Monsanto 4/62

MONSANTO MODIFIERS

for Thiokol® polysulfide liquid polymers

TECHNICAL BULLETIN No. PL-331

APRIL 1962

Monsanto

ST. LOUIS 66, MISSOURI

0221315

LEXOLDMON003993
WATER_PCB-00029374

INTRODUCTION

*Thiokol** polysulfide liquid polymers, essentially difunctional mercaptans, are easily converted in-place to rubber-like materials. Cured polysulfide-based compounds are noted for their outstanding oil and solvent resistance, excellent resistance to weathering (oxygen, ozone, and light), good electrical insulation properties, resilience, impermeability to gases, and a broad service-temperature range (from —55° to 175°C). They are used in potting and casting compounds, sealants, adhesives, coatings, and in combinations with epoxy and phenolic resins.

The choice of materials and concentrations used in formulating finished compounds depends upon the requirements of the application. The purpose of this bulletin is to discuss several Monsanto modifiers that enable the formulator to reduce the cost of polysulfide-based compounds without detracting appreciably from the useful characteristics of these compounds.

We acknowledge, with thanks, the cooperation of the Thiokol Chemical Corp. in the preparation of this bulletin.

CONTENTS

MONSANTO MODIFIERS COMPATIBLE WITH POLYSULFIDES 1

PHYSICAL PROPERTIES OF MONSANTO MODIFIERS 2

MONSANTO SPECIFICATIONS 4

POLYSULFIDE APPLICATIONS 6

- Joint-Sealant Compounds 6
- Casting Compounds 7
- Flexible Polysulfide-Epoxy Formulations 7
- Adhesives for Concrete 8

TECHNICAL BULLETINS ON MONSANTO MODIFIERS 8

The information contained in this bulletin is, to our best knowledge, true and accurate, but all recommendations or suggestions are made without guarantee, since the conditions of use are beyond our control. The Monsanto Chemical Company disclaims any liability incurred in connection with the use of these data or suggestions.

Furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing patents covering any material or its use.

*Thiokol: Registered trademark of the Thiokol Chemical Corp., Trenton, N. J.

0221316

LEXOLDMON003994
WATER_PCB-00029375

MONSANTO MODIFIERS COMPATIBLE WITH POLYSULFIDES

AROCLOR* Compounds

The AROCLOR chlorinated biphenyls and terphenyls are highly compatible with polysulfide liquid polymers and offer an attractive means of reducing formulation costs.

Although the AROCLOR compounds are compatible up to 100 PHR, the concentration to be used depends upon the handling and performance properties required in the finished compound. The formulations shown in this bulletin suggest a maximum of 15 parts of AROCLOR plasticizer for sealant compounds and a maximum of 40 parts for casting compounds.

Liquid AROCLOR compounds (such as AROCLOR 1248) are used to give reduced casting viscosity and higher filler levels, whereas the resinous and solid AROCLOR compounds (such as AROCLOR 5460) are useful where low volatility is desired. The 12 available AROCLOR compounds offer a range of physical properties.

*HB-40**

HB-40 hydrocarbon plasticizer is compatible with polysulfide liquid polymers up to 40 PHR. Like the AROCLOR compounds, *HB-40* offers reduced viscosity in formulation plus reduced costs.

Dibutyl Phthalate

Dibutyl Phthalate is also compatible up to 40 PHR and is used both as a plasticizer and as a grinding medium for the peroxide curing agents.

SANTICIZER* M-17

SANTICIZER M-17 glycolate plasticizer is frequently used to give improved low-temperature characteristics in combination with the AROCLOR compounds.

MOD-EPOX*

MOD-EPOX epoxy-resin modifier reduces viscosity of polysulfide-epoxy resin blends for easier handling and application; it also lowers the overall cost.

*AROCLOR, *HB-40*, MOD-EPOX, and SANTICIZER: Monsanto Chemical Company trademarks, registered in the U. S. Patent Office.

