

BISPHENOL A FREE RESIN OPTIONS FOR INKS AND OVERPRINT VARNISHES

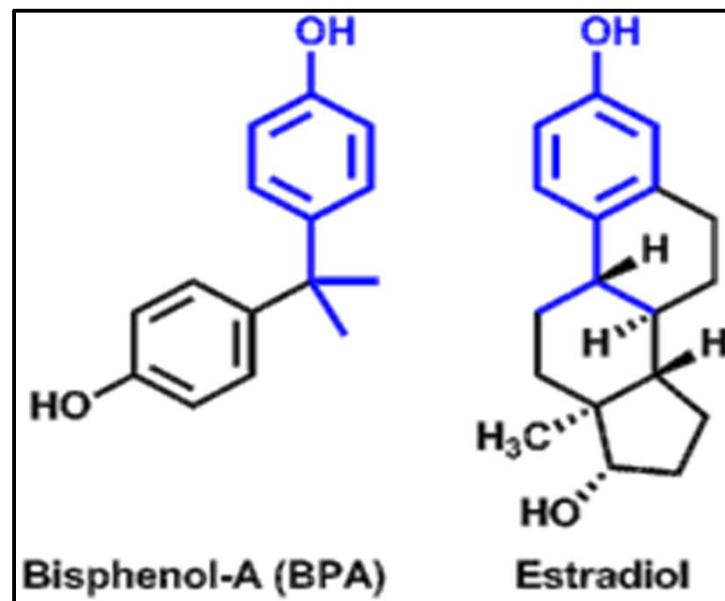


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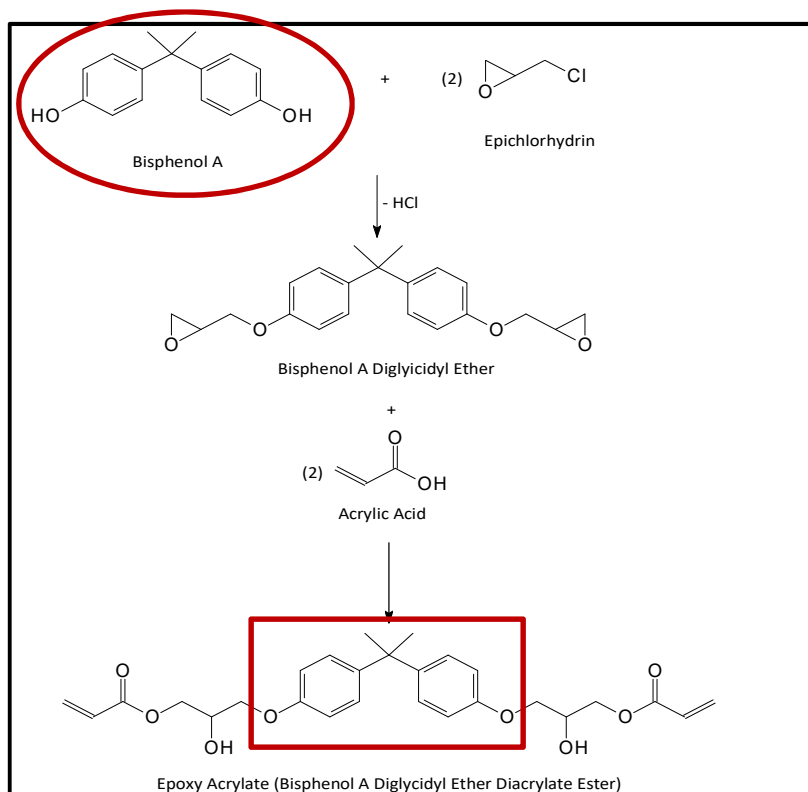
BISPHENOL A: AN ESTROGEN MIMIC



