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AUTOMOTIVE ENGINEERING CENTRE

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AUTO INEXSS

• ISSUE 11 : 2016 •

Innovative, Excellence, Success and Betterment of Society

Advanced Innovation & Engineering Exhibition (AiNEX 2015)

Official Visit of Research & Human Capital Development Collaboration Programme To South Korea

Asia Joint Symposium: "Mould & Die In Automotive Engineering"

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AUTOMOTIVE ENGINEERING CENTRE

Automotive Engineering Centre (AEC) was officially established on 1st February 2008. Prior to that Automotive Focus Group was formed which was responsible for all the automotive related activities in UMP. In year 2007, the Automotive Focus Group proposed to UMP top management to developed a centre which focus on automotive engineering research activities to be known as Automotive Development Centre. The proposal was endorsed by UMP Board of Directors, however with the name changed to Automotive Excellence Centre. In March 2010, AEC was reorganized to expand its capabalities and operation to meet the changing needs of the local automotive industries. 20 researchers from Mechanical, Electrical and Electronics and Manufacturing Faculties were appointed to be the AEC members. The AEC name was later changed to Automotive Engineering Centre effective from 22nd July 2010 to better reflect its activities. AEC had make several collaboration with automotive industries such as HICOM Automotive Manufacturers, Modenas, Miyazu, Sapura and with overseas technical universities such as National Kaohsiung Unversity of Applied Science (KUAS) of Taiwan and Iwate University of Japan.

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From the Director's Office

Assalamualaikum and warm wishes from us at AEC.

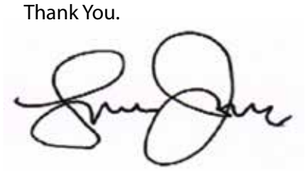
First and foremost we would like to express our gratefulness to the Almighty and gratitude to those involved towards the successful publication of Auto INEXSS, the news bulletin for the Automotive Engineering Centre (AEC).

I would also like to congratulate AEC staff for successfully organising The Asia Joint Symposium: Mould & Die in Automotive Engineering (AJS) and Advanced Innovation & Engineering Exhibition (AiNEX) for the first time.

Truthfully, there were many challenging events that occured this session and they have been tested the commintments of AEC team at the same time. Among them was the organisation of the international conference, AJS 2015 for the first time. The success has proven the unwavering commitment and support given by AEC team. The success of AEC is the success of its team.

I would like to express my appreciation all AEC members and researchers for their controbution and professionalism to uplift the performance of the centre. Please take the opportunity to review the news in the bulletin and we welcome any contribution and feedback for the betterment of Auto INEXSS and AEC.

Thank You.