

WE ADD PERFORMANCE

WITH DOVERPHOS® HiPURE 4 TNPP



Conventional TNPP



Doverphos® HiPure 4

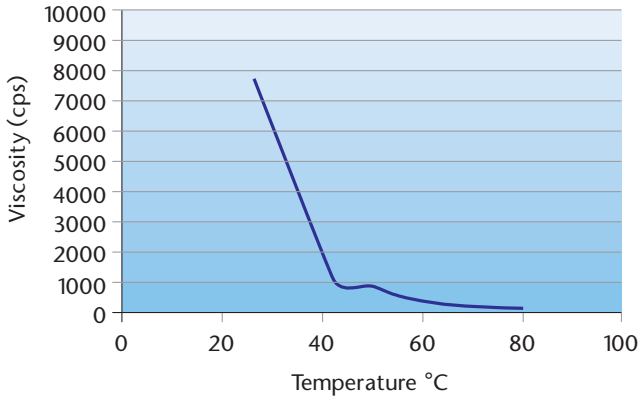
Water

THE CLEAR CHOICE

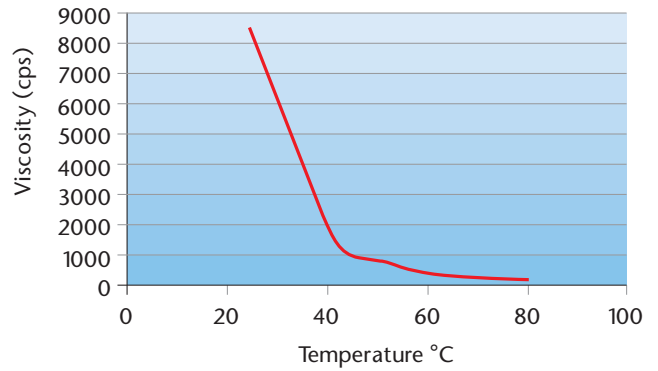
FOR BETTER COLOR, LOWER COST AND LESS FREE NONYLPHENOL

PHYSICAL PROPERTIES

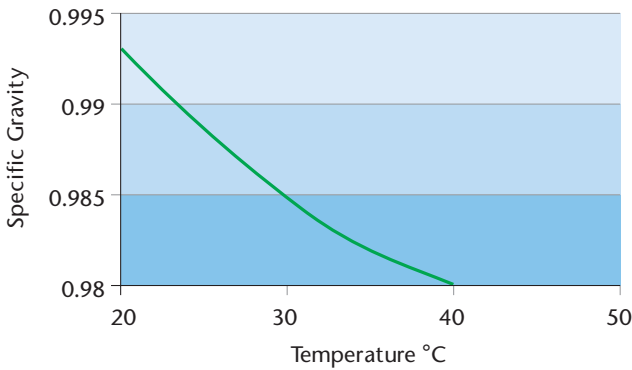
Doverphos® HiPure 4 Viscosity (cps)



Doverphos® HiPure 4HR Viscosity (cps)



Doverphos® HiPure 4 Specific Gravity



BETTER HYDROLYTIC STABILITY THAN OTHER TNPP PRODUCTS

Hydrolysis Conditions: 35°C and 85% relative humidity

TNPP is often used in a water emulsion for stabilizing polymers. It is critical that TNPP used in this application has good hydrolytic stability, since hydrolyzed TNPP is not an effective stabilizer and also can cause black specks.

Doverphos 4, the Competitor TNPP and Doverphos HiPure 4 sampled in this test do not contain TiPA. After 24 hours, Doverphos HiPure 4 released 58% less nonylphenol than the competing TNPP and 29% less than Doverphos 4.

	Doverphos 4	Competitor TNPP	Doverphos HiPure 4
Time	% Free Nonylphenol		
Initial	2.50	1.60	0.06
4 hours	6.20	3.40	0.15
7 hours	7.00	8.00	0.18
12 hours	12.90	19.00	0.98
24 hours	19.80	34.00	14.10

	Doverphos 4HR	Doverphos HiPure 4HR
Time	% Free Nonylphenol	
Initial	4.00	0.03
4 hours	4.30	0.04
7 hours	4.60	0.04
12 hours	5.40	0.04
24 hours	5.50	0.04
48 hours		0.06
4 days		0.07
8 days		0.09
83 days		0.12

Doverphos 4-HR and Doverphos HiPure 4-HR contain TiPA to extend the hydrolytic stability of these products.

This test shows the excellent long-term hydrolytic stability of Doverphos HiPure 4-HR, which contains 0.75% TiPA. Even after 83 days, very little nonylphenol was generated.

