

Assessment of PhD Thesis

Aspirant:	Promoda Kumar Behera, M.Sc.
Thesis title:	Influence of High Temperatures on Properties of Geopolymers Filled by Inorganic Fibrous Particles
Specialization:	Textile Technics and Materials Engineering
Supervisor:	prof. Ing. Jiří Militký, CSc.
Reviewer:	doc. Ing. Antonín Potěšil, CSc.

Topicality of the thesis					
Comment: The topic of the presented dissertation is undoubtedly up-to-date and it respects current innovative trends towards the development, manufacturing and use of alternative environmental materials which could be applied in industrial applications. The goal is to decrease the devastation of non-renewable natural resources.					
excellent ¹	above standard	<input checked="" type="checkbox"/>	standard	substandard	weak

¹ Mark selected with a cross

Meet the objectives of the thesis						
Comment: The present work clearly describes and clarifies approaches to the preparation and testing of metakaolin-based geopolymers filled with basalt and recycled carbon particles. The author is aware of the limits and limitations of their industrial use. After studying the work as a whole, it can be stated that the defined goals of the work and PhD students intentions were fulfilled.						
excellent	above standard	<input checked="" type="checkbox"/>	standard	<input checked="" type="checkbox"/>	substandard	weak

Methods and solutions						
Comment: Standard test methods, procedures and measuring devices (SEM, EDS, Image analysis, XRD, TGA, temperature and mechanical test, etc.) were used to characterize the properties of students created geopolymer structures.						
excellent	above standard		standard	<input checked="" type="checkbox"/>	substandard	weak

Results of the Thesis - specific benefits of the student

Comments:

The main contribution of this work is the comparison of selected physical and especially mechanical properties of several geopolymers filled with basalt (VEBA Industries) and recycled carbon particles (Easy composites, UK).

Valuable information for the use of made geopolymers is especially data about material failure of geopolymer structures - destruction in compression. However, it is worth noting that the work is devoid of the deeper theoretical mechanics foundations of composite materials, which geopolymers undoubtedly are. Reported results of experimental findings do not always contain otherwise usual statistical processing.

excellent	above standard	X	standard	substandard	weak
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Significance for practice and for the development of the scientific branch

Comments:

The work presented is a good starting point for further research and development activities in the field of use of these geopolymers types in various industrial applications. That being said corresponds with student current publishing activities.

I recommend the follow-up work be oriented deeper into the theoretical areas of geocomposite materials physical properties both regard to following processing technologies in the production and their industrial applications in a specific sense.

excellent	above standard	X	standard	substandard	weak
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Formal layout of the Thesis and its language level

Comments:

The work has a logical division, the text is understandable, the Czech version of the abstract text has minor editing errors, but does not spoil the overall impression of the work.

excellent	above standard	standard	X	substandard	weak
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Comments and questions

1. What methods were used to determine the volume fractions of particulate fillers and matrix (metakaolin) in geopolymer samples? Please state the relationship between the weight and the volume part of the filler and geopolymers matrix structure.
2. In terms of continuum mechanics, geopolymer materials should generally be considered as composite structures exhibiting anisotropic properties, so-called geocomposites. What approaches are used to describe the relationship between stress and strain, which makes it possible to use modern simulation tools (CAD)?

Final evaluation of the Thesis

Based on the preview above I recommend the thesis submitted for defence in front of the scientific committee for the defence of the doctoral thesis.

I recommend after a successful defence of the dissertation grant Ph.D.²

yes

~~no~~

² Delete where applicable

Place and Date: In Liberec 20.12.2019



Signature: Antonín Potěšil



Posudek disertační práce

Uchazeč Promoda Kumar Behera

Název disertační práce Influence of High Temperatures on Properties of Geopolymers Filled by Inorganic Fibrous Particles

Studijní obor Textile Engineering

Školitel Prof. Ing. Jiří Militký, CSc.

Oponent Prof. Ing. Michal Šejnoha, Ph.D., DSc.

