Marcel Krohnen, Head of Global End-Use Wood at BYK Additives & Instruments, discusses the development of two new solvent-free defoamers, BYK-1788 and BYK-1799, which have been designed with a particular focus on 100% UV-curing coating systems

Strike back the bubble attack

Thanks to their greater environmental compatibility compared with conventional solventborne systems and their economic formulation and application, solvent-free and UV-curing coating systems for various final applications are increasing in importance. The technology of UV-curing coating systems, in particular, is one of the most rapidly growing technologies with above-average annual growth rates around the world. It is being used more and more in wood, furniture and general industrial coatings, as well as in the printing inks industry.

However, the environmentally conscious solvent-free formulation and the frequently resulting high processing or application viscosity makes defoaming of 100% UV-curing coating systems difficult. Especially if the formulation also contains matting agents or pigments or is applied under very challenging conditions, spontaneous and highly efficient defoaming is essential. Taking these technical requirements into account, two new solvent-free defoamers have been developed with a particular focus on 100% UV-curing coating systems: BYK-1788 and BYK-1799.

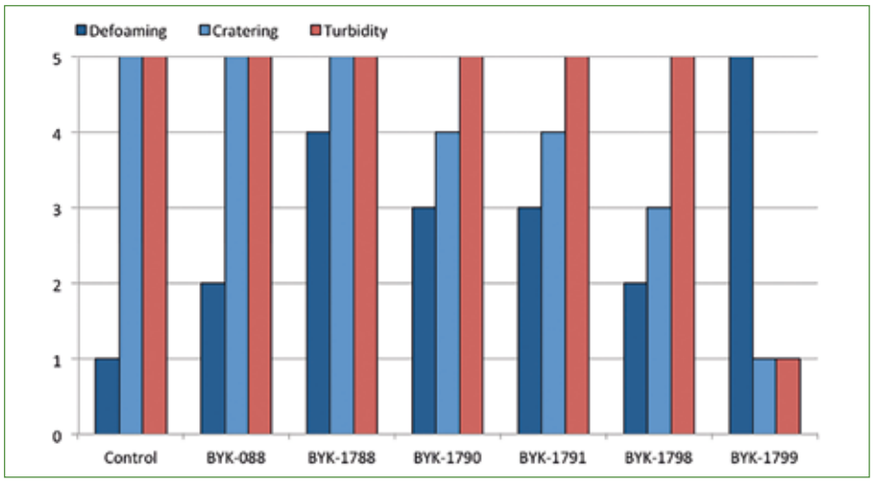
BYK-1788 is a solvent-free and silicone-free polymer defoamer that has a well-balanced ratio of defoaming properties and system compatibility. This makes it particularly suitable for clear coat systems that demand a high level of gloss and transparency. In comparison, BYK-1799 is a solvent-free defoamer based on an organic modified polydimethylsiloxane with extremely strong defoaming properties, making it an excellent choice for use in matted or pigmented UV-curing systems. It eliminates both macro- and microfoam and, thanks to its spontaneous and highly effective defoaming properties, the additive is ideally suited to very demanding application methods, such as roller application.

DEFOAMING PROPERTIES FOR 100% UV-CURING CLEAR COAT SYSTEMS

BYK-1788 and BYK-1799 were tested for use in various 100% UV-curing systems with regard to their defoaming properties compared with representatives in the product portfolio. **Figure 1** summarises the application technology results for a 100% UV-curing clear coat system based on an urethane acrylate. In each case, 0.2% defoamer, based upon the total formulation, was added. After storing the samples for one day, they were foamed for one minute at a rotational speed of 2m/s using a dissolver, immediately poured on to a Plexiglas panel fixed at a 65° angle and, after a two-minute wait, cured by UV radiation.

As summarised in **figure 1**, BYK-1788 shows the most well-balanced ratio between efficiency and compatibility for all the tested defoamers, resulting in a very good level of defoaming of the clear coat system without cratering or having a negative impact on transparency. Furthermore, the strong defoaming properties of BYK-1799, as a consequence of the specific incompatibility, shows that at this dosage it also results in significant cratering and has a negative impact on the transparency of the clear coat system. The primary reason for this result is the selected dosage. Particularly in the case of BYK-1799, a clear dependency of defoamer compatibility on the selected quantity could be determined. Consequently, BYK-1799 can be used at a correspondingly low selected dosage for defoaming clear coat systems, without, as illustrated in **figure 2**, exhibiting negative side effects on levelling or transparency.

Fig 1. Evaluation of the tested defoamers in terms of their defoaming properties (from 5 = excellent to 1 = inadequate), cratering tendency (from 5 = no cratering tendency to 1 = highly pronounced cratering) and impact on transparency (from 5 = no turbidity to 1 = high turbidity) of a UV-curing clear coat system based on urethane acrylate



DEFOAMING PROPERTIES FOR MATTED 100% UV-CURING COATING SYSTEMS

In addition to various UV-curing clear coat systems, BYK-1788 and BYK-1799 were also extensively tested for matted 100% UV-curing coating systems. As an example, the application results shown in **Figures 3** and **4** are recorded for a matted 100% UV-curing coating system based on an unsaturated polyester. To test the various defoamers, they were each added to the test system at a dosage of 0.3%, based upon the total formulation and incorporated. After storing the samples for one day, they were foamed for one minute at a rotational speed of 2m/s using a dissolver, immediately poured on to a Plexiglas panel fixed at a 65° angle and after a two-minute wait, cured by UV radiation.

