Review

Dissertation of

Muhammad Usman Javaid

called

Knife Stabbing Resistance of Woven Fabrics

Liberec, 29th July 2019 *written by: doc. Ing. Lukáš Čapek, Ph.D.*

1. Introduction

The thesis has 103 pages comprising graphs, figures and tables. The appendix contains the bibliography and author´s scientific articles aiming to the topic of the work. The work has six chapters that contains introduction following by independent research topics. The principle goal of the work is to get a knowledge how woven fabric behave against change orientation of knife stab and according to this knowledge increase the resistance properties of selected woven fabric by changing the friction behaviour of individual fibres.

2. Comments to originality and aims of the work

The stab resistance of different textile fabric is a current topic with importance regarding the increasing number of stab attacks worldwide. From the scientific point of view, the topic is still open with many unsolved tasks. The aims of the work are well described in the chapter two. However, the scientific hypotheses are missing. My opinion is that the scientific work should have hypotheses. If not, it decreases the work to a general engineering issues.

3. Comments to the state of the art and methods used in the work

To my opinion the state of the art is insufficient. There are much more articles dealing with stab resistance (AND/OR) textile fabric following standard scientific article websites. Some of them are marginal, but some of them are completely focused on the same topic. Namely the PhD thesis of Priscilla Reiners focused on Investigation about the stab resistance of textile structures, methods for their testing and improvements could not be skipped in this work.

The work flow of used methods is well described in figure 13. I really appreciated it. The standardized tests are well described and there is no need for comments. On the other hand, the individual yarn cutting resistance experiment is not described well. It is not clear how the experiment was done. The figure 22 is misleading and there is no description what letters in the figure mean.

Questions to author:

1) Explain the individual yarn cutting resistance experiment. Mainly focus how you get outcomes from this experiment (force and energy).
2) Can you explain why you provided the air permeability and surface feel properties measurement? How these experiments are linked to your topic?

4. Comments to results

It is evident that the author provided a large number of experiments. Unfortunately, regarding the number of experiments, the results are not well described.

Questions and comments to this section:

1) Why you start your results with your last experiment?
2) Can you explain why there is so high scatter in your results for neat fabrics and so low for treated one (Fig. 28)?
3) Figure 41 – what means best of various samples?
4) Page 59 – "….QSKPR increase linearly with the increase in amount of SiO_2…". I cannot see it from fig. 40. Can you prove it?
5) Page 62 – why you make conclusion from experiment on sketch? How can one believe it? Can you prove it on images gained from experiment? Is the knife really sliding on the surface of the fabrics?
6) Page 63 – what do you mean by the expression "plastic deformation"?
7) Page 63 – what is the meaning of sentence "The ultimate tensile strength of yarns removed from different fabrics…"?
8) Page 68 – figure 47 – units on vertical axis is missing.
9) Regarding comment 1 above in methods, can you explain the results in 5.9 more deeply?

5. Overall decision

I invite the author to answer my questions during the defence of the work.

I recommend the work for defence

(Doporučuji práci k obhajobě)

doc. Ing. Lukáš Čapek, Ph.D., v.r.

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Posudek disertační práce

Uchazeč Muhamad Usman Javaid

Název disertační práce Knife stabbing resistance of woven fabrics

Studijní obor Textile Engineering

Školitel Ing. Jana Salačová, Ph.D.

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Aktuálnost tématu disertační práce

komentář: Scientific relevance of the submitted work

The present thesis is focused on the applicability of Aramid fiber based woven fabrics to provide protection against knife stabbing. Unlike ballistic protection armor, which has been at the engineering forefront for many years, the protection armor against sharp objects such as knifes has received less attention. There is no doubt that personal protection against such attacks plays an important role and as such the selected topic is up to date and certainly deserves attention.

☐ vynikající	☒ nadprůměrný	☐ průměrný	☐ podprůměrný	☐ slabý

Splnění cílů disertační práce

komentář: Goals of the work and their achievements
The main research objectives are clearly stated in Chapter 2. They arise from a literature survey given in Chapter 1 and particularly from the state of the art Chapter 3, which in my opinion should be part of the introductory section thus preceding Chapter 2. One may identify two principal research directions aiming (1) at improving the yarn internal friction by suitably modifying the fiber surface while not reducing the comfort properties and (2) at investigating the influence of stabbing angle with the goal of providing the most optimal layup of several fabric layers. It is clear from the overall summary provided in Chapter 6 and in particular from Chapter 5 presenting a thorough discussion on the results of extensive experimental program that all goals were successfully achieved.

