Introduction

Ceramic bearings using silicon nitride were put to practical use in 1984, and since then applications of ceramic bearings have been increasing steadily, because silicon nitride has many superior characteristics. We explain the characteristics of silicon nitride and fundamental performance of ceramic bearings, and then introduce the ceramic bearing application for motors and generators. In particular, the bearings for wind turbine generator application are subject to electrical pitting, which may cause the bearings to break down. To avoid such pitting, hybrid ceramic bearings have been used in this application.

Characteristics of ceramic bearings

Comparing the characteristics of silicon nitride and bearing steel, ceramic bearings have many advantages for applications with requirement for high temperature, high speed rotation, high seizure resistance, high rigidity, corrosive environment, electrical insulation, etc.

Rolling life and seizure life of hybrid ceramic bearings

Fig.1 shows the life test results for hybrid ceramic bearings. Life of hybrid ceramic bearings is equal to life of steel bearings using the lubricant with high viscosity. Using the lubricant with low viscosity, hybrid ceramic bearings have a longer service life than steel bearings. Hybrid ceramic bearings have superior anti-seizure characteristics.

High Rigidity

Fig.2 show the comparison of rigidity between hybrid ceramic bearings and steel bearings. Since the modulus of longitudinal elasticity of ceramic is larger than that of bearing steel, the rigidity of hybrid ceramic bearings are 1.12 times higher than that of steel bearings.

Temperature rise and power loss

Fig.3 shows the high speed performance of hybrid ceramic cylindrical roller bearings. Hybrid cylindrical roller bearings are superior to steel cylindrical roller bearings in both temperature rise and power loss characteristics. This is because the centrifugal force of ceramic roller and the slide of ceramic roller attributable to gyro-moment are lower than those of steel roller.

Insulated hybrid ceramic bearings for generator

One of the causes of bearing failure in motors and generators is electric pitting. Electric pitting occurs when a surface in rolling contact is locally molten due to sparks produced over the very thin lubricating oil film on the surface when electricity passes through the bearing in operation. Electric pitting appears as a series of pits or a series of ridges on the surface in rolling contact. In order to avoid the damage, insulated hybrid ceramic bearings have been adopted. In these bearings the rolling elements are made of ceramic material with superior insulation capability. Hybrid ceramic bearings prevent electric pitting, and also reduce bearing temperature rise, and increase grease service life. For these reasons hybrid ceramic bearings assure long term maintenance free operation and high speed equipment operation.

Reference
JTEKT Co., Ltd.: CAT. NO. B2004E