HUHNSEAL

SEALING TECHNOLOGY

Diamond –

the next big change in the mechanical seal industry

The emerging nanotechnology of diamond for seal face applications is set to send a shockwave in the mechanical seal industry.

The first seals utilizing diamond have been brought to market. The results so far have been nothing short of incredible.

Imagine creating a synthetically manufactured ultrapure crystalline diamond with the same outstanding properties as the natural stone. By developing the technology to deposit a microcrystalline extra thick diamond coating on silicon carbide seal faces, the reliability of mechanical seals and hence their pumping systems has now been proven to be greatly improved.

Huhnseal Diamond Seal being Installed on a Goulds 3175 Pump

What is this “new” nanotechnology?

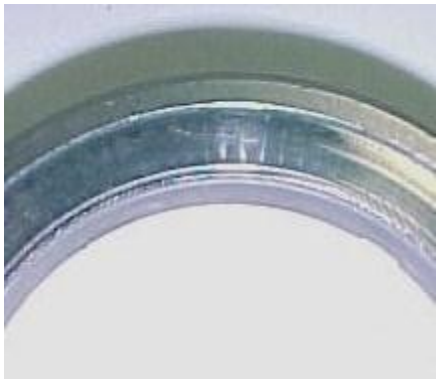
The diamond seal faces are fabricated by growing a polycrystalline diamond film onto the face of a conventional finished SiC ring. The SiC ring is then placed into a chamber where the pressure, gas composition and temperature are accurately controlled. A carbon bearing gas such as methane is introduced into the chamber and, under the right combination of processing conditions, diamond crystals grow on the SiC. The process occurs under vacuum at temperatures around 800-deg C (1,472-deg F). This process is called Chemical Vapor Deposition (CVD).

The diamond is not precipitating out from the vapor phase but grows up from the surface of the SiC. As these small diamond crystals grow, they coalesce together and form a continuous diamond surface. Specific processing conditions determine the diamond's properties. The relatively high temperature of the process results in a significant chemical interaction and subsequent bonding of the diamond onto the SiC. Excellent bonding is critical to ensure the diamond adheres well. Tests have shown that the bond between the SiC and the diamond can be stronger than the strength of the SiC itself.

What can this technology do for mechanical seals;

Mechanical seals have been successfully applied to many problem areas in pumping applications. Still solving the application of these devices for pumping aggressive media has been a difficult journey.

For example, in a typical North American pulp & paper mill, OEM pump suppliers have promoted the use of repeller/dynamic lip seal systems to seal the paper stock pumps. Quickly, the end users realize the reliability of such a system is just not there. In vain, they try flushed mechanical seals to gain better reliability. The increase in Mean Time Between Failure (MTBF) just simply cannot be achieved with the currently existing seal face materials. Any form of under lubrication which causes dry-running results in massive temperature increases and damages the sliding faces and secondary seals (O-rings). In extreme cases, the time to total failure of the sliding faces may be just a matter of a few seconds.



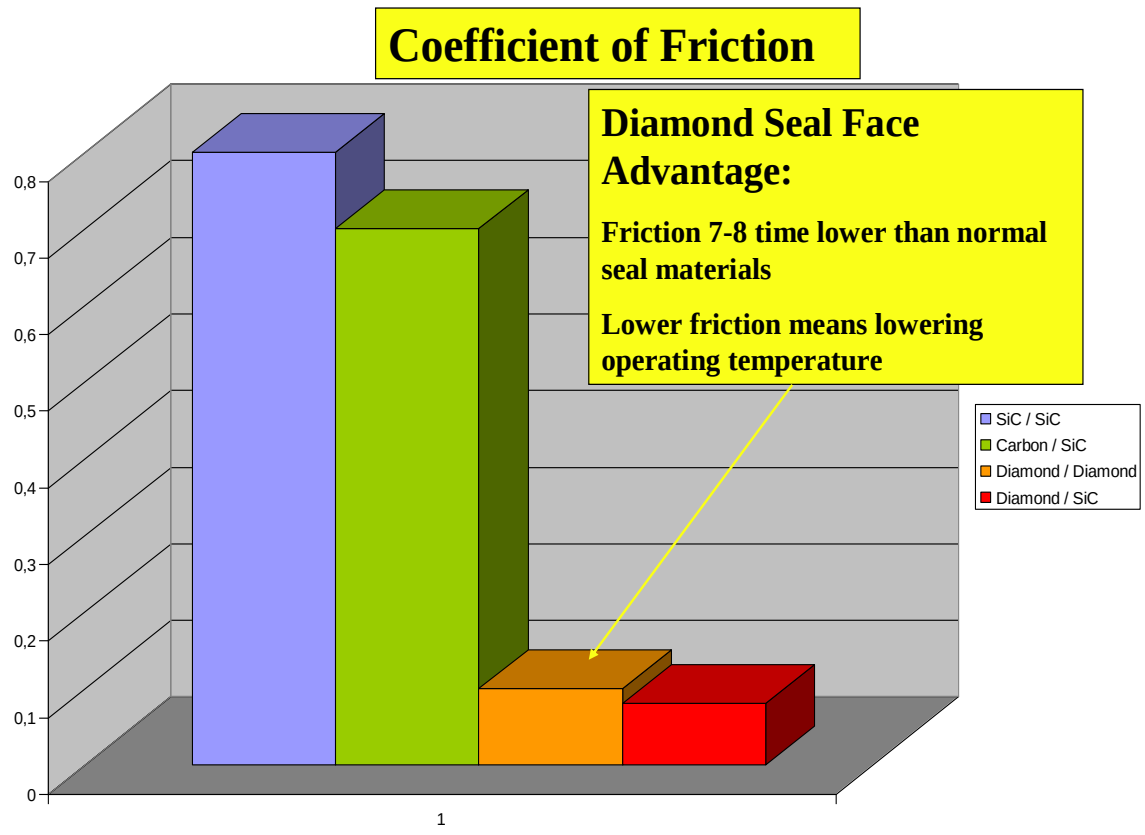
Dry running causes thermal cracking of seal faces and burning of the elastomers.

