

Review of the Doctoral Thesis

“Prestressed Fibre Reinforced Composites: Manufacturing and Mechanical Characterisation”

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The work focuses on a highly current approach towards minimizing process-induced residual stresses through elastic fibre prestressing in carbon fibre reinforced polymer laminates (CFRP). Compared to other methods used to reduce process-induced residual stresses, such as embedding shape memory alloys, using expanding monomers, or incorporating nano-additives, this method offers a cost-effective solution applicable across a wide range of fields, from aerospace, marine, and automotive systems to civil engineering and beyond. In this context, the presented Doctoral Thesis concentrates on: (i) the design of a custom fibre prestressing jig, (ii) the design and manufacturing of elastic fibre prestressed CFRP composite laminates with unidirectional and cross-ply stacking configurations, and (iii) mechanical, thermal, and electrical evaluation of both prestressed and non-prestressed CFRP composite laminates. Some of the presented results have already been published in peer-reviewed journal, while others are likely to be published soon. It would be appropriate to specify which results have already undergone peer review and which have not yet. Nevertheless, this does not diminish the quality of any of the results presented in the Doctoral Thesis.

The Doctoral Thesis is written as a monograph and consists of about 138 pages, referring to respectable number of 176 sources. The Doctoral Thesis consists of usual sequence of following chapters: *Acknowledgement*; *Czech and English summaries*; *Introduction* to state-of-the-art; *Aim and Objectives*; *Experimental part* divided into methodological, results and discussion sections; *Conclusions of the Dissertation*; *Contribution to Knowledge*; *References*; *Lists of Figures, Tables and Abbreviations & Symbols*; *List of Candidate's Publications* and *Professional Curriculum Vitae* of the Candidate. The scope of the individual parts is

appropriately selected in the context of the type of work in the form of a monograph for a Dissertation.

This Doctoral Thesis further extends the long-term research devoted to composite materials of the group of the supervisor (assoc. prof. Rusnáková). The added value of the dissertation can be seen not only in the approach towards minimizing process-induced residual stresses through elastic fibre prestressing in CFRP composite laminates, but also in the relatively in-depth electrical conductivity analysis in both, DC and AC field, which is new to this group.

The Thesis is written in appropriate English, when the Candidate demonstrated the ability to present a professional text in a clear manner as a co-author of four review articles on topics related to the focus of the Dissertation itself. From a formal point of view, one can only point out the unnecessary reintroduction of abbreviations and the failure to consistently align equations to the centre of the line.

During the Doctoral Thesis defence, the following questions may be discussed by the Candidate:

1. Could the Candidate comment on the potential impact of improved fibre orientation within CFRP composite laminates (suppressed waviness and mutual fibre flying) on the corrosion resistance of these materials?
2. A few partial questions about the process of prestressing carbon fibres using a custom fibre prestressing jig:
 - (i) How long were the carbon fibres prestressed?
 - (ii) Does the time between the prestressing and curing process play any role in terms of possible fibre relaxation?
 - (iii) Does the curing temperature affect the final properties of a prestressed CFRP composite laminate under the same conditions (e.g. 20 MPa)?
3. Was any non-destructive analysis other than electrical conductivity analysis used to assess the effect of prestressing level (0 – 25 MPa)?
4. Would it be possible to clarify the reason for the analysis determining the time dependence of the AC conductivity of the epoxy-glass fibre composite at elevated temperatures (Fig. 4.12)? The reason for the subsequent post-curing is generally known, and in this case the given analysis seems to be taken out of context. Moreover, only here glass fibres are used instead of carbon fibres used consistently throughout the work.

5. Why is the base 10 logarithm used and not the natural logarithm to interpret the Arrhenius formalism in Fig. 4.14?
6. From a structural point of view, what determines the lower DC conductivity of U-5 and U-10 compared to U-0 along the longitudinal direction? How does this correlate with the results of mechanical analyses?
7. For sample U-25, an unconventional DC conductivity with temperature in the transverse direction was observed (Fig. 4.15). How does the Candidate explain this? Did he measure the sample again after cooling?

In summary, the submitted Doctoral Thesis of M. Tech. Ogunleye meets the standard quality of PhD Thesis. I am pleased to recommend, without reservation, this Doctoral Thesis for public defense in a disputation and, after that, to award to M. Tech. Ogunleye the degree Doctor of Philosophy.

In Zlín, August 31, 2025

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