VOELPKER | plastic series

TECHNICAL STUDY

Flame retardant

Improved dispersion

Reduced costs

Improved mechanical properties

EFFECTS OF CEVO® 3105 IN HALOGEN FREE FLAME-RETARDENT GLASS FIBRE REINFORCED PA

Achievement of the UL 94 V0 Standard and improved mechanical properties

Introduction

The following problems frequently occur in the manufacture of glass fibre reinforced, flame retardant polyamide formulations using halogen-free flame retardants:

- Foaming of the compound at the extruder head due to the shear sensitivity of the flame retardant and the associated release of hypophosphorous acid.
- As a result: partial chain degradation of the polyamide into the oligomeric range.
- Achieving an inadequate level of mechanical properties and fluctuating burning behaviour due to insufficient homogeneous distribution of the high quantities of glass fibres and flame retardant.

A well-balanced input of shear energy is undispensable in order to achieve an optimum glass fibre length distribution and a homogeneous distribution of both, glass fibres and flame retardant. CEVO® 3105 regulates the shear stress, triggered by the high concentrations, and thus protects the sensitive flame retardant from undesired decomposition during incorporation.

Moreover the distribution of the fillers has an positive effect on the mechanical properties of the final parts. The also improved distribution of the flame retardant improves its effectivity.

Results

Tab. 1: Formulations and properties

Formulation	PA6/66 [%]	Glas fibre [%]	Glas beads [%]	Exolit OP 1311 [%]	Stabiliser[1)] [%]	CEVO® 3105 [%]
1	60,4	20,0	-	18,0	0,4	1,0
2	58,4	25,0	-	15,0	0,4	1,0
3	53,4	25,0	5,0	15,0	0,4	1,0

[1)] Combination of phenolic/phosphitic anitoxidants. Alternative: copper stabilisation (100 - 150 ppm Cu); applicable mainly for black compounds.

Tab.2: Mechnical properties and flame retardancy

Formulation	MVR275 °C/5kg [cm³/10 min]	Tensile strength [Mpa]	Elongation at break [%]	Tensile modulus [Mpa]	Impact strength [kJ/m²]	Notched impact strength [kJ/m²]	UL 94 [1,6mm]	CTI [V]	GWT [° C]
1	29	115	2,9	8120	63	9,5	V0	-	-
2	29	130	2,9	9245	77	12,0	V0	-	-
3	70	130	2,9	9600	68	10,0	V0	600	960

The design of the formulations 1. – 3. enables the flame retardant to be incorporated effective – yet gently – even at a total of 30% filler amount (-> formulation 3.).
The formulations meet the requirement for a V0 classification in accordance with UL 94 and achieve a high level of mechanical properties, comparable to PA6 GF30 or PA66 GF30.
Further requirements of the electrical industry were also achieved: CTI 600 V (Comparative tracking indices of solid insulating materials; IEC 60112:2020) and Glow wire resistance 960 °C (IEC 60695-2-1).

The proportion of CEVO® 3105 can be reduced experimentally in small steps under certain circumstances, depending on the screw geometry and the frictional energy occurring in each case.

Conclusion

In the present study, it has been demonstrated, that CEVO® 3105 regulates the shear stress in PA with high filler loads and thus protects the sensitive flame retardant from undesired decomposition during incorporation. Moreover the distribution of fillers has an positive effect on the mechanical properties of the final parts. The improved distribution of the flame retardant improves its effectiveness and enables its economical and cost-effective use.

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