Technical University in Liberec

Opponents review for the degree of Doctor of Philosophy defence

Candidate: Hafsa Jamshaid, M.Sc.

Thesis title: Hybrid woven structures

Thesis tutor: Doc. Rajesh Mishra, Ph.D.

Study subject: Textile Engineering/Textile Technics and Materials Engineering

This opponent’s review was written based on request of Ing. Jana Drašarová, Ph.D. – dean of the Faculty of textile, ref. no. TUL-16/4814/029198 of August 8, 2016.

General information: Thesis is composed from 5 chapters and 2 appendices, total volume of 160 A4 pages. Thesis structure is based on commented individual chapters dealing with the introduction, definition of the objectives, state of the art of the matter under study, experimental, results and discussion, summary and conclusions. Totally there was cited 139 references. Thesis were written in English language.

1. The nature and the scope of the investigation: The thesis presented deals with interesting scientific and technical problem of application and processing and manufacturing of basalt hybrid fabrics for technical application in the construction industry. The thesis presented is of applied materials engineering nature. The main objectives of the study were to analyse the weavability of the basalt hybrid fibres, to predict structural and mechanical properties of the fabrics manufactured by means of geometrical/computational tools, to characterize the effect of weave and fibre composition on mechanical, thermal and functional properties of the studied hybrid basalt textiles, study thermomechanical characteristics of the latter systems, their acoustic performance as well as their resistance against accelerated ageing conditions. Finally the compatibility study of the latter systems with the cement compositions were performed as well.

2. The contribution made to the subject field, including the extent to which the thesis contains original, publishable work or merit: Obtained results are the original contribution to the studied problem of novel type of composite structure preparation and manufacturing and their material characterization. Author in her thesis has vigorously analysed and compared wide range of physico-chemical and material characteristics and their mutual dependences. Thesis represent complex experimental study with excellent theoretical data evaluation and analysis. Results obtained by the applicant’s study brought a new valuable knowledge to the applied materials science and engineering study field. Student has published majority of the results in prestigious scientific journals of the materials engineering/ materials science and textiles materials scientific orientation, to name a few such as J Textile Institute (2 publications, Q1), Fibers and Polymers (2 publications, Q2, Q3), Polymer Composites (1 publication, Q2) which were already published in international scientific journals. Two manuscripts are under review consideration. Applicant has attended many scientific conferences were she has presented her results in 17 contributions, 9 book chapters. Majority of the papers has successfully passed through vigorous review process in the journals, where the papers were published.
3. **The quality of the submission and, where appropriate, of the investigative work described:**
Presented Ph.D. thesis is of usual quality standard both in content as well as in form of presentation and data analysis and interpretation. I have found several formal stylistic and graphical errors such as too small axes legends and numbers in many figures in the text, wrong averaging of the obtained data as using too many valid digits etc. However this is not lowering an overall high standard of the thesis. That is why I am fully supporting submission of this thesis as a base for final examination. Ph.D. thesis presented fulfils usual quality requirements for PhD thesis.

Signed: Prof. Ing. Lubomír Lapčík, PhD.  

Date: September 2, 2016
Opponent's review of the PhD thesis

PhD student: Hafsa Jamshaid, M.Sc.

Title: Hybrid woven structures

The submitted PhD thesis in the range of 160 pages of text is rich in content, formally clearly arranged and carefully prepared with high graphical level. Also factual formulations and technical expressions contribute to the level of the work. Furthermore, a purposeful arrangement into 5 chapters that logically follow each other is the positives of the work.

The subject of the thesis is examination and design of hybrid woven fabrics intended for the production of composite materials. These are, in this case, concrete matrices with textile reinforcement. It is assumed that the basic component of the textile reinforcement will consist of basalt fibers or fibrous bundles and the hybridizing component of PP, PET fibers and jute.

The aim of the thesis is to describe the influence of hybridization and fabric structure on the physical and chemical properties of the composite reinforcement. It is studied and assessed with the help of experiments and the results are confronted with computer models in some cases.

In initial chapters, there is carried out an extensive and careful research of state of the art, importance of hybrid components, their structures and properties. The chemical, physical, mechanical static, mechanical dynamic, electric, thermal and acoustic parameters determining the properties of composites are depicted in detail. Furthermore, the available means for modeling the properties and measurements of particular parameters of the composite reinforcement are presented.

