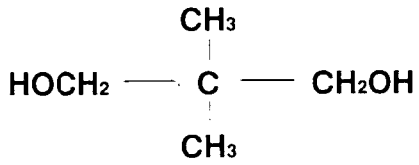
NEOPENTYL GLYCOL

INTRODUCTION

Neopentyl Glycol is a white powder. Its chemical structure is;



2,2 - dimethyl - 1,3 - propanediol

Neopentyl Glycol is a polyhydric alcohol which has two symmetrical primary hydroxyl groups and two methyl radicals arranged around a central carbon atom, and gives it a number of advantages over other glycols in the manufacture of synthetic resins. Unsaturated polyester resins derived from Neopentyl Glycol have excellent thermal stability, water and chemical resistance.

SPECIFICATIONS

	Flake Limits	90% aqueous solusion Limits
Appearance	White crystal	Clear liquid
Molten Color (Hazen)	20 max.	15 max.
Melting Point (°C)	126.0 min.	—
Ester (wt. %)	1.00 max.	0.9 max.
Aldehyde (wt. %)	0.50 max.	0.45 max.
Acidity Matter (wt. %)	0.040 max.	0.04 max.
Moisture (wt. %)	0.50 max.	9.5~10.5 max.
Rasin test	2 max.	—
Purity	—	89.5~90.5 max.

PACKING

Multiple paper bags of 25 kgs net weight. (Flake)

Flexible bags of 500 kgs net weight. (Flake)

Stainless tank container with heating coil (90% Aqueous solusion)

APPLICATIONS

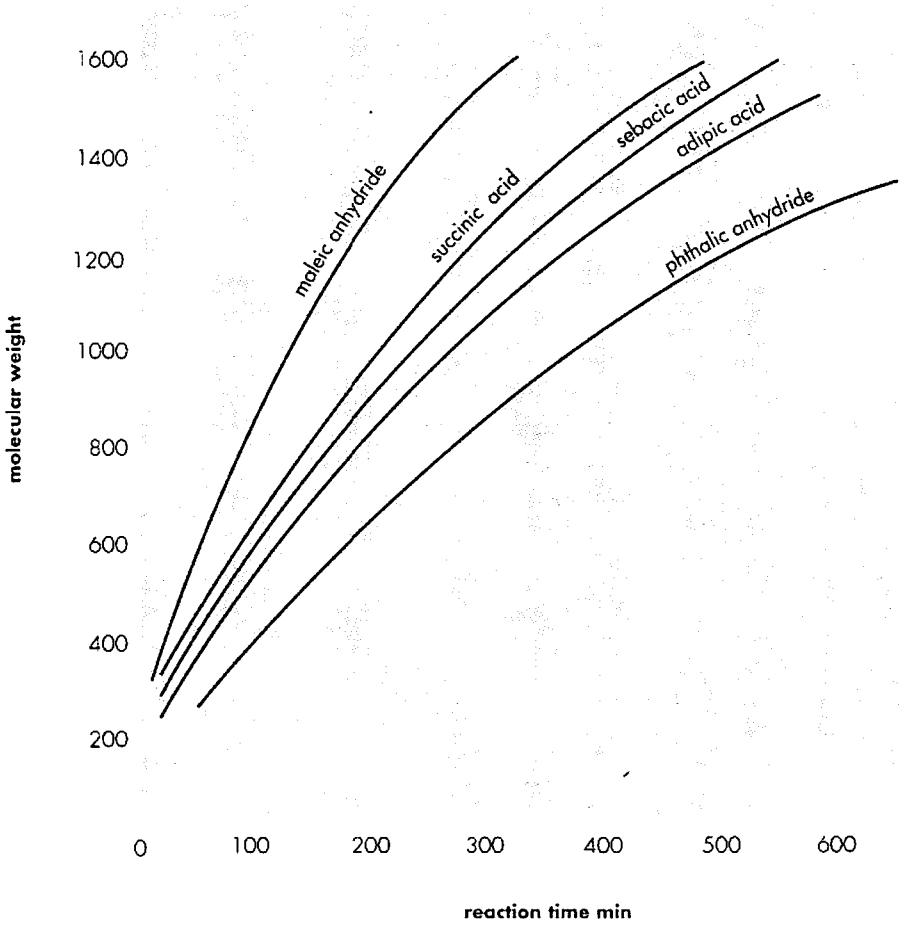
Neopentyl Glycol has become recognized as a valuable chemical intermediate. Neopentyl Glycol and its delivatives find application in unsaturated polyester resins; short-oil, medium-oil, oil-free, and water-soluble alkyds; monomeric and polymeric plasticizers; and other chemical intermediates.

