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TECHNICAL STUDY

POSITIVE EFFECTS OF MONTAN WAXES ON THE MECHANICAL PROPERTIES OF PA 6 GF 30

Tensile Strength | Impact Strength

WARADUR® E | WARADUR® OP

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Abstract

The montan waxes WARADUR® E and WARADUR® OP are excellent release agents for polyamides. Concentrations of 0.3 – 0.5 % are recommended in unfilled polyamide. In the case of filled materials, depending on the filler content, 0.5 – 1.0 % can be beneficial. This study analyzed the effect of montan waxes WARADUR® E and WARADUR® OP on the material properties as additives in glass fiber filled polyamide compounds. The mechanical properties were analyzed in particular. The study demonstrated that using the aforementioned additives can further improve both the tensile modulus and Charpy notch impact strength.

Material

The analyzed material recipes are summarized in Table 1.

Matrix	Additive	Additive [phr]	Comments
Durethane BKV 30 H3.0 (PA 6 GF 30) + Irganox 245 [0.1 wt.%] + Irgafos 168 [0.2 wt.%]	none	0.0	Reference/blank
	WARADUR® E	0.5	Montan ester wax
	WARADUR® OP	0.5	Montan ester wax, saponified
	Amide wax (EBS)	0.5	
	Calcium stearate	0.5	

Table 1: Dosage of wax additives in PA 6 GF 30

Results

Tensile modulus of elasticity

The tensile modulus of elasticity could be improved by approx. 5 % with WARADUR® OP and WARADUR® E in comparison to the wax-free reference. A significantly smaller improvement could be determined with calcium stearate and amide wax.

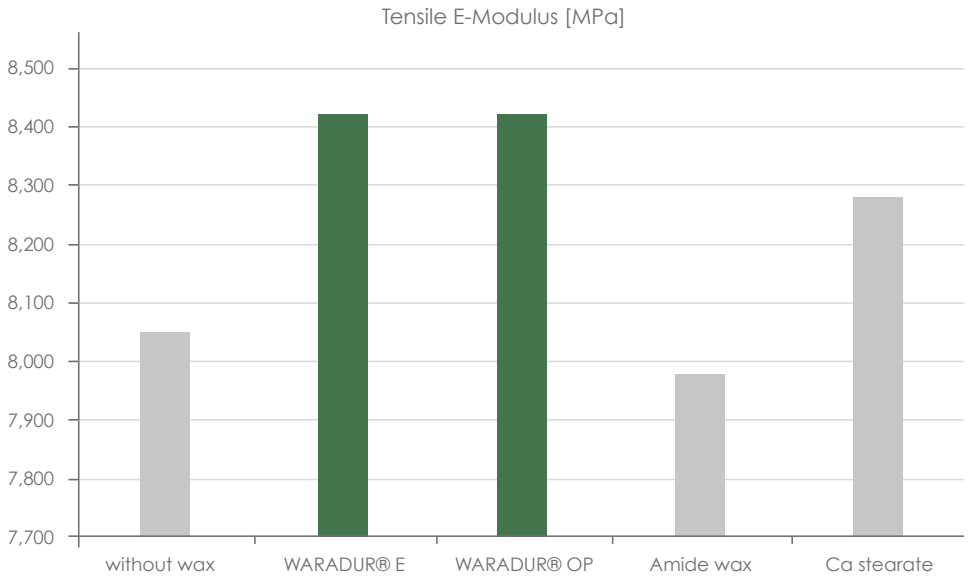

Fig. 1: Tensile E-Modulus

Tensile strength

The tensile strength could be increased with the WARADUR® OP recipe by approx. 9 %. At the same time, the positive effect on the material rigidity and strength did not have any negative effect on the elongation at break of the polyamide compound. In respect to the tensile strength, the amide wax did not reveal a relevant effect on the material behavior. In the case of the calcium stearate, only a small positive effect (3 %) on the tensile properties could be observed.

