

Opponent's review of the doctoral thesis

Candidate: Sari Panikkassery Sasidharan

Title of the doctoral thesis: Application of Plasma Modified Polyethylene in Composites with Natural Materials

Branch of Study: Materials Engineering

Supervisor: Prof. RNDr. Petr Špatenka, CSc.

Opponent: Prof. Ing. Josef Steidl, CSc.

Topicality of the problem solved

The research performed by the candidate is highly topical, it follows new trends in polymer composites science. The basic task solved in the doctoral thesis is the effect of plasma treated polyethylene on the properties of its mixture with another polymer or reinforcing fibres. The critical problem is interfacial bonding. Plasma treating seems to be an effective method of how to enhance adhesion capabilities of nonpolar polyethylene. Over the last decade, the economic, environmental and renewability aspects have encouraged the emergence of new polymer matrix composites with natural fibres. It creates a new domain in materials engineering. Plasma treated polyethylene with coir fibres has been selected for experiments. As a second experimental material, natural rubber filled with polyethylene has been studied.

Fulfilment of the objectives

The objectives of the dissertation are focused on two material areas which seem to be rather ambitious and somewhat inconsistent. Namely, the thesis deals with the role of polyethylene as a matrix of coir fibre composite and on the other side as a filler to natural rubber. Research has also been focused on several processing technologies. Nevertheless, all individual objectives outlined in the thesis can be evaluated as fulfilled.

Research methods and procedures

A large number of experimental techniques have been used for characterization of the structure and properties of prepared materials. Suitable procedures were chosen for the evaluation of specific properties of the materials studied. It is not justified what is the idea and aim of adding plasma treated polyethylene with polar groups to nonpolar polyisoprene (NR).

Results of the doctoral thesis and dissertant's specific achievements

As regards the scientific level of the thesis, several notable advances have been made. Most of the results have already been processed in the form of publications. All of them contribute to the development of polyethylene miscibility with natural types of fibres and as the case may be with natural rubber.

Importance of results for practice and branch of science

The thesis brings results usable for applications of natural fibre/polymer composites in the industrial sector and it offers new and useful knowledge to modification of natural rubber for advanced applications. The results contribute to the expansion of polymer and composites material concept.

Formal layout of the thesis and language level

The thesis suffers from a number of formal drawbacks, e.g. publications of the candidate are not cited according to bibliography standards, some of the pictures in the theoretical part are not cited, some photos are not comparable owing to different magnification (Fig.2.6). Fig. 2.8 is fully unclear. It is useless to describe general principles of plastics processing. There is a mismatch in citations of figures, e.g. citations [60] in the text are designed as [2] in the list of figures. Brief synthetic conclusions, without repeating what has been done, is missing. The structure of the thesis is not compact. The supplier of polyethylene is missing.

Remarks and questions for the defence

What is the idea and aim of adding plasma treated polyethylene with polar groups to nonpolar polyisoprene (NR)? Where individual experiments and technologies were carried out?. Was the rotomolding grade of polyethylene used for injection molding? The reason for coir selection? What is the difference in properties between composites containing alkali treated and hydrogen peroxide treated coir fibres?

Final assessment

The submitted doctoral thesis follows recent research trends in natural-fibre composites. It includes a number of original and already published results or results submitted to publication. It gives rise to new suggestions for the future research and development of perspective natural fibres as a reinforcement for composite materials with polymer matrix. In summary, the thesis of the candidate meets the scientific criteria for doctoral thesis. On condition of a successful defence of doctoral thesis, I recommend to award the Ph.D. degree to the candidate.

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