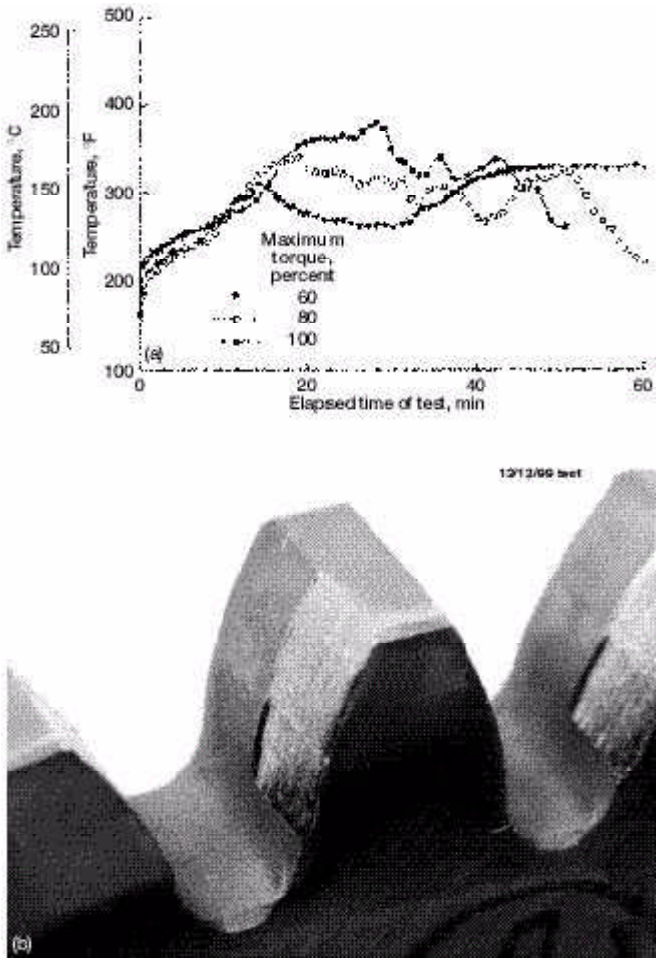
Vapor/Mist Used to Lubricate Gears After Loss of Primary Lubrication System

Loss of lubrication in rotorcraft drive systems is a demanding requirement placed on drive system manufacturers. The drive system must operate for at least 30 minutes once the primary lubrication system has failed. This test is a military requirement that must be passed prior to certification of the aircraft. As new aircraft engines, operating at higher speeds, are fielded, the requirements for the drive system become increasingly more difficult. Also, the drive system must be lightweight, which minimizes the opportunity to use the gear bodies to absorb the tremendous amount of heating that takes place. In many cases, the amount of heat generated because of the high speed and load requires an emergency lubrication system that negatively impacts the aircraft's weight, complexity, and cost.

A single mesh spur gear test rig is being used at the NASA Glenn Research Center to investigate possible emergency lubrication system improvements that will minimize the impact of having these systems onboard rotorcraft. A technique currently being investigated uses a vapor/mist system to lubricate the contacting surfaces after the primary lubrication system has been shut down. A number of tests were conducted in which the vapor/mist used the same lubricant as the primary system, but at a greatly reduced flow rate. Each test was initiated with the primary lubrication system operational and at steady-state conditions for a given speed and load. Then the primary lubrication system was shut down, and the vapor/mist lubrication system was initiated. An example of the tests conducted is shown in the figures.

These preliminary tests have uncovered a mechanism that provides a lubricious, carbonaceous solid on the surface that actually reduces the surface temperature of the meshing gear teeth during operation. Surface analysis of the carbonaceous solid revealed it was graphitic. This mechanism is the synthetic lubricant "coking" on the active profile of the gears, which reduces the friction between the contacting gear surfaces. The level of load affects the onset of this mechanism: the higher the load, the sooner coking takes place. Future work will investigate several other factors that could improve the already promising results that have been attained.



Top: Effect of load on mist-fed lubrication after primary lubrication was terminated. Tests conducted at 10,000 rpm; pitch line velocity, 46.6 m/sec (152.7 ft/min). Bottom: Posttest photograph after primary lubrication terminated and gear was mist lubricated.

Find out more about this research at http://www.grc.nasa.gov/WWW/5900/5950/

Bibliography

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