

## Tribology-Related Researches at Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka (UTeM)

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### 1. Introduction

The establishment of the Faculty of Mechanical Engineering (FME), Universiti Teknikal Malaysia Melaka (UTeM) was officially approved by the Ministry of Education Malaysia on June 22, 2001. FME is located at the Industrial Campus, UTeM. Center of Advanced Research on Energy also known as CARE is one of UTeM Centers of Excellence driven by management and knowledge from FME. The Center acts as a base for bringing together people from a variety of disciplines to work on specific problems of interest. These problems may be defined within the Center without particular knowledge of funding, drawing upon strengths of the people involved. People within the Center then seek possible funding sources for this work. Alternatively, funding opportunities may become known to Center personnel, and research groups will be formed to attack these problems. Currently, seven potential research groups have been identified for development of energy technologies:

- a. Energy Efficient Building & Plant
- b. Green Technology Vehicle
- c. Advanced Materials
- d. High Performance Structure
- e. Maintenance Engineering
- f. Integrated Design
- g. Advanced Vehicle Technology

### 2. Tribology-Related Researches

All the tribology-related researches in FME are mainly under the Advanced Vehicle Technology research group.

Several projects are responsible for development of nano-based engine oil and biodiesel fuels. Experimental investigation on its tribological performance is a key factor to address the problems faced by vehicles.

With the increase in the number of vehicles, the problems with fuel consumption and environmental pollution are becoming more prominent. No less than one-third of vehicle fuel consumption is spent in overcoming friction, and this friction loss has a direct impact on both fuel consumption and emissions. In Malaysia, a study on nanoparticles as lubricating oil additive effect on performance and emission characteristics of a diesel engine has not yet been studied extensively. Therefore, it would be beneficial if

the unique features of nanoparticles, as lubricating oil additives, could directly enhance the diesel engine performance by reducing fuel consumption and hydrocarbon emissions; as well as increase engine power and torque.

Emphasis must also be given to the study of tribological properties of engine oil diluted by biodiesel fuels. Many diesel engine manufacturers have implemented what's called post-injection, the introduction of fuel late in the combustion cycle, as part of an advanced control strategy to reduce emissions. However, post-injection of biodiesel blends facilitates dilution of engine oil while interacting with oil additives to potentially accelerate engine wear. Through the slapping motion of the pistons and oil rings, the unburned fuel from post-injection can make its way through the tight, hot quarters between the piston, rings and cylinder walls. The fuel accumulates in the crankcase and dilutes the oil, which is a major concern regarding engine wear and longevity. With conventional diesel fuel, it can boil out of the lube oil, minimizing long-term dilution effects. But, this effect is accentuated with biodiesel because of its high boiling point relative to petroleum diesel, which can lead to a disproportionate amount of fuel being retained in the lube oil.

Besides, it is imperative to study on lubricity properties of alkaline-based catalyzed biodiesel. The biodiesel fuels are produce from several alkaline-base catalysts (KOH, NaOH, NaOCH<sub>3</sub>) with methanol via transesterification. High lubricity is vital for the proper operation of fuel injectors and fuel pumps, which rely on this property to stop the wear and tear. These parts are not lubricated by the oil in the engine but instead are lubricated by the fuel itself. One of the more serious side effects of removing sulphur from diesel is reduced lubricity. In some countries, the lubricity level is at the minimum allowed by standards - this is not good for a vehicle. The higher the lubricity value the longer fuel-injection system will last, period.

### 3. Research Facilities

In order to serve education, training and scientific research activities, the FME is equipped with faculty's laboratories. Most of the tribology-related research activities at the FME are conducted in

Tribology Laboratory, Chemical Laboratory and Engine Performance Laboratory.

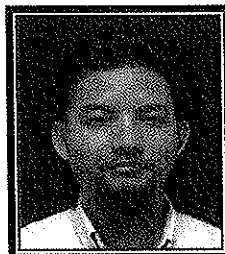
For friction and wear test, pin-on-disc apparatus and four-ball tester are available in Tribology Laboratory. Homogenizer, ultrasonic bath and Fourier Transform Infrared Spectroscopy (FTIR) are available in Chemical Laboratory for preparing nano-based engine oil. In addition, the Engine Performance Laboratory is equipped with engine and chassis dynamometers as well as an automotive gas analyzer for engine performance and emission characteristics test.

On the other hand, qualitative analysis has been performed at other university facilities such as Universiti Kebangsaan Malaysia (UKM) and Universiti Malaya (UM). At the same time, collaborated with Malaysian Palm Oil Institute (MPOB), who has now become one of the successful technology providers for the production of biodiesel, in order to produce biodiesel that meets international standards, e.g. EN 14214. All the biodiesel samples are sent to the MPOB for undergo certain chemical testing to get its fuel properties.

#### 4. Research Fellows



Dr. Mohd Fadzli Abdollah received his Bachelor of Engineering Honors in Mechanical Engineering and Master of Engineering (Mechanical) from Universiti Kebangsaan Malaysia (UKM) in 2004 and 2005, respectively. He is later completed his Doctor of Engineering from Nagoya University, Japan in 2011. His research interest includes automotive tribology. Currently, he is a Head of Department (Diploma Studies) at Faculty of Mechanical Engineering, UTeM.



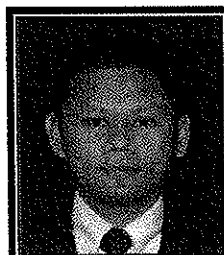
Dr. Noreffendy Tamaldin received his Bachelor of Science in Mechanical Engineering and Master of Engineering (Mechanical) from University of Hartford, CT, United States of America in 1998 and 2000, respectively. He is later completed his Doctor of Philosophy from Coventry University, United Kingdom in 2011. His research interest includes automotive diesel emission. Currently, he is a Head of Department (Automotive) at Faculty of Mechanical Engineering, UTeM.



Mr. Hilmi Amiruddin received his Bachelor of Engineering in Mechanical-Automotive from Universiti Teknologi Malaysia (UTM) in 2002. He is later completed his Master of Science (Automotive) from Coventry University, United Kingdom in 2006. His research interest includes automotive powertrain and emission. Currently, he is a lecturer at Faculty of Mechanical Engineering, UTeM.



Mrs. Mahanum Mohd Zamberi received his Bachelor of Engineering in Mechanical Engineering (Thermal-Fluids) from Universiti Teknikal Malaysia Melaka (UTeM) in 2006. She is later completed her Master of Science in Combustion & Energy from University of Leeds, United Kingdom in 2008. Her research interest includes biofuels and combustion. Currently, she is a lecturer at Faculty of Mechanical Engineering, UTeM.



Mr. Mohd Rody Mohamad Zin received his Bachelor of Engineering in Mechanical Engineering (Thermal-Fluids) from Universiti Teknikal Malaysia Melaka (UTeM) in 2006. He is later completed his Master of Engineering (Mechanical) from Universiti Teknologi Malaysia (UTM) in 2009. His research interest includes renewable energy. Currently, He is a lecturer at Faculty of Mechanical Engineering, UTeM.



Mrs. Sushella Edayu Mat Kamal received his Bachelor of Engineering Honors in Mechanical Engineering from Universiti Kebangsaan Malaysia (UKM) in 2007. Her research interest includes wear and tribology in automotive engine. Currently, she is a Tutor at Faculty of Mechanical Engineering, UTeM.