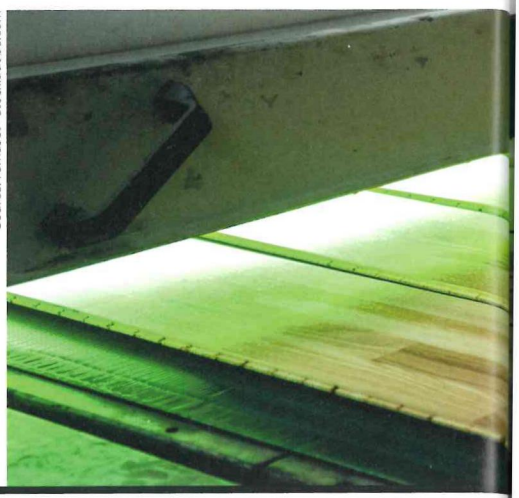
Two questions, two answers:

1 How do HSE topics affect your developments of radiation curing products and how have they changed over time?

2 What trends do you expect to influence radiation curing in the next years?



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1 It is obvious that the regulatory landscape is becoming more and more challenging and Rahn as a responsible player in the market invests a lot in safety of its products and to manage and meet regulatory obstacles as an organisation.

While business is increasingly acting global, the regulatory landscape is becoming more and more fragmented, various countries are setting up chemical inventories and end applications become more regulated, resulting in very limited harmonisation between all these regulations.

Rahn is supporting its customers in regulatory aspects and to manage the complexity and demanding obligations an in depth knowledge is needed. Here we can provide valuable assistance with our expertise to our customers who are often SME's. Regulatory know-how is necessary no matter the size of the business.

Implication continues as more time is needed to market new developed products, a global product launch is taking more time, at higher cost and a start with limited market areas stays in conflict with a global business approach.

Innovations and new chemistries are of high stakes as time-consuming and expensive tests are required to complete data sets as preparation for products launches in various market areas. Besides costs, the test outcome at the very end of a development might be unfavorable with respect to classification stopping market introduction after spending significant resources in development and maybe even beta testing at customers.

The future of small volume and customised products (raw materials of a formulation) which meet requirements of a customer's application might become more difficult as the relatively small business will no longer justify the regulatory efforts needed to bring the product to the market.

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> "Only for very few carefully selected new products based on new chemistry, costs and risks will be justified."

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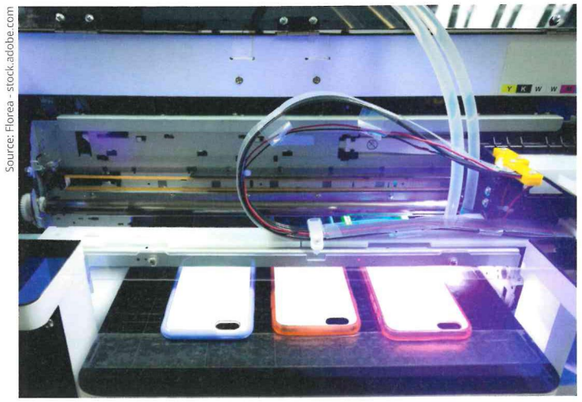
Brand-owners feel pressure coming from NGOs and the public, fear the loss or reputation, and decide to block the use of certain classified materials. Consequently, formally approved, well-known and technically performing products are no longer accepted and barred from the market.

2 Rahn has the ambition to develop new products that meet today's long list of challenges. Our innovation are fed by LED (phase out of mercury) and new applications (e.g. in electronics, 3D printing etc.). Currently of increased interest are UV/EB curable environmentally friendly, "bio" based products. However, they compete with other coating technologies, such as powder coating, but with the advantage of less needed heat and energy consumption and better performance on sensitive substrates.

UV formulations consist of highly reactive chemical components, many of these will be classified in the near future. Today and in the future manufacturing Industry including brand-owners and associations need to adjust company policies and practices in order to enable work with classified materials within the specific industrial setting of the supply chain (limit exposure/train staff). Consequently a right mindset that assess the exposure side, not the hazard is needed Raw material suppliers have experience in handling these materials and are willing to share this experience along the supply chain.

UV, EXCIMER OR LED?



Source: Florea - stock.adobe.com

Radiation-curing lacquers are no longer a marginal phenomenon in industrial lacquer processing. Technology has evolved, so there are different technologies for activation available today. The photoinitiators and binders had to be adapted. By Nina Musche

As a rule, coatings dry, or better cure, by energy input - just like almost any other chemical reaction. For some, the ambient temperature is sufficient as long as it does not fall below a certain value. Others require temperatures above 200 °C, such as coil coatings, for example. Another type of activation is based on irradiation with high energy light. The photoinitiators contained in the coating decompose to radicals and start a classical radical polymerisation.

