More than just Lubricants

Montan Waxes serve variously in the plastics processing industry as lubricants, nucleating agents and dispersing agents. They owe this versatility to special properties conferred by their chemical structure. Obtained from fossilized vegetation, the waxes are in demand for applications requiring low viscosity.

The basis of bleached montan wax is crude montan wax, which is derived from fossilized plants (figures: Völpker)

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Due to their chemical structure and composition, montan waxes are incorporated into many polymers as additives, and especially to act as lubricants during processing. Bleached montan waxes are obtained from crude montan wax, a fossilized vegetable wax that has accumulated over millions of years in certain lignite deposits. Romonta GmbH, Amsdorf, Germany, extracts the fossilized vegetable wax from bitumen-rich lignite obtained from the company's own open-cast mine.

The wax substance contained in raw montan wax is primarily a mixture of ester of long-chains with long-chain alcohols. Lignite mined in central Germany has a high wax content because of its geological history.

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Long-term Availability

According to Romonta, the availability of crude montan wax is also secure into the future. Operations at the Amsdorf, Röblingen open-cast mine are scheduled to actively continue until at least 2030 or 2032. This means that there will be a continuous supply of montan wax in the prevailing quality. Meanwhile, several lignite deposits are currently being explored with a view to making montan wax available beyond 2032.

At Völpker Spezialprodukte GmbH, Völpke, Germany, the crude montan wax is saponified and oxidized in sophisticated processes, followed by various purification operations to yield a light yellow raffinate. This consists of mainly long-chain wax acids with carbon chain lengths of 22–34 atoms. These are then converted, e.g. by esterification, into semi-synthetic montan wax derivatives that are extremely hard, very light in color and have special lubricating properties.

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External and Internal Lubrication

Conventional lubricant additives for plastics processing may be external or internal. The external types are insoluble in the polymer melt and migrate during processing to the hot polymer interface or the surface of the metal, where they act as release agent. In contrast, internal lubricants lower the friction among polymer particles, thereby enhancing the flow properties and the homogeneity of the melt. It is essential that the internal lubricant and the polymer are as similar in polarity as possible and that the former is

soluble in the latter. External lubricants, by contrast, have a polarity different than that of the polymer and so have a tendency to move toward the surface.

The structure and composition of montan waxes imbues them with a solubility in between the two extremes outlined above. This means that they have both an external and an internal lubricating effect. Montan ester waxes exhibit a wide spectrum of activity owing to their molecular structure. They contain both very long, non-polar CH_2 chains of up to about 64 carbon atoms in length, as well as highly polar centers, such as carboxyl groups, carboxylic acid ester groups and if so carboxylic acid salts. By virtue of their polar fraction and associated high solubility in polyvinyl chloride (PVC), montan ester waxes reduce shear heating by lowering friction among the polymer particles. This underpins their use in injection molding applications, and applications requiring a low melt viscosity. At the same time, the non-polar fraction of montan waxes acts as an external release agent by accumulating at the polymer interface or at the mold surface. Even so, they are firmly "anchored" in the polymer by virtue of their polar fraction. The waxes also serve to enhance surface quality and smoothness of the final product.

Montan Waxes as Nucleating and Dispersing Agents

The calcium salts of montanic acid act as nucleating agents and are added to crystallizable thermoplastics, such as polyamides. Their purpose is to accelerate crystallization and thus speed up the production process. They also influence the thermal, mechanical and chemical properties of the polymer. Montan ester waxes make excellent release agents for polyamide, too.

Montan waxes serve as dispersing agents for masterbatches for coloring plastics. They ensure that the pigment particles are properly wetted and give rise to a finer dispersion. Agglomerates are thus prevented from forming in the polymer. In the end product, this leads to very good color strength and distribution, provided that the wax and polymer are of similar polarity and are highly compatible with one another.

Waradur E, a montan ester wax, serves as a high-performance additive in the production of plug connectors made from polyoxymethylene (POM)

Montan waxes are used in many types of plastics and are processed in various forms by many technologies. They are particularly suitable for technically demanding applications requiring a high-performance lubricant that must be compatible, have low volatility and be heat resistant. As lubricants, nucleating agents and dispersing agents, montan esters and montan acid waxes are used inter alia in polyamide (PA), polybutylene terephthalate (PBT), polycarbonate (PC), thermoplastic polyurethane (TPU), and styrene-maleic anhydride (SMA). The materials comply with the food-contact recommendations of the Federal Institute for Risk Assessment (BfR) in Germany and are FDA and EU compliant. ■

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