A NEW FORMULATION FOR CONVECTIVE HEAT TRANSFER IN OIL JET LUBRICATED SPUR GEARS

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ABSTRACT
A test rig designed to study heat transfer between an oil jet and a rotating gear has been developed [1]. It allows to study the $(hS)_{oil}$ product of the before mentioned heat transfer, with h the convection coefficient between the oil and the spur gear and S the surface area wetted by the oil on the gear. This consideration is applied to gears because they function as a power transmission make it necessary to be properly lubricated for thermal considerations.

The test rig allows to study several parameters that can affect heat exchange, such as: oil flow rate, injection temperature, nozzle geometry, nozzle position, gear rotational speed, gear tooth geometry and oil properties.

Several experiments were carried out on different types of spur gear. For all tests, the same trend is observed (Fig. 1): A first phase where the $(hS)_{oil}$ product increases. A second phase, beyond a given gear rotational speed, where the product decreases and then a stagnation phase. The experimental results are compared with existing models [2] that represent the convective exchanges between the oil and the gear in order to develop a formulation of the convective heat transfer between a spur gear and an oil jet.

Several authors use this coefficient h by assessing an exchange over the entire gear tooth. Some oil flow visualisations performed on the above-mentioned test rig show that this hypothesis is not correct at high rotational speed.

Then, based on Akin's work [3], a new formulation is proposed that considers both the geometric parameters of the spur gear and the lubrication conditions.

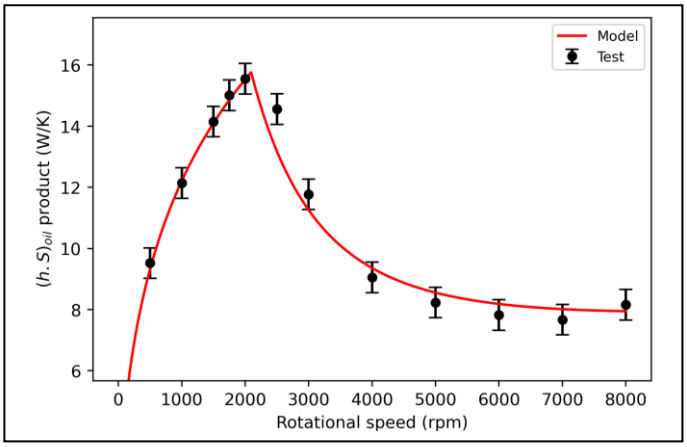

Fig.1 hS model for spur gears

REFERENCES
[1] T. Torres, C. Changenet, , T. Touret, B. Guilbert, "*A New Experimental Methodology to Study Convective Heat Transfer in Oil Jet Lubricated Gear Units*,". *Lubricants* 2023, *11*, 408.

[2] H. Blok, "Fling-Off Cooling of Gear Teeth," *Journal of Engineering for Industry*, vol. 96, no. 1, pp. 60–70, Feb. 1974.

[3] L. S. Akin, J. J. Mross, and D. P. Townsend, "Study of Lubricant Jet Flow Phenomena in Spur Gears," *Journal of Lubrication Technology*, vol. 97, no. 2, pp. 283–288, Apr. 1975