Company	Product name	Chemical basis	Dilution	Viscosity	Functionality	Acid number
Alberdingk	LUX 220	Polyester-polyurethane dispersion	35 % in water	20-200 mPas	–	–
	LUX 481	Polyurethan-acrylat-copolymer-dispersion	40 % in water	10-500 mPas	–	–
BASF	Laromer UA 9089	Aliphatic urethane-acrylate	–	18-24 Pas (D=25s-1)	2	–
	Laromer UP 35 D	Unsaturated polyester resin	45 % DPGDA	3-6000 mPas (D=100s-1)		< 35 mg KOH/g
Covestro	Bayhydrol UV 2282	Polyurethane dispersion	39 % in water			
	Bayhydrol UV 2877	Self-crosslinking urethane acrylate dispersion	40 % in water	<500 mPas (D=40s-1)		
Rahn	Genomer 3430	Amin-modified polyether acrylate	–	600 mPas	4	1 mg KOH/g
	Genomer 5696	Acrylated oligoamine resin	–	8000 mPas	6	1 mg KOH/g
Robert Kraemer	Rokracure SL 7100	Modified polymer, based on renewable resources	85 % in DPGDA	5-10000 mPas (DIN 53019)	–	5 mg KOH/g
	Rokracure SL 7700	Modified, aliphatic urethan-acrylate	70 % in DPGDA	20000-40000 mPas (DIN 53019)	–	5 mg KOH/g

This is quite energy-intensive - so the idea of using LED technology is logical. In a domino effect, this leads to a cascade of adjustments. LED has a different light spectrum than previous UV lamps. In order to continue producing radicals, the initiators must be checked and adjusted if necessary. This can also have an influence on the oligomers used - which ones still work with the new conditions, which ones don't? What is the situation with pigmented coatings? What adjustments do they require? A start has been made and suitable products found.

Matting of UV coating is difficult due to the lack of shrinkage. Most traditional methods are based on particles that come to and through the surface due to shrinkage during drying. This roughens the surface and creates the necessary scattering. None of this works with UV coatings. This is where the Excimer laser technology can help. The surface is dried very quickly with short-wave, high-energy UV light at 172 nm and shrinks. This leads to irregular wrinkles, which diffuse the light and thus achieve a matting effect. The through-drying is done with the classic UV lamp.

Aqueous UV lacquers are usually first physically dried and then cross-linked. The advantage is, for example, the possibility of processing like sanding before UV-drying.

Properties	Application
Chemical resistance in transparent and pigmented systems, strong physically drying and scratch resistance before UV-curing.	UV and LED, dual-cure formulations (clear and pigmented); parquet and furniture coatings; wood, plastic, metal and paper substrates
Chemical resistance in transparent and pigmented systems, good adhesion to plastics and 100% UV-systems, higher UV-reactivity	UV and LED, dual-cure formulations (clear and pigmented); parquet and furniture coatings; wood, MDF, plastic, metal and paper substrates
Weather resistance, high flexibility, tough, tin-free	UV and EB, Excimer surfaces in combination with Laromer UP 35 D, coatings for wood, paper and plastic (PVC, LVT
Levelling and adhesion on many substrates, sandability	Excimer surfaces in combination with Laromer UA 9089, radiation curable putties, primers and topcoats on different substrates
Dual cure, physical and UV curing, good adhesion to many substrates (incl. plastics), easy to matt	Water-borne high quality UV curing wood coating, conventional and LED technology
App. 35 % carbon content based on biomaterial, sandable after physical drying, easy to matt	Water-borne, wood/wood material coating, with or without UV-curing, LED compatible
High reactivity in LED formulation, flexibility, low yellowing, reduces oxygen sensitivity	UV and LED formulations; flexo, screen and inkjet inks and varnishes, industrial coatings and adhesives
High reactivity in LED, improves surface cure in UV, good flexibility, low yellowing, reduces oxygen inhibition, low odor, good adhesion to plastic substrates	UV and LED formulations; flexo, screen and inkjet inks and varnishes, industrial coatings and adhesives
Adhesion promoter, high flexibility	UV and LED activated formulations, primer, top-coats and printing inks
No yellowing, tough, abrasion resistant, adhesion, especially on aluminium and plastics	UV and LED activated forumulations

"Roughly 13000€ can be safed in energy cost per line with LED vs.UV"

EUROPEAN COATINGS 360°

This platform summarises technical content for coating systems. There are more than 650 hits for UV coatings. A 360° view on presentations, videos, books as well as articles from the European Journal on UV coatings are available upon registration.

https://360.european-coatings.com/

SYNTHESIS OF NON-ISO PU'S AND THEIR APPLICATION IN RADIATION-CURABLE COATINGS

A feasible and efficient synthesis route for UV-curable non-isocyanate polyurethane acrylates has been demonstrated. UV-curable coatings based on NIPU-acrylates have been formulated and their film properties studied. Absence of isocyanates, and reducing VOC/HAPs make these coatings more sustainable. Some coatings even met key aerospace requirements such as 3 mm flexibility at -54 °C and resistance to specified chemicals.

F. Zareanshahraki et. al. Progress in Organic Coatings 2/2020

Source: Lunatictm - stock.adobe.com