



TECHNISCHE
UNIVERSITÄT
WIEN

VIENNA
UNIVERSITY OF
TECHNOLOGY

Institute of Materials Science and Technology

Favoritenstraße 9-11
1040 Vienna

o.Univ.Prof.Dipl.-Ing.Dr.techn. Sabine Seidler
Nonmetallic Materials

tel.: +43-1-58801-30860

fax: +43-1-58801-30895

web: <http://info.tuwien.ac.at/E308/>

e-mail: sseidler@mail.zserv.tuwien.ac.at

Doctoral Thesis Review

"Self-reinforcement of polyolefins"

presented by

Ing. Veronica Habrová

1. Currency of the topic

Low-cost polymers (commodities) with improved mechanical properties have occupied a central role in the development of polymer science and engineering. Mechanical performance factors such as strength, Young's modulus, creep resistance, fatigue life, toughness and the stability of properties with time, stress and temperature are subjects of major activities. Within this context, the search for quantitative processing – structure – property correlations for the control and prediction of the mechanical behaviour of polymers is of a great importance.

Improving mechanical properties, especially strength and stiffness is often realized by reinforcing with organic and inorganic fibres. Such composites are characterized by the expected property level, but their production and application can be accompanied by some disadvantages like raised wear in the processing machines, worse recyclability and many more. An other way is shown in the given thesis, the so-called self-reinforcement. In polymers, due to the large property reserves regarding the theoretical limits a strong property enhancement can be reached by orientation of the polymer chains.

In detail the thesis are focused on:

1. Melt-state orientation methods, esp. extrusion with a semi-hyperbolic extrusion die,
2. characterization of the resulting morphology at different structural levels with light and electron microscopy as well as WAXS, and
3. mechanical properties, determined by dynamic mechanical analysis and conventional tensile tests.

2. Evaluation of the scientific content

The work starts with an introduction to self-reinforcement. Solid-state and melt-state orientation are introduced, whereas the main focus is directed to the main topic of the work, the self-reinforcing extrusion method. From this theoretical background, the aims of the work are deduced.

Chapter 3 describes the materials, experimental methods for rheological, morphological, structural and mechanical characterization as well as the processing conditions. In spite of

the several methods this chapter is clear structured and focused on the relevant informations.

Chapter 4 summarizes the results, starting with the rheological characterization of the used materials, followed by the morphological, structural and property characterization. Why the DSC is assigned to "Property Characterization" is not clear, in 4.4.1 are mainly discussed structural aspects. On the other hand, melting temperature and heat of fusion are thermal properties, strong depending on supermolecular structure. The extrudates are characterized mainly by comparison of the common and the self-reinforced ones. This offers the possibility for a direct comparison and for showing the self-reinforcing effect. On the other hand, for example the temperature dependencies of storage modulus are not really discussed. The statement "one can say that the tensile characteristics of the self-reinforced extrudate are more sensitive to temperature changes" is not sufficient for the discussion of morphology-property correlations especially under the aspect that the used method (Dynamic Mechanical Analysis) includes a much higher information content. An other open question is: Why the differences in the temperature dependencies between L1 and L2 or L4-L11 in comparison to the common state L3 are higher than between L12 and L13-L14. At this point a stronger connection between the results of structure and morphology characterization would be desirable.

In the closing Chapters 5 (Conclusions) and 6 (Contribution to the Science and Practice) the main results are summarized in a very good way.

All formal standards on a PhD thesis are fulfilled.

3. Appraisal

The reached results demonstrate regarding their expressiveness related to the correlation processing – structure formation – properties a clear increase in knowledge. Ing. Habrová has been proved her qualification for independent scientific comprehension of theoretical results and their further development. With that, all requirements on a doctorate are fulfilled.

I recommend the thesis for presentation.



Vienna, 08.10.2006

S. Seidler

o.Univ.Prof.Dipl.-Ing.Dr.techn.