The executive part of the thesis starts with the choice of samples of the reinforcement for experimental analysis. As a manufacturing process, it is determined weaving, plain, matt and twill fabric structure, basalt as a material of the reinforcement, alternatively combined with PP, PES and jute. The arguments supporting just this selection along with the prediction of the expected changes in the properties and effect of the product could be defined in a more explicit form. When comparing with the extensive array and number of tests, the number of samples, particularly in terms of changes and combinations of thread parameters, is somewhat insufficient to obtain convincing results (thread fineness 250-280, thread densities not shown).

Experiments and their results:

The tests of weavability have been carried out on the CCI (sampling laboratory equipment) and on a weaving machine. The protocols show that the final outcome of those tests is the coefficient of efficiency (KTE). From the perspective of the CCI at the speed in an order of tens of min⁻¹, the evaluation of KTE is illusory. From the viewpoint of the weaving machine, the values of KTE in the range of 40-70% are unacceptable for the practice. A fortiori that this is a net KTE, involving only downtimes liquidating weft, warp and machine failures and by the fact that the fabric quality was not assessed simultaneously. In the description of the weaving tests, I have not found any mention of particular weft and warp densities.
The parts Characterization of fiber and cement raw, Accelerated aging in alkaline solution and Yarn pull out test from cement matrix, are processed in accordance with the procedures from the cited sources.

Another part of the work deals with the testing of fabric samples. Physical properties, i.e. real densities, basis weight, thickness and porosity are evaluated on the basis of standardized procedures. The tests of static mechanical parameters, tension (stress), elongation, pressure, and shear are complemented by predicting values of tension using simulation in SW Wisetex. The object of investigating the dynamic properties of the samples is essentially damping whose significance in the hybrid reinforcements is greater in polymer materials than in basalt. Damping coefficients are evaluated for all the samples depending on temperature.

Thermal and transmission related properties are evaluated by measuring on an Alambeta apparatus, acoustic properties are characterized by the SAC coefficient (sound absorption) and the NRC (noise reduction). The NRC has been associated with air flow resistivity and fabric porosity.

All experiments are carefully documented and evaluated. Laboratory equipment and technological processes as well.

The evaluations of the work results and the conclusions are relatively brief. Their validity and importance will be usually only applied within the study of individual parameters. With regard to a wide definition of goals of the work and to examining a considerable number of mutually different parameters selected from several disciplines, an expectation of generalized results and a definition of directions for innovations is difficult. The only, but expected, generalized result is an increase in the strength and rigidity of the composite with basalt fibers and vice versa, a decrease in the strength and an increase of elongation using PP and PET fibers.

Comments on the work:

1/ The coefficient of technical efficiency of the weaving machine is very low. Explain the causes and suggest measures for its increase.

2/ The set of the evaluated parameters is so diverse and extensive that it can be difficult to analyze it and to determine which combination of input parameters can provide, if not optimal, at least a rational solution of the quality of the composite product. Would it not be more effective to choose to study a smaller number of dominant and interrelated parameters?
Conclusion

The PhD thesis fulfills the set goal and contributes to solving the current and important problems in the development of hybrid reinforcements for concrete matrices.

The PhD thesis corresponds to the generally recognized requirements for granting the academic title of Ph.D.

I recommend this work for defense without reservation.

Prof. Ing. Miroslav Václavík, CSc.

VÚTS, a.s., Liberec

Liberec, 6.9.2016
Opponent's Assessment of the Doctoral Dissertation

Doctoral Candidate: Hafsa Jamshaid, M.Sc.

Dissertation Title: Hybrid woven structures

On the basis of appointment by Ing. Jana Drašarová, Ph.D., Dean of the Textiles Faculty of Liberec TU, I prepared this opponent's assessment of the doctoral dissertation.

The submitted dissertation contains the total of 155 pages. Of this text, the actual text comprises 133 pages. The dissertation is divided into five connected chapters, including the introduction and conclusion. The chapters are further broken down into sub-chapters. The dissertation has been prepared responsibly and without any significant terminological errors. The written text is supplemented with 31 tables and 66 images.

The structure of the dissertation is as follows: The current status is stated in the introductory part of the dissertation. The student when processing this part exploited scientific papers, professional books, collections of conference papers, publications from prestigious international scientific magazines. The information is corroborated by suitable references stated in the bibliography. The next part of the dissertation discusses the contribution of the doctoral student. The third chapter deals with the preparation of material for measurement and its realisation. It describes the methods applied to prepare the material samples. It further states the methods applied to the measurement of the selected textile structure parameters. The fourth chapter focuses on analysis of the measurement results and their discussion. The fifth chapter summarises the results of the author's dissertation. The conclusion is followed by the bibliography showing the list of the author's publications related to the research task and the list of publications, which were used during the research task.

