PHOTO: VÖLPKER SPEZIALPRODUKTE

The greening of processing aids

Recent feedstock shortages set some wax producers looking for alternatives and have led to the introduction of bio-based and enhanced performance options, writes Peter Mapleston

Speciality waxes are a staple of plastics compounding that are used both to improve properties such as flow and gloss and for enhancing dispersion of pigments and other additives. There are numerous types available and most are derived from fossil-based raw materials – typically oil for low molecular weight polymer waxes and brown coal (lignite) for montan waxes. With long and successful histories, these products continue to play a vital role in the compounder's toolbox but producers continue, for reasons ranging from supply security to environmental, to look for alternatives.

Manufacture of traditional montanic wax products is based on solvent extraction from lignite. Commercially viable lignite deposits exist in only a few locations, including Germany in Europe, California in the US, and Yunnan and Jilin in China. Global shortages of available raw materials earlier this decade started a search for replacements, some of which have since come to market.

Völpker Spezialprodukte in Germany is a leading producer of montan waxes, which it sells under the Waradur brand name. It increased its offering around three years ago when it acquired BASF's montan wax business. Lutz Matthies, the company's Head of Business Development, says that, due to their special properties, montan waxes have been highly valued in the plastics industry as multifunctional additives for decades. They act as excellent effective viscosity reducers (flow improvers), mould release agents and dispersing aids for pigments and other additives, all at the same time. Montan ester and acid waxes are used in PVC, polyamides (PA), polycarbonate (PC), thermoplastic polyurethane (TPU) and styrene maleic anhydride (SMA).

Main image: Speciality wax additives are a staple of the polymer compounding industry, improving attributes such as processing and dispersion

Matthies says that while Montan wax derivatives are used by preference in the processing of engineering plastics, their benefits can also be taken advantage of in PVC processing, particularly where demands on the quality of the end products are especially high. In terms of chemistry, for example, they are similar to fatty acid esters but benefit from considerably longer carbon chains. As a result, montanic esters display low volatility and this, together with their very good compatibility with PVC, means they exhibit a low tendency to migration. Even at high addition rates in PVC applications, he says they have a very low tendency to form a coating on the finished part.

Release and flow

In PVC, montan waxes function primarily as release agents by providing external lubrication. They also improve the surface quality and smoothness and provide the final product with a superior gloss. Montanic esters are used in injection moulding and other applications where good melt flow is required, as they also reduce the melt viscosity – internal lubrication. In high-speed cable extrusion they exhibit advantageous lubricating properties, especially at the tip of the processing screw.

Völpker says that its Waradur OP grade tends to have a slightly lower external lubrication effect than Waradur E. The latter, on the other hand, lowers the melt viscosity slightly more, which results in lower extrusion pressures (Table 1).

Matthies explains that montan waxes are particularly advantageous in PVC, where their effect on melt viscosity is much greater than that of glycerol monostearate and complex esters (Figure 1). He says this performance advantage is particularly interesting in applications where high shear forces occur, for example in injection moulding or coextrusion of window profiles.

During extrusion of PVC window profiles, montan waxes improve gloss (Figure 2) and can also solve problems such as 'chattering' or 'juddering' if they are used to partially replace primarily external lubricants such as Fischer-Tropsch paraffins or PE waxes, Matthies says. This effect is attributed to the reduction of the polymer melt viscosity. "Experience has shown that the shrinkage of the extrudate during calibration is improved in this way," he says.

Another advantage of montan waxes is their relatively high melting point. This means that they reduce the Vicat softening point in, for example, PVC injection moulding applications by much less than common fatty acid esters, which have significantly lower melting points (Figure 3).

Newly renewed

Velox is the exclusive distributor of Völpker's waxes for plastics applications in various European countries, supplying not only montan waxes but also other types. The distributor highlights Voelpker Wax 4418, an organic ester based on renewable plant waxes, saying that this new product optimally combines the characteristics of a multipurpose plastics additive with the appeal of bio-based raw materials. This makes the grade particularly appropriate for use in thermoplastic polymers derived from renewable resources. The company says Voelpker Wax 4418 contains modified natural long-chain fatty acids. It is

Table 1: Chemical, physical and rheological data of typical Völpker lubricants (==> indicates fusion is delayed; ⇐: fusion is promoted; ⇑: torque or pressure increases; ⇓: torque or pressure decreases ⇔: insignificant influence. Two symbols indicates a more pronounced effect at the same dosage)

Lubricant	Average molecular weight [g/mol]	Drop point range [°C]	Effect on fusion time	Effect on extrusion torque	Effect on extrusion pressure
Waradur S Fatty acids, montan wax	approx. 425	82 – 88	==>==>	⇓⇓	⇓⇓
Waradur E Fatty acids, montan wax, ethylene esters	approx. 900	82 – 88	==>==>	⇓⇓	⇓⇓
Waradur GE Fatty acids, montan wax, glycerol esters	approx. 900	80 – 88	==>==>	⇓⇓	⇓⇓
Waradur OP Fatty acids, montan-wax, 1-methyl-1,3-propanediyl esters	approx. 900	99 – 105	==>	⇓⇓	⇓

Source: Völpker Spezialprodukte

predominantly derived from acids and alcohols in the C26 – C30 range.