GET MORE ACTIVE PHOSPHITE

AND LESS FREE NONYLPHENOL WITH DOVERPHOS® HiPURE 4 TNPP

Doverphos HiPure 4, HiPure 4-HR and HiPure 4-HR Plus offer the highest purity TNPP with the lowest level of free nonylphenol of any commercially available product. You get more active phosphite per pound with less free nonylphenol that could come off as a volatile during polymer processing.

This patented process heat stabilizer is so cost effective that you can probably use a truckload less if you typically purchase one million pounds. Doverphos HiPure 4 has 0.1% residual nonylphenol (NP) maximum, compared to the 2.5% to 6.0% typically contained in competitive products.

Doverphos HiPure 4-HR and Doverphos HiPure 4-HR Plus provide enhanced hydrolytic stability to give better final color in end-use products and prevent black specks when used in a water emulsion for

stabilizing polymers. All Doverphos HiPure 4 grades are produced in a totally automated, Dover Chemical patented, ISO 9001 certified process.

FOOD CONTACT PACKAGING

Doverphos HiPure 4 is Kosher approved and sanctioned under FDA regulations for food-contact packaging applications in a number of polymer and rubber systems.

HEAT STABILIZATION

Doverphos HiPure 4 is an effective liquid phosphite heat stabilizer for a wide variety of polymer and rubber systems, including:

- Polyolefins
- Acrylics
- Polycarbonates
- Elastomers
- ABS
- Polyethylene Terephthalate
- Adhesives
- PVC
- Polyurethanes
- Coatings
- Nylon
- Polystyrenes

Typical use levels range from 0.05% - 3.0% for most applications.

NOMENCLATURE (C₉H₁₉-C₆H₄-O-)₃P

CAS Name	Trisnonylphenyl Phosphite
Molecular Weight	688
CAS Number	26523-78-4
U.S. Patent No.	5,532,401

PHYSICAL PROPERTIES

Appearance	Clear liquid
% Phosphorous	4.3
Density, lb./gal.	8.2
Viscosity	7800cps @ 25° C

SPECIFICATIONS

Free Nonylphenol	0.1% maximum
Color, APHA	75 maximum
Acid No., mg KOH/gm	0.1 maximum (HiPure 4)
Refractive Index, 25° C	1.5265 - 1.5290
Specific Gravity	0.980 - 0.997

Doverphos HiPURE 4

Gives better final color in end-use products and less free nonylphenol released during processing.

Doverphos HiPURE 4HR

Contains 0.75% maximum triisopropanolamine for improved hydrolytic stability.

Doverphos HiPURE 4HR PLUS

Contains 1.0% triisopropanolamine for maximum hydrolytic stability.

STORAGE AND HANDLING

Phosphites tend to hydrolyze when exposed to moisture such as humid air. The extent of the hydrolysis will depend on the type of phosphite, temperature, degree of humidity and length of exposure.

Liquid phosphites, such as Doverphos HiPure 4, are more hydrolysis resistant than solid phosphites, due to a lower surface area exposed to moisture. The degree of hydrolysis can be determined by running an acid value on the phosphite. If the acid value is above the specification, some hydrolysis has occurred. A small degree of hydrolysis should not greatly affect the performance of the phosphite.

Doverphos HiPure 4-HR and Doverphos HiPure 4-HR Plus can be hazy at room temperature. This will not affect performance.

If the practices below are followed, unopened drums of liquid phosphites will have a shelf life of at least one year:

- Store bulk containers of phosphites under a dry atmosphere of nitrogen. Use either stainless steel tanks, glass-lined tanks or carbon steel tanks coated with a phenolic lining such as Plasite® 3066 from Wisconsin Protective Coating Corporation.
- Handle phosphites in a dry nitrogen atmosphere.
- Use the entire drum of phosphite at one time. If the drum needs to be re-sealed, purge the vacant volume with dry nitrogen and re-seal the drum tightly.
- Store unopened drums inside to minimize temperature fluctuations that can cause the drum to breathe.

