HIGH HEAT TRANSFER USING HYBRID ENGINE COOLANT

INVENTOR: AP DR DEVARAJAN RAMASAMY
FACULTY: COLLEGE OF ENGINEERING
UNIVERSITY: UNIVERSITI MALAYSIA PAHANG
EMAIL: *deva@ump.edu.my*
CO-INVENTORS: MADDERLA SANDHYA, AP DR KUMARAN KADIRGAMA, AP DR MAHENDRAN SAMYKANO, DR SUDHAKAR, PROF DR MUSTAFIZUR RAHMAN, AP DR WAN SHARUZI

Background

- Conventional Heat transfer fluids such as Ethylene Glycol and Water exhibits very low thermal conductivity (EG+W: 0.2-0.8W/mK) and fail to meet the design criteria to increase the thermal efficiency of heat exchanger.
- 35% of the energy produced by internal combustion in the engine is lost as heat. The overheating in engines is due to insufficient heat dissipation from engines and leading to engine damage. The thermal efficiency of an engine can be improved by introducing high thermal conductivity Nanofluid into the existing system, without any modifications (design) in existing system.
- Engines are designed to operate within a specific temperature range for optimum efficiency, when engine reaches the optimum temperature it consumes more fuel, therefore emitting more CO_2 and engine wear to withstand the high temperature and reduce emissions the conventional coolants should be replaced by nanofluids.

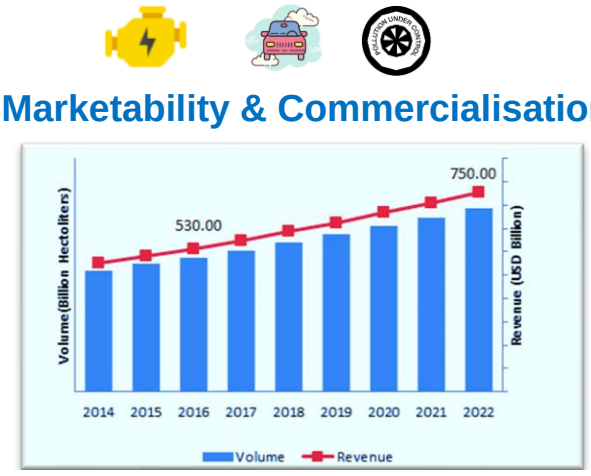
Novelty/ Originality/ Inventiveness

- Heat transfer coefficient for Graphene/CNC can be >1000 W/mK higher than EG-W base nanofluid.
- 25% Improvement in Heat Transfer due to Graphene Properties

Benefits/Usefulness

- A better Hybrid Engine Coolant can be attained with high Heat transfer rate.
- Heat dissipation problems can be resolved and provide better performance. The CO_2 emissions will be reduced
- Engine wear is reduced, and can withstand the high temperature and increase the radiator efficiency

Marketability & Commercialisation



Cost Analysis for Hybrid Engine Coolant (HEC)

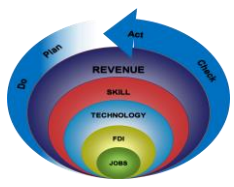
	Conventional	HEC
Average Mileage	48,000 KM	60,000 KM
Cost per Bottle – 500 ml	RM 25	RM 20
Improved Mileage		12,000 KM
MILEAGE IMPROVEMENT		**25.0 %**
COST REDUCTION		**20.0 %**

Status of Innovation

- Patent will be applied through PNI UMP

Expected Market

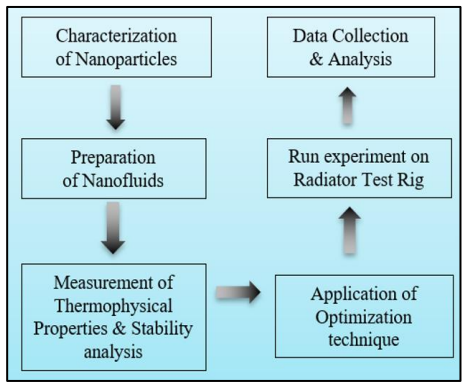
Automobile Industries
Green Environment
Employment
Enhance skill workers



