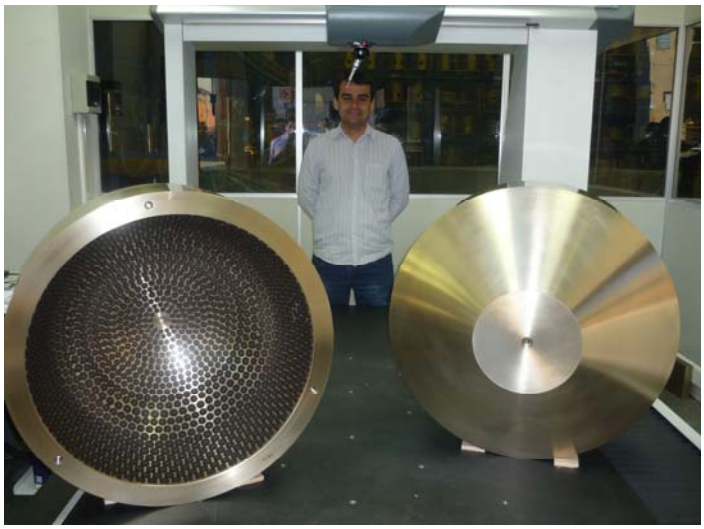
Innovative new bearings help keep Panama Canal cleaner



GGB pintle bearings for the miter gates in the Panama Canal lock system

GGB Bearing Technology, formerly Glacier Garlock Bearings, recently developed a new type of pintle bearings for refurbishment of the Panama Canal's lock system. The bearings are now operating in hydraulically operated miter gates, which open and close the navigational locks to allow passage through the canal's multiple levels.

These gates have two leaves that meet in a mitered joint that closes one end of a lock. Among the requirements specified by the Panama Canal Authority for the new pintle bearings were 25-year service life, abrasion-resistance, underwater operability, ease of assembly, opening and closing, and no lapped pin.

In addition the U.S. Army Corps of Engineers stipulated the use of self-lubricating instead of greased bronze bearings to eliminate contamination of the water. The canal has three groups of gates with 16 gates per group, each of which required 50 pounds of grease a year, releasing 2,400 pounds of the lubricant into the water.

GGB's relationship with the Panama Canal Authority dates to 2003, when the company began supplying its GAR-MAX® filament-wound bearings for applications such as the shock absorbers on the canal walls, a rail system for pedestrian walkways and clevis bearings for hydraulic cylinders.

For the miter gates, however, it had to submit certified, third-party test results to have its bearings considered for the lock refurbishment project.

GGB designed and produced two one-piece, quarter-scale hemispherical bronze bearings lined with its Multifil™ PTFE-based tape for accelerated testing and analysis by Canada's Powertech Labs, which specializes in clean energy consulting, testing and power solutions. Unfortunately the liner delaminated during testing and debris collected in the bearing causing it to fail prematurely.

Using House of Quality methodology, GGB correlated the specified needs of the Panama Canal Authority and Army Corps of Engineers with the functional requirements of the bearings, i.e. low friction, high load capacity, high embeddability, drop-in design, no swelling when submerged, high conformability and self-cleaning. After extensive study of various polymer materials, the company selected an advanced polymer resin with PTFE fibers designed for applications requiring low wear and friction against metals, other plastics and itself.

GGB produced another pintle bearing lined with the new material, which passed a second round of testing, validating both the material and GGB's hemispherical bearing design. The company subsequently presented the unique concept of using the polymer material in the form of embedded, solid lubricant plugs protruding ⅛-in. above and covering 70% of the surface area. This configuration not only allowed for efficient flushing of the bearing via integral cleaning grooves, but also enhanced its structural integrity and facilitated its production.

New quarter-scale prototypes were again submitted to Powertech Labs for testing and evaluation. Supplied by GGB in 5-in. and 6-in. diameters, the bearings were run against 316 stainless steel pintles for 200,000 open/close cycles. The tests yielded excellent results in terms of static/dynamic friction, axial/horizontal direct wear and temperature resistance, with only nominal grooving of the pintles.

GGB then modeled a full-size, 24-in diameter bearing for finite element analysis of the new design. Analysis of 285,000 elements and 74,500 nodes in the contact region and evaluation of the compression and shear strength of the protruding lubricant plugs confirmed that contact pressure and shear force were well within the bearing's mechanical properties with a sufficient margin of safety.

The imprimatur of the Army Corps of Engineers combined with GGB's performance in this project is leading to additional opportunities with the Panama Canal, and the potential to refurbish more than 600 such miter gates just in the U.S. The new bearings are also suitable for use in bridges, telescopes and other applications involving pivoting movements and requiring high axial load resistance.