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TECHNICAL STUDY





FLOW IMPROVEMENT OF UNREINFORCED PA6 ENABLED BY MONTAN WAX

Flow improvement

WARADUR® E | WARADUR® OP

FLOW IMPROVEMENT OF UNREINFORCED PA6 ENABLED BY MONTAN WAX

Abstract

The montan waxes WARADUR® E and WARADUR® OP are excellent thermal stable and low volatile 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.

These studies analyse effect the montan waxes WARADUR® E and WARADUR® OP have on the melt flow, as additives in unfilled PA. The spiral flow number (SFN) was measured in particular.

SFN is determined by injecting the molten resin into a long, spiral-channel mold. The SFN is defined as the length of flow for the resin. It was demonstrated that the flowability can be significantly increased by using WARADUR® OP.

Material and equipment

The analysed material recipes are summarised in Tab. 1.

Matrix	Additive	Additive [phr]	Comments
PA6 Durethan B 30 S (non-reinforced, Lanxess) + Irganox 245 BASF [0.1 wt.%] Irgafos 168 [0.2 wt.%]	none	0.0	Reference/blank
	WARADUR® OP	0.5	Montan ester wax, saponified
	WARADUR® E	0.5	Montan ester wax

Table 1: Dosage of wax additives in PA6 Durethan B 30 S

Injection moulding: Demag IntElect 100/470-340 smart

Injection moulding trials to determine the spiral flow number (SFN)

Screw diameter: 30 mm
Tool: Flow spiral wall thickness 2 mm (1x)
Set closing force: 1000 kN
Injection speed: 3 ccm/s
Temperature control medium flow temperature: 90 °C
Cylinder temperatures: [260, 260, 250, 190, 75] °C

At a thickness of 2 mm, a wall thickness typical for injection molding was selected.

The results of the injection molding tests were quantified with the measuring gauge (see Figure 1). The basis for averaging is 10 spirals each per recipe.

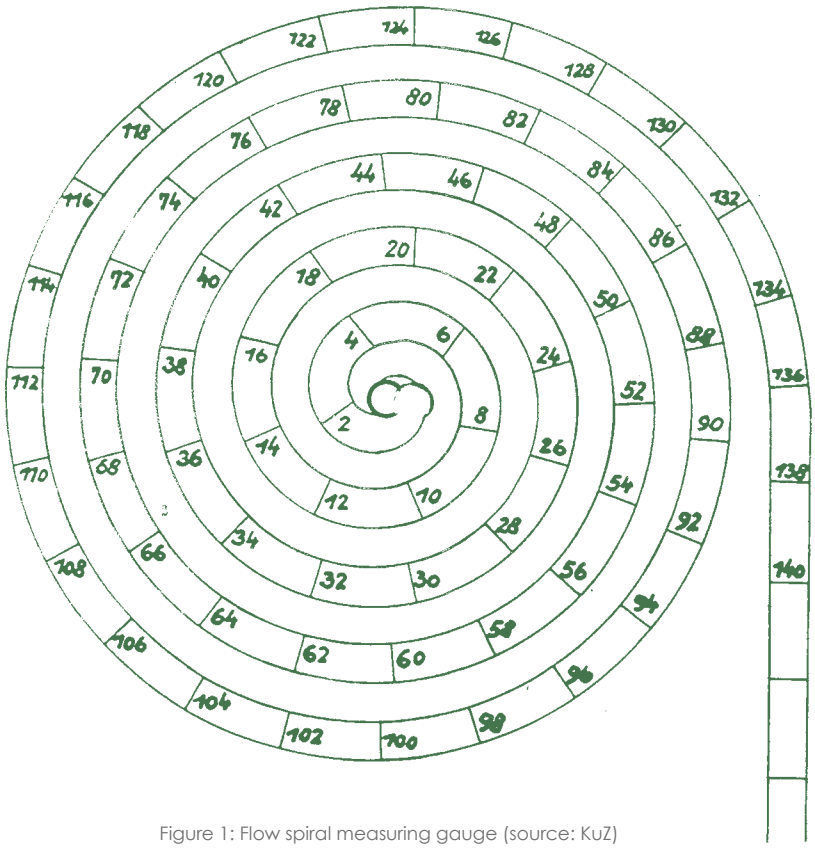


Figure 1: Flow spiral measuring gauge (source: KuZ)

Results

The best flow result was achieved with WARADUR® OP. The flow spirals with Waradur OP are longer than the reference by 17.1%. The extension in the equipment setup used with Waradur E is 6.6%.



1.0 without montan wax | 1.1 WARADUR® E | 1.2 WARADUR® OP

Figure 2: Flow spirals from PA compounds without flow aids and with WARADUR® E and WARADUR® OP

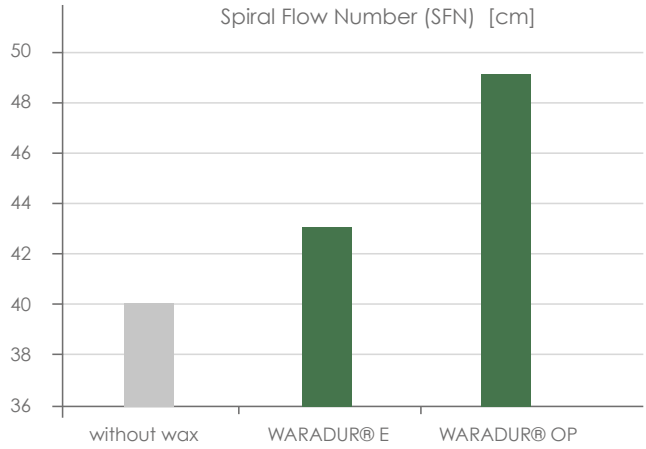


Figure 2: Systematic examination of the flow behavior by Durethan B 30 S, depending on the formula with Demag InElect 100/470-340

Conclusion

WARADUR® E, and especially WARADUR® OP, cause an enlargement of the mold content, i.e. an extension of the flow path of the melted plastic in the flow spiral compared to the reference/blank without wax.

In practice, calcium stearate is also frequently used as a flow improver. Nevertheless, according to the literature, a part of the inner gliding effect is said to trace back to the degradation of the polymer:

"Although the metal stearates improve the flowability of the melt, they often cause considerable molecular weight degradation of the polymers. Montan Wax esters and their salts improve the flowability of plastics, such as polyamides, solely through internal lubricant action, Withoutwithout reducing the molecular weight of the polymer."[1)]

1) Lit.: Pub. No.: US 2005/0038153 A1

Our previous study "POSITIVE EFFECTS OF MONTAN WAXES ON THE MECHANICAL PROPERTIES OF PA 6 GF 30" analyzed the mechanical properties of PA compounds with 0.5 phr of different lubricants. The study demonstrated, that using Ca calcium stearate a detiration of mechanical properties took place. In contrast, with WARADUR® E and WARADUR® OP a significant improvement of both the tensile modulus and Charpy notch impact strength was identified. We suppose that the a.m. montan waxes promote a better dispersion of the glas fibres. Further studies are planned to support this statement.

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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