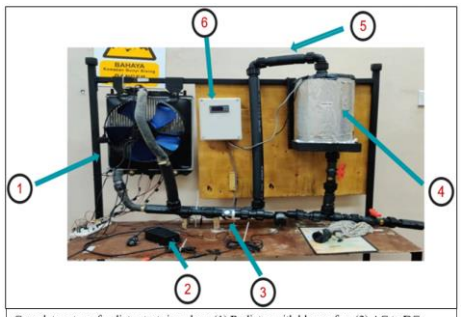
Objective and Experiment

To develop a stable Nanofluid based on Water & Ethylene Glycol by using nanoparticles Graphene and Crystal Nano Cellulose (CNC) and analyze the Characteristic properties and the thermo-physical properties of Water & Ethylene Glycol-based Graphene/CNC hybrid nanofluids and evaluate the heat transfer performance of the newly developed hybrid nanofluid in a Radiator

Methodology

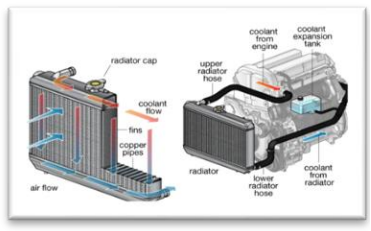


Radiator Test Rig

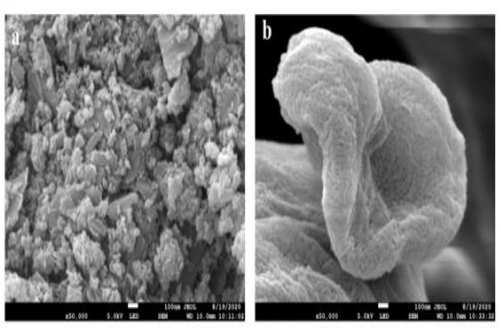


Complete setup of radiator test rig, where (1) Radiator with blower fan, (2) AC to DC voltage adjustable adaptor, (3) Water pump, (4) Water tank with immersion heater and waterproof thermocouple, (5) PE pipes, and (6) Panel box

