

Review of a Doctoral Dissertation

<u>Title of the dissertation:</u>	<i>Degradation of Adhesive Joints on Mild Steels</i>
<u>Name of the PhD.-student:</u>	Ing. Alp Özdemir
<u>Supervisor:</u>	doc. Ing. Pavel Švanda, Ph.D.
<u>Reviewer:</u>	prof. Dr. Ing. Libor BENEŠ, IWE Czech Technical University in Prague Faculty of Mechanical Engineering, <i>Department of Materials Engineering</i>

Summary of the review:

The reviewed doctoral dissertation has been prepared in compliance with the Study and Exam Regulations of the University of Pardubice, the Jan Perner Transport Faculty.

The extent of the submitted dissertation is 98 pages. The text includes symbols, tables, figures and references. The work is devoted to the issue of degradation for the adhesive joints on zinc plated (mild) steel. Author has divided it into eight parts.

In the introductory section (Chapter 1 and 2), the dissertation objectives are defined and the literature review with characteristics of adhesively bonded joints is given, as well as the main benefits from using a surface pre-treatment technics are described. These are the main factors significantly influencing the joint strength, in case of the adhesive bonding process.

After this relatively short critical analysis (with 88 literature sources) of the current and up-to-date situation in the area of dissertation, in the Chapter 1 and 2, mainly for the *light-weight design* of transport engineering, the definition of the three set dissertation objectives follows (*Chapter 2*). In my opinion, these targets are appropriately chosen, realistic and achievable within the training / faculty workplace.

The *third chapter* gives the overview of the experimental methods and applied materials, such as surface treatment, scratch test method, surface characterization and morphology. However, I would appreciate here the interesting and promising Contact Angle Measurement (chapter 3.3.5)

Next part (*Chapter 4*) is submitting the discussion about the acquired results, concerning the surface analysis and the investigations of treated surfaces respectively (peeling test, SEM-EDX analysis, scratch tests results), with consideration of the failure mechanisms via the scratch force or scratch energy analysis. The presented statistical analysis of the scratch tests (*Chapter 4.4.3*) seems to be very powerful instrument how to obtain some objective results, but I would like to highlight about the small number of specimens (only 8) carried out for the analysis.

Chapter 5 contains the conclusion of the dissertation outline. In this chapter the results of materials testing for the glued joints, performed by author for various methods of surface treatments and different two types of adhesives are summarized, and also the results of strength tests of these joints by means of the scratch force or scratch energy analysis.

The submitted doctoral dissertation finally presents the list of 88 references as well as the short list of publication activity (6 items) - in 2 s journals and 4 international conference where Ing. Alp Özdemir is the main author or co-author, respectively.

Conclusion of the review:

The main targets of the doctoral dissertation were fully met, with regards to the experimentally verified relation between the strength of the adhesive (glue) joints and the materials properties of the adherent and adhesive, respectively.

From the application point of view, the achieved results are very interesting, promising and topical due to the growing importance of this technology, mainly with broad application possibilities in transport means (automotive, marine, aircrafts), constructions (civil engineering) as well as any industrial bonding structures.

Questions for defence:

(Several questions and critical remarks, written below, should be answered during the defence-discussion):

- 1) Why just the “zinc-coated” steel has been used for the experiments, while the etching process (removing the zinc layer) was the following step?
- 2) Can a stainless steel also be tested (as a future research work) in the similar way, with regards to the “Degradation of Adhesive Joints” (as the main topic of the thesis)? Because a stainless steel (ferritic; austenitic; duplex) is also very promising structural material, with a wide range of applications.
- 3) What about the discussed scratch-test method, and its advantages / disadvantages? It seems to be very interesting innovation procedure in materials testing (of the adhesive joints).

General evaluation:

I can state here that Ing. Alp Özdemir has convincingly demonstrated his capabilities to gain a good theoretical knowledge of the problems and a sufficient experience of the mathematical modelling as well as of the experimenting and testing in the field of materials science and engineering.

The reviewed doctoral dissertation has been prepared carefully and comprehensibly, the proposed goals were really accomplished. I had some remarks and questions in my review, nevertheless, they are of rather formal character, see the previous paragraph.

In my opinion, the doctoral dissertation meets the general requirements for awarding the title Ph.D.

Therefore, **I recommend that this doctoral dissertation should be defended** and - in the positive case - that the applicant should be awarded with the scientific title “Ph.D”.



27th October 2016

prof. Dr. Ing. Libor Beneš, IWE
reviewer