Editorial

Bearing Steels—Exponential Growth of Technology

The popular press, as well as strategic thinkers such as Peter Drucker, expound on the exponential growth of technology in particular areas, such as computers and communications. However, there are other areas of technology, which may in fact be more important to us as materials engineers, but due to limited press, go unnoticed. I would like to discuss one of these areas of technology, bearing steels, and how they have affected bearing lives, and in turn, our lives as technical designers and users of bearings.

During the last ten to twelve years, the bearing steel manufacturers around the world have introduced significant improvements in steel melting practices, including ladle refining and bottom poured ingots with shrouding, along with improved solidification practices. These improvements have essentially eliminated both macro and micro inclusions by reducing reoxidation of the liquid stream and the erosion of refractories. Lundberg and Palmgren (Ref 1), more than 45 years ago, developed equations which quantified classic rolling contact fatigue and allowed one to statistically calculate bearing life. Over the last thirty years or so, the role which oxide inclusions, particularly aluminum oxides, have on rolling contact fatigue has been well documented, and in fact, ASTM defines standard procedures and levels of inclusions for bearing steels. Prior to the development of what is now called "ladle refining," clean bearing steels required expensive double melting practices, like vacuum arc remelt and electroslag remelt. With the development, at great capital expense as well as time, of the ladle refining process and the other important practices, bearing steels with oxygen contents under 10 ppm are the norm. (My mother was correct when she told me, "Cleanliness is next to godliness.") Although improved geometry and surface finishes are important, as has been shown by many bearing companies, the clean steels have been the primary factor in increasing bearing life by a factor of five to ten. These increases have been so dramatic, that in a well designed and lubricated bearing, rolling contact fatigue is only a "fleeting" memory. Premature bearing failures are now due to contamination, surface defects such as scratches, and corrosion. With these dramatic changes, the old method for calculating bearing life is no longer valid, and ISO is now in the process of developing a new standard for calculating bearing life, taking into consideration factors such as contamination, and introducing the concept of an endurance limit, which means one can have infinite life.

One last technical comment, and one philosophical comment. For those readers who may be involved in gear design, take a look at increasing the power density of gears by utilizing bearing steels. You may be surprised at the results. For those of you who have a philosophical bent, as Michael Kami (Ref 2) suggests, technology is *amoral*. It does not distinguish between good and bad. This is not to say that clean steels are amoral, but it is our responsibility as technical people to ascertain the moral aspects of our creativity.

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References

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