

A NUMERICAL INVESTIGATION OF LOCAL HEAT TRANSFER COEFFICIENTS ON THE UNDERSIDE OF AN OIL-JET COOLED PISTON

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Driven by the demand for improvement in fuel economy, the average engine size has been progressively decreasing, and consequently the power-density of engines has been increasing to meet the engine power requirements. This increase in engine power-density

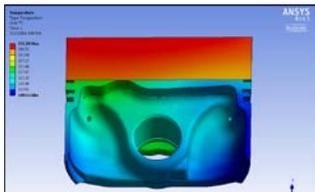
has resulted in significant increases in the thermal loads on pistons, necessitating the use of oil jets to cool the pistons and avoid exceeding the pistons' metallurgical temperature limits. This



investigation aims to numerically validate the local heat transfer coefficient on the underside of an engine piston due to an impinging oil jet. Boundary conditions, which were based on a previously conducted reference experiment, were applied to a thermal finite-element piston model. A

commercial solver was used to perform a parametric study of the piston thermal boundary conditions and the oil jet heat transfer coefficient values. In a parallel study, a commercially available CFD package was

also used to model the behavior of the oil jet striking the piston in the presence of an air environment, and to numerically determine the local heat transfer



coefficient. Combined, these studies allow for the computational prediction of the heat transfer by the impinging oil jet and compared favorably with the experimental data.

Project Blog: <http://oiljetcooling.blogspot.com>

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Student Research Poster Session

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REU Students at Chrysler Sterling Heights Assembly Plant

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This REU program provides hands-on, paid 10-week summer research experiences to undergraduate students from across the U.S. Student participants work in teams on automotive and energy-related research projects and also take part in other activities such as industrial tours, meetings with working engineers, conferences and seminars. A total of 72 students from 51 different universities have taken part in the program since its inception in 2006.

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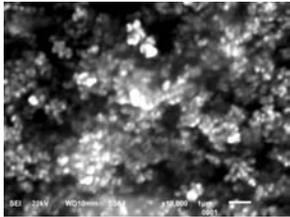


EFFECT OF HARDNESS ON FRICTION AND WEAR CHARACTERISTICS OF OIL-BASED ZNO NANOFUIDS

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Nanofluids are fluids with a suspension of nanoparticles in base fluids. With a growing demand for efficiency and reliability, nanofluids with significant friction reduction and anti-wear properties have been studied extensively. Many different variables have been examined in order to find their effects on friction and wear performance of nanofluids. Those variables include: the surface roughness of a material, the size, shape, and concentration of nanoparticles, the type of nanoparticles, and base fluids and surfactants used. However, the effect of the hardness of a material on friction and wear when using nanofluids as lubricants has not been studied. In this project, reciprocating pin on flat tests with carbon steels of varying hardness alongside ZnO-oil based nanofluids were carried out in order to assess the effect of the hardness on friction and wear performance of nanofluids. The results show that the harder carbon steel showed a greater relative improvement in friction reduction when a 2% by weight Zinc Oxide nanofluid is used versus base oil.



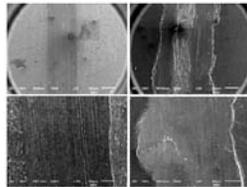
Project Blog: <http://ouaerimnanofluidsgroup.blogspot.com>

INVESTIGATION OF SCUFFING RESISTANCE OF ALUMINUM-SILICON ALLOYS

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Aluminum-silicon alloys are increasingly being used in the automotive industry due to their light weight and ease of manufacturability. With their increasing usage, it is imperative that the scuffing behavior of aluminum-silicon alloys be studied, particularly under the high-speed reciprocating contact that is very common in automotive applications. Scuffing is one of the major failure mechanisms for automotive mechanical components. Understanding the causes of scuffing could assist in finding ways to prevent it and extend the life cycles of parts. This study examines the scuffing resistance of aluminum-silicon alloys under reciprocating conditions. The effects of different factors such as heat treatment, hardness, and microstructure, which can affect the scuffing performance of materials, were investigated. Materials tested include A356, A356 with Strontium (Sr), and 6101. Lubricated tests on the softer 6101 resulted in similar scuffing track characteristics as dry tests on the harder materials. 6101 also had a lower wear resistance. Experiments indicated that there is no direct correlation between hardness and scuffing resistance.



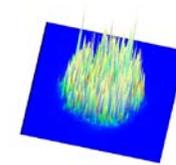
Project Blog: <http://alsiscuffing.blogspot.com/>

NUMERICAL MODELING OF TEMPERATURE RISE DURING BALL-ON-DISK TESTING AND SCUFFING

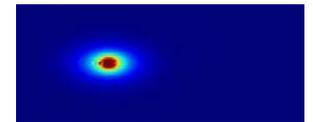
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Scuffing is an abrasive surface phenomenon occurring in tribosystems that leads to failure in mechanical and automotive components. The occurrence of scuffing is directly related to a dramatic rise in the coefficient of friction and in the surface temperature of contact surfaces due to the interaction of asperities between the two surfaces. One



of the most common ways of studying scuffing is through the use of a ball-on-disk tribometer test. In this type of test, a load is applied to a stationary ball which is placed in contact with either a rotating or reciprocating workpiece and friction and wear are then monitored as the load is varied over time. In this study, we focused on numerically modeling the transient temperature rise that may occur during such a test. First, results from experimental testing are input into an elastohydrodynamic lubrication (EHL) model of an elastic solid in contact with a rigid adiabatic sphere is used to generate the pressure distribution in the contact area. Then a computational COMSOL heat transfer model that implements the reciprocating sliding motion of the test sample is used to simulate the transient temperature rise in the solid during ball-on-disk (BOD) experimental testing. The effects of various thermomechanical loads on both the bulk and flash temperatures of the solid were also investigated.



Project Blog: <http://bodscuffing.blogspot.com>