This is precisely where the Diamond technology comes into its own.

Diamond seal faces can withstand dry-running phases for up to 60 times the currently available technology with reduced heat generation. Thus, the secondary seals (elastomers) are safe from heat generated by dry running seal faces.

The reason for this lies in the coefficient of friction of diamond seal faces which is only an eighth of that of silicon carbide.

Much Lower Coefficient of Friction:



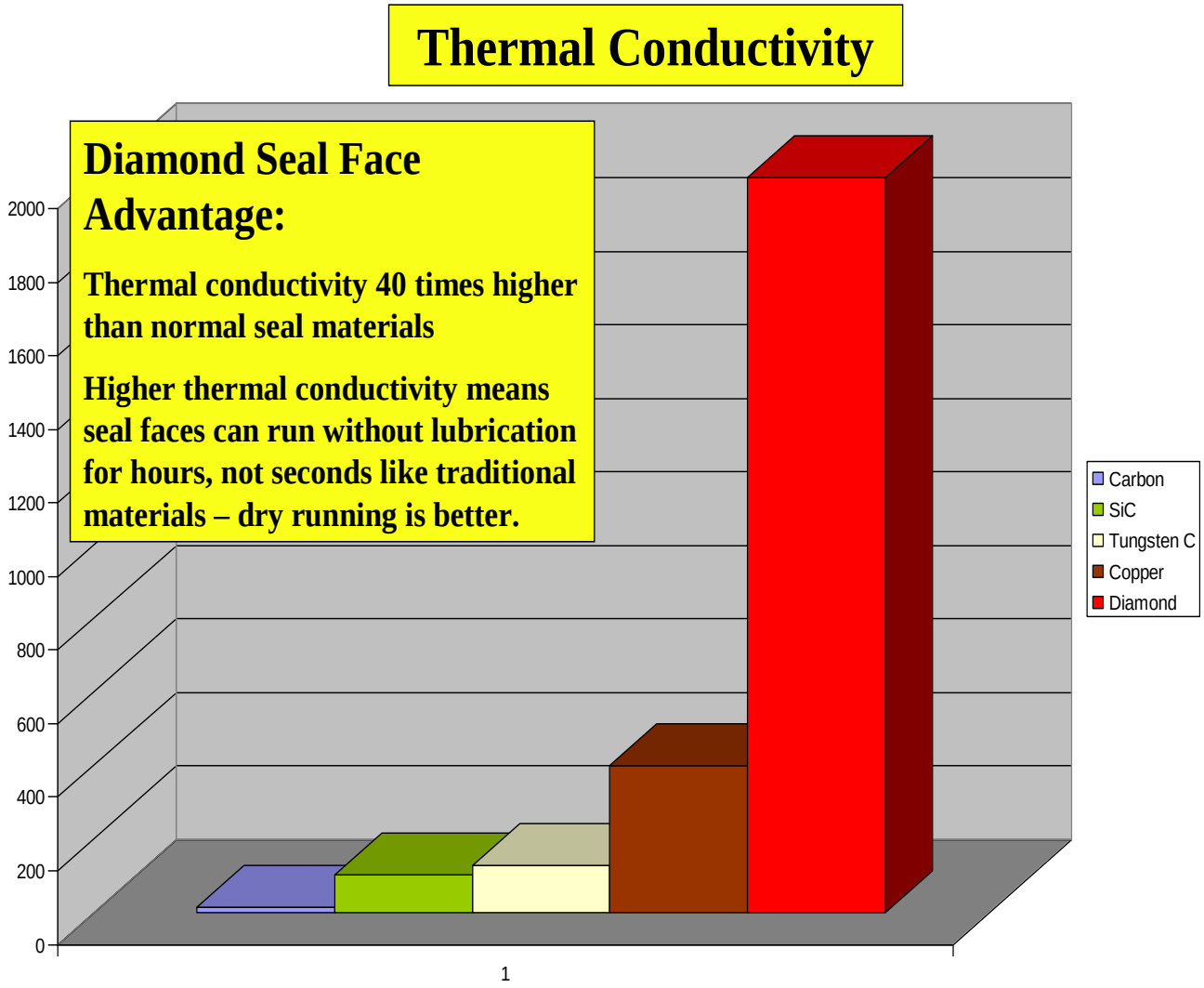
Diamond overcomes two of the major challenges of seal face materials.

