ELVACITE® ACRYLIC RESINS AS ADDITIVES FOR RADIATION CURABLE PLASTIC COATINGS

1. OVERALL BENEFITS OF ELVACITE® 4026

Elvacite® 4026 is a solid acrylic bead resin which has been specially developed for use as a performance enhancing additive in a range of radiation (UV and EB) curable inks and coatings. These enhancements stem from the use of novel polymer chemistry which enables Lucite International to confer Elvacite® 4026 with a unique, UV reactive macromolecular design. Elvacite® 4026 is designed for use in applications such as radiation curable silk screen inks, wood coatings, and plastic coatings.

The new technology embodied by Elvacite® 4026 is designed to complement the existing art where resins such as Elvacite® 2028, 2013, and 2927 have been used as "passive" resins in UV formulations for years. Such "passive" Elvacite® resins act as modifiers that add value to radiation curable formulations in a variety of ways, some of which are listed in the Retained Benefits section below. By using Elvacite® 4026 in radiation curable applications, the following additional benefits can be gained while the traditional benefits of using "passive" Elvacite® resins are retained.

Additional Benefits from Elvacite® 4026

*Faster cure rate
*Improved chemical and solvent resistance
*Lower formulation viscosity

Retained Benefits from "Passive" Technology

*Reduced shrinkage
*Enhanced adhesion to substrate and improved intercoat adhesion
*Improved pigment dispersion
*Increased film flexibility

*Reduced system costs through replacing expensive acrylate oligomers

2. GENERAL PRINCIPLES

These have been demonstrated in clear formulations by partly replacing oligomers with Elvacite® acrylic resins. When replacing conventional oligomers, *care has to be taken to ensure that the combined concentrations of Elvacite® 4026 and oligomer are not too high*. Examples using formulations based on CN965 and Ebecryl® 245 aliphatic urethane acrylates are shown in Table 1. 50% (w/w) of the oligomer originally present in the control formulation (15 parts out of 30 parts) was replaced by Elvacite® acrylic resin, with all other components and concentrations remaining the same. The formulations were applied on to paper substrates at a thickness of 12 μm and cured using 1 pass with a single medium pressure mercury arc lamp with an output of 80 W/cm^2.

Table 1

Material	Control formulation	Acrylic resin formulation
Elvacite® 4026	0	15
urethane acrylate	30	15
TPGDA	40	40
TMPTA	20	20
Darocur® 1173 photoinitiator	5	5
Ebecryl® P115 synergist	5	5

Comparative results for partially replacing CN 965 and Ebecryl® 245 are shown in Tables 2 and 3, respectively. Partial replacement of urethane acrylate oligomer with Elvacite® 4026 results in a limited increase in formulation viscosity and much higher cure rates. Additionally, the resultant coatings have good flexibility with increased solvent resistance. Compared to the UV reactive Elvacite® 4026, the passive Elvacite® 2028 produces higher formulation viscosity, lower cure rate and inferior solvent resistance.

Table 2

CN965 Formulation	Viscosity (cP)	Cure rate (m/min)	Solvent resistance (MEK DR)	Flexibility	Pencil Hardness
Control	360	33	60	Pass	3B
Elvacite® 2028	2340	47	30	Pass	B
Elvacite® 4026	1170	57	150	Pass	2B

Table 3

Ebecryl® 245 Formulation	Viscosity (cP)	Cure rate (m/min)	Solvent resistance (MEK DR)	Flexibility	Pencil Hardness
Control	220	33	150	Pass	2B
Elvacite® 2028	1910	41	20	Pass	3B
Elvacite® 4026	820	52	120	Pass	H

Whilst absolute results differ and results are not illustrated, the same qualitative performance features are observed when epoxy acrylate and polyester acrylate oligomers are partly replaced by the new UV reactive Elvacite® acrylic resin. Overall, the results suggest that Elvacite® 4026 can be used in a generic fashion to provide a new balance of properties.

3. VINYL FLOORING

Coatings were applied on to flexible PVC for vinyl flooring at a thickness of 24 µm, and cured with 2 passes using a medium pressure mercury lamp with an output of 120 W/cm^2. Elvacite® 4026 was used to partly replace aliphatic urethane acrylate oligomers in a control formulation, as shown in Table 4.

Table 4

Formulation A (urethane/ monomer 33.2/62.3)	**% weight**	**Formulation B (acrylic resin/ monomer ratio 33.9/61.2)**	**% weight**
Ebecryl® 245 (75% urethane acrylate in TPGDA)	44.24	Elvacite® 4026 (45% in TPGDA)	75.43
TPGDA	26.00	TPGDA	-
TMPTA	13.71	TMPTA	14.73
EEEA	11.55	EEEA	5.00
Fluorad FC430	0.09	Fluorad FC430	0.09
Benzophenone	2.65	Benzophenone	2.85
Irgacure® 651	0.88	Irgacure® 651	0.95
Syloid ED3	0.88	Syloid ED3	0.95

Formulation A was mixed with formulation B in ratios varying from 90:10 to 50:50 and the properties are shown in Table 5. NB for stain resistance, P refers to (shoe) polish, Ma refers to marker pen, Mu refers to mustard and C refers to coffee (1=strong stain and 5=no stain).

Table 5

A:B formulation blend ratio	**Viscosity (cP)**	**Cure rate (m/min)**	**Adhesion (%)**	**Flexibility**	**Stain resistance (P, Ma, Mu, C)**
90/10	710	10	100	Pass	1, 4, 3, 4
80/20	870	6	100	Pass	2, 4, 3, 4
70/30	***1210***	***6***	***100***	***Pass***	***3, 5, 4, 4***
60/40	1650	6	100	Fail	3, 5, 4, 5
50/50	2160	6	100	fail	4, 5, 5, 5

The results show that replacing 30% of the urethane oligomer by Elvacite® 4026 produces optimum results, where the formulation viscosity is adequate for the application. This formulation provides flexible coatings with good adhesion and superior stain resistance.

For Further Information Contact:

USA

Lucite International
Lucite Center
7275 Goodlett Farms Parkway
Cordova TN 38016
TEL: 800 4-LUCITE
www.luciteinternational.com

Europe

Lucite International Speciality Polymers & Resins Ltd.
Horndale Avenue
Newton Aycliffe
County Durham DL5 6YE UK
TEL: +44 (0) 1325 300990
FAX: +44 (0) 1325 314925
www.luciteinternational.com