IMPACT OF THE PROCESS PARAMETERS ON THE MECHANICAL PROPERTIES OF THERMOPLASTIC VULCANIZATES

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Thermoplastic Vulcanizates

Thermoplastic vulcanizates can be classified in block polymers with hard and soft segments in the polymer chain and in polymer blends. These blends consist of a thermoplastic matrix and a non-cured (TPE-O) or a cured elastomer phase (TPE-V). In case of a TPE-V the elastomer phase is dispersed in a continuous thermoplastic phase, due to the good compatibility in most cases EPDM in PP. This morphology is generated by a vulcanization in a shear field that leads to a break up of rubber droplets. Because of the combination of polymers and the isle-matrix-morphology the blend shows elastic properties while it can be molten and processed like a thermoplastic.

Subject of this study

Beside the recipe, the material properties of TPE-Vs depend on the domain size of the elastomer which should be around 1- 2 µm. This size is naturally affected by the raw polymer properties, but also by the process conditions. In this study the impact of process parameter variation on the material properties of TPE-Vs was investigated.

Machinery, recipe and varied process parameters

A recipe based on PP and EPDM with a peroxidic curing system was used for this study which stayed unchanged. The process machine was a co-rotating, intermeshing twin screw extruder with a diameter of 25 mm. The varied process parameters were the screw configuration and the screw speed. Both parameters directly affect the mechanical energy input.
For the characterisation of the produced TPE-V samples, measurements of the tensile behaviour, oil swelling and temperature scanning stress relaxation (TSSR) were applied.

Results

The investigations clearly show that the process parameters affect the material properties of the TPE-Vs.
In general the properties deteriorate when the mechanical energy input is raised by screw speed or screw configuration. Having the theory of the relation of finer morphologies - from the process side of view achieved by high shear rates - and better properties in mind there seems to be a contradiction. Even by using the screw configuration "C" with the lowest energy input a higher shear rate by increasing the screw speed leads to worse properties.
It is obvious that beside the TPE-V - recipe the process parameters must be considered too when a TPE-V is produced and play an equal role.

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- Thermoplastische Elastomere, speziell TPE-V auf Basis von PP/EPDM
- Zweischneckenextruder, Prozessanalyse, Materialcharakterisierung