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Aktuálnost tématu disertační práce

komentář: Scientific relevance of the submitted work

The present thesis is focused on the evaluation of the effect of high temperature on metakaolin based geopolymers modified by inorganic fibrous particles. Given its potential application as a replacement of OPC based mortar thus reducing the negative environmental impact by both the reduction of CO₂ emission and exploitation of waste material, the alkali activated cementitious materials have enjoyed a considerable attention in the last decades. However, the use of these binders in large scale engineering applications is still an open question and much research is still needed. The presented study is another promising fragment in this endeavor and the achieved results certainly deserve attention.

☐ vynikající ☒ nadprůměrný ☐ průměrný ☐ podprůměrný ☐ slabý

Splnění cílů disertační práce

komentář: Goals of the work and their achievements

The research objectives are stated in Chapter 2. Concentrating on metakaolin as one particular source of aluminosilicate for geopolymer preparation I find reasonable, since it made the thesis compact and allowed for achieving all the goals stated. This is evident from Chapter 5 summarizing the principal outcomes of a very broad and diverse experimental program. Their choice is also supported by a detailed state of the art section and literature survey presented in Chapter 3, which shows a good orientation of the candidate in this field.

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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 outlining the experimental program carried out in the course of this thesis. While the program is rather broad, its theoretical description is quite brief particularly for a reader not familiar with the subject. In most cases, the number of specimens is either not mentioned or the selection of a particular number is not explained. For example, from Section 4.10 it is not clear, whether the experiment was run in a stress or displacement controlled regime. One may only guess from the presented results that

the latter approach was adopted. When discussing the results the author quite often refers to the available literature suggesting similar observations. But no direct comparison is provided. So a non-experienced reader may just take these conclusions for granted. For example, the discussion on thermal stresses is rather difficult to accept if the mismatch in coefficients of thermal expansion of geopolymer and fibrous particles is not provided. This I find as the principal thesis shortcoming, which slightly pollutes otherwise interesting research activities.

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Výsledky disertace - konkrétní přínosy disertanta

komentář: Thesis results - author's specific contribution

The principal outcomes are summarized in Chapter 5. Regardless of the above comments the results show a positive effect of fibrous particles over the neat samples with carbon particles appearing slightly more advantageous in comparison to basalt particles.

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Význam pro praxi a pro rozvoj vědního oboru

komentář: Extent of new knowledge and contribution to the practice

The thesis certainly shed a light on a number of specific issues concerning thermal behavior of geopolymer based composites. 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 particularly in conjunction with large scale engineering applications such as prefabricated concrete elements.

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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. If leaving out too brief description of individual experimental measurements, the thesis are easy to follow and the results are clearly explained. However, in my opinion it might be beneficial to present some of the results of both composites within the same tables or graphs. Also, some of the general conclusions are not always fully supported by the presented results, e.g. the mentioned increase of hardness of CMF based composites with increasing amount of particles over of the whole range of temperature, see Table 8. The results for 800 0C of BMF composites in Table 7 are missing.

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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. Please explain what the difference between W_i and W_a in Eq. (1) is.
2. Please check Eq. (2). I suppose the temperature should be replaced with BMF(CMF)%.
3. Table 7: Why there is such a huge drop in hardness for G samples from 200 to 400 C?

4. Table 8: Please explain the increase in hardness for 15% CMF composite from 200 to 400 C. Perhaps this is an error.
5. Could you please plot the stress strain curves for both composites on the common graph to support the last sentence on page 56 and the first sentence on page 57?
6. Please explain the drop in weight for BMF composites in Fig. 33(a) not seen for CMF composites.
7. Please provide the coefficients of thermal expansion for individual phases in BMF and CMF based composites. I expect some mismatch which might generate excessive local stresses. In this regard, the last sentence on page 61 is not clear to me. Please explain.

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. P.K. Behera the title

doctor (Ph.D.)

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

Datum: 17.12.2019

Podpis oponenta: 