

UV/EB CURABLE RESINS

Dual Cure Product Guide - Automotive Interior - Worldwide



About allnex



Table of Contents

- Introduction 4
- Applications..... 6
- Performance keys..... 7
- Urethane acrylates for dual cure..... 8
- Regional availability 9
- Testing specifications & typical substrates 12

Facts & Figures

- Global company with over €2.1 billion in sales
- Broad Technology portfolio: liquid coating resins, energy curable resins, powder coating resins, crosslinkers and additives, composites and construction materials
- Approximately 4000 employees
- Customers in more than 100 countries
- 33 manufacturing facilities
- 23 research and technology centers
- 5 ventures
- Extensive range of solutions for key coating segments: automotive, industrial, packaging coating and inks, protective, industrial plastics and specialty architectural

With manufacturing, R&D and technical facilities located throughout Europe, North America, Asia Pacific and Latin America, allnex offers global and reliable supply of resins and additives combined with local, responsive customer support.

Introduction

UV/EB Curable Resins (Radcure)

Ultraviolet (UV) and electron beam (EB) energy-cured coatings have excellent appearance, durability, and little or no VOC emissions, while enabling increased productivity and lower overall costs per cured part. allnex is the pioneer in UV resin / Radcure technology and applications development. We are the world's leading producer of energy-curable resins for the industrial and plastic coatings as well as the packaging coatings and inks applications, driving market growth and end-user acceptance of this unique technology.

Our customers have come to rely on our broad range of innovative EBECRYL® and UCECOAT® resins including:

- 100% solids UV curable resins and oligomers
- Waterborne UV curable resins
- UV curable resins derived from renewable raw materials
- A wide range of urethane acrylates, polyester acrylates, amino acrylates and epoxy acrylates
- Specially-designed photo initiators and additives that enhance the performance of energy-cured coatings.

UV Curing for Automotive Applications

With the proliferation of plastics in automotive interior applications and ever more stringent OEM requirements, automakers and tiered suppliers are turning to energy-curable coatings that are the only technology currently available that offers performance, robustness, specific haptic and aesthetic effects, as well as improved productivity, durability, and chemical resistance.

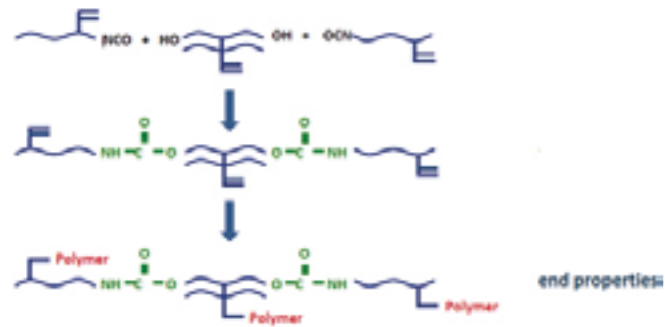
- **PERFORMANCE:** coating suppliers will be able to achieve good weathering and great scratch, abrasion, stain, and chemical resistance, compared to those achieved with other coating technologies.
- **PRODUCTIVITY:** the almost instantaneous cure brought by UV/EB technology allows for increased efficiency and better productivity, which in turn reduce manufacturing costs and coating rejects.
- **SUSTAINABILITY:** substantial energy savings can be achieved thanks to faster curing time, and there is little to no Volatile Organic Compounds (VOC) emissions. On top of this, using plastics in automotive interior also helps lower the overall weight of the vehicle, resulting in a lower carbon footprint, improved energy and fossil fuel consumption, and much reduced CO2 emissions.
- **VERSATILITY:** Due to the low heat impact of the coating process, UV/EB coatings can be applied to a host of thin, pliable, or heat sensitive plastic substrates and formulated to have direct adhesion thus eliminating the need for primer.



Applications

Dual cure technology

The significant advantage of dual cure systems is that thermal curing can help when curing non-planar parts, while UV curing provides excellent scratch and chemical resistance, as well as short curing times which help to minimize dirt on the parts' surface. It should be noted that UV curing of non-planar (3D) parts is known to be challenging from an equipment perspective, as the curing layout needs to be custom-made when dealing with very complex 3D structures. This makes dual cure technology all the more valuable in the market. The combination of hydroxy functional acrylates with isocyanate (NCO)-bearing acrylates allows formulators to have the best of both worlds (thermal and energy-curable kinetics)*. The implementation of such an additional reaction can create a coating with improved weatherability and similar hardness to a traditional hardcoat, but at a lower acrylate crosslinking density with greater ductility. Another benefit of employing this chemistry is overcoming the line of sight limitations (shadow cure) with energy-curable chemistry because coatings not exposed to the UV light do not cure. In this case, crosslinking can take place through a two-component curing process. Dual cure technology also offers process improvements typically not seen with UV/EB coatings. After the thermal process, dual cure coatings can be tack-free and non-blocking. At this particular stage, the coated substrates can be formed, cut, or molded into a variety of shapes or sizes prior to exposure to UV light.