Unsaturated polyester resins

Neopentyl Glycol-derived polyester resins are finding application in resinforced plastics.

Typical properties of certain diesters of Neopentyl Glycol are presented in Figure 1.

Figure 1



The following studies (Shown in Table 1-4) point out the very definite advantages of Neopentyl Glycol. Some of the advantages of Neopentyl Glycol are water and chemical resistance, better resin color and lower glycol losses.

Table 1 Charge

Unit Grams

Resin No.	GL-1 NPG	GL-2 EG	GL-3 PG	GL-4 NPG-PG	GL-5 NPG-EG	GL-6 NPG-IPA	GL-7 PG-IPA
Neopentyl glycol	328.1			175.0	196.8	328.1	
Ethylene glycol		260.7			117.3		
Propylene glycol			271.7	127.8			271.7
Phthalic anhydride	222.2	296.2	251.8	237.0	266.6		
Isophthalic acid						249.2	282.4
Maleic anhydride	147.1	196.1	166.7	156.9	176.5	147.1	166.7
Styrene monomer	428.9	291.8	419.3	426.0	296.7	428.1	419.0
Monomer content (%)	40	30	40	40	30	40	40
Inhibitor HQM (%)	0.01	0.02	0.02	0.02	0.02	0.02	0.02

HQM: hydroquinone monomethyl ether. NPG: neopentyl glycol.
EG: ethylene glycol. PG: propylene glycol. IPA: isophthalic acid.

Table 2 Conditions during preparation of NPG-IPA resins (GL-6 ... Table 1)

Charge	Moles	Grams
Isophthalic acid	1.50	249.2
Maleic anhydride	1.50	147.1
Neopentyl glycol	3.65	328.1
Styrene Monomer		428.9
HQM		0.2

Time	Reaction Temp °C.	Water Grams	Remarks
7 : 50			NPG, IPA charge, Heat on
9 : 10	180		
10 : 30	195	20	
14 : 00	202	53	
14 : 15	182		Acid No. 22.3
14 : 30	171		Maleic anhydride added
15 : 30	200	70	
18 : 30	202	81	Acid No. 18.3 Heat off
19 : 15	202	82	
20 : 40	115		Styrene monomer, HQM added

Table 3 Properties of unsaturated polyester resins

Properties	Resin No	GL-1	GL2	GL-3	GL-4	GL-5	GL-6	GL-7
Acid No.		32.5	38.3	47.6	37.0	33.5	18.3	49.9
Viscosity, poises 1.8		22.0	2.1	1.7	13.0	5.2	5.9	
Color, hazen No.20		100	40	50	50	60	–	
Specific gravity, solution		1,068	1,186	1,106	1,082	1,136	1,066	1,104
Specific gravity, casting resin		1,161	1,283	1,204	1,180	1,224	1,152	1,197
Shrinkage, %		8.0	7.6	8.1	8.3	7.2	7.5	7.8
Gel Test JIS K-6901	Gel time (minutes)	8	13	5	7	6	–	–
	Peak exotherm (°C)	135	177	170	158	150	–	–
	Cure Time (minutes)	32	19	17	22	15	–	–
Hardness Rockwell M scale		108	115	114	113	111	107.5	115.5
Impact strength, Izod notch ($kg \cdot cm/cm^2$)		1.35	1.46	1.34	1.40	1.39	1.40	1.29
Flexural strength (kg/mm^2)		11.2	10.6	11.0	10.9	10.6	12.1	11.3
Heat Distortion Temp (°C.) ASTMD 648-45T		84	86	97	86.5	81	93	113
Water absorption (%) 23°C. 24 hrs		0.12	0.16	0.21	0.16	0.15	0.13	0.19
Nitric acid resistance 10%, 23°C., 7 days, weight increase %		0.42	0.63	0.52	0.39	0.59	0.33	0.50
NaOH resistance * weight change %		0.13	–	-4.14	-0.24	–	0.12	-1.11

* NaOH 10% solution.
Phthalic anhydride type, 6 hrs after immersion at 95°C., dried 48 hrs at 50°C.
Isophthalic acid type, 8 hrs after immersion at 95°C., dried 48 hrs at 50°C.

