will return the product to a liquid state. Versalink P-1000 is soluble in most organic solvents and is insoluble in water. Its vapor pressure is negligible and its shelf life is indefinite in a closed container.

Table 5 - Hydrolytic Stability Comparison of VERSALINK/MDI System to Conventional TDI-Ether/MBOCA System [in water at 80 °C (pH = 3)]

	VERSALINK P-1000				TDI-ETHER PREPOLYMER			
	ISONATE 2143L				MBOCA CURED			
Elastomer Physical Properties								
Time, days	0	7	14	28	0	7	14	28
Hardness, Shore A	95	94	92	90	95	95	95	93
Tensile Strength, psi	4,700	3,738	2,788	1,826	4,850	3,940	3,389	2,012
Elongation, %	450	622	679	703	300	402	448	455
Modulus, psi								
100%	1,200	1,049	981	942	1,790	1,527	1,446	1,341
300%	1,754	1,290	1,182	1,055	4,500	2,568	2,118	1,609
Tear Strength Die C, pli	356	478	453	385	400	468	481	436
Rebound, %	45	50	50	51	40	43	44	45
% Retention of Physical Properties								
Hardness, Shore A	100	99	97	95	100	100	100	98
Tensile Strength, psi	100	80	59	39	100	81	70	41
Elongation, %	100	138	151	156	100	134	149	152
Modulus, psi								
100%	100	87	82	79	100	85	81	75
300%	100	74	67	60	100	57	47	36
Tear Strength Die C, pli	100	134	127	108	100	117	120	109
Rebound, %	100	111	111	113	100	108	110	113

Health and Safety Information

Toxicity based upon analogy to similar compounds would indicate that Versalink P-1000 oligomeric diamine is non-hazardous. Toxicity testing conducted up to this point on this product has revealed the following information:

- Versalink P-1000 is non-mutagenic, based on Ames Salmonella test and is without metabolic activity
- LD₅₀ > 5000 mg/kg
- Versalink P-1000 is a mild eye and skin irritant
- Versalink P-1000 is not rated acutely toxic

These Versalink products are analogs of Versalink 740M diamine curative. Versalink 740M diamine curative has not been found to pose a threat to the workplace or its inhabitants when properly handled. Versalink 740M diamine curative is also FDA-approved for dry food use.

Information regarding safety and health concerns when handling these products is contained on the product label and in the Material Safety Data Sheets. It is recommended that you read and become familiar with this information before working with the products.

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