UV CURABLE RESINS FOR PULTRUSION

Cure With the Power of Light

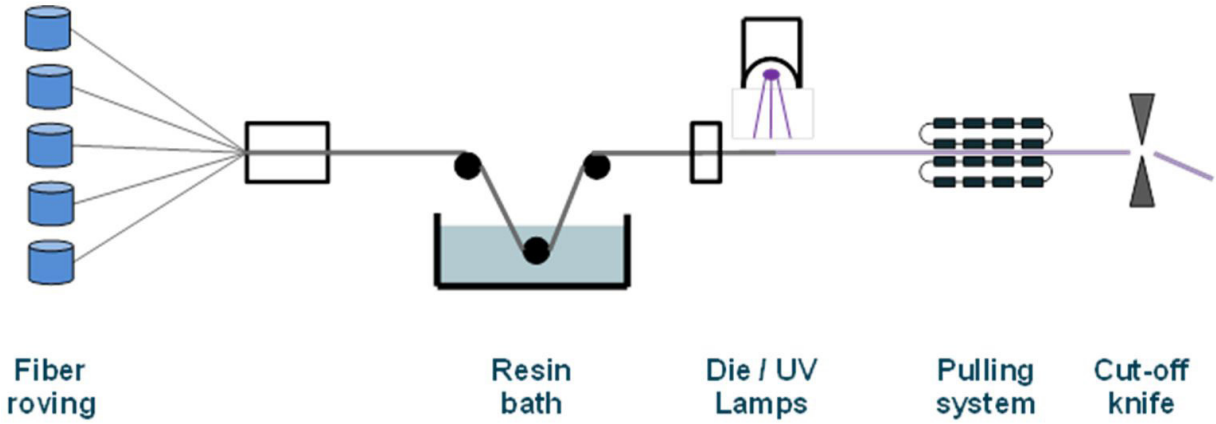
allnex
The Coating Resins Company

- ✓ Styrene-free
- ✓ No pot life for reduced cleaning time and waste
- ✓ Fast UV curing process for high line speed
- ✓ Reduced energy consumption during curing
- ✓ Possibility of tailoring material properties to requirements of diverse applications

UV Curing Technology

(LED) UV curing is a well-established technology in markets where easy processing, cure speed and material performance go hand in hand. UV curing processes use a reactive, usually 1K and solvent-free, liquid material which hardens upon exposure to UV light. This polymerization, depending on thickness of the laminate and material type, is typically completed in a couple of seconds.

The installation of a UV curing process proves effective for optimizing the manufacturing process of GRP composites. The fast curing not only allows to increase output per line, it also reduces any material variations that typically occur while the resin is uncured. UV-curable materials are 100% reactive and non-volatile. Styrene, which is currently the subject of a governmental risk assessment evaluation, is not used in this technology. Being one-component systems, the liquid has virtually unlimited pot life, eliminating the need for cleaning and reducing waste. Capturing these benefits, and ultimately capturing a total cost saving, can be done effectively for pultruded parts, where UV light can reach all areas of the relatively simple geometries.



Speed up your composite manufacturing processes and ensure quality via a highly controlled and effective curing process.

Comparison of thermal versus UV filament winding

Thermal curing	UV curing
Fiber Type	
Glass fiber / Carbon fiber	Glass fiber
Curing Installation	
Production heating chamber, with intensive capital and floor space requirements	UV installation, more effective in cost and floor space requirements
Curing Time	
Minutes	Seconds
Pultruding	
Same pultrusion process	
Emissions (Styrene)	
Ecological & regulatory concerns (Incineration) Installation	Very low to no VOC
Cleaning of Processing equipment	
0,5-1h / production shift	Virtually unlimited open time (no pot life) No regular cleaning necessary
Resin Waste	
Excess in resin bath is to be removed (= disposed of)	Excess in resin bath can be re-used

Material options

Materials used in this technology are very versatile in nature and based on (meth)acrylate functionality.

