DIAMOND SEAL FACE TECHNOLOGY
Diamond Treatment for Mechanical Seal Faces

- Micro Crystalline Diamond (MCD)
- Significant reliability improvement for mission critical seal applications where hard versus hard face materials are required

For pump and agitator applications MCD provides the best coating performance for target applications

Surface image showing micron-size diamond grains

Diamond treated component – 3D profilometer

Diamond performs best when running against itself – diamond vs diamond. Sealing face designs must be silicon configuration compliant.
The Most Important Seal Face Qualities For Rotating Equipment

- Modulus
- Refractive Index
- Electron mobility

- Electrical Breakdown
- Electrochemistry

Low Friction
Hardness
Chemically Inert
Thermal Conductivity

- Stiction
- Biocompatible

- Corrosion resistant
- Optical Transparency
Diamond - Benefits

Diamond is best suited for the following applications:

- Slurries
- Hot water
- Abrasives
- Multi phase
- Poor lubrication conditions

Providing:

- Lower coefficient of friction
- Expected cooler running seal face temperature
- Higher wear resistance
- Reduced power consumption

Control over upset conditions (ex: intermittent dry running episodes); the lower coefficient of friction reduces the heat generated and in turn increased dry-running capabilities.

Abrasives resistance - Much lower wear rates compared to other hard materials when applied in abrasive environments.

Simply put – A coefficient of friction better than carbon graphite and a hardness better than SiC.
Industries Served

Diamond can easily be applied in many industries ranging from the water industries to mining, oil and gas, chemical, energy and pulp and paper.

(Boiler feeds, light hydrocarbons, abrasive slurries)
Field Applications

- Size: 1.000” - 8.000” shaft diameter (25.40 – 203.00 MM)
- RPM: 10 - 25,000
- Fluid: Acidic - base – alkaline
- Seal type: Various
- Application: Mainly slurries, abrasives, multiphase, hot water
- Location/support: Global
- Results/Feedback: Fair - highly positive
Diamond is chemically grown directly onto the sealing ring face

Section diamond coating on silicon carbide

Source / Courtesy DiacCon GmbH
Diamond Manufacturing Process

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Diamond Manufacturing Process

Treatment setup of mechanical seal faces

Barbecue-Principle

Horizontal filaments with gasflow through filaments onto the substrates

homogeneous coating
Diamond Manufacturing Process

Process
- Hot Filament Chemical Vapor Deposition Process (HF CVD)
- Coating applied at temperatures of 600 – 800 °C at grow rates of 0.1 to 1 µm per hour
- Coated materials generally silicon carbides

Diamond crystal grown onto the surface

Very strong adhesion due to high coating temperature in comparison to DLC

Source / Courtesy DiacCon GmbH
Quality

Measurement of Coating Thickness

Check of Crystallinity By Light Microscope

Measurement of Flatness (Tropel Flatmaster)

SEM Investigation Especially for R&D

Circumferential Flatness/Waviness Radial Slope

Raman Measurement of Diamond Quality

Source / Courtesy DiacCon GmbH
The Challenges

Diamond is an optional treatment (film) performed on the SiC seal faces to enhance overall seal performance. It can resist certain abrupt/upset system conditions such as intermittent dry running.

Diamond has shown in dynamic testing and field trial applications to have benefits in many areas such as lower wear rates and good handling of upset conditions; however its capabilities like any other known material has limitations.

- Wear is a complex metric that includes several features beside hardness (Deformation, fracture, abrasion, chemical, etc.)
- We have come to accept that hard materials wear as a result of interactions with much softer materials; diamond behaves similarly, but with reduced wear rates

Unexpected failure should not be 'expected'. MTBR can be improved with the correct application of diamond treatment. Ask John Crane how.