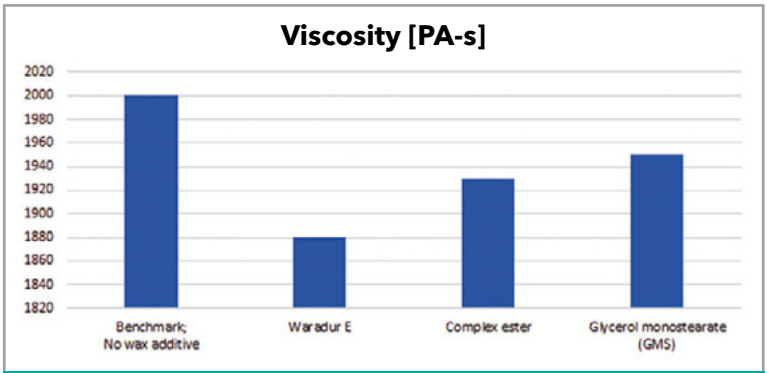

Figure 1: Influence of different waxes on the viscosity of PVC melt
Source: Völpker Spezialprodukte

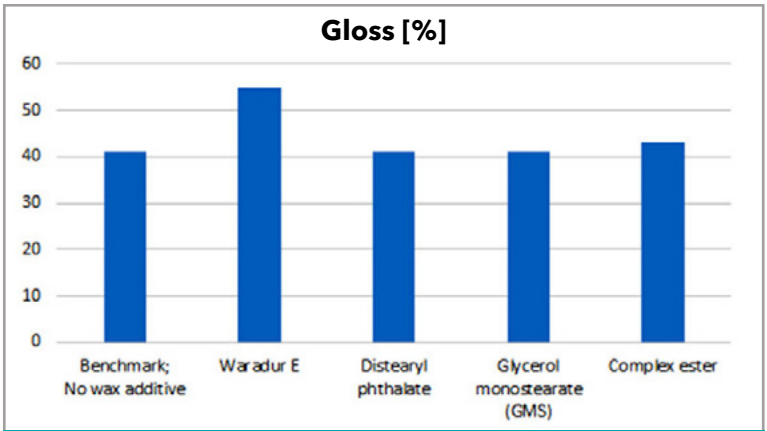

Figure 2: Influence of different waxes on the viscosity of PVC melt
Source: Völpker Spezialprodukte

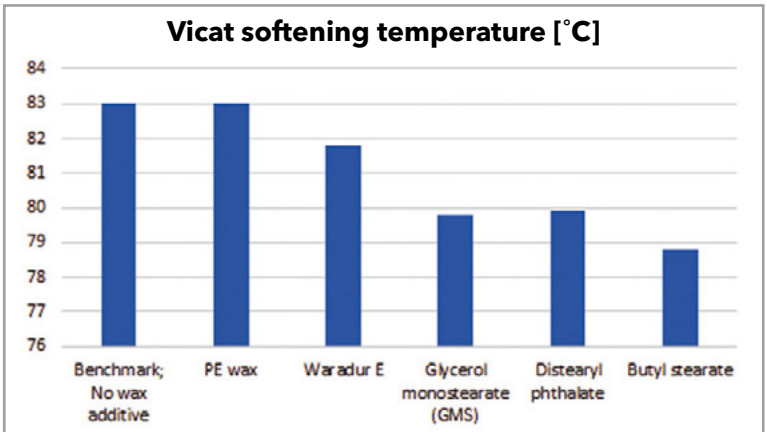

Figure 3: Influence of different waxes on the viscosity of PVC melt
Source: Völpker Spezialprodukte

Voelpker – a Family-owned Company with Innovative Strength

With more than 115 years of production history, Voelpker is among the most long-standing wax producers in Europe and is renowned worldwide as a reliable manufacturer and supplier of montan waxes and special wax blends. Due to their unique properties, special waxes developed and produced by VOELPKER are used as high-performance additives in the plastics industry. They serve as combined external and internal lubricants, nucleation additives and dispersing agents in many types of plastics and processing methods.

True to the motto 'to make ideas work', we do everything to improve and optimise our customers' products and processes. We design special waxes that are precisely tailored to their requirements. We served our customers as a reliable partner and have developed individual solutions for many branches over the last few decades.

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