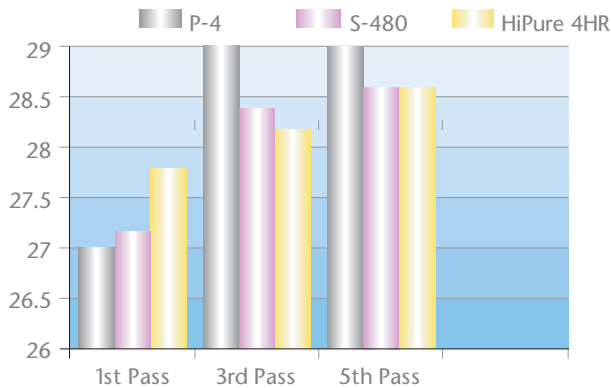
SUPERIOR PERFORMANCE IN LLDPE

Multi-Pass Extrusion results

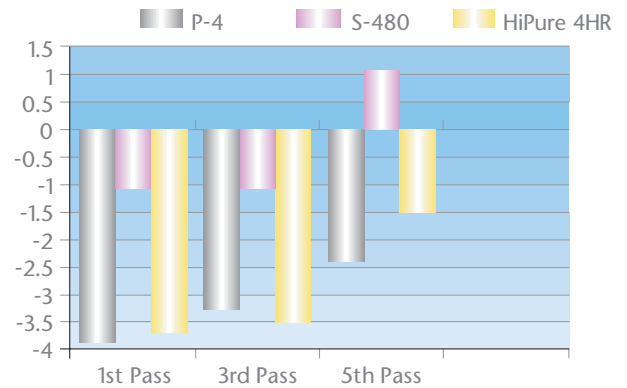
P-4 (Tetrakis (2,4-di-t-butylphenyl) 4,4'-biphenylene diphosphonite) @ 800ppm

Doverphos® S-480 @ 1200ppm • Doverphos® HiPure 4HR @ 1200ppm • Dovernox® 10 @ 200ppm

Melt Stability— MFI 21.6 Kg load, @ 190°C, g/10 minutes



Color Stability YI



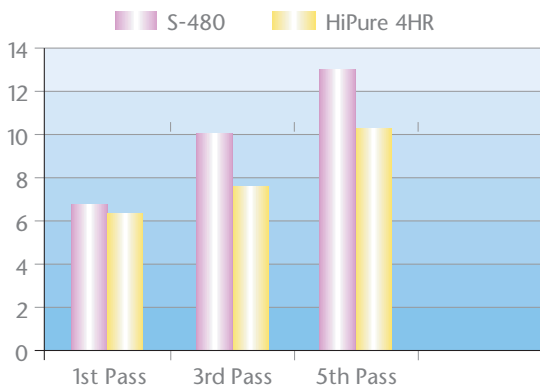
SUPERIOR PERFORMANCE IN PP 6501

Multi-Pass Extrusion results

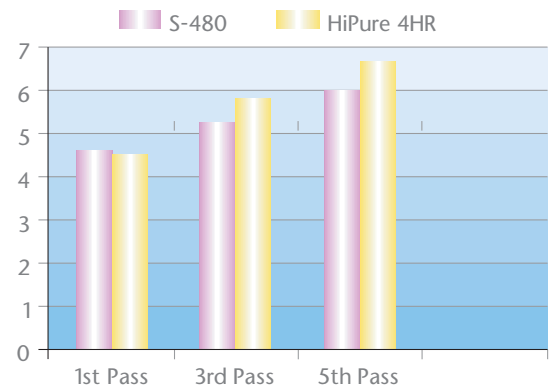
Doverphos S-480 @ 1000ppm • Doverphos HiPure 4HR @ 1000ppm

Dovernox 10 @ 500ppm • Doverlube® Calcium Stearate @ 250ppm

Melt Stability— MFI 2.16 Kg @ 230°C



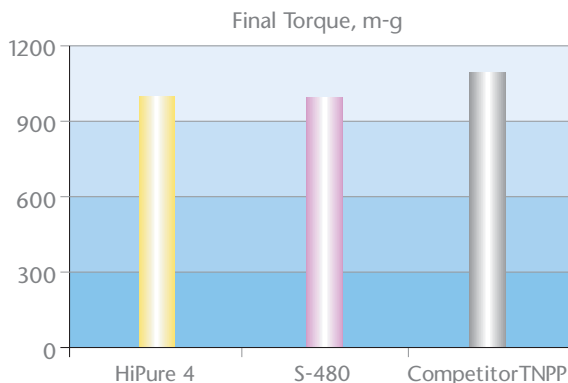
Color Stability YI



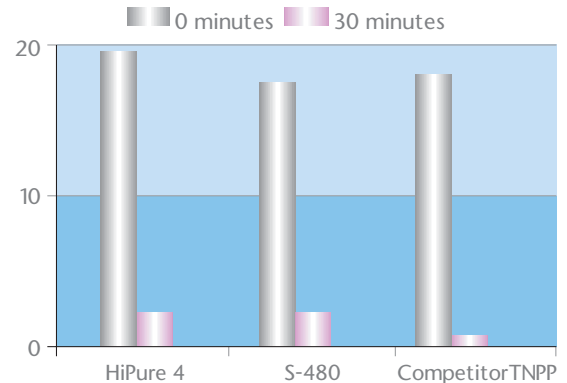
LOWER-COST S-B ELASTOMER STABILIZATION

Dovernox 76 @ 1000ppm • Doverphos S-480 @ 5000ppm • Doverphos HiPure @ 5000ppm

Torque Rheometry— 200°C, 30 minutes @ 50 rpm



Melt Flow— g/10 minutes, 200°C/5 kg



Doverphos HiPure 4 helps control cross-linking in S-B elastomers, as illustrated by its lower torque values and higher melt flow values compared to a competitive TNPP. Doverphos HiPure 4 performs as well as Doverphos S-480, while offering significant cost savings.

