Viton™ Fluoroelastomers

Viton™ Curing Agents

Technical Information

Introduction

There are three members of the family of Viton™ curing agents—Viton™ Curatives No. 1A (VC-1A), No. 3 (VC-3), and No. 7 (VC-7).

VC-1A and VC-3 are diamines and find application in the curing of the A, B, and E types of Viton™ fluoroelastomer. VC-7, a reactive polyfunctional triazine, is a coagent necessary for use with the "G-family" of peroxide-curable Viton™ fluoroelastomers.

Viton™ curing agents differ in their curing activity depending upon the conditions and the polymer in which they are used. This bulletin gives product descriptions for the three Viton™ curing agents as well as their principal properties and applications. Also included are appropriate references to technical literature reporting test results of Viton™ curing agents in different polymers and under different conditions.

The data in this report compares the performance of the various Viton™ curing agents with each other. Many of the property and processing characteristics for compounds of Viton™ (particularly compression set, scorch safety, and cure rate) can be improved still further through the use of Viton™ Curative Masterbatches (Curative No. 20 and No. 30). For information on curing with the Curative Masterbatches, see the Chemours technical bulletin, "Compounding with Viton™ Curative Masterbatches."

General Comments

VC-1A and VC-3 are widely used to cure the A, B, and E types of Viton™ fluoroelastomer. The main difference between the Viton™ curing agents is in processing safety. VC-1A gives the least processing safety, while VC-3 gives the best and, at the same time, exhibits some plasticizing effect. In general, the compression set and physical properties obtained with VC-3 are not quite as good as with VC-1A.

Where FDA-approved vulcanizates of Viton™ are required in the formulation of rubber articles intended for repeated use in contact with food, VC-1A should be used. For more information, see the Chemours technical bulletin, "Viton™ in Applications Regulated by the Food and Drug Administration."

Handling Precautions

VC-1A and VC-3 may form flammable dust-air mixtures. Also, they may cause irritation of eyes and skin. Keep away from heat, sparks, and open flame. Use only in areas provided with grounded equipment. Breathing of dust and contact with eyes, skin, and clothing should be avoided. Wash thoroughly after handling. Good ventilation should be provided during all processing and curing operations; avoid dust hazards. Avoid breathing vapors during processing.

In rat inhalation studies on VC-3, the approximate lethal concentration (ALC) was found to be 6.2 mg/L of air for an exposure period of 4 hr. Observations indicated that there was an irritating effect on the respiratory system. If VC-3 is inhaled, remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

VC-7 should be stored and used above its melting point (25 ± 2 °C [77 ± 4 °F]). Preferable temperature range for storage and use is 30–40 °C (85–105 °F). Like the other Viton™ curing agents, it may cause irritation. Contact with eyes, skin, and clothing should be avoided. Wash thoroughly after handling.

For all three Viton™ curing agents, in case of contact, immediately flush eyes with plenty of water for at least 15 min. Call a physician. Flush skin with water.

Chemours™

Viton™ Curative No. 1A—Properties and Applications

VC-1A provides excellent vulcanizate properties in the A, B, and E types of Viton™. Stocks containing VC-1A are fast curing and have good physical properties, particularly resistance to compression set and aging. However, such compounds have lower processing safety than those cured with VC-3. Satisfactory cures are produced with roughly 1–1.5 phr of VC-1A.

In the A types of Viton™, in general, VC-1A produces compounds with higher tensile strength in both the original and heat-aged conditions than those produced with VC-3. In Viton™ B and B-50, VC-1A produces compounds having lower original tensile strength, but higher tensile strength after heat-aging, than those produced with VC-3.

For more complete information and data including test results on the use of VC-1A in the A types of Viton™ and Viton™ B and B-50, see the Chemours technical bulletins, "The Viton™ A-Type Fluoroelastomers," "Viton™ B-50," and "Compounding and Curing Viton™ for Maximum Compression Set Resistance."

Viton™ Curative No. 3—Properties and Applications

VC-3 is a blocked diamine curing agent for Viton™. It gives better processing safety than VC-1A and has some plasticizing effect, but, in general, vulcanizate properties are not as good as those obtained with VC-1.

Satisfactory cures in the A, B, and E types of Viton™ are produced with roughly 3 phr of VC-3.

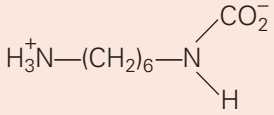
For more complete information and data including test results on the use of VC-3 in the A types of Viton™ and Viton™ B and B-50, see the Chemours technical bulletins, "The Viton™ A-Type Fluoroelastomers," "Viton™ B-50," and "Compounding and Curing Viton™ for Maximum Compression Set Resistance."

Viton™ Curative Nos. 1A and 3—Compounding and Processing

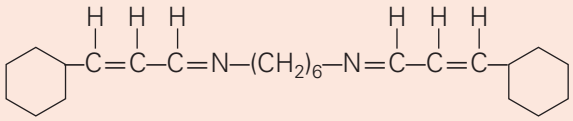
For use with VC-1A and VC-3, the general-purpose acid acceptor system is low activity magnesium oxide. Calcium oxide may be used in place of magnesia to reduce the shrinkage of compounds of Viton™ during cure, eliminate voids in thick sections, and improve compression set resistance.

Compounds of Viton™ cured with VC-1A or VC-3 should be mixed on a mill that is kept as cool as possible. The Viton™ curing agent should be blended thoroughly with the filler before either it or the filler is added to the polymer.