BYK-1799 proved impressive in this test, as a result of its very strong defoaming

Fig 2. Defoaming properties of BYK-1799 (right), used at 0.05% based on the total formulation compared with the system without defoamer (left) for a 100% UV-curing clear coat system applied using a moltopren roller

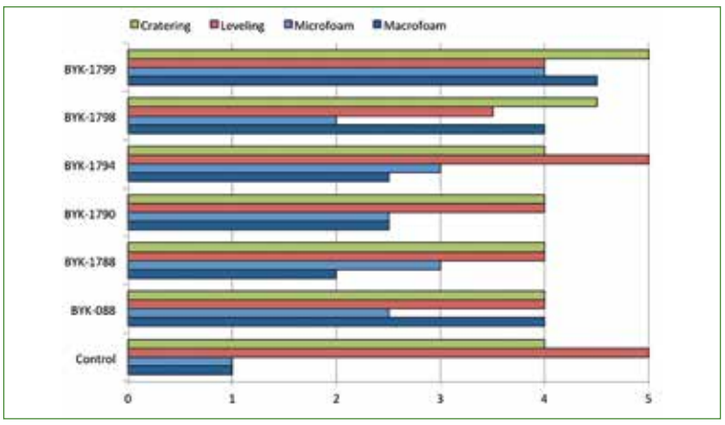


Fig 3. Evaluation of the tested defoamers with regard to macro- and microfoam (from 5 = excellent to 1 = inadequate), impact on levelling (from 5 = no impact to 1 = significant negative impact) and cratering tendency (from 5 = no cratering tendency to 1 = highly pronounced cratering tendency) for a matted UV-curing coating system based on an unsaturated polyester

properties, essentially preventing macro- and microfoam, however, without negatively impacting the levelling of the coating system or having a tendency to form craters. For the silicone-free polymer defoamer BYK-1788, it could be concluded, as part of this matted test system, that the very well-balanced compatibility of this defoamer neither negatively impacts levelling nor leads to cratering. However, it is not adequate to effectively defoam the test system.

SUMMARY

The ever-increasing importance of 100% UV-curing coating systems and the challenge of spontaneous and effective defoaming associated with their technical properties and the most frequently employed application methods was addressed by the development of BYK-1788 and BYK-1799. The different property profiles of these two solvent-free defoamers provide technical responses to the defoaming of both 100% UV-curing clear coat systems for which maximum gloss and transparency are an essential requirement and matted or pigmented 100% UV-curing coating systems for which maximum defoaming properties are critical (see **figure 5**). The more system-compatible polymer basis of BYK-1788 and the comparatively incompatible polydimethylsiloxane base in BYK-1799, make these two defoamers ideal additions to the existing defoamer portfolio for use in 100% UV-curing coating systems. **PPCJ**

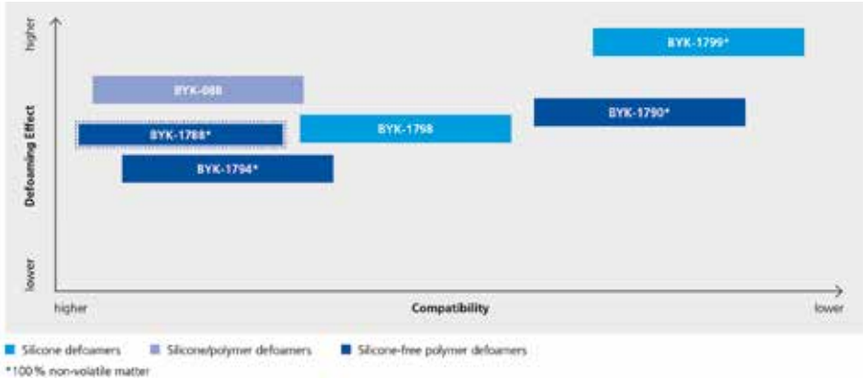
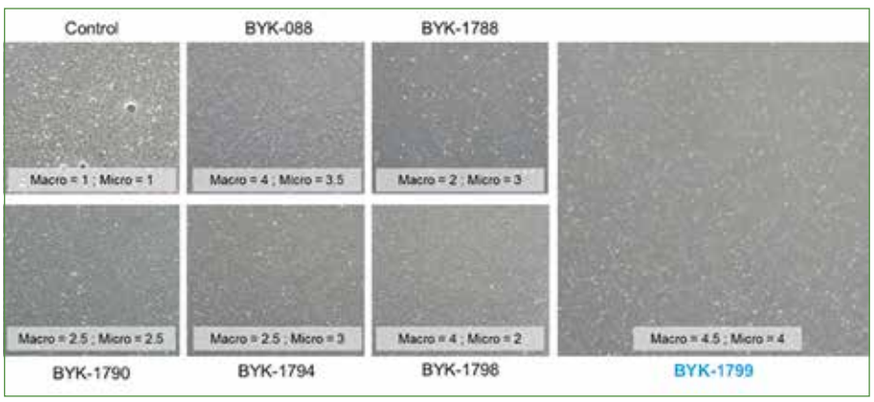


Fig 5. Integration of BYK-1788 and BYK-1799 in the defoamer portfolio for 100% UV-curing coating systems as a function of the defoamer compatibility and the resulting defoaming properties (figure shows a representative selection of defoamers)

Fig 4. Photo protocol for the varying effectiveness of the tested defoamers for a matted UV-curing coating system based on an unsaturated polyester. Assessment of macro- and microfoam from 5 = excellent to 1 = inadequate



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