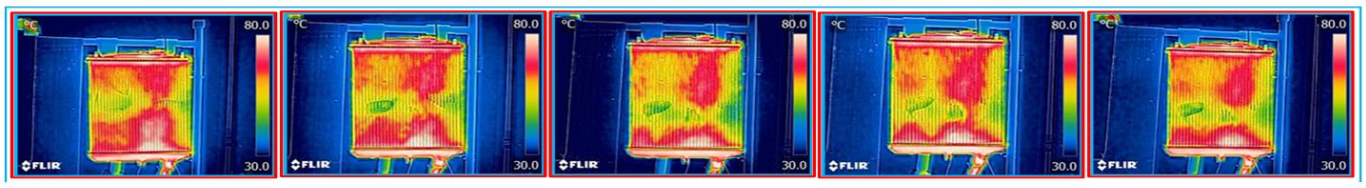
Hybrid Engine Coolant



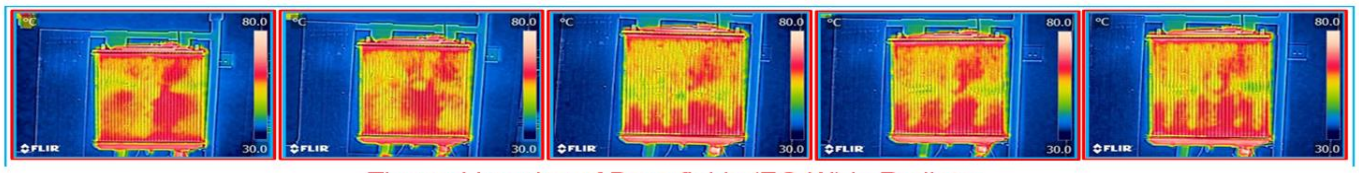
Experiment and Results



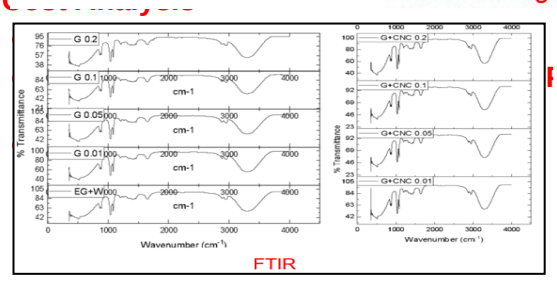
FESEM (a) Graphene and (b) CNC



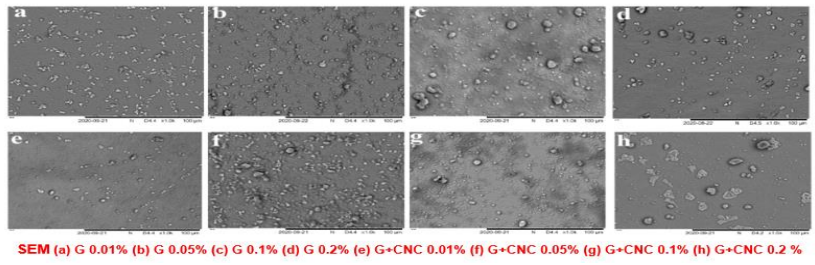
Thermal Imaging of Graphene/CNC with 0.1% volume concentration in Radiator



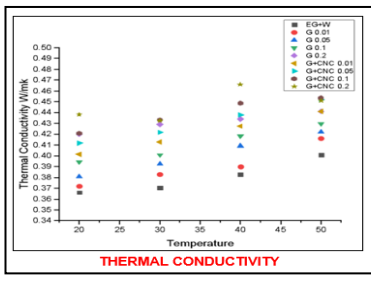
Thermal Imaging of Base fluids (EG-W) in Radiator



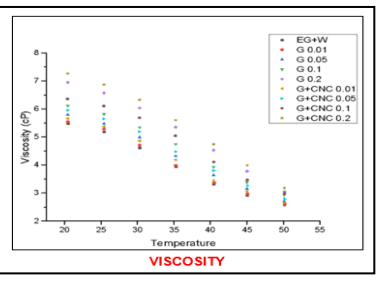
FTIR



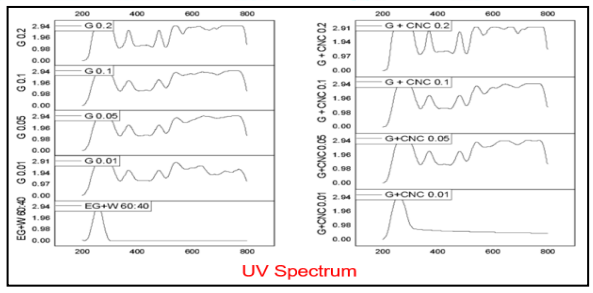
SEM (a) G 0.01% (b) G 0.05% (c) G 0.1% (d) G 0.2% (e) G+CNC 0.01% (f) G+CNC 0.05% (g) G+CNC 0.1% (h) G+CNC 0.2 %



THERMAL CONDUCTIVITY



VISCOSITY



UV Spectrum

Publication

- Madderla Sandhya, D. Ramasamy, K. Kadirgama, 2021, Ultrasonication an intensifying tool for preparation of stable nanofluids and study the time influence on distinct properties of Graphene Nanofluids - A systematic overview. WOS : 6.35 Published
- Madderla Sandhya, D. Ramasamy, K. Sudhakar, K. Kadirgama, M. Samykano. W.S.W. Harun , G. Najafi , 2021, M. Mofijur: A Systematic Review on Graphene-based Nanofluids application in renewable energy systems: Preparation, characterization, and Thermophysical Properties, Accepted
- Madderla Sandhya, D. Ramasamy, K. Sudhakar, K. Kadirgama, W. S. W. Harun. 2021, Heat transfer performance of a radiator with and without louvered strip by using Graphene-based nanofluids. IOP Accepted
- M. Sandhya , D. Ramasamy , K. Kadirgama, W.S.W. Harun, M. Samykano, A.Ameer, 2021 : Enhancement of tribological behaviour and thermophysical properties of engine oil lubricant by graphene/co-cr nanoparticle additives for preparation of stable nanolubricant, IOP Acccepted

Achievement/Award

- **GOLD CITREX, 2020 for Bio Inpired Lubricant**

Collaboration/Industrial Partner