SCHAEFFLER *at the Fourth Edition of The International* Academic Bearing Conference: BEARING WORLD 2022

Schaeffler is one of the main sponsors and supporters of the International Bearing World conference, and sees it as a leading event to exchange state of the art technology and latest research results in order to make machines more powerful and more reliable.

We tried to reveal why Schaeffler, the global bearing supplier and leading company in bearing research and technology is sponsoring the Bearing World Conference during an interview with Mr. Martin Correns, The Principal Expert, R&D Analysis Methods Fundamentals at Schaeffler Technologies AG & Co. KG.

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Q: Why do you support the BEARING WORLD conference?

The BEARING WORLD has developed into a significant platform for the exchange of ideas and research findings in the rolling bearing business, especially on the European side. It is also important as a showcase to convey the message that there is still significant research being conducted, and that there are still enough topics that require future research.

Q: In your opinion, how important is the exchange between research and industry?

Actually, I would question the differentiation between research and industry. As a leading manufacturer of rolling bearings, we conduct cutting edge research both internally, in joint projects with universities or research institutes, and in frameworks like the FVA. Other than that, every field of research benefits from the exchange of ideas. Especially the FVA is a great platform for that and for shaping the direction of research, to focus on topics that are or will be relevant in future developments.

Q: Can you tell us more about the presentations SCHAEFFLER have selected for BEARING WORLD 2022?

The Schaeffler group contributes six presentations, that cover the whole range of our in-house research, from fundamentals of failure mechanism over dimensioning and design up to manufacturing simulation: "Differences between cathodic and energetic WEC fatigue" addresses our understanding of the mechanical or electrical triggers that contribute to the formation of White Etching Cracks. "Electric properties of gears and bearings" describes the workflow and algorithms in our Bearinx software for the simulation of electric load on bearings, a topic that becomes more and more important with the transition to electro-mobility, but also with the increasing understanding of the potential effect of parasitic currents on premature failure. Hybrid bearings are one potential solution for applications under electric load, so "Performance enhancement of hybrid bearings at grease lubrication" shows our research on extended grease life for these bearings.

Regarding the utilization phase, "Sustainability in the Bearing World through Digitalization" shows Schaeffler's approach on efficiency optimization through digital twin concepts, while "Wind Turbine Main Shaft Bearing for Uptower Replacement" addresses our solution for the customer demand of bearings that can be replaced in-situ in a wind-turbine, which greatly reduces maintenance costs.

And finally, a topic that is often overlooked in research, is the fact that the primary business of a bearing manufacturer is the manufacturing of literally millions of extremely precise components at competitive costs, therefore "Bearing towards the cutting edge: Grinding & Honing Simulation" gives some insight into our efforts in manufacturing simulation.

Q: What challenges will the bearing industry have to face in the future? Is it still worth allocating research and development resources to bearing technologies?

It is a misunderstanding to assume that research on rolling bearings is essentially completed.

Just looking at the current development of 10+ Megawatt Wind-turbines needed for the energy transition, there are significant challenges in the required power density and life requirements, but also in the manufacturing and heat treatment of bearings in the required sizes. We are also understanding more and more of the detrimental effects of potential parasitic currents on bearing performance, and we are actively developing calculation methods both for the prediction of electric load on bearings as well as their effect on performance and reliability.

In electro-mobility, we are again facing electric loads on the bearings, but also very high speeds that significantly exceed the application limits of standard bearing designs that require dedicated solutions like Schaeffler's High Speed Motor Bearings. Another topic here is obviously efficiency friction optimization, which directly affects the range of the vehicle. And finally, without internal combustion engines, we also need to consider the sound spectrum of our bearings in automotive applications.

On the manufacturing side, there are considerable research activities to optimize energy-intensive processes like forging and heat treatment, and we also need to investigate the potential and challenges of green steel.

So, the question is not, if it is still worth to allocate development resources to bearing technology, but rather if we can get enough resources for all the development that is needed.

Q: What consequences will technological and economic changes have for the bearing industry? Are there new business models on the horizon?

Obviously, the transition to electro-mobility creates to a reduced demand for typical gearbox components, but it also creates additional demand in electric drive components, and also in the renewable energy business. However, adapting to changes in market and demand are the nature of any industrial business, so this

considered in long term planning and measures are taken to adapt.

Regarding new business models, there are approaches like selling operating time or reliability instead of selling components, however the actual market demand for such new business models seems to be rather small and concentrated to very specific applications.

