Determining the Material Properties of Aluminum Using Digital Image Correlation

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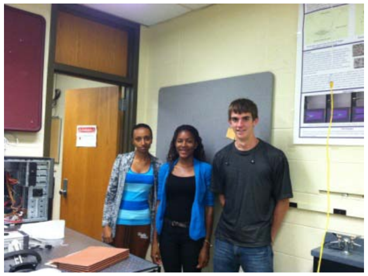
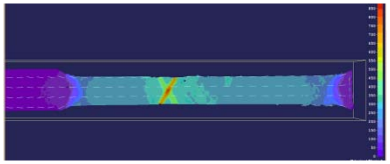


One of the improvements that many automakers focus on is the weight of their vehicles. Reducing the weight of vehicles is a complicated task to complete since the lightweight material must still be strong enough to endure collision stresses. Before automakers can determine if a material will be useful they must know the material properties and forming limit. There are many ways to determine the forming limit and material properties including the Marciniak Method, Nakazima method, and Digital Image Correlation. The Marciniak and Nakazima methods have many disadvantages such as high cost, inaccuracy, and require a large number of test samples. The best way to steer away from those disadvantages would be by using DIC, which is a full field, non-contact evaluation method that uses CCD cameras to record and track the individual points of a test specimen. By using two or more cameras the software is able to calculate X, Y, and Z coordinates as well as the strain in each direction. This method was used to produce both engineering and true stress vs. strain curves for 5754 and 6016 aluminum samples.



Investigation of Tribological Performance of Nanofluids

Kayla Owens – Oakland University
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Steven De Jesús Santiago – Universitad del Turabo, PR
Advisors: Steven Thrush, J. David Schall and Dr. Gary Barber

The tribological performance of ZnO nanoparticles in a PAO oil was investigated. Recent research suggests that these fluids may reduce friction and wear compared to the base oil. In addition, the effect of nanoparticle concentration and temperature on friction and wear was studied while viscosity of the fluids was also explored. Polished 4140 steel samples were used to examine the lubricants in a rotary pin-on disk test. Reduction in friction and wear was observed, but friction was reduced at the lower temperature while wear was reduced at the higher temperature. This is likely due to the breakdown of the stabilizer, which is needed to disperse the nanoparticles, at higher temperatures.

Acknowledgments - A number of professionals kindly volunteered their time to help with the program in 2012. They include: Ms. Meg Novacek, Ms. Thalia Graham, Mr. Mark Gleason, and Mr. Todd Lounsberry from Chrysler; Mr. Glenn Denomme from A123 Systems; Mr. Jeff Dix from Nissan, Dr. Dean Tomaszic from FEV, Inc, and Ms. Eva Barber, from Ford Motor Co;. Further assistance was provided by OU staff and faculty, including Mr. Peter Taylor, Mr. Matt Bruer, Mr. Eric Stevens, Ms. Jane Dietrich, Mr. Keith Harvey, Ms. Barbara Kleine, Dr. Michael Latcha, as well as several OU students. Last but not least, we wish to acknowledge the invaluable help of Ms. Brenda Bond.

Oakland UNIVERSITY

AERIM: Automotive and Energy Research and Industrial Mentorship
Research Experience for Undergraduates Program

Student Research Poster Session
July 24, 2012

The AERIM REU program in the dept. of Mechanical Engineering at Oakland University is supported in 2010-2012 by the National Science Foundation REU Site program and the Department of Defense ASSURE program through NSF award No. EEC-1004915 (PI: Dr. Laila Guessous, Co-PI: Dr. Qian Zou). Additional Funding has been provided by the Office of the Provost and Vice President for Academic Affairs, the office of the Vice Provost for Research and by the School of Engineering and Computer Science at Oakland University.

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 62 students from 46 different universities have taken part in the program since its inception in 2006.

For more info: http://me-reu.secs.oakland.edu

Oakland UNIVERSITY

Evaluation of Coal Fly Ash as a Filler for Thermoplastic Polymer Composite Blends

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Advisor: Dr. J. David Schall

The goal of our research project was to explore the properties of polymer composites using various waste-stream materials as fillers. We created fifteen different material combinations using the Arburg Allrounder Injection Molding Machine and C.W. Brabender Extruder. With these samples we tested the unique mechanical properties of each blend. Utilizing the MTS Insight Machine we were able to perform tensile and stress relaxation tests. We also were able to collect heat deflection temperatures, fractural energy, and viscosity results of the different material combinations. After analyzing the plethora of data we obtained, we decided to narrow our focus down to blends of polypropylene, glass fibers, and varying weight percentages of coal fly ash due to their significant effects on the base materials. Upon analyzing their results we found that the recycled additives preserved many of the mechanical properties of the original blends and therefore have the opportunity to be applied in interior design applications of automobiles.

Experimental and Computational Analysis of Piston Oil Cooling Jet Behavior

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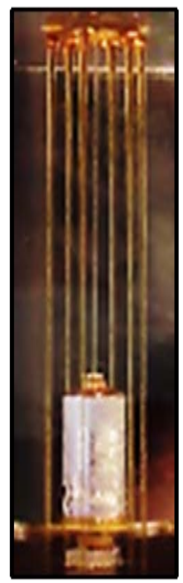
Samantha Echaves – University of Rochester
Brianna Griffin – University of Wisconsin Madison
Trevor Rodriguez-Sotelo - Augsburg College
Advisors: Dr. Brian Sangeorzan, Dr. Laila Guessous and Dr. Alex Alkidas

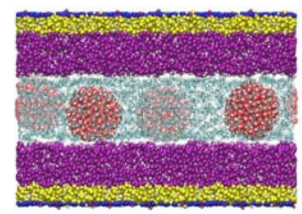
Due to the demand for smaller, yet more powerful engines, higher specific output engines are currently being used in the automotive industry. However, power outputs are limited by the material properties of the piston crown as it reaches temperatures above 300°C. Oil cooling jets are one method that is currently being used to cool the under-crown area of the piston head. Yet, very little research has been done on predicting the rates of heat transfer to such jets. In particular, little is known about the jet impingement area, which is needed to predict convective heat transfer rates. In this study, we developed an apparatus to experimentally measure impingement area of an oil jet on a flat plate and performed a Design of Experiment analysis to select the test conditions. Several different flow patterns were observed as a function for flow rate, plate height, nozzle diameter and oil temperature and were correlated to dimensionless numbers such as the Ohsenorge and Reynolds numbers. Attempts were also made to simulate the oil jet flow using Computational Fluid Dynamics. We also developed an apparatus to experimentally measure the heat transfer coefficient between an oil jet and a flat plate and performed a Design of Experiment analysis to select the test conditions. Computational Heat Transfer simulations of the temperature distribution in a flat disk were performed to assist in the placement of the thermocouples. Collection of heat transfer data and analysis of results is still ongoing.



Molecular simulation of Nanofluid Tribology

Steven De Jesús Santiago – Universitad del Turabo, PR
Advisor: Dr. J. David Schall

Diamond nanoparticles as additives in oil have earned great attention in the recent years in the field of tribology due to their contradictory properties. For example they can reduce coefficient of friction, but can increase wear. Trying to prove by experimental methods why diamond nanoparticles have these tribological properties is very difficult, but with molecular dynamics simulations one might conclude if they rolling, sliding or forming a film. In this study molecular dynamics simulations are used to elucidate the tribological properties of spherical nanodiamond particles in a DLC system. The coefficient of friction of the system with nanoparticles at 300K is 0.0948. The coefficient of friction of the system without nanoparticles at 300K is 0.07277.



* Support for this project was provided by US Army TACOM via Battelle Memorial Institute 11-087.