2018 Nestle Guidance Note: “Bisphenol A (BPA) and materials manufactured from or incorporating BPA in reacted form as part of the chemical structure must not be used where safe suitable alternatives exist. Any BPA residue/cross contamination must not be detected in food product from ink above 0.1 ppb. ”

Brand owners do not want BPA in their products

EPOXY ACRYLATE: DERIVED FROM BISPHENOL A



Structural Properties	Uncured & Cured Properties
Aromatic group	• Hardness and high gloss
	• High tensile strength & modulus
	• Brittle
Hydroxyl group	• High Tg
	• High viscosity
Low MW	• Steep viscosity-temp. curve
Double bonds	
	• Fast cure

- Bisphenol A is a residual of raw materials for epoxy acrylate
- Fast cure speed, high gloss, and low cost make epoxy acrylates a good choice for OPVs

EPOXY ACRYLATE: BASIC OPV FORMULATION

Component	Parts
Epoxy Acrylate	15
TMPTA (trimethylolpropane triacrylate)	10
TMPEOTA (ethoxylated trimethylolpropane triacrylate)	60
Photoinitiator (benzophenone)	5
Amine synergist	6
Photoinitiator (2-Hydroxy-2-methyl-1-phenyl-propan-1-one)	4
Silicone Acrylate	0.5
Viscosity 25°C (cP)	300-500

OPV properties:

- Surface cure, gloss, scratch resistance, chemical resistance and etc.

NESTLE LIST REQUIREMENTS AND RESTRICTIONS

Swiss ordinance list

- Specific Migration Limits (SMLs) from Swiss List must be met
 - Part A: based on toxicological evaluations
 - Part B: not yet evaluated; defaults to 10 ppb

Nestle guidance note

- No CMRs (carcinogens, mutagens, reprotoxins)
- No materials containing or derived from BPA if there are any alternatives available
- Bans the use of several photoinitiators (Benzophenone and ITX)
- Prohibits the use of some monomers (BDDA and DEGDA)
- Restricts the use of other monomers (“minimize”)(TMPTA and HDDA)

Higher functionality (≥ 3) and higher MW materials (> 1000 g/mol)

- can help limit migrating species

Formulating a Nestle compliant ink or OPV requires a good understanding of the regulations and multiple material options

STANDARD, LOW MIGRATION, AND LEO PRODUCTS

	Standard	Low Migration	LEO (Full GMP)
Raw Material Selection	Technical Performance	Technical Performance	Technical Performance
	Cost	Cost	Cost
		No CMR	No CMR
			Purity
Production	ISO 9001	ISO 9001	ISO 9001
		Purification Step	Purification Step
		Measures to avoid Cross Contamination	GMP
QC	Physico-Chemical	Physico-Chemical	Physico-Chemical
			Impurities
			GC-MS

- Easier to formulate for food packaging with LM or LEO products

OLIGOMER CLASSES AS REPLACEMENTS FOR BPA EPOXY ACRYLATES

Other Epoxy Acrylates

- Bis F Based Epoxy Acrylates
- Acrylated Epoxidized Oils (pigment wetting)
- Acrylated Epoxy Novolacs
- Acrylated Aliphatic Epoxies

Amino Acrylates

- Fast Cure Speed
- Lower Viscosity
- Not Suitable for Litho Inks

Polyester/Polyether Acrylates

- Lower Resistance Properties
- Lower Viscosity
- Higher Cost
- Pigment Wetting

Waterbased EC PUDs

- High MW
- Multifunctional
- Very Low Viscosity

Urethane Acrylates

- Excellent Resistance Properties
- High Cost
- Not Suitable for Inks

No obvious “drop-in” replacement for epoxy acrylates

BPA FREE PEAs AS REPLACEMENTS FOR EPOXY ACRYLATE

Product	Description	Viscosity cP	Functionality	Tensile strength psi	Young's modulus psi	Elongation at break %	Tg °C
EBECRYL 3720	BPA epoxy acrylate	1500-2500 (65°C)	2	11000	204000	8	67
EBECRYL 810	Polyester acrylate	400-600 (25°)	4	6000	/	6	31
EBECRYL 5781 	Polyester acrylate	450 (25°C)	2	1740	456750	< 1	162
EBECRYL 5850 	Polyester acrylate	4000 – 8000 (25°C)	2	3625	420500	1	115

