Introduction

In the multi-component injection moulding process, two components are injected sequentially or simultaneously in the mould, which results in products that consist of a layered structure (figure 1). This technique can be used to combine the various properties of different polymers in one product. Examples are soft touch (hard/soft) or recycling with a core of recycled and a skin of virgin material. The goal in the FINIMOL (an acronym for FINishing In MOuLd) project is to integrate the production of plastic parts with the finishing painting/coating step.

Under the proper injection conditions, a skin-core structure can be realised with a ratio of about 30/70. Nevertheless, the concept is only economically feasible if no more than 10% paint is used. One possible route to achieve this objective is to use a filler material in the skin that is introduced via shear induced phase separation.

Theory

Depending on the location in the two-phase region, phase separation occurs either by nucleation and growth or by spinodal decomposition (figure 2). From literature is known that polymer solutions can phase separate in the homogeneous region under the influence of shear. Two theories can be found to explain the shear induced demixing:

- An elastic term ($E_s$) is added to the free energy of mixing equation and is responsible for the shift to higher or lower (figure 4) demixing temperatures [1].
- The concentration fluctuations (figure 5) in a binary mixture in the vicinity of the phase transition boundaries are enhanced by a flow field (shear) and can lead to demixed morphologies [2].

Future works

An attempt to model the phase separation process was made by Maykel Verschueren [3]. To verify the model, a Structure Factor $S$ can be generated easily both from numerical experiments and from SALS patterns.

Furthermore the rheological behaviour of phase separating systems is investigated, mainly for the influence of the viscosity on the flow behaviour.

References: