

Industry Needs Fulfilled by Patented NASA PS300 Solid Lubricant Technology



PS300 powder used as starting material for both plasma-sprayed PS300 coatings and powder-metallurgy-formed PM300 bushings.



PM300 bushings used in industrial drying furnace conveyor system.

In 1999, the NASA Glenn Research Center was awarded a patent (#5866518) for a new high-temperature solid lubricant coating material, PS300. A combination of wear-resistant metals and ceramics with solid lubricant additives, PS300 reduces friction and wear in sliding contacts from below ambient to over 650 °C. This lubricant is an outgrowth of over three decades of high-temperature tribological research and was specifically developed as a shaft lubricant to protect foil air bearings used in Oil-Free turbomachinery, like gas turbines. Foil bearings are lubricated by air at high speeds but experience sliding and wear during initial startup and shut down when a lubricating film of air has not yet developed. PS300 shaft coatings have successfully lubricated foil bearings for over 100 000 cycles without wearing out.

Several intrinsic characteristics of PS300, namely its good high-temperature friction and wear behavior, low material cost, ease of manufacturing, and thermal stability make it an ideal candidate technology to spin off from aerospace to industry. Two recent spinoff successes include using PS300 coatings to lubricate high-temperature, high-pressure steam turbine control valves used in advanced power plants and using PM300, a solid form made via powder metallurgy techniques, for bushings to lubricate high-temperature conveyor components in an industrial drying furnace.

Newly developed steam-turbine-based power plants achieve high efficiencies by operating at high steam pressures and temperatures sometimes exceeding 540 °C. In this

environment, one steam turbine manufacturer experienced severe wear and sticking of their steam turbine control valves. To solve this problem, the NASA PS304 coating was plasma spray deposited onto the large (2-m-long) valve stems and was ground to the desired thickness and surface finish. These valves were put into service and, upon inspection at 1- and 2-yr intervals (during planned plant shutdowns), have shown no signs of wear or degradation. Numerous previous attempts to solve this problem with other materials (e.g., graphite and Teflon) were unsuccessful. Future power plant applications are planned.

The second spinoff is in the welding rod industry. A major manufacturer of welding rods and equipment was experiencing wear and seizure of conveyor bushings in their welding rod drying furnaces, which had been in service for 50 years. The furnaces, which use bronze bushings to lubricate the conveyor system, originally had operated at a few hundred degrees centigrade. The modern process exposes the conveyor components to temperatures over 500 °C, which quickly degrades the best bronze bushings in a matter of days or weeks. This degradation results in lost time, product, and revenue. Attempts to use replacement bushings made from ceramics, graphite, and other advanced polymers failed. The environment was too severe. To respond to this technical need, Advanced Materials (ADMA), a NASA patent licensee working in conjunction with Glenn staff, fabricated free-standing bushings of PS300 material using powder metallurgy techniques. These powder metallurgy bushings are called PM300. The first of 12 furnaces were retrofitted with over 2000 bushings made of the PM300 material. These bushings have experienced no measurable wear after a successful year of service. In the upgraded furnace, product losses due to seized bushings no longer occur.

These two success stories, one for the PS300 coating and one for the new powder metallurgy form, PM300, clearly demonstrate the commercial value of this NASA patented technology. To date, three commercial, nonexclusive licenses have been granted and more are being sought.

Find out more about Oil-Free Turbomachinery research
<http://www.grc.nasa.gov/WWW/Oilfree/>

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