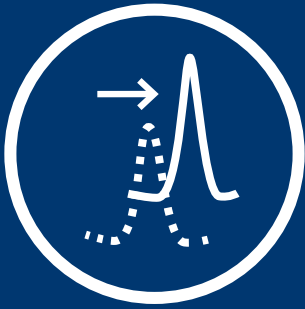


TECHNICAL STUDY



Nucleation



**Cycle time
reduction**



**Reduced
costs**



Demolding



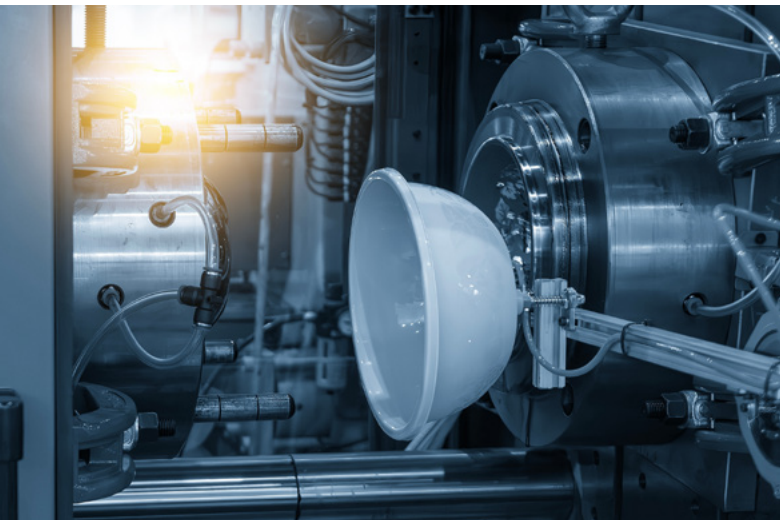
THE EFFECT OF WARADUR® OP*plus*
ON THE NUCLEATION BEHAVIOUR OF PET

Introduction

WARADUR® OPplus is a proprietary formulation based on polar montan ester wax with a particularly high proportion of calcium montante.

In the present study the crystallisation temperature of PET with 0,5 % WARADUR® OPplus has been DSC-analysed

in comparison to the non additivated polymer. The aim of the study was to demonstrate a nucleation effect of WARADUR® OPplus by increasing the PET crystallization temperature.



	Target value	Unit	Method
Acid number	< 10	[mg KOH/g]	ISO 2114
Melting range	88-114	[°C]	DSC
Solidification range	92-65	[°C]	DSC
Ca content	3,5 – 5,0	[%]	RFA

Table 1: Characteristics of WARADUR® OPplus

Test material

1. PET: Lighter C93, unfilled (Equipolymers)

2. WARADUR® OPplus (VOELPKER)

Pretreatment of PET: dried at 120 °C / 2,5 h

Test equipment

Injection molding: Arburg Allrounder 320 C 500-170

Temperature profile: 250/265/275/285 °C

Differential Scanning Calometry (DSC):
Mettler Modul: 822e/1344/500

Method: PET ASTM D 3410 40-300:

Dt 0,5 s

[1] 40 °C, 5 min

[2] 40,0..300 °C, 10,00 K/min

[3] 300°C, 5 min

[4] 300,0 °C..40 °C, -2,00 K/min

[5] 40,0 °C, 5 min

[6] 40,0 °C..300,0 °C, 10 K/min

Results

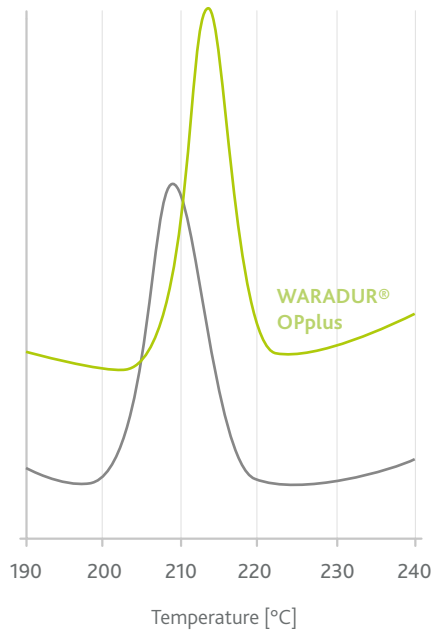


Table 2:
Shift of the DSC Crystallisation temperature PET
→ and PET with WARADUR® OPplus

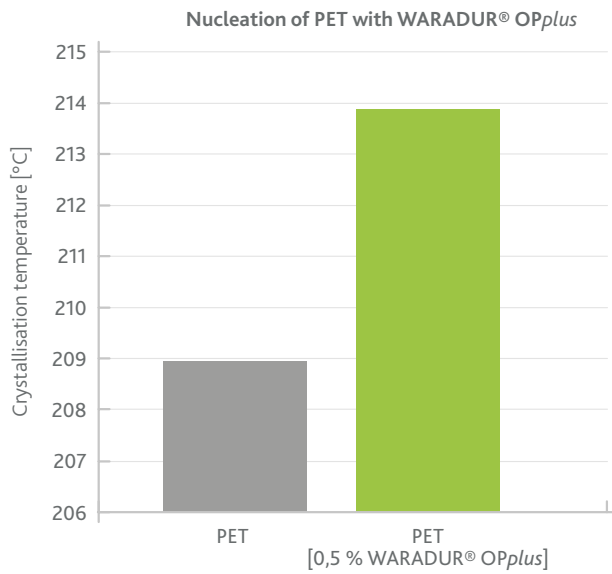


Table 4: Difference of the DSC Crystallisation temperature PET and PET with WARADUR® OPplus

Nr.	PET/PET Formulation	Solidification temperature [°C]	Solidification temperature Difference [Δ °C]
1	100 % PET	208,9	-
2	99,5 % PET + 0,5 % WARADUR® OPplus	213,7	+ 4,8

Table 3: Formulation and solidification temperature difference

Summary

WARADUR® OPplus acts as a suitable nucleating agent in PET. It can enhance the crystallization rate of PET and provide reduced cycle times in injection molding.

WARADUR® OPplus is effective at concentrations of 0.1 – 0.5 % in polyester. It exhibits additional desirable

properties for PET injection molding, for example: low volatility and favourable lubrication, mold-release and surface improving effects. WARADUR® OPplus thus contributes to improved PET processing and final product performance.

Völpker Spezialprodukte GmbH
Fabrikstraße 1 | 39393 Völpke | Germany
Tel. +49 (0) 39402 962-0
Fax +49 (0) 39402 215
application@voelpker.com
www.voelpker.com

Design: www.artfaktor.de



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