BPA FREE PEAs AS REPLACEMENTS FOR EPOXY ACRYLATE

Components	EB3720	EB810	EB5781	EB5850
EBECRYL 3720	20			
EBECRYL 810		22		
EBECRYL 5781			50	
EBECRYL 5850				30
TMPEOTA (3f)	60	38	15	50
EBECRYL 40 (4f)			15	
EBECRYL 895(5.5f)		10		
EBECRYL LEO 10101 (PI; SCR)	20	20	20	20
Total	100	100	100	100
Viscosity at 25°C(cP)	589	557	556	422
~5 µm on uncoated Leneta chart, cured with 1 x 400 wpi Hg lamp				
Max Surface Cure Speed (fpm)	100	100	200	100
20° Gloss (3 x 100 fpm)	89	84	87	86
MEK DR (3 x 100 fpm)	>200	>200	>200	>200
Scratch Resistance (3 x 100 fpm; 6-layer cheese cloth, 1 kg hammer)	>100	>100	>100	>100

- PEAs generally require less monomer dilution, resulting in higher costs
- EBECRYL 5781 has exceptional cure speed

BPA FREE AMINE POLYETHER ACRYLATES AS REPLACEMENTS FOR EPOXY ACRYLATE

Product	Description	Viscosity cP	Functionality	Tensile strength psi	Young's modulus psi	Elongation at break %	Tg °C
EBECRYL 3720	BPA epoxy acrylate	1500-2500 (65°C)	2	11000	204000	8	67
EBECRYL 80	Amine modified polyether acrylate	3000 (25°C)	4	/	/	/	/
EBECRYL 81	Amine modified polyether acrylate	80 – 120 (25°C)	2.5	790	16000	8	-18
EBECRYL 83	Amine modified polyether acrylate	450 – 550 (25°C)	3.5	2000	70000	13	6

BPA FREE AMINE POLYETHER ACRYLATES AS REPLACEMENTS FOR EPOXY ACRYLATE

Components	EB3720	EB80	EB81	EB83
EBECRYL 3720	20			
EBECRYL 80		20		
EBECRYL 81			25	
EBECRYL 83				35
TMPEOTA (3f)	60	50	25	35
EBECRYL 895 (5.5f)		10	30	10
EBECRYL LEO 10101 (PI; SCR)	20	20	20	20
Total	100	100	100	100
Viscosity at 25°C(cP)	589	497	585	468
~5 µm on uncoated Leneta chart, cured with 1 x 400 wpi Hg lamp				
Max Surface Cure Speed (fpm)	100	100	125	100
20° Gloss (3 x 100 fpm)	89	88	85	85
MEK DR (3 x 100 fpm)	>200	>200	>200	>200
Scratch Resistance (3 x 100 fpm; 6-layer cheese cloth, 1 kg hammer)	>100	>100	>100	>100

Amine polyether acrylates require high func. monomer (EB 895) to obtain cure speed

BPA FREE DROP-IN REPLACEMENT FOR DILUTED EPOXY ACRYLATE

Product	Description	Viscosity at 25°C cP	Functionality	Tensile strength psi	Young's modulus psi	Elongation at break %	Tg °C
EBECRYL 3720-TM40	Diluted epoxy acrylate	5500 - 8500	2	8300	/	4	80
EBECRYL 876	Polyester acrylate	6500-10500	2.2	2900	75600	16	36

