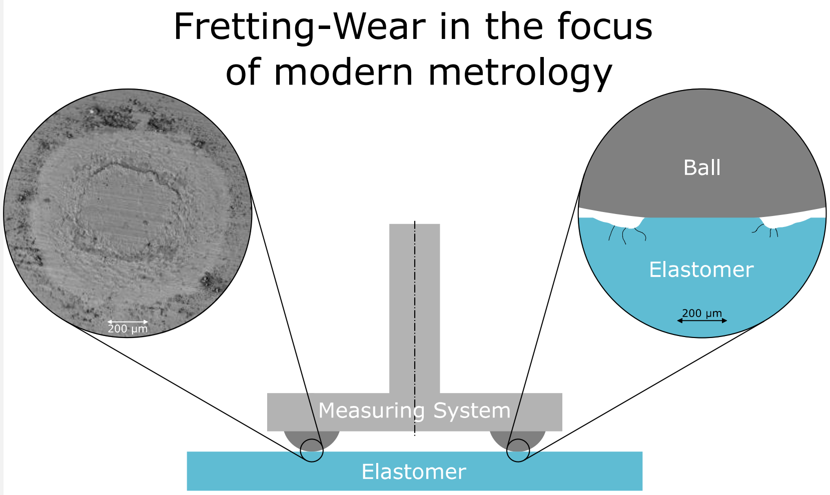
SUCCESS STORY

PCCL-K1
K1-Center in Polymer Engineering and Science

Program: COMET – Competence Centers for Excellent Technologies

Funding: COMET-Zentrum (K1)

Project type: IMPROVED SEALING MATERIALS FOR HARSH TRIBOLOGICAL ENVIRONMENTS, 01/2021-12/2024, multi-firm



LESS WEAR, MORE PERFORMANCE: HOW TO MAKE THE SEALS OF THE FUTURE LAST LONGER

THE INNOVATIVE MEASURING SYSTEM DEVELOPED AS PART OF THE RESEARCH PROJECT HAS REVOLUTIONIZED THE ASSESSMENT OF FRETTING WEAR ON SEALING MATERIALS. BY COVERING A WIDE TEMPERATURE RANGE, THIS SYSTEM ALLOWS FOR A COMPREHENSIVE EVALUATION OF THE MATERIAL'S PERFORMANCE. IN THE DEVELOPMENT AND DESIGN PROCESS, SEALING MATERIALS CAN BE OPTIMIZED MORE EFFICIENTLY AND SPECIFICALLY TO MEET APPLICATION REQUIREMENTS, AND THE PROBABILITY OF FAILURE CAN BE REDUCED.

Although they play a seemingly minor role in most applications, seals are an integral part of modern, efficient machines. However, their need for functionality only becomes apparent when they break down. On an industrial scale, seals perform essential tasks that, if they fail, can sometimes result in horrendous costs and potentially serious damage to human beings and the environment. For example, state-of-the-art seals for ship propellers form a barrier between seawater and the engine compartment, preventing lubricants from leaking into the environment and flooding the engine compartment. In addition, seals are essential machine elements in sustainable energy sources such as hydroelectric power plants and wind turbines. A wide range of applications and environmental conditions place high demands on the materials used. Typically, elastically deformable polymers (elastomers) are used. Vibrations, i.e., microscopic movements at high frequencies, as they occur in generators/motors, can cause cracks and

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wear. In the worst case, such cracks can cause abrupt failure, resulting in a total breakdown of the system or machine. This type of wear is called fretting wear. The challenges in reproducing this wear mechanism on a laboratory scale are the microscopic deflections and the high frequencies. In addition, the mechanical properties of polymers are highly temperature dependent, which is why testing over a wide temperature range is essential for optimizing the material. In cooperation with the project partners, a testing device has been developed that, for the first time, allows the realistic characterization of fretting wear in sealing materials over a wide temperature range.

Impacts and Effects

The test setup has been implemented in an Anton Paar rheometer and has already undergone a large number of test series with a wide range of test parameters. Depending on the application, test frequencies between 0.1 Hz and 100 Hz and deflections of a few micrometers can be achieved. Thanks to the sophisticated design, tests can be performed at ambient temperature as well as in the desired environmental medium, e.g., lubricating greases or oils, nitrogen atmosphere, or water. With the help of the innovative testing device, it is possible to take this wear mechanism into account at an early stage in the development of new materials and to optimize the material accordingly. Expensive and time-consuming component tests and field studies can be minimized, and the probability of failure due to fretting wear can be further reduced. This is not only a significant cost-reduction factor in economic terms, but also in terms of sustainability and energy reduction.

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- Anton Paar Graz GmbH, Austria
- Montanuniversity Leoben, Materials Science and Testing of Polymers, Austria
- Montanuniversity Leoben, Mechanical Engineering, Austria

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