

Roller Bearing Technology for the Highest Demands

Ceramic surpasses the performance of speciality roller bearing steels. Demands for high machine availability, energy efficiency or anti-septic production conditions, for instance, are tailor-made to suit the use of ceramic roller bearings.

Having been established as a spin-off of the *Fraunhofer Institute of Production Technology (IPT)*, CEROBEAR started business in 1989 at the *Aachen Technology Centre/DE*. With its relocation to its own facilities in Herzogenrath near Aachen in 1997, the foundation for further growth was laid.

Today CEROBEAR is a leading manufacturer of ceramic roller bearings, pioneering completely new directions in

roller bearing technology. Ceramic roller bearings are a key product for industries and processes with exacting requirements such as e.g. the semiconductor, aerospace, foodstuffs and beverage industries as well as medical technology and other speciality applications. CEROBEAR currently employs in Germany around 100 people. Company founder and owner *Jens Wemhöner (JW)* agreed to tell us about the success story of ceramic roller bearings.



Jens Wemhöner

CA: *Ceramic roller bearings are a niche market as the high price presents a barrier to wider application. How high is your market share, what prospects are there for ceramic roller bearings?*

JW: The global market volume for standard roller bearings is worth around EUR 20 billion, bearings made of speciality steels account for another EUR 1,5 billion. Only around one tenth of the market volume for standard roller bearings is accounted for by roller bearings made of or with ceramic. By 2020, however, a potential market of around EUR 1 billion is expected although hybrid and ceramic

roller bearings are 2,5 to 10 times more expensive than steel roller bearings of the same size. The mass production of roller bearings is shared essentially by seven big international manufacturers. At CEROBEAR we concentrate exclusively on roller bearings made of or with ceramic.

CA: *What possibilities do you have to lower the price barrier for new applications? As these bearings are customized components, wouldn't it be possible by increasing the unit numbers?*

JW: On account of their price level, ceramic roller bearings are only used in applications where they lower the costs of ownership. Nevertheless, we are in international competition and have to make sure that we can offer our bearings at attractive prices. In the past we have succeeded in this by continuously improving our business processes, especially in production. From the outset, our manufacturing process has been computer-controlled and -monitored. Here, of course, the know-how from the Fraunhofer IPT in production technology has been utilized. Consequently, we have a detailed data archive, which is not only useful for customer enquiries, but also helps us when we want to improve sub-steps in technical and/or economic terms.

At present an extension is being built that will increase our manufacturing capacity to 2,2 times what it is currently. This will be accompanied by a further automation of the hard machining process. Our parts store will be designed according to the latest automation standards. In addition we are creating clean rooms for assembly and measurement technology. We shall increase our staff in Germany by a maximum of 20 % in the next few years as the investments will increase our productivity significantly. In addition, in 2016 we want to produce in the USA so as to offer our products there at a lower price and to become more intensely involved in the growth market of aviation.

CA: *What are the most important user segments for ceramic roller bearings today?*

JW: Besides aviation, growth markets for the application of ceramic roller bearings are machines in semiconductor production and fluid machines. Established segments are food and beverage industry as well as medical technology.



Fig. 1
Silicon nitride spherical roller bearings for semiconductor capital equipment (source: CEROBEAR)



Fig. 2
Stainless steel/silicon nitride spherical thrust hybrid bearing for autoclaves in LDPE production (source: CEROBEAR)

Besides these, there are speciality applications such as, for example, motor sport. The forecast growth, however, will be essentially carried by aviation. Our export quota is above 60 % (USA, Asia and Europe).

CA: Are the same other applications relevant in the USA?

JW: Yes. Our investments are carried out primarily by cooperative developments with the manufacturers of aeroplane engines. At present with the use of our bearings, it is possible to save around 20 % of the fuel for an aeroplane because they enable higher operating temperatures and torques. That's why the prospects and possibilities for development are so positive in this user segment. In addition comes semiconductor production and increasingly the oil and gas (fracking) market in the USA.

CA: What are the most important arguments for ceramic roller bearings?

JW: Outstanding is the stable, covalent bond of the ceramic, which prevents adhesive wear (microfusion, seizing) between the roller partners. The bearings are suitable for dry running (for applications above 280 °C there are no suitable lubricants) or for innovative lubrication technologies. Their low lubrication requirements increase operational reliability and lifetime while minimizing running costs. Their price is relative to a certain extent as you have to take into consideration the cost of ownership aspect as well as the markedly higher availability of the machines in which the ceramic roller bearings are installed. If maintenance cycles can be eliminated or minimized, then that is another valid sales argument, justifying the higher price, as more and more production plants have to run 24 h seven days of the week to be efficient. Moreover the high corrosion and temperature resistance of the bearings, their 60-% lower weight compared to roller bearing steel (with

the resulting lower centrifugal forces of the roller on the outer ring, at the same inner bearing loads around 50-% high speeds are possible) are interesting characteristics. Their hardness is around double that of roller bearing steels.

CA: What materials do you use?

JW: Silicon nitride (HIP-Si₃N₄) and zirconia (ZrO₂), special plastics and speciality steels. We buy in everything semi-finished and sintered. With our high-precision hard machining technology we manufacture all types of bearings (ceramic and hybrid bearings). We add around 80 % value.

CA: Did the ceramic materials have to be optimized for the production of roller bearings?

JW: This work goes back to our initial years. The HIP-Si₃N₄ came from R&D projects for gas turbines in the 1980s and was accordingly optimized for high-temperature applications that we don't need on that scale. Thanks to alloying with aluminium, yttrium, iron as the glassy phase formers, the fracture toughness of the material could be further improved. Today our development work only addresses application-specific, design solutions. The roller bearing is a machine element suited to ceramic as the load is limited at a point on a very small volume in the boundary layer of the ceramic. That leads to its extremely high reliability.

CA: What is the key to CEROBEAR's business success?

JW: Solid continuous growth of 10–15 % per annum combined with a regular profit-making purpose. We have always used this for the further development of the company. We manage to invest 10 % of our sales in development work. In the high-wage country Germany, we have to produce innovative products to stay in international demand as a partner in the long term too.

CA: Thank you for talking to us.

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