- EBECRYL 876 is Nestle/Swiss compliant

BPA FREE DROP-IN REPLACEMENT FOR DILUTED EPOXY ACRYLATE

Components	EB 3720-TM40	EB 876
EBECRYL 3720-TM40	25	
EBECRYL 876		25
TMPEOTA (3f)	55	55
EBECRYL LEO 10101 (PI; GMP Self Curing Resin)	20	20
Total	100	100
Viscosity at 25 °C (cP)	492	451
~5 µm on uncoated Leneta chart, cured with 1 x 400 wpi Hg lamp		
Max Surface Cure Speed (fpm)	100	100
20° Gloss (3 x 100 fpm)	86	86
MEK DR (3 x 100 fpm)	>200	>200
Scratch Resistance (3 x 100 fpm; 6-layer cheese cloth, 1 kg hammer)	>100	>100

EBECRYL 876 is a drop in for diluted epoxy acrylates: similar properties and cost

REPLACEMENT of BPA CONTAINING MONOMER (EB150)

Product	Description	Viscosity at 25°C cP	Functionality
EBECRYL 150	BPA ethoxylate diacrylate monomer	1400	2
EBECRYL 833	Polyester acrylate	1300	5

REPLACEMENT of BPA CONTAINING MONOMER (EB150)

Component	EB 150	EB 833
EBECRYL 150	12	
EBECRYL 833		12
EBECRYL 895	10	10
EBECRYL 40	58	58
EBECRYL LEO10101	20	20
Total	100	100
Viscosity at 25°C (cP)	579	562
~5 µm on uncoated Leneta chart , 1x400 wpi Hg lamp		
Max. speed for surface cure(fpm)	100	100
Gloss at 20°(3 x100 fpm)	88	87
MEK DR (3 x 100 fpm)	>200	>200
Scratch resistance (3x 100 fpm, 6-layer cheese cloth, 1 kg hammer)	>100	>100

BASIC OPV FORMULATION FOR FOOD PACKAGING BASED ON LM MATERIALS

Component	Description	Parts
EBECRYL 85	LM amine modified polyether acrylate (3.6 f)	50
EBECRYL 45	LM diluting acrylate (4 f)	28
EBECRYL 895	LM dipentaerythritol penta/hexa-acrylate (DPHA; 5.5 f)	10
EBECRYL P39	LM polymeric benzophenone derivative	12

OPVs for food packaging can be formulated with low migration materials

LM FLEXO INK STARTING POINT FORMULATION

Component	Parts
PIGMENT PASTE	
EBECRYL 820 (LM polyester hexaacrylate)	50 – 70
Dispersing agent	4 - 10
Pigment	30 – 40
Stabilizer	0.1
INK	
Pigment paste	35 – 45
EBECRYL 85 (LM amine modified polyether acrylate (3.6 f))	0 - 25
EBECRYL LEO 10501 (3 f diluting acrylate)	15 - 35
EBECRYL LEO 10101 (PI; SCR)	20 - 30

LM LITHO INK STARTING POINT FORMULATION

Component	Parts
PIGMENT PASTE	
EBECRYL LEO 10801 (hexafunctional polyester acrylate)	35
Filler	4 - 8
Pigment	14 - 20
Stabilizer	0.1
INK	
Pigment Paste	70 - 75
EBECRYL 895 (LM DPHA; 5.5 f)	20
Photoinitiator Blend	8 - 10

Litho inks can be designed for food packaging applications

CONCLUSIONS

- **Polyester acrylates** or **amino acrylates** can be BPA free replacement for epoxy acrylates but require reformulation. Similar performance are achieved.
- **EBECRYL 876** has been developed as a BPA free “drop-in” replacement for EBECRYL 3720-TM40 (epoxy acrylate diluted in 40% TMPTA). In OPV formulations, similar properties and cost are obtained.
- BPA free monomer is also available.
- By choosing **LM** or **LEO** grade products, one can develop OPV, flexo and litho ink formulations for food packaging applications.

THANK YOU FOR YOUR ATTENTION!

Questions?

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