Table 4 Relationship of light transmission with weather resistance (one of properties) in unsaturated polyester resins.

	Styrene monomer content (%)	Thickness (mm)	Light Transmission (%) Ultraviolet exposure time (hrs) 0	500	1,000
NPT	40	3.65	90.0	86.3	84.2
NPG + PG	40	3.65	89.2	85.8	84.1
NPG	30	3.65	89.6	85.4	81.7
NPG + EG	30	3.65	87.3	84.8	81.3
PG	30	3.55	88.8	84.3	80.7
EG	30	3.85	87.7	82.6	79.0

Note: glycol/dibasic acid = 1.05
maleic anhydride/phthalic anhydride = 1.00
cobalt nophthenate 0.07%

Short oil alkyd resins

Neopentyl Glycol is used with pentaerythriol as short oil alkyd resins. This resin type is frequently used with amino resins in backed-on coatings, and has excellent gloss retention and water resistance. The formulas and properties of the resultant alkyds are given in Table 5. Solvent cook procedure is employed.

Table 5 The formulas and properties of the alkyds.

	Alkyd		
	G-1 (G-PAA)	**N-2 (NPG/PE-PAA)**	**T-3 TMP-PAA**
Base composition (%)			
Coconut oil fatty acids	17.5	17.4	17.4
Soy bean oil fatty acids	11.5	11.5	11.5
Phthalic anhydride (PAA)	43.2	37.4	36.1
Glycerine (G)	27.8		
Neopentyl glycol (NPG)		18.5	
Pentaerythritol (PE)		15.2	
Trimethylolpropane (TMP)			35.0
Total	100.0	100.0	100.0
Properties			
% Excess OH	28	28	28
Polyol functionality	3	2.77	3
Acid number (solids)	12.9	10.3	10.2
Non volatile matter, %	59.7	61.0	59.4
Viscosity (Gardner)	Z2 ~ Z3	O	Q
Color (Gardner)	4	3	3 ~ 4
Reaction temperature, °C.	180 ~ 230	180 ~ 220	180 ~ 230
Reaction time, hrs	3.2	5	4.8

Table 6 shows the data of the amino-alkyds in white enamels.
Enamels formula are as follows.

Pigment TiO_2 (Rutile)	25wt%
Alkyd resins (60% N.V.)	46
Melamine resins (15% N.V.)	25
Xylol	4
Total	100

Pigment/Resin solids 1/1.6
Alkyd/Melamine resins 70/30
Reduced to xylol for spray
Dry film 25~35 μ
Baking temperature, 120°C., 140°C., 160°C., 20 min.

Table 6 Evaluation of alkyds in enamels.

	G-1	N-2	T-3
Properties after 20 min, 120°C.			
Sward hardness	63	60	63
Impact resistance, cm[a]	10	20	10
Bending test, 3 mmø. 180°	Good	Good	Good
Solvent resistance, toluene 20°C.	30 min	30 min	30 min
Humidity resistance, 50°C. 95-100% RH.[b]	60%	40%	100%
Hot water resistance, 99°C.[c]	20 min	30 min	20 min
Gloss, not rubbed, 60°	84	92	89
Properties after 20 min, 140°C			
Sward hardness	66	63	66
Impact resistance, cm[a]	10	20	10
Bending test, 3mmø. 180°	Fail	G00d	Fail
Solvent resistance, toluene 20°C	60 min	60 min	60 min
Humidity resistance 50°C. 95-100% RH[b]	40%	20%	60%
Gloss, not rubbed, 60°	80	88	85
Properties after 20 min, 140°C			
Sward hardness	69	66	72
Impact resistance, cm[a]	10	15	10
Bending test, 3mmø. 180°	Fail	Fail	Fail
Solvent resistance, toluene 20°C	>60 min	>60 min	>60 min
Humidity resistance 50°C. 90-100% RH[b]	40%	20%	60%
Gloss, not rubbed, 60°	75	85	81
Gloss decrease between 120°C. and 160°C.	10.7%	7.6%	9.0%

[a] 500gr. 3/16" *Du Pont* method.
[b] Visual examination. Blisters area %
[c] Time to blisters occur.

As shown by these data, Neopentyl glycol-Pentaerythritol type alkyd resins are almost equal to trimethylolpropane type alkyd resins.

Neopentyl glycol type alkyd resins offer some advantages in short oil alkyd resins. Low viscosity, pale resin color, excellent gloss retention, improved water and chemical resistance.