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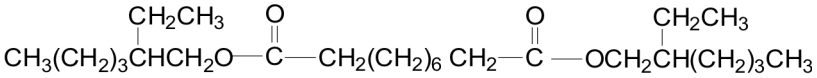
Di-2-Ethylhexyl Sebacate (DOS): A Very Versatile, Low-Temperature Ester

Stephen O'Rourke, Technical Director, Industrial



Di-2-ethylhexyl sebacate (DOS) is an ester type plasticizer sebacic acid, and 2-ethyl hexyl alcohol has been used for many years as a standard in polyvinyl chloride (PVC) compounds requiring flexibility at low temperatures.

Considered to be low polarity, sebacic acid in combination with a polar alcohol (2-ethyl hexanol) is an ideal ester component for creating low-temperature properties. Low-temperature properties are enhanced when the plasticizer used is marginally compatible. A highly compatible plasticizer will solvate the polymer, thus not creating the free volume or freedom of molecular movement needed for flexibility at low temperatures.

The most important features of DOS are low volatility; high plasticizing efficiency; excellent resistance to extraction by water, soaps and detergents; and excellent flexibility at low temperatures. These basic qualities make DOS substantially better than phthalate and adipate esters (see Table I). Due to its low molecular weight and low polarity, it is deficient in terms of migration resistance and extraction by hydrocarbon fluids. It should be used in minimal amounts that meet specific low-temperature performance requirements.

DOS is a very useful plasticizer for organosols and plastisols. The viscosity of plastisols based on DOS as the sole plasticizer is approximately one-third that of comparable dioctyl phthalate systems. The initial viscosity advantage over dioctyl phthalate is retained, even on prolonged aging.

TABLE I

Plasticizer	DOS	DOA	DOP
Original Physical Properties			
Hardness, Duro A, pts.	68	64	67
100% Modulus, MPa	6.0	5.2	6.2
Elongation at Break, %	380	410	390
Tensile Strength, psi	1875	1825	2025
Tensile Strength, MPa	12.9	12.6	14.0
Specific Gravity	1.158	1.167	1.200
Low-Temperature, °C			
Brittle Point	-56	-53	-30
T-45,000 psi	-69	-69	-44
T-135,000 psi	-87	-85	-53
Air Oven Aging, 3 d at 121 °C			
Tensile Change, %	+9	*	+17
Elongation Change, %	+5	*	-45
Weight Change, %	-7.0	-34	-20
Percent Weight Change after:			
n-Hexane, 24 h at 23 °C, DO	-34	-32	-34
1% Soapy Water, 7 d at 90 °C, DO	-6.6	-25	-15
Cottonseed Oil, 24 h at 60 °C	-28	-29	-19
Distilled Water, 24 h at 60 °C, DO	-1.8	-1.7	-0.58
High Humidity, 9 d at 90 °C, DO	-1.4	-2.3	-0.98

*samples too brittle to test

DOS is used in several elastomers, such as polychloroprene, chlorinated polyethylene and chlorosulfonated polyethylene. Table II shows data for these elastomers. As seen with PVC, DOS provides excellent low-temperature properties to elastomers.

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TABLE II

Acrylic-Based Elastomers	
Plasticizer	**DOS**
Original Physical Properties	
Tensile, Ultimate, MPa	9.7
psi	1400
Elongation @ Break, %	470
Hardness, Duro A, pts.	57
Specific Gravity	1.154
Low-Temperature Impact: Nonbrittle,	
All Pass, °C	-55
Low-Temperature Torsion	
As Molded/Air Oven Aging	
T-10,000 psi, °C	-48
T F- 45,000 psi, °C	-56
Air Oven Aging, 70 h at 149 °C	
Tensile Change, %	+11
Elongation Change, %	-19
Hardness Change, pts.	+18
Weight Change, %	-15
ASTM Oil #1 Immersion, 70 h at 149 °C	
Tensile Change, %	+14
Elongation Change, %	-21
Hardness Change, pts.	+8
Volume Change, %	-7.0
Weight Change, %	-6.2

Polychloroprene	
Plasticizer	**DOS**
Original Physical Properties	
100% Modulus, psi	400
Tensile Strength, psi	1525
Elongation @ Break, %	260
Hardness Duro A, pts.	69
Specific Gravity	1.453
Low Temperature Properties	
Brittle Point, °C	-50
T2, °C	-27
Heat Resistance, 70 h at 100 °C	
Elongation Change, %	-14
Hardness Change, pts.	4
Weight Change, %	-0. 59
Brittle Point, °C	-48
ASTM Oil #1, 70 h at 100 °C	
Elongation Change, %	-20
Hardness Change, pts.	8
Volume Change, %	-8. 9
Brittle Point, °C	-30
ASTM Oil #3, 70 h at 100 °C	
Elongation Change, %	-18
Hardness Change, pts.	20
Volume Change, %	40
Brittle Point, °C	-40
Transmission Fluid, Dextron-II Type, 70 h at 100 °C	
Elongation Change, %	-5
Hardness Change, pts.	-7
Volume Change, %	5. 3
Brittle Point, °C	-35

Hypalon	
Plasticizer	**DOS**
Original Physical Properties	
Tensile, Ultimate, MPa	12.8
psi	1850
Elong. @ Break, %	290
Hardness, Duro A, pts.	63
Specific Gravity	1.288
Low-Temperature Impact:	
As Molded,	
All Pass, °C	52
Low-Temperature Torsion - Gehman: Original	
T2, °C	-12
T5, °C	-28
T10, °C	-35
Air Oven Aging, 70 h at 121 °C	
Tensile Change, %	1
Elongation Change, %	-7
Hardness Change, pts.	7
Weight Change, %	-4.7
Compression Set: 70 h at 121 °C	
% Set	28
Distilled Water Dry Out: 22 h at 85 °C	
Hardness, Duro A, pts.	69
Hardness Change, pts.	6
Volume Change, %	0.29
Weight Change, %	-0.14