

## Principal supervisor's final report on the PhD study

<b>1. PhD candidate</b>
Ing. Daniel Kvarda / Daniel.Kvarda@vut.cz
<b>2. Name of PhD programme</b>
Design and Process Engineering
<b>3. Title of PhD thesis</b>
Experimental investigation and numerical modelling of top of rail products
<b>4. Principal supervisor</b>
prof. Ing. Martin Hartl, Ph.D. / martin.hartl@vut.cz
<b>5. Co-supervisor</b>
Ing. Milan Omasta, Ph.D. / omasta@fme.vutbr.cz
<b>6. Stays at other institutions (min. 7 days)</b>
Southwest Jiaotong University / People's Republic of China / 31/03/2018 / 04/08/2018 Railway Technical Research Institute / Japan / 25/07/2019 / 07/11/2019 Virtual Vehicle Research GmbH / Austria / 01/10/2021 / 31/03/2021
<b>7. Teaching activities</b>
3CD - CAD / 78 1K – Engineering Drawing Fundamentals / 104 2K – Engineering Drawing / 78 ZSY-A – Finite Element Method – ANSYS Classic / 78 ZSY-A – Finite Element Method – Structural Analyses / 58 ZAW – Finite Element Method – ANSYS Workbench / 90 ZAW – Finite Element Method – Advanced Analyses / 70 ZBW – Finite Element Method – Advanced Analyses / 32 ZAP – Analytical Project / 147 ZTR – Tribology / 4
<b>8. List of main publications</b>
<b>Publications related to the topic of this thesis:</b>
<ul style="list-style-type: none"> <li>• KVARDA, D., R. GALAS, M. OMASTA, L.B. SHI, H.H. DING, W.J. WANG, I. KRUPKA and M. HARTL. Asperity-based model for prediction of traction in water-contaminated wheel-rail contact. Tribology International, 2021, 157, 1–11. (IF 5.620)</li> <li>• KVARDA, D., S. SKURKA, R. GALAS, M. OMASTA, L.B. SHI, H.H. DING, W.J. WANG, I. KRUPKA and M. HARTL. The effect of top of rail lubricant composition on adhesion and</li> </ul>



rheological behaviour. *Engineering Science and Technology, an International Journal*. 2022, 35, 1–9. (IF 4.36)

- KVARDA, D., R. GALAS, M. OMASTA, M. DZIMKO, I. KRUPKA and M. HARTL. Shear properties of top-of-rail products in numerical modelling. *Proceedings of the Institution of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit*. 2022, 0, 1–10. (IF 1.87)

#### **Other publications**

- GALAS, R., D. KVARDA, M. OMASTA, I. KRUPKA and M. HARTL. The role of constituents contained in water-based friction modifiers for top-of-rail application. *Tribology International*. 2018, 117, 87–97. (IF 5.620)
- SHI, L.B., Q. LI, D. KVARDA, R. GALAS, M. OMASTA, W.J. WANG, J. GUO and Q.Y. LIU. Study on the wheel/rail adhesion restoration and damage evolution in the single application of alumina particles. *Wear*. 2019, 426-427, 1807–1819. (IF 4.695)
- SHI, L.B., C. WANG, H.H. DING, D. KVARDA, R. GALAS, M. OMASTA, W.J. WANG, Q.Y. LIU and M. HARTL. Laboratory investigation on the particle-size effects in railway sanding: Comparisons between standard sand and its micro fragments. *Tribology International*. 2020, 146, 1–12. (IF 5.620)
- REMESOVA, M., S. TKACHENKO, D. KVARDA, I. ROCNAKOVA, B. GOLLAS, M. MENELAOU, L. CELKO and J. KAISER. Effects of anodizing conditions and the addition of Al<sub>2</sub>O<sub>3</sub>/PTFE particles on the microstructure and the mechanical properties of porous anodic coatings on the AA1050 aluminium alloy. *Applied Surface Science*. 2020, 513, 1–10. (IF 7.392)
- LI, Q., B.N. WU, H.H. DING, R. GALAS, D. KVARDA, Q.Y. LIU, Z.R. ZHOU, M. OMASTA and W.J. WANG. Numerical prediction on the effect of friction modifiers on adhesion behaviours in the wheel-rail starved EHL contact. *Tribology International*. 2022, 170, 1–11. (IF 5.620)
- NAVRATIL, V., R. GALAS, M. KLAPKA, D. KVARDA, M. OMASTA, L.B. SHI, H.H. DING, W.J. WANG, I. KRUPKA and M. HARTL. Wheel squeal noise in rail transport: the effect of friction modifier composition. *Tribology in Industry*. 2022, 44, 361–373.
- LI, Q., S.Y. ZHANG, B.N. WU, Q. LIN, H.H. DING, R. GALAS, D. KVARDA, M. OMASTA, W.J. WANG and Z.F. Wen. Analysis on the effect of starved elastohydrodynamic lubrication on the adhesion behavior and fatigue index of wheel-rail contact. *Wear*. 2022, 510-511, 1–12. (IF 4.695)

### **9. Assessment of the supervision process**

#### **Very good**

The supervision process was based on regular meetings with the supervisor, co-supervisor and particularly the research team of the Wheel-rail interface research group. Daniel Kvarda always came up with his own ideas and suggestions for solutions. The supervision of the student was seamless, based on his own initiative and acquired knowledge in the field.

The candidate spent more than 13 months on internships at the world's leading workplaces in China, Japan and Austria. The work at these institutes also contributed to the formation of his PhD work, especially staying at Virtual Vehicle Research Center under the supervision of dr. Klaus Six.

### **10. Assessment of the candidate's ability to work independently**

#### **Excellent**

Daniel Kvarda was a very independent and self-motivated student. The development of the model, which is part of the dissertation, was entirely in the student's competence. Similarly, the design and implementation of the experiments included in the main publications were carried out by the student independently.



The candidate was also involved in projects that were more or less related to the thesis topic. These projects were carried out within a broader research team and Daniel was able to participate very well in team projects and activities.

In conclusion, I found Daniel Kvarda a very caring, responsible and individually-minded PhD student with a significant contribution to the development of the research group.

#### **11. Assessment of the contribution that the research makes to knowledge in the field**

##### **Very good**

In his PhD work, Ing. Daniel Kvarda was investigating the frictional behaviour and low adhesion conditions of the top-of-rail products with the use of a mathematical model and experimental data. He prepared and published three papers as the first author in high-quality journals, namely Tribology International (Q1), Engineering Science and Technology, an International Journal (Q2) and Proceedings of the Institution of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit (Q3). This research presents a novel solution that contributes to the development of more general models that may be of use in the management of rolling stock. Besides the main publications, the candidate is a co-author of 7 papers that also contributes to knowledge in the field of wheel-rail tribology significantly.

#### **12. Other comments**

Apart from the research activities, Daniel Kvarda contributed significantly to preparing and teaching the course Finite Element Method - Advanced Analyses (ZAW) and Finite Element Method - Structural Analyses (ZSY-A).

#### **13. Conclusion**

PhD thesis is an independent scientific work that presents a novel solution to a significant problem in the research area and demonstrates the candidate's ability to conduct independent research.

**YES**

#### **14. Date and signature**

Date: 14.06.2023

Please note

- Evaluate categories 9 to 11 using the following scale: unacceptable, acceptable, satisfactory, good, very good, excellent.
- In each category 9 to 11 explain reasons for evaluation using between 100–200 words.
- E-mail the completed form to: [Klara.Javorcekova@vut.cz](mailto:Klara.Javorcekova@vut.cz)