Overview of Doctoral Dissertation Objectives

The objective of the dissertation is already clearly defined by its title. The selected dissertation topic fully corresponds to the scientific branch and field of study, in which the dissertation is submitted. The objectives are stated immediately in the dissertation introduction and are summarised into seven areas:

- To analyze the weavability problém during production of basalt hybrid fabrics.
- To predict structural parameters and mechanical properties by using suitable geometrical/computational tools and verify the predictability.
- To investigate the effect of weave and fiber composition on mechanical, thermal and functional properties in basalt based hybrid woven structures.
- Study of thermo-mechanical characteristics of basalt hybrid fabrics.
- Study of acoustic properties of basalt hybrid fabrics.
- Study of durability under accelerated aging conditions.
- Compatibility study of basalt and other yarns with cement.

In my opinion, all the objectives are not balanced in terms of their importance and their fulfilment for the main objective's successful completion.
Opinion on the Up-to-Date Character of the Dissertation

The development of new material structures, which can become full-fledged material for industrial applications and fulfil the ever-increasing requirements for physical mechanical properties, are a worldwide trend. This research work is based on an interdisciplinary approach, which combines knowledge of physics, chemistry, material research, etc.

The dissertation is set in the framework of the current thinking of engineers on materials for industrial applications. On one hand is the application of conventional materials where emphasis is placed on precision processing, and on the other hand, on conventional materials whose properties can be modified by completely different technological procedures other than those applied to conventional materials. The common objective of both are new technical solutions that bring new utility parameters. The interpretation of the procedures, which lead to the design and optimisation of construction from a hybrid material structure, must be classified into the area of non-conventional materials. This makes the topic really current. Besides this, it is necessary to highlight the current character of the research methods applied in this dissertation.

Opinion on the Solution Procedure and Applied Methods

For solution of the issues stated in the doctoral dissertation, the methods applied have been selected correctly. The solution procedure is logical and systematic. In the introduction, the author formulates the objectives of her dissertation, which she gradually fulfils in subsequent chapters. The applied procedures and methods completely meet the requirements, although they are inadequately specified at several points.

Achievement of the Results and Objectives of the Dissertation

I see the dissertation author’s actual contribution mainly in the dissertation’s practical part. It mainly concerns the preparation of samples for measurement, and its performance and evaluation. All these activities brought new knowledge and procedures. The above-stated conclusions of the presented dissertation’s individual chapters prove that the main and partial objectives set forth in the dissertation were achieved.

The Dissertation’s Formal Processing

The dissertation is also a success in terms of the formal aspect. The text is comprehensible. Many professional resources are used in the dissertation, to which references are made in the text. The images, graphs, and diagrams are demonstrative and properly legible. The opening part of the dissertation that provides information about the current position is unnecessarily extensive. It often features information that is generally known, which does not give any added value to dissertation’s quality.

Suggestions and Problematic Areas
I do not have any major suggestions regarding the presented dissertation, but during the defence of the dissertation, the student should express her opinion regarding the following areas:

- To which type of a loom do the setting parameters expressed in the dissertation apply (Section 4.1.1)? What is the probability of application of the parameters you have set here for another type of a loom?
- Have you considered how recycling of material made in this way shall be done?
- Explain your reasons for stating the production efficiency of the material sample production used in the measurement at the CCI machine (Table 3.2)? Does stating the efficiency make sense in this case?

Conclusion

The doctoral student has proven that she mastered the scientific work methods and possesses corresponding knowledge in the researched area. According to the bibliography, it is clear that during her studies, she continuously published the results of her research work both at scientific conferences, as well as in the form of magazine articles. She published a significant part of her scientific works in foreign magazines listed in the WoS or Scopus databases. It is necessary to emphasise that part of the articles were published in magazines with an impact factor. This fact proves the student’s capability to formulate and present achieved results to the scientific and professional community. From the submitted dissertation, it is clear that the published materials have the character of original solutions.

I recommend acceptance of the doctoral dissertation titled Hybrid Woven Structures for defence and in the event of successful defence, I recommend awarding of the Ph.D. academic title.


Doc. Ing. Martin Bilek, Ph.D.

Technical university of Liberec