



The Best of Both Worlds—UCECOAT[®] Waterborne UV-Curable Resins

Cytec was asked by a major customer, a Swedish manufacturer of resilient flooring, to develop PUDs (polyurethane dispersions) as coatings for demanding commercial, residential and sports applications. At the same time, environmental protective legislation was being introduced in Europe, mainly in Germany and Scandinavia, for wood and plastic coatings.

The range of the PUDs still contained 5-15% of a co-solvent (NMP; N-methyl-pyrrolidone) to allow for processing and film formation. The customer, though, was facing impending legislation that would severely limit the NMP emissions. On top of that, the customer was still using polyaziridines as a crosslinker while reports were beginning to draw attention to the presence of toxic aziridines.

The objective was as clear as it was nearly impossible: develop waterborne polyurethanes without any solvent, and with a crosslinking mechanism that was both environmentally friendly and economically feasible. Additionally, all other properties (chemical resistance and abrasion resistance) were expected to be improved as well.

The solution? Invent a new technology which combined the advantages of both UV curing¹ and PUDs: UV-PUD.

Our team of scientists first developed the new UV-PUD as a polyurethane dispersion (PUD) with a special crosslinking mechanism: UV light. The Polyurethanes R&D team developed the chemistry and application, and was later joined by our RADCURE² chemists, in collaboration with the customer.

The result? The new UV-PUD exceeded all expectations! It combined the flexibility of the existing PUDs with the excellent abrasion and stain resistance of standard UV systems, while eliminating solvents used in PUDs and the volatile, odorous monomers used in 100% UV.

The new UV-PUD product took the name UCECOAT[®] in line with Cytec's brand of existing polyurethanes which were developed originally as an extension of the company's waterborne PUD technology for fabric coating applications.

The first target application was resilient flooring. Resilient flooring was and is popular worldwide because it is easy to clean, comes in many different colors and designs, and is relatively inexpensive. Two major drawbacks, however, are that many household materials and dyes can create stains, and many types of shoe soles can leave scuff marks.

Also, it was typically installed in reels 2 to 4 meters wide that are thermowelded together to avoid dust pick-up and ensure water tightness. Thus, the coating needed to be sufficiently thermoplastic to survive thermowelding at 600-700°C for a couple of seconds! This is something a traditional 100% UV system would not allow; crosslinking density was too high, resulting in a more rigid network.

A second target application was parquet lacquers. In addition to the demands of resilient flooring, the UV-PUD technology needed to dry fast, provide a good definition of image (respecting the natural depth and texture of wood surfaces), and formulate into specific viscosity and gloss values.

In both applications, UCECOAT proved to be a superior technology! It was dry and tack-free before cure, and once the water evaporated, the polymer was of sufficient high molecular weight to result in a dry film. This enabled the coating to be treated to have specific features, like thermal embossing and sanding, or to be stored or transported prior to UV-curing.

In the case of resilient flooring, the surface could be embossed thermally before curing, without sticking to the embossed rolls. If necessary, the flooring material could even be rolled up at another time or place. Also, the use of the UV-PUD technology resulted in a higher degree of freedom in both process and design, as gloss, thickness and surface embossing could be arranged on the same coating equipment. This was a clear process advantage over 100% UV systems.

These “best-of-both-worlds” advantages of UCECOAT’s UV-PUD technology are described in the following table.

	100% UV	UV-PUD	PUD
Organic cosolvent-free Monomer/Oligomers	OK Reactive diluents	OK Water	3-14% NMP Water
96% EtOH resistance	OK	OK	Limited
Stain resistance	OK	OK	OK
Hard yet flexible	Limited	OK	OK
Sprayable	Limited	OK	OK
Thickness control	Limited	OK	OK
Tack free before cure	Limited	OK	OK
60° gloss range	30-90%	5-80%	5-70%
Shrinkage upon curing	5-10%	1-2%	< 1%
Monomer deep-cure	Problematic	OK	NA
Adhesion to plastics	Problematic	OK	OK

Today, UCECOAT® waterborne UV curable resins are being used for an even wider range of coating applications, including kitchen cabinets. Understandably, the world’s largest coatings manufacturers have now embraced the family of UCECOAT waterborne UV curable resins because of their innovative combination of fast curing, excellent resistance and performance properties, eco-friendliness, and lower total systems costs.

Building on this success, Cytec is well positioned to help its customers formulate the next generation of value-added products—tomorrow’s innovations—with expertise in application development, global manufacturing, and technology ahead of its time.

¹ Curing using low-cost ultraviolet light (UV)

² Abbreviation for “radiation curable”, a technology pioneered by Cytec. Also referred to as “energy curable” using ultraviolet light/electron beam (UV/EB) technology