Q: How can your company contribute to the reduction of Co2 emissions?

I think it is not about what we can, but what we actually do. Energy efficiency is the core business of the rolling bearing industry. Looking at the Schaeffler brands, FAG was founded on the idea of improving the ball-milling process which significantly reduced frictional losses of ball bearings, INA was founded on the idea of cage-guided needle bearings with greatly improved efficiency.

Since then, considerable effort has been devoted to the further optimization and reduction of friction. Today we have very sophisticated calculation programs enabling us to precisely predict rolling bearing friction and thus to optimize bearings for the application conditions, and these programs have been used in the last decade to significantly reduce energy losses in numerous applications, from automotive over railway bearings to large industrial climate compressors.

On the energy generation side, we are one of the leading suppliers of rolling bearings to the wind industry, where we have taken significant efforts to optimize our bearings for improved reliability. We are also a significant supplier of drives and components for electro-mobility, so we actively contribute to all efforts in the transition to a decarbonized economy.

A further reduction of the CO2 footprint can be achieved by use of recently introduced high performance materials like Mancrodur or Cromadur, which allow either for life-extension and thus reduced carbon footprint in production, or mainly for downsizing or reducing the number of rolling elements, which can significantly reduce the energy losses in the application.

And last but not least, we are actively pursuing the reduction of the total carbon footprint of our products, from raw material over manufacturing and heat treatment to use phase and refurbishing and recycling. Schaeffler Group Europe already sources 100% of its electricity from renewable sources, and worldwide, Schaeffler Group aims to produce climate neutral by 2030.

Q: Are digitization and artificial intelligence important for bearing technologies?

Artificial intelligence is certainly used in the analysis of big data, like data from test fields, condition monitoring, digital twins or from manufacturing, to gain additional insight and optimize processes and algorithms and for predictive maintenance, however there is no room her to go into details.

Regarding digitalization, we will most likely not see digital components in the majority of our bearings, but there are cases like smart bearings, where significant added value can be provided.In a broader sense, the general proliferation of digital devices enables the provisioning added value by new services like the Schaeffler Grease App for mobile phones, “Origin Check” for verification of original products, or Optime as a very affordable condition monitoring system, and there is certainly more to come.

Q: What are smart bearings, and how are they being implemented?

Smart bearings are rolling bearings with embedded sensors. At Schaeffler, we have developed rolling bearings for measurements of speeds, loads, temperature, acceleration, or even lubricant condition, that allow for the realization of additional functionality and added value without the need for additional components or design space.

For example, our “Spindle Sense” bearings allow for the measurement of deflection of machine tools spindles in operation with sub-micrometer-precision in 5 axes, and for detection of collision or overload within 2 microseconds. Such a functionality would be nearly impossible to realize with conventional sensors in the given design space.

By providing data in a precision that was previously not accessible, these smart bearings allow for new concepts of precision control, machining process optimization, increased machine safety and reliability, and better planning of scheduled maintenance.

Obviously, smart bearings can also allow for condition monitoring and fault detection, however in stationary machines, the use of external sensors is generally more economical. For this, Schaeffler has developed the OPTIME sensors that, thanks to its simple plug & play installation, allow for comprehensive condition monitoring in an easy and affordable way.

It should be noted that in most applications, properly dimensioned and lubricated rolling bearings require very little attention, so we certainly not envision condition monitoring to be used in every application, but rather in machinery where predictive maintenance and early fault detection can contribute to a reduction in total cost of ownership.

Q: Considering recent trends, do you feel that we need a new type of engineering education?

Basing education concept on recent trends may not be the best approach, since these trends may already be over once the new education is established and the first students have finished their exams.

In Germany we have a very successful tradition of engineering education that focusses on solid and broad knowledge, which has enabled engineers to easily adapt to new challenges and acquire the necessary knowledge. This broad knowledge approach should be maintained and probably even strengthened.

What we should do is starting one step earlier and focusing more on getting the best and the brightest to consider studying engineering. For this, it would be helpful to put more emphasis on MINT- subjects in secondary education, but we as engineers should also be more vocal in illustrating our contribution to society, economy and especially to decarbonization. The biggest challenge for the next decade will be reliable generation and distribution of renewable energy, this requires huge efforts in solid mechanical and electrical engineering, however the role of engineering in this challenge is not sufficiently reflected in media and public discourse.