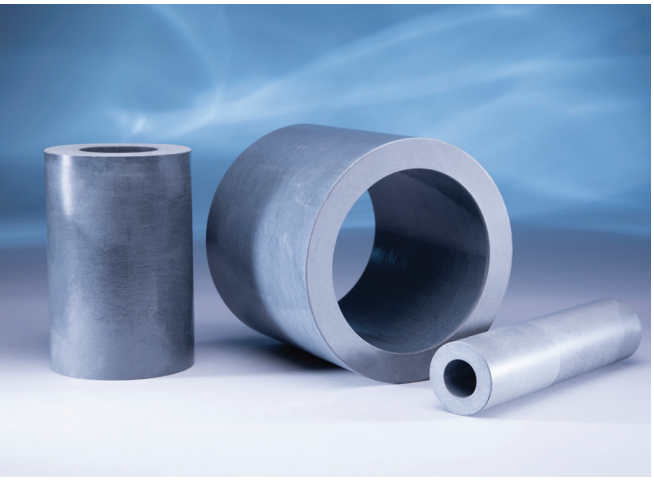
CASE STUDY

Composite Bearings Resist Wear in Circulating Water Pumps

A thermoplastic composition in abrasive applications helped bearings meet end user specifications.



AR-HT *- A bearing made of the proprietary thermoplastic material and a stainless steel shaft*

Customer

One of the largest electric power generation companies in the U.S. conducted an upgrade project of their water pumps at their nuclear plant facility. The pump original equipment manufacturer (OEM) was contracted to produce a series of vertical circulating water pumps. The vertical pump model is designed to pump high volumes of seawater and has an external flush provided to each of the four composite bearing locations. The bearings are composed of a proprietary thermoplastic material, which is designed specifically for use as bushings, bearings and wear rings in pumps handling abrasive media up to 250°F (120°C). Its properties make it a more reliable material than traditional rubber, ceramic or bronze.

The Challenge

The nuclear plant engineering team requested that the pump manufacturer extend the low flow/flush alarm to the upgraded pumps from two minutes to 15 minutes. The alarm would trigger when the flush drops below 5 gallons per minute (GPM) of flow to the bearings. The bearings in the pump must survive 15 minutes of low-flow/flush conditions to give the operators adequate time to respond.

Although the pump OEM was confident the bearings would survive for 15 minutes under low-flow/flush conditions, sufficient data was unavailable to confirm the composite bearings' performance.

Test Matrix

Bearing Material: AR-HT
AR-HT Density: 1.63 [g/cm^3]
Number of Grooves: 6
Hi Reliability Clearance: 0.22 [mm] (0.0087 [in.])
Shaft Material: S Steel W/Nr 1.4529
Shaft Diameter: 68.50 (mm) (2.697 [in.])
Rotational Speed: 1052 (rpm)
Surface Speed, V: 3.773 (m/s) (12.379 [ft/s])

Bearing #	Test #	Radial Load, P	PV	Test Duration
[-]	[-]	[MPa] (psi)	[MPa*m/s] (psi*ft/s])	[min]
1	1.1	0.0345 (5)	0.13 (61.9)	15
	1.2			30
	1.3			60
2	2.1			15
	2.2			30
	2.3			60
3	3.1	0.0689 (10)	0.26 (123.8)	15
	3.2			30
	3.3			60
4	4.1			15
	4.2			30
	4.3			60

The test matrix shows the results of using the testing rig.

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Table 1	Before Test	Test 1 (15 min)	Test 2 (30 min)	Test 3 (60 min)
Test Results: 5 psi load	**Inner Diameter**	**Inner Diameter**	**Inner Diameter**	**Inner Diameter**
Bearing 1	2.705" (68.72 mm)	2.706" (68.73 mm)	2.705" (68.72 mm)	2.706" (68.73 mm)
Bearing 2	2.705" (68.72 mm)	2.705" (68.72 mm)	2.705" (68.72 mm)	2.705" (68.72 mm)
Test Results: 10 psi load				
Bearing 3	2.705" (68.71 mm)	2.705" (68.7 1 mm)	2.705" (68.70 mm)	2.705" (68.70 mm)
Bearing 4	2.706" (68.74 mm)	2.706" (68.73 mm)	2.706" (68.73 mm)	2.706" (68.74 mm)

The inner diameter of the bearings measured in inches (") and millimeters (mm) before and after testing.

The Solution

A test program was developed to confirm the bearing's ability to survive in the end user's condition. The program's objective was to verify that the running clearance would remain within an acceptable limit (less than two times the original clearance) after a 15-minute dry run, using the same operating conditions as the vertical pump.

The Results

Four bearings were tested on a horizontal testing rig. Multiple tests were run on the four bearings, each for a specified amount of time (15, 30 and 60 minutes). The bearings demonstrated outstanding wear resistance throughout the test program, shown by the minimal change in measured internal diameters (ID) on Table 1.

The results show a greater than 4x safety factor. The bearings showed no problems when tested for up to 60 minutes. The pump manufacturer integrated the alarm, and the power generation company specified bearings made from the proprietary thermoplastic material for all circulating water pumps supplied to their nuclear facility.

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