* SB UV 2K Principle (OH acrylate -NCO reaction)

Dual cure technology can be used in two main applications when it comes to automotive interior.

- **Automotive Interior Spray** (consoles, dashboards, seats, door panels, instrument panels and more)



- **Automotive Interior Film** (IMD, thermoforming of parts)



Performance Keys

•	•	••	•••	••••	•••••
Reactivity	Poor	Good	Very good	Excellent	Outstanding
Hardness	Poor	Good	Very good	Excellent	Outstanding
Flexibility	Poor	Good	Very good	Excellent	Outstanding
Chemical resistance	Poor	Good	Very good	Excellent	Outstanding
Adhesion	Poor	Good	Very good	Excellent	Outstanding

Definitions

Color

Maximum values in:

- Gardner scale when no units are specified – range from light yellow to red defined by the chromaticities of glass standards numbered from 1 for the lightest to 18 for the darkest
- Pt/Co or APHA-Hazen (A) scale – defined by specified dilutions of a platinum-cobalt stock solution, ranging from 1 at the light end of the scale to 500 at the darkest
- Iodine scale - defined by specified dilutions of an iodine solution, ranging from 1 for the lightest colour to 500 for the darkest

Density

Expressed in g/cm³

Dilution

Parts of diluent in 100 parts of product

Functionality

Theoretical value, expressed as number of double bonds per molecule

Molecular weight (Mn)

Theoretical molecular weight

Viscosity

Viscosity in milliPascal-seconds (mPa·s) at the specified temperature.

Note: mPa·s = centiPoise (cP)

Abbreviations

EtAc

Ethyl acetate

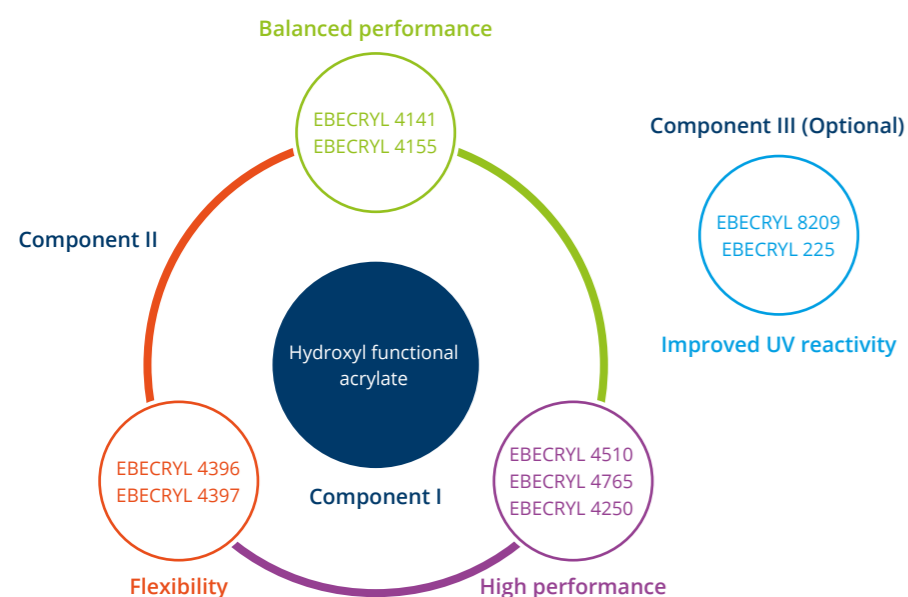
BuAc

Butyl acetate

Urethane acrylates for Dual Cure

Products	Description	Dilution	Functionality Double Bonds	Functionality NCO Groups	Viscosity at 25°C approx. mPas	NCO content % on supply form	Color	Density	Molecular Weight (Mn)	Properties	Reactivity	Hardness	Flexibility	Chemical resistance	Adhesion
Component I															
Hydroxyl functional acrylate	Acrylic acrylate (tack-free before UV cure)	45 BuAc			3000		<2	1.07							
Component II															
EBECRYL® 4141	Aliphatic urethane acrylate		2	2	10000	12	150 A	1.13	700	Hard. For dual cure technology; improves adhesion and coin test.	●	●●●●	●	●●●●	●●●
EBECRYL 4155 (NEW)	Aliphatic urethane acrylate				5500	9		1.1		Flexible. For dual cure technology; improves adhesion on critical substrates and electrical insulating properties	●	●●	●●●●	●●●	●●●●●
EBECRYL 4250	Aliphatic urethane acrylate		3.4	1.4	2000	5	100 A	1.10	1100	Hard. For dual cure technology; improves adhesion and coin test; suitable for one component moisture curing UV-coatings; high UV-reactivity.	●●●	●●	●●●	●●	●●●●
EBECRYL 4396	Aliphatic urethane acrylate		1	2.2	14000	7.5	150 A	1.12	1200	Flexible For dual cure technology; improves adhesion, coin test and flexibility.	●	●●	●●●●	●●●	●●●●
EBECRYL 4397	Aliphatic urethane acrylate		1	2.2	12000	6.8	50A	1.1	1400	Low Tg and flexible. For dual cure technology; improves adhesion, coin test and flexibility.	●	●●	●●●●●	●●●	●●●●
EBECRYL 4510	Aliphatic urethane acrylate	10 BuAc	2	2	17000	7	100 A	1.16	1200	Hard. For dual cure technology; improves adhesion, coin test; high UV reactivity.	●●●●	●●●●	●	●●●●	●●●
EBECRYL 4765	Aliphatic urethane acrylate	45 EtAc	2	2.5	125	4.3	100 A	1.04	2300	Hard. For dual cure technology; in combination with hydroxyl-bearing resins suitable for precoated formable films.	●●●	●●●	●●	●●●●	●●●
Component III															
EBECRYL 8209	Aliphatic urethane acrylate		4		4000		2	1.12	600	OH-functionalized urethane acrylate for dual cure application.	●●●●	●●●●	●	●●●●	●●●
EBECRYL 225	Aliphatic urethane acrylate				75500		100 A	1.19	1200	High functionality resins with outstanding hardness; excellent scratch and abrasion resistance including steel wool.	●●●●	●●●●●	●	●●●●	●●●●

