

## Influence of humidity of environment on fatigue crack propagation in railway axle

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The presentation is devoted to the crack propagation in the railway axle made of EA4T steel. The propagating fatigue crack is subjected to the different kinds of crack closure. The paper describes contribution of plasticity induced crack closure, roughness induced crack closure and oxide induced crack closure to the total crack closure and their influence on the residual fatigue lifetime of the railway axle. Special attention is devoted to the influence of humidity of the air to the fatigue crack propagation and railway axle residual fatigue lifetime. Fig.1 shows detail of fracture surfaces with different width of oxide layers occurred during fatigue testing under different humidity of laboratory air. It is evident the increase of oxides on the fracture surfaces with the increase of absolute air humidity. The experimental results were obtained using chamber developed at Institute of Physics of Materials CAS for fatigue testing machine, which enables fatigue tests under different air humidity. The chamber used is shown in Fig. 2.

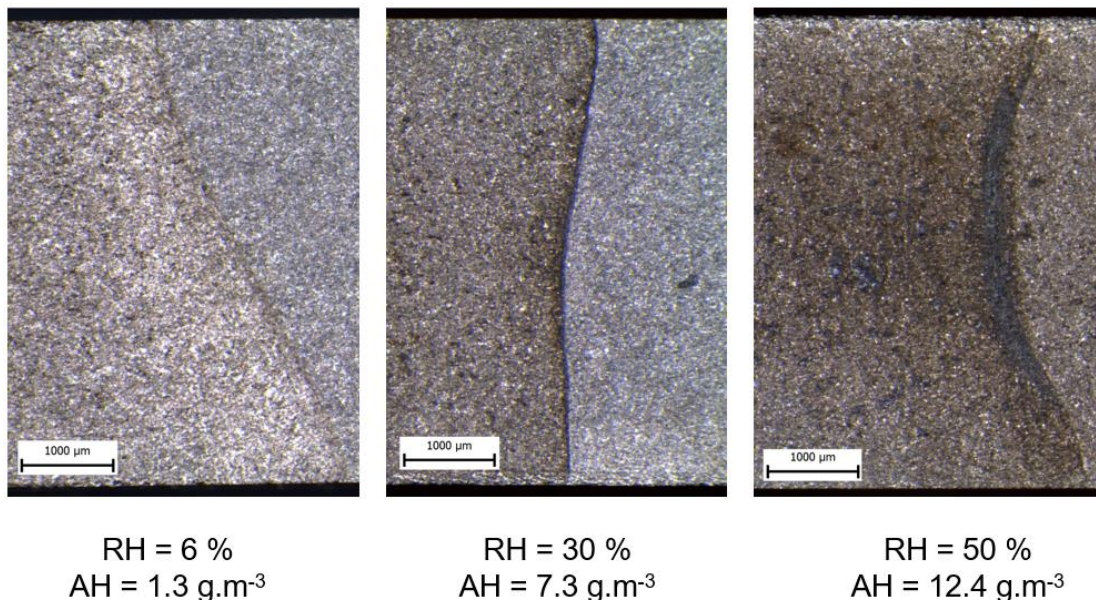


Fig. 1. Fracture surfaces of specimens tested under different humidity conditions (abbreviations RH = relative humidity, AH = absolute humidity)

Experimentally measured data were used for following analysis of residual fatigue lifetime of the railway axle designed in Bonatrans company. All necessary numerical calculations based on finite element method (stress-strain analysis, calculations of fracture parameters, etc.) were performed and own procedure for determination of residual fatigue lifetime of railway axles was applied. Detailed description of the procedure can be found in [1]. It can be

concluded that different air humidity leads to the important change of fatigue crack closure due to existence of oxide layers on the fracture surfaces. The existence of oxides result in important change of residual fatigue lifetime, therefore for reliable estimation of residual fatigue lifetime air humidity should be taken into account during material testing.

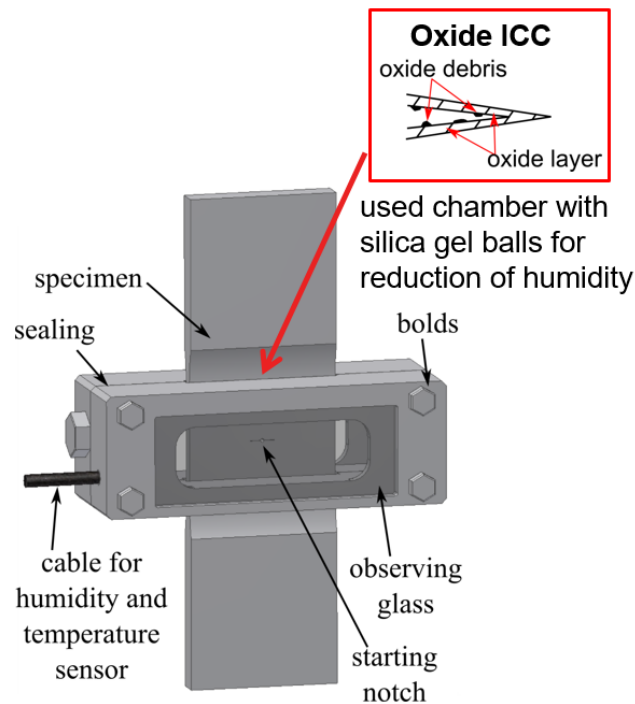


Fig. 2. Chamber for fatigue crack testing under different air conditions (author P. Pokorný, Institute of Physics of Materials CAS)

The presentation contributes to the better understanding of fatigue damage of engineering structures and higher reliability of railway axles.

### Acknowledgements

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### References

- [1] Pokorný, P., Vojtek, T., Náhlík, L., Hutař, P., Crack closure in near-threshold fatigue crack propagation in railway axle steel EA4T, *Engineering Fracture Mechanics* 185 (2017) 2-19.