First, a seal face must be manufactured to micrometer or sub-micrometer precision, enabling the seal design to properly maintain the seal face lubrication film.

Second, the seal face must maintain the required surface quality and geometry even in poorly lubricating conditions (e.g., pumping near a fluid's vapor pressure or intermittent dry running), during exposure to abrasive solids in the media and to highly corrosive environments. Diamond-faced seals have been shown to have significantly longer useful life in poor lubricating environments such as hot water and during extremely abrasive pumping applications.

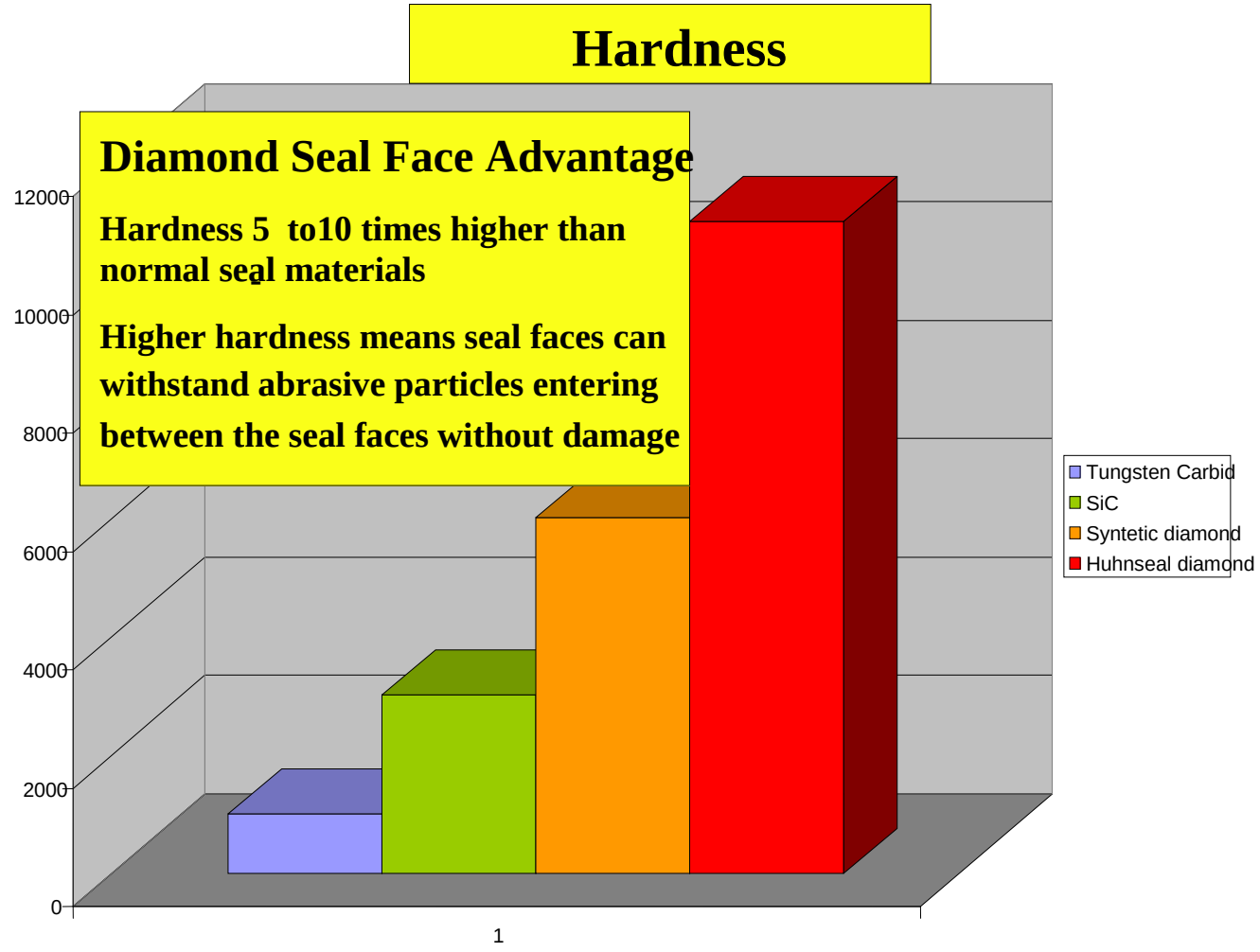
Diamond reduces the heat generation that can result in thermal distortions of the faces and heat attack of the secondary seals. The low coefficient of friction of diamond seal faces results in less heat generated when face lubrication is interrupted, minimizing seal failures during start-up and improving seal life during dry operation.