Sn-free *EBECRYL UV curable resins and diluting oligomers



Dual Cure product matrix

Products	Regional Availability NORTH AMERICA	EMEA	CHINA	JAPAN	SOUTH KOREA	TAIWAN
Component I						
Hydroxyl functional acrylate	Yes	Yes	Yes		Yes	Yes
Component II						
EBECRYL® 4141		Yes	Yes, for specific allnex notification units	Yes		
EBECRYL 4155	Yes	Yes	Yes, for specific allnex notification units	Yes	Yes	Yes
EBECRYL 4250	Yes	Yes	Yes, for specific allnex notification units	Yes		Yes
EBECRYL 4396	Yes	Yes	Yes	Yes		Yes
EBECRYL 4397	Yes	Yes	No, but OK for specific notification units	Yes		
EBECRYL 4510	Yes	Yes	Yes	Yes	Yes	Yes
EBECRYL 4765		Yes	No, but OK for specific notification units	No, but OK for specific notification units		
Component III						
EBECRYL 8209	Yes	Yes	Yes	Yes		Yes
EBECRYL 225	Yes	Yes	Yes	Yes		Yes

Testing Specifications & Typical Substrates

VW testing specifications are broadly used as performance benchmark when it comes to OEM testing methods for automotive interior applications.

Testing specification	Criteria
Cross hatch adhesion (CHA)	0 = no adhesion; 5 = full adhesion
Erichsen scratch/adhesion (PEN 318)	20 N
Abrasion resistance (Taber haze - CS10F 500g)	Haziness value: the lower, the better
Sun lotion (VW PV3964: 24 hours at 80°C)	<ul style="list-style-type: none"> CHA = 5 Erichsen = 20 N Appearance (film attacked: yes or no) Gloss retention
Hand cream (VW PV3964: 24 hours at 80°C)	<ul style="list-style-type: none"> CHA = 5 Erichsen = 20 N Appearance (film attacked: yes or no) Gloss retention
Humidity resistance (VW TL 226: 72h at 90°C and 95 % RH)	<ul style="list-style-type: none"> CHA = 5 Appearance (no haze)

Type of substrate	Grade
ABS	<ul style="list-style-type: none"> ABS Magnum 3616
ABS/PC	<ul style="list-style-type: none"> Bayblend T65 Bayblend T65XF Bayblend T85 Bayblend T85XF
PC	<ul style="list-style-type: none"> Lexan 9030 Lexan 8010 sheet

Disclaimer: allnex Group companies ('allnex') decline any liability with respect to the use made by anyone of the information contained herein. The information contained herein represents allnex's best knowledge thereon without constituting any express or implied guarantee or warranty of any kind (including, but not limited to, regarding the accuracy, the completeness or relevance of the data set out herein). Nothing contained herein shall be construed as conferring any license or right under any patent or other intellectual property rights of allnex or of any third party. The information relating to the products is given for information purposes only. No guarantee or warranty is provided that the product and/or information is adapted for any specific use, performance or result and that product and/or information do not infringe any allnex and/or third party intellectual property rights. The user should perform his/her own tests to determine the suitability for a particular purpose. The final choice of use of a product and/or information as well as the investigation of any possible violation of intellectual property rights of allnex and/or third parties remains the sole responsibility of the user.

Notice: Trademarks indicated with ®, ™ or * as well as the allnex name and logo are registered, unregistered or pending trademarks of Allnex IP s.à.r.l. or its directly or indirectly affiliated allnex Group companies.



Corporate Center

Frankfurt
The Squire
Am Flughafen
D 60549 Frankfurt am Main
Germany

The operating allnex group is legally owned by Allnex Holdings S.à r.l., a company based in Luxembourg, which also provides long term strategic decisions relating to its investment in allnex.

www.allnex.com

