

## TECHNICAL BULLETIN

# NOFIA HM5000 FOR UNSATURATED POLYESTER RESINS

### Overview

Nofia HM5000 is a phosphonate additive that is recommended for use in unsaturated polyester resin (UPET) formulations. It is soluble in styrene and fully dissolves into the UPET resin. It is available in either pellet or powder form, but the powder form is recommended as it dissolves much faster in styrene and or the resin.

### Feature and Benefits of Nofia HM5000:

- Soluble in reactive diluents, styrene, and methyl methacrylate
- Maintains transparency in the final product
- Achieves UL94 V-0 (3mm), ASTM E162 Class A
- Improves mechanical properties
- Enables > 50% reduction of typical ATH loading

### Applications:

- Transparent/translucent panels for building and construction applications.
- Composite sheet for transportation and building applications.

	Typical Properties Nofia HM5000
Appearance	Pellets or white powder
Phosphorus Content	10.5 wt%
Glass Transition Temp	90°C
Soluble in:	Styrene, Methyl methacrylate (MMA), Methyl ethyl ketone (MEK)

## Recommended Starting Formulations

### Formulations for Transparent Applications:

	A [phr]	B [phr]	C [phr]
Unsaturated Polyester Resin (64% solids) <sup>(1)</sup>	100	100	100
Nofia HM5000	71	59	53
Styrene	60	59	43
Resorcinol bis(diphenylphosphate) (RDP)	-	12	-
Triethyl Phosphate (TEP)	-	-	11
Luperox 224	5	5	5
12% Cobalt Octoate	0.4	0.4	0.4
N,N-Dimethylacetoacetamide (DMAA)	2	2	2
Nofia HM5000 content [wt%]	30	25	25
RDP or TEP content [wt%]	-	5	5
Total Phosphorus [wt%]	3.2	3.2	3.5
Total Styrene [wt%]	40	40	37
Gel Time at 25°C [s]	8	8	8
Viscosity [Pa.s]	1.1	0.6	0.8
UL94 Rating <sup>(2)</sup>	V0	V0	V0

<sup>1)</sup> All viscosity measurements: LV spindle #4, at 200rpm @ 22°C. Neat resin viscosity: 1.7 Pa.s.

<sup>2)</sup> Test specimen dimensions: 125mm x 13mm x 3 mm, cured at 50°C for 4 hours.

**Formulations for Transparent/Translucent Applications:**

	A [phr]	B [phr]	C [phr]
Unsaturated Polyester Resin (64% solids) <sup>(1)</sup>	100	100	100
Nofia HM5000	76	62	53
Styrene	84	78	43
Resorcinol bis(diphenylphosphate) (RDP)	-	16	13
Alumina Trihydrate (ATH)	67	47	54
Luperox 224	6.7	6.2	5.4
12% Cobalt Octoate	0.34	0.3	0.3
N,N-Dimethylacetoacetamide (DMAA)	2.4	2.0	2.0
Nofia HM5000 content [wt%]	22.5	20	15
RDP content [wt%]	-	5	5
ATH content [wt%]	20	15	20
Total Phosphorus [wt%]	2.6	2.6	2.1
Total Styrene [wt%]	35	36	33
Gel Time at 25°C [s]	8	8	8
Viscosity [Pa.s]	0.8	0.4	0.8
UL94 Rating <sup>(3)</sup>	V0	V0	V0

<sup>(1)</sup> All viscosity measurements: LV spindle #4, at 200rpm @ 22°C. Neat resin viscosity: 1.7 Pa.s.

<sup>(2)</sup> For example, Onyx® Elite-300 from JM Huber Corporation.

<sup>(3)</sup> Test specimen dimensions: 125mm x 13mm x 3 mm, cured at 50°C for 4 hours.

## Combining Nofia HM5000 with Low Filler Loadings (Opaque Applications):

	A [phr]	B [phr]
Unsaturated Polyester Resin (64% solids) <sup>(1)</sup>	100	100
Nofia HM5000	26.5	40
Styrene	53	67
Melamine Polyphosphate <sup>(2)</sup> (MPP)	26.5	-
Ammonium Polyphosphate <sup>(3)</sup> (AP)	-	13
Alumina Trihydrate (ATH)	-	40
Luperox 224	4	5
12% Cobalt Octoate	0.3	0.4
N,N-Dimethylacetoacetamide (DMAA)	1.5	2
Nofia HM5000 content [wt%]	12.5	15
MPP content [wt%]	12.5	-
AP content	-	5
ATH content [wt%]	-	15
Total Phosphorus [wt%]	2.9	3.2
Total Styrene [wt%]	42	39
Gel Time at 25°C [s]	8	8
Viscosity [Pa.s]	0.5	0.5
UL94 Rating <sup>(4)</sup>	V0	V0

<sup>(1)</sup> All viscosity measurements: LV spindle #4, at 200rpm @ 22°C. Neat resin viscosity: 1.7 Pa.s.

<sup>(2)</sup> For example, Melapur® MP200 from BASF.

<sup>(3)</sup> For example, Exolit® 420 from Clariant.

<sup>(4)</sup> Test specimen dimensions: 125mm x 13mm x 3 mm, cured at 50°C for 4 hours.

## General Recommendations:

- If supplied as pellets, grind Nofia HM5000 into powder before using. Ground material significantly reduces dissolution time in styrene or in the resin.
- Nofia HM5000 can be pre-dissolved in styrene at up to 60 wt% solids and stored for 6 months at 22°C.
- Nofia HM5000 can also be directly added to the resin containing additional styrene as needed and mixed until fully dissolved.
- Standard MEK peroxides may be used though gel times are typically longer than with Luperox 224.
- Recommended co-promoter DMAA provides best clarity and shortest gel time at 25°C.

If higher processing viscosities can be handled, levels of additional styrene can be reduced, which helps improve the flame retardant characteristics.

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