Extremely High Thermal Conductivity:



The low coefficient of friction along with the extremely high thermal conductivity of the diamond means that the little heat generated at the seal faces is quickly dissipated away from the seal faces.

Unsurpassed Hardness:



Diamond is the hardest substance known to mankind. With this kind of hardness, the seal faces simply pulverize any solid material that enters the seal faces. This allows pumping of clay or metal slurries without the need for expensive double seal systems and their resulting operation difficulties. In many cases, the need for water requirements to make the seals last in service is no longer required.

Although diamond seal faces will eventually wear out, it wears at a rate that is about 1000 times slower than conventional SiC faces wear. This makes diamond an excellent choice for applications where it is desired to minimize the transfer of seal face material into the fluid media; for example pharmaceutical applications.

Discussion:

The mechanical seal is the pump component with the shortest service life (on average 14 months) followed by the bearing with an average of 36 months. By increasing the service life of the mechanical seal – for example with Diamond Seal Faces – to make it the same as that of the bearing, it is possible to significantly reduce the number of pump repairs and therefore the number of downtimes and production stoppages. This reduced maintenance alone can justify the higher investment dollars for Diamond Seal Faces, even within one year.


Huhnseal Diamond Seal still in operation; (installed in 1998).

Applications:

It is important to remember that a seal face is one of many elements within a properly operating mechanical seal and all the major elements should be considered when diagnosing problem pumps.

Diamond, however, enables pumps to function with higher reliability in demanding applications. These new diamond products enable hard face materials to be used while only softer carbon materials are used today due to the requirements of dry running. High performance single seals are now available that are practical alternatives to the higher costs and maintenance of dual seals and associated systems.

As a result of these and other benefits, diamond-faced seals are finding their way into a wide range of applications such as pumping light hydrocarbons, boiler feeds, water recirculation systems, deionized (DI) water systems, refinery and material processing applications, pulp and paper processing, metal slurry pumping and pharmaceutical production.

The added cost of a conventional ANSI pump seal with diamond is equivalent to other face upgrade options. If an application could benefit from increased hardness and reduced friction, particularly if it is susceptible to dry running, consider installing diamond-faced seals during the next maintenance cycle to experience the benefits first-hand.

Why HUHNSEAL?

Not just anybody can make Diamonds from Methane Gas. If so, then it would be commonplace and available everywhere and from every mechanical seal manufacturer in the world. It is a fact that this Diamond technology is not universally available.

The reason for this is that the Chemical Vapor Deposition process is proprietary and not common knowledge. Within this process there are over 1200 variables that can be (and have to be) precision controlled during the manufacturing process. Thus, no two manufacturers produce the same diamond.

Huhnseal has extensively researched and tested their diamond seal technology, both in the laboratory, and in actual operating services. The first diamond seals in Canada were installed in a Paper Recycling Plant; twelve years ago. These seals are still performing today.

As demand for the technology was growing, Huhnseal was able to develop a far superior diamond seal face with properties that outperform any of its competitors. The development of the technology to produce market quantities at fair market pricing structure close to competitors SiC faced mechanical seals has resulted in a growing demand for Huhnseal's diamond seals.

And Diamond Seal faces are not Huhnseal's only claim to fame; with over 6 new patents in the mechanical seal industry; Huhnseal has a lot to offer these days.

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