0221317

LEXOLDMON003995
WATER_PCB-00029376

PHYSICAL PROPERTIES OF MONSANTO POLYSULFIDE-MODIFIERS

Property	AROCLOR 1221	AROCLOR 1242	AROCLOR 1254
Molecular Weight	—	—	—
Refractive Index, 25°C	1.617-1.618 (20°C)	1.627-1.629 (20°C)	1.639-1.641 (20°C)
Density, 25°C, lb./gal	9.85	11.50	12.82
Crystallizing Point, °C	1	—	—
Pour Point, °C	—	—19	10
Boiling Point, 760 mm Hg, °C	275-320	325-366	365-390
Vapor Pressure, mm Hg			
150°C	—	—	—
200°C	—	—	—
300°C	—	—	—
Viscosity, cs			
0°C	—	—	—
37.8°C (100°F)	*38-41 (SSU)	*82-92 (SSU)	1800-2500 (SSU)
25°C	—	—	—
54.4°C (130°F)	35-37 (SSU)	49-56 (SSU)	260-340 (SSU)
98.9°C (210°F)	30-31 (SSU)	34-35 (SSU)	*44-48 (SSU)
Surface Tension, 20° C, dynes/cm	—	—	—
Flash Point, °F	286-302	348-356	none to b.p.
Fire Point, °F	349	none to b.p.	none to b.p.

*Specification

0221318

LEXOLDMON003996
WATER_PCB-00029377

AROCLOR 5460	HB-40	Dibutyl Phthalate	SANTICIZER M-17	MOD-EPOX
—	—	278.34	266.24	—
1.660-1.665 (20°C)	1.5600-1.5750	1.4895-1.4915	1.504	*1.587-1.590
13.91	8.37	8.72	10.20	9.83
—	—	< —35	< —35	25
*98-105.5 (softening)	—26	—40	—26	—
280-335 (5 mm Hg)	345-396	340.0	310	360
—	2	1	0.5	—
—	15	9	8	11 (220°C)
—	230	300	600	—
—	70.0	55.0	1476	—
—	29.0	—	—	—
—	—	15.6	82.0	—
—	—	—	—	—
—	3.8	2.4	2.8	—
—	40.1 (25°C)	35	43.6 (25°C)	—
none to b.p.	345	340	380	375
none to b.p.	385	395	—	525

0221319

LEXOLDMON003997
WATER_PCB-00029378

MONSANTO SPECIFICATIONS

	AROCLOR 1221	AROCLOR 1242	AROCLOR 1254
Appearance	†colorless mobile oil	practically colorless, clear, mobile oil	†light-yellow viscous oil
Acidity, meq. KOH/g	0.014	0.010	0.010
Color, APHA	100	100	100
Moisture (KF in methanol), %	—	50 (ppm)	50 (ppm)
Odor	—	—	—
Specific Gravity, 25°/25°C	1.182-1.192 (25°C/15.5°C)	1.381-1.392 (25°/15.5°C)	1.495-1.505 (25°/15.5°C)

† Not a specification

0221320

LEXOLDMON003998
WATER_PCB-00029379

AROCLOR 5460	HB-40	Dibutyl Phthalate	SANTICIZER M-17	MOD-EPOX
clear, yellow-to-amber, brittle resin or flakes	†practically colorless, oily liquid	clear, water-white oily liquid with no sediment or turbidity	clear, practically white, oily liquid, with no turbidity or sediment	oily liquid or light-yellow solid
†0.05	—	0.12	0.33	0.2 (mg KOH/g)
2 (NPA)	150	20	20	150
—	125 (ppm)	0.15	0.15	—
—	†Faint, Characteristic	Slight, Characteristic	Slight, Characteristic	—
†1.670	1.001-1.007 (25°/15.5°C)	1.044-1.048	1.217-1.227	1.179-1.183 (30°/15.5°C)

0221321

LEXOLDMON003999
WATER_PCB-00029380

POLYSULFIDE APPLICATIONS

Joint-Sealant Compounds

Curtain-wall construction, which is growing rapidly, requires large quantities of permanently flexible, strongly adhering sealants. The AROCLOR compounds have long been used as cost-reducing modifiers for polysulfide polymers in this and other construction applications. Sealant compounds are also widely used to seal concrete joints in airport runways and to impart skid-resistant surfaces by bonding abrasive particles to highways and bridges. The following formulation illustrates the use of AROCLOR 1232 in a joint-sealer formulation:

JOINT-SEALANT COMPOUND
FOR CURTAIN-WALL CONSTRUCTION

Ingredients	Parts by Weight
Thiokol LP-32 polysulfide	100
Phenolic resin	5
AROCLOR 1232	5-15
Calcium carbonate	40
Titanium dioxide	10
Stearic acid	1
Sulfur	0.1
C-5 paste (lead peroxide, 50%; dibutyl phthalate, 45%; stearic acid, 5%: passed three times through a tight paint mill.)	