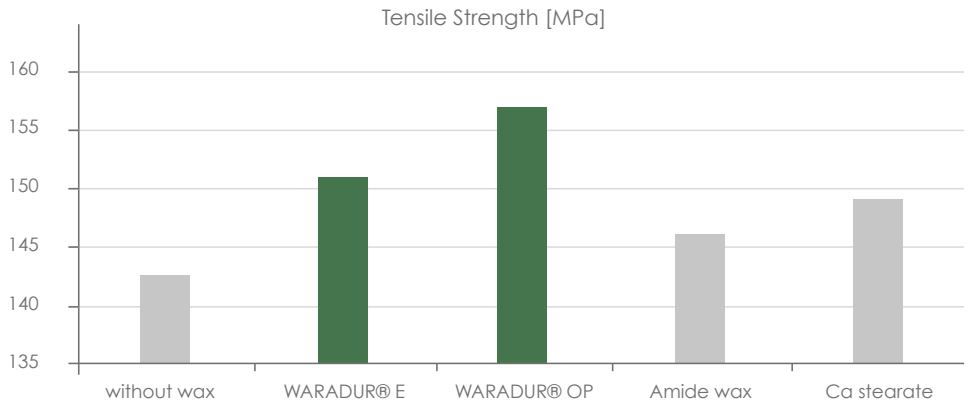

Fig. 2: Tensile Strength

Charpy notch impact strength

The toughness behavior of the polyamide compound upon abrupt stress to notched samples could also be improved by the montan waxes. The increase in the Charpy notch impact strength was 5 % (WARADUR® E) and 7 % (WARADUR® OP).
No improvement in the impact strength could be observed with the calcium stearate. In the case of the amide wax, the Charpy notch impact strength increased by approx. 4 %.

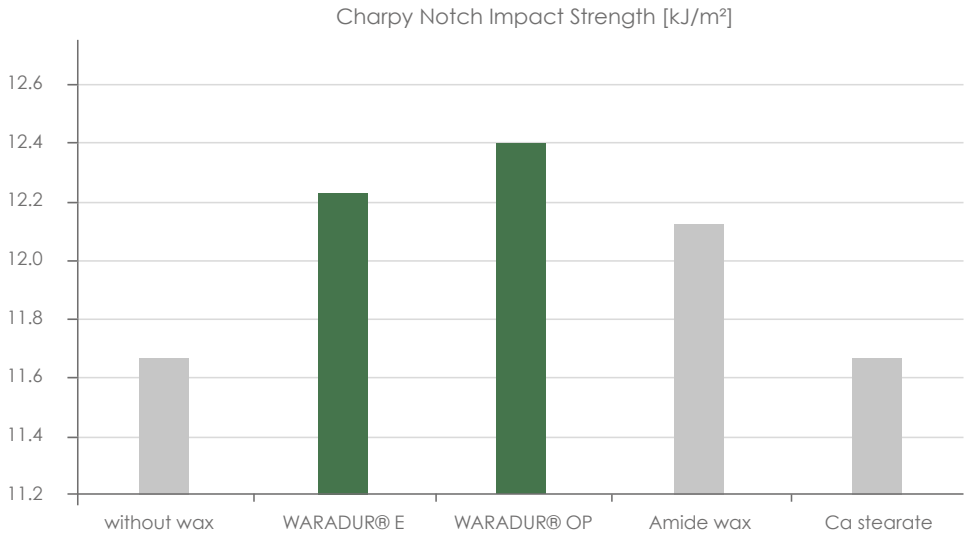

Fig. 3: Charpy Notch Impact Strength

Conclusion

As shown above, in comparison to all other recipes, the WARADUR® OP recipe shows the greatest further improvements in respect to material rigidity and strength, even in glass fiber reinforced polyamide.

Outlook

In further studies, DSC (Differential Scanning Calorimetry) analyses were conducted on the material recipes.
The results reveal that the recrystallization temperature has shifted to higher values through the addition of WARADUR® OP.

This effect on the crystallization process makes it possible to positively affect the thermal, mechanical and chemical processes of the polymer. In a further study, we shall examine in detail the crystallization behavior of montan wax additivated non-reinforced polyamide (in progress).

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, montan waxes 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 optimize 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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