Viton™ Curative No. 1A—Product Description

Chemical Composition	Hexamethylenediamine carbamate
	
Physical Form	Very fine powder
Color	White
Odor	Slight amine
Specific Gravity at 25/4 °C (77/39 °F)	1.28 ± 0.02
Decomposition Point	154.0 °C (309.2 °F) min.
Ash	0.1% max.
Moisture	0.5% max.
Purity	98.0% min.
Solubility	Soluble in water; insoluble in non-polar solvents
Storage Stability	Excellent
CAS Registry No.	143-06-6

Viton™ Curative No. 3—Product Description

Chemical Composition	N,N′-dicinnamylidene-1,6 hexanediamine
	
Physical Form	Coarse powder
Color	Tan
Odor	Cinnamon
Specific Gravity at 25/4 °C (77/39 °F)	1.09 ± 0.02
Melting Point	80 °C (176 °F) min.
Ash	0.5% max.
Moisture	0.5% max.
Particle Size	0.0% max. retained on No. 8 screen
Solubility	Slightly soluble in water; soluble in polar solvents
Storage Stability	Excellent
CAS Registry No.	140-73-8

This procedure minimizes dusting and, at the same time, improves dispersion considerably. Short scorch times with VC-1A may dictate its addition during a second pass on a cool mill, especially in harder stocks.

Stocks containing VC-1A or VC-3 are molded and cured at temperatures and in a manner that is similar for all. In general, press temperatures of 149–163 °C (300–325 °F) are satisfactory. Oven post-cure temperatures of 204–260 °C (400–500 °F) are recommended for applications involving high temperature service—particularly those requiring high temperature compression set resistance.

Viton™ Curative No. 7—Properties and Applications

VC-7 is a reactive polyfunctional triazine. It is a coagent necessary for use with the "G-types" of peroxide-curable Viton™ fluoroelastomers. The "G-family" of fluoroelastomers requires a peroxide and a coagent for curing; peroxides, by themselves, are ineffective. VC-7, in combination with peroxide, produces an excellent balance of tensile properties and high temperature compression set resistance, without sacrifice in heat resistance. VC-7 serves an entirely different purpose and should not be confused with the other Viton™ curing agents—VC-1A and VC-3. The latter are all diamines and find application in the curing of the A, B, and E types of Viton™.

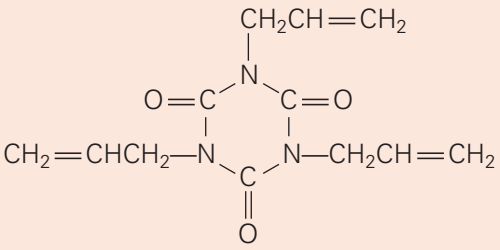
Because its melting point is near that of ambient room temperature, VC-7 can be either in solid or liquid state, depending on storage conditions. For both convenience and consistent cure characteristics, it is recommended that when a container of VC-7 is received, it be melted thoroughly and stirred to ensure homogeneity. Temperature while being melted should not exceed 50 °C (122 °F). It should then be stored above its melting point, preferably between 30–40 °C (85–105 °F). Use of partially crystallized VC-7 can impart erratic cure characteristics.

Generally, 2.5 to 4 parts of VC-7 provide a fast cure rate with good processing safety and excellent vulcanizate properties. The amount will vary with the particular polymer and properties required. As would be expected, increasing the amount of VC-7 will produce a vulcanizate with a higher modulus and lower elongation. In Viton™ GLT, 4 parts of VC-7 provide the best balance of properties. In Viton™ GF, 2.5 to 3 parts are preferred.

The G-type Viton™ fluoroelastomers may be mixed using conventional techniques. VC-7 should be blended with the filler and all other ingredients and then added to the polymer. This procedure improves dispersion considerably.

For more complete information and data including test results on the use of VC-7 in the G-types of Viton™, see the Chemours technical bulletins, "Viton™ GF" and "Viton™ GLT."

Viton™ Curative No. 7—Product Description

Chemical Composition	Triallyl isocyanurate containing a small amount of a hydroquinone inhibitor for storage stability
	
Physical Form	Liquid above 27 °C (81 °F)
Color	Straw yellow
Odor	Pungent
Specific Gravity at 30/4 °C (86/39 °F)	1.16 ± 0.02
Melting Point	25 ± 2 °C (77 ± 4 °F)
Brookfield Viscosity at 30 °C (86 °F), cP	100 ± 15
Purity	98.5% min.
Moisture	0.03% max.
Solubility	Slightly soluble in water; soluble in benzene, ethyl alcohol, acetone, and heptane
Storage Stability	Temperature in storage or while being melted should not exceed 50 °C (122 °F)
CAS Registry No.	1025-15-6

Test Procedures

Property Measured	Test Procedure
Compression Set	ASTM D395-85, Method B (25% deflection)
Compression Set—Low Temperature	ASTM D1299-87, Method B (25% deflection)
Compression Set, O-Rings	ASTM D1414-78 (87)
Hardness	ASTM D2240-87, durometer A
Mooney Scorch	ASTM D1646-87, using the small rotor. Minimum viscosity and time to a 1-, 5-, or 10-unit rise are reported.
Mooney Viscosity	ASTM D1646-87, ten pass 100 °C (212 °F), 121 °C (250 °F)
ODR (vulcanization characteristics measured with an oscillating disk cure meter)	ASTM D2084
Property Change After Oven Heat-Aging	ASTM D573-88
Stress/Strain Properties 100% Modulus Tensile Strength Elongation at Break	ASTM D412-87, pulled at 8.5 mm/sec (20 in/min)
Stiffness, Torsional, Clash-Berg	ASTM D1043-87
Temperature Retraction	ASTM D1329-88
Volume Change in Fluids	ASTM D471-79

Note: Test temperature is 24 °C (75 °F), except where specified otherwise.

For more information, visit Viton.com

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