Properties

Cast sheets, after cure of 7 days at room temperature:

Tensile strength, psi	150-250
Elongation, %	500-700
Hardness, Shore "A"	30-40

0221322

LEXOLDMON004000
WATER_PCB-00029381

Casting Compounds

Solvent-resistant gaskets of polysulfide polymers may be poured and cured in-place. Either dibutyl phthalate or AROCLOR 1248 may be used to modify polysulfide casting compounds, as exemplified by the following starting formulation:

Ingredients	Parts by Weight
Thiokol LP-2 polysulfide	100
Dibutyl phthalate (or AROCLOR 1248)	20-40
Zinc sulfide	40
Sulfur	0.1
C-5 paste (See previous formulation)	15

Properties

Cast sheets, after cure of 7 days at room temperature:

Tensile strength, psi	150-200
Elongation, %	300-400
Hardness, Shore "A"	25-35

Flexible Polysulfide-Epoxy Formulations

Epoxy resins are made flexible by modification with about equal amounts of polysulfide resins. The viscosity of the resulting formulation is markedly decreased, for easier handling and application, by incorporation of MOD-EPOX, which also permits the use of less epoxy curing agent, reduces the overall cost, increases bond strength, yet has very little effect on aging, as indicated by the following formulations:

ROOM-TEMPERATURE AGING
OF FLEXIBLE POLYSULFIDE-EPOXY FORMULATIONS

Ingredients	Parts by Weight	
Thiokol LP-3	100	100
*Epon** 828 epoxy resin	100	100
MOD-EPOX	—	25
Diethylenetriamine	12	8

Properties

After cure at 23°C for:	Hardness, Rockwell	
10 days	—69R	—35R
10 weeks	—79R	—32R

*Registered trademark of Shell Chemical Co.

0221323

LEXOLDMON004001
WATER_PCB-00029382

Adhesives for Concrete

Formulations based on polysulfide liquid polymers and epoxy resins, and modified with AROCLOR compounds or MOD-EPOX, are frequently used as adhesives for concrete. These adhesives are excellent for repairing and patching concrete floors and highways, and they permit fresh concrete to be bonded to old concrete. They are also used to bond pre-cast or broken concrete parts together, as well as metal parts to concrete. As concrete sealers, they speed hardening, curing, and dustproofing of fresh concrete; and they resist freeze-thaw, salt, and scraper damage to highways.

TECHNICAL BULLETINS ON MONSANTO MODIFIERS

Complete details of the properties, applications, and performance of the Monsanto modifiers for polysulfide liquid polymers are included in the following technical bulletins, which are available without obligation from Monsanto's Organic Chemicals Division, in St. Louis, or from any District Sales Office:

Number	Title
PL-306	The AROCLOR Plasticizers
PL-40	*HB-40*
PL-302	Dibutyl Phthalate
PL-17	SANTICIZER M-17
PL-313	MOD-EPOX

WFW:LSS-1.5M-4:62

0221324

LEXOLDMON004002
WATER_PCB-00029383



AKRON
ATLANTA
BOSTON
CHICAGO
CINCINNATI
CLEVELAND
DETROIT
HOUSTON
LOS ANGELES
MINNEAPOLIS
NEW YORK
PITTSBURGH
SAN FRANCISCO
SEATTLE
SYRACUSE
WILMINGTON
MONSANTO CHEMICALS LTD.
London
MONSANTO CHEMICALS
(AUSTRALIA) LTD. Melbourne
MONSANTO (CANADA) LTD.
Montreal • Toronto • Vancouver

ST. LOUIS 66, MISSOURI

0221325

LEXOLDMON004003
WATER_PCB-00029384