Dovernox 10

Dovernox 76

Doverphos S-480

Tetrakis methylene (3,5-di-t-butyl-4-hydroxyhydrocinnamate) methane

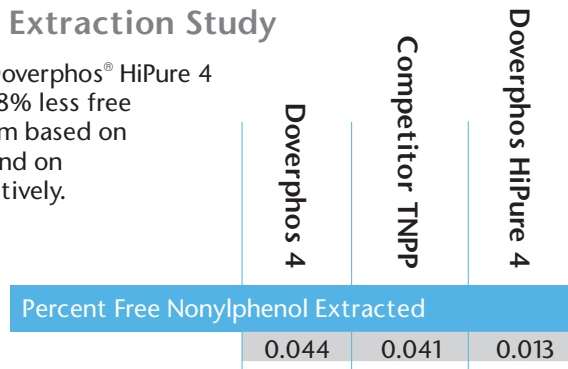
Octadecyl 3,5-di-t-butyl-4-hydroxyhydrocinnamate

Tris (2,4-di-t-butylphenyl) Phosphite

GREATER STABILITY IN POLYMERS

PVC Food Film Extraction Study

PVC film based on Doverphos® HiPure 4 contains 70% and 68% less free nonylphenol than film based on a competing TNPP and on Doverphos 4, respectively.



HIPS Extraction Study

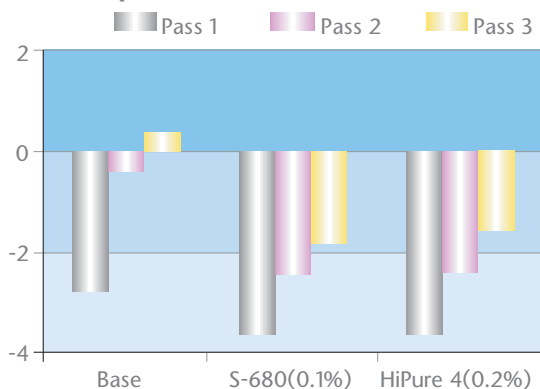
Doverphos HiPure 4 and Doverphos HiPure 4-HR experience less loss in compounding, as shown by the higher initial levels of TNPP. Long-term product stability increases with Doverphos HiPure 4 and Doverphos HiPure 4-HR, as shown by the higher exposed levels of TNPP. The Doverphos TNPP product appears to be stable, even when exposed to water for seven days.

	%TNPP Initial	%TNPP Air 25°C 7 days	%TNPP Water 40°C 3 days	%TNPP Water 40°C 7 days
Doverphos 4	0.17	0.16	0.12	0.13
Doverphos 4HR	0.30	0.30	0.28	0.27
Doverphos HiPure 4	0.39	0.39	0.38	0.35
Doverphos HiPure 4HR	0.42	0.42	0.38	0.38

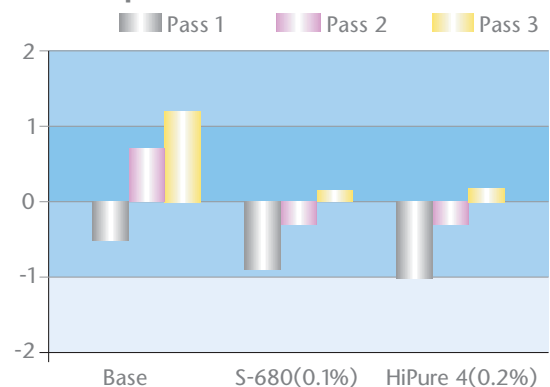
- Each HIPS formulation has 0.5% of Doverphos TNPP compounded and pressed into 30 mil sheets
- One set of sheets was exposed to air at 25° C for 7 days
- One set of sheets was immersed in water at 40° C for 3 days
- One set of sheets was immersed in water at 40° C for 7 days
- All sheets were then extracted to measure the remaining TNPP level

COST-EFFECTIVE HIPS STABILIZATION

HIPS Stabilization Color, YI Multiple Pass Extrusion 220°C



HIPS Stabilization Color, b Value Multiple Pass Extrusion 220°C



S-680 is Doverphos S-680 (distearyl pentaerythritol diphosphite) HiPure 4 is Doverphos HiPure 4
 Doverphos HiPure 4 significantly improves color compared to unstabilized HIPS. It provides comparable performance to solid phosphites, such as Doverphos S-680, at lower cost.



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Certification No.
QSR-130