Depending on the desired performance, different chemistries can be selected:

- **Polyester acrylates** exhibit good wetting and adhesion properties. Diluting unsaturated polyesters with reactive diluents can be an elegant approach to eliminate styrene.
- **Epoxy acrylates** combine good thoughness with excellent chemical resistance, with mechanical properties according to the type of modification. These resins are akin to the well known vinylester types.
- **Urethane acrylates** cover a broad range of properties joining for example hardness and resistance to failure.
- **The viscosity of UV-curable resins** is often adjusted using non-volatile reactive diluents which will be incorporated in the network and will contribute to the properties of the end material.

Please reach out to your allnex representative to support you with the development of your formulation and to help you explore the broad possibilities of UV cured composites.

EBECRYL® resins

allnex EBECRYL product line consists of a broad range of (meth)acrylates which are used to formulate into UV, EB and/or peroxide curable liquid products. These resins and monomers can be blended with a photoinitiator and/or peroxide to trigger radical curing reactions caused by irradiation (UV and EB) or heat (peroxide).

The table on the next page provides a non-comprehensive list of acrylates that can be used to fine tune formulations to your specific requirements.

	Tough	High Tg	Strong
Viscosity (mPa s, 23°C)	450	490	500
Tg (°C)	89	157	89
Flexural Modulus (23°C, GPa)	3.3	2.1	3.4
Flexural Strain (23°C, %)	9	1	4
Flexural Strength (23°C, MPa)	90	22	110

Viscosity, glass transition temperature (T(tan δmax) determined with dynamic mechanical analysis) and flexural properties of three typical UV cured systems.

Additive name	Dilution	Viscosity (25°C)	Tg-DMA	Young's Modulus (23°C)	Tensile Strength (23°C)	Elongation at break (23°C)	Remarks
		mPa.s	°C	MPa	MPa	%	
Epoxy Acrylates							
EBECRYL 600		3,000 (60°C)	130	2,200	67	4	Base resin, high Tg
EBECRYL 3300	35 DPGDA	1,100	80	2,400	68	5	Low viscosity, strong
EBECRYL 3416	35 TPGDA	18,000	90	2,100	37	3	High crosslinking
EBECRYL 3639	30 DPGDA	16,500	49	774	19	34	Good flexibility
EBECRYL 3700		2,300 (60°C)	82	2,040	19	1	Base resin, high reactivity
EBECRYL 3708		3,500 (60°C)	24	22	4	86	Excellent flexibility
(Unsaturated) Polyester Acrylates							
EBECRYL 4175	25 DPGDA	15,000	13	53	3	11	Styrene-free UP
EBECRYL 4266		6,000	15		15	8	Tough but flexible, good reactivity
EBECRYL 872		7,000	58	1,100	29	14	Based on recycled PET
EBECRYL 5850		5,000	115	2,910	25	1	56% renewable content, high reactivity
Urethane Acrylates							
EBECRYL 204	25 HDDA	17,000	64	1,480	38	8	Aromatic structure, hard and flexible
EBECRYL 265	25 TPGDA	35,000	67	870	27	12	Aromatic structure, hard and flexible
EBECRYL 1258	20 HPMA	7,100 (60°C)	79	860	33	66	Aliphatic methacrylate structure, combines toughness with good Tg
EBECRYL 1290		2,000 (60°C)	132	2,830	41	2	Aliphatic structure, highly reactive, strong
EBECRYL 4201		7,000	31	82	8.4	16	Aliphatic structure, combines flexibility with toughness
Reactive Diluting Monomers							
IBOA		9	86	Not available	Not available	Not available	Monofunctional
DPGDA		10	115	2,030	48	4	Di-functional
HDDA		5		1,700	35	2	Di-functional
TPGDA		3	80	1,550	38	5	Di-functional
EBECRYL 130		160	157	2,880	50	2	Di-functional, high Tg
EBECRYL 160		3	117	1,920	17	1	Tri-functional

allnex – your development partner

To support customers developing their filament winding process with UV technology, allnex is offering formulation guidance to develop a resin matching specific applications' requirements.

These resins only react upon exposure to UV lamps and immediately reach the final properties upon using the correct UV intensity and dose. These mechanical properties can be adjusted by choosing different resins and reactive dilutions.

Further information

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