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Metody a postupy řešení

komentář: Treatment of the topic - methodical and conceptual approach

The methodical and conceptual approach is described in Chapter 4 presenting individual approaches to the fabric surface treatment as well as the experimental program. For the sake of clarity I would split this chapter into separate chapters combining the material section and surface treatment in one while presenting the actual experimental program devoted to the stabbing resistance measurement in a separate chapter. It might be the lack of my knowledge, but I found some parts a bit unclear. The following items might be addressed during presentation:

1. Section 4.2.2.2 - please explain how the strain of each yarn before rupture was measured.

2. Section 4.2.2.3 - it is not clear to me with respect to what direction the KPA was measured

when assuming 8 sheets in Fig. 20(c) with 45 stacking sequence.

3. Section 4.2.5.3 - it is not clear to me how the bending experiment was performed for the fabric. Neither the sample size is mentioned nor is the measurement of bending angle. The force unit [gf] is also not a standard force unit. Please provide the relation to [N].

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Výsledky disertace - konkrétní přínosy disertanta

komentář: Thesis results - author's specific contribution

The principal outcomes of the theses can be extracted from Chapters 5 and 6. The author clearly identified the most optimal treatment of fabric surface, pointed out some dead ends such as the surface modification by Titanium dioxide and thoroughly described the influence of stabbing angle on the stabbing resistance. Unfortunately, similar to Chapter 4, there are some issues which need some explanation. These include:

1. Table 10 – what is the reason for reducing the thickness in treated fabrics compared to a Neat fabric? Are these fabrics stretched during treatment? This might certainly have some impact, e.g. on bending rigidity. Please make a comment on that.

2. Table 11 – what type of fabric these results refer to? There is no comparison between treated and untreated fabrics.

3. Figure 33 – it is not clear what KPA the plotted results refer to.

4. Figure 35 – it is not clear to what percentage of WG the results refer to.

5. Figure 36 – I suppose the notation 2ZS4 refers to the last read square only. How about 20% WG, does that mean 2ZS3? Please explain.

6. Section 5.12. Do I understand correctly that the effect of stacking sequence has been examined for the untreated fabric only? Why not for the treated fabric as well. That I would found more important. Or perhaps I am missing something. Please make a breaf comment on that.

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Význam pro praxi a pro rozvoj vědního oboru

komentář: Extent of new knowledge and contribution to the practice

The thesis ceratinly shed light on a number of specific issues concerning the protection armor againts sharp objects. But I am not an expert in this field so I suggest the author to give, during the thesis defense, his own opinion on a potential applicability of the proposed surface treatment in practice.

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Formální úprava disertační práce a její jazyková úroveň

komentář: Organization of the work and overall comprehensiveness

The thesis are written in good English with only few grammatical errors. It is well structured and easy to follow. The only source of criticism is associated, as already mentioned, with insufficient explanation of some procedures, variables or figures. The author should put more attention to that when extracting a journal paper from the presented results. But even this drawback does not reduce significantly the thesis high standard.

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Připomínky

Comments:
Apart from comments raised already in the review sections "Treatment of the topic" and "Thesis results" the following questions might be addressed in more details:

1. Can you please comment on a relatively high variability in bending rigidity observed in Fig. 28 for Neat fabric in comparison to treated fabrics?
2. Section 5.12.5 - please make a brief comment on the last sentence. In particular, what would be your approach to the optimum design?
3. Section 5.13 - please make a brief comment on the last sentence. In case of QSKPR you promote the 450 angle as most efficient in comparison to other SAs. So how is this related to the requirement of a small stacking angle in case DSR? How about zero degree angle?
4. Should we be concerned with material aging, i.e. degradation of properties of treated fabrics with time? How about the effect of temperature?

Závěrečné zhodnocení disertace

Final statement:

Based on the submitted review, consisting of an assessment of the scientific relevance, fulfillment of the goals of the work, the quality of treatment of the topic and the extent of new knowledge, it is concluded that this work meets high quality standards.

As it complies with the requirements for a Ph.D. work, I recommend the thesis for further defense and if successful to appoint Mr. M.U. Javaid the title

doctor (Ph.D.)

Doporučuji po úspěšné obhajobě disertační práce udělení titulu Ph.D.	***ano*** ☒	***ne*** ☐

Datum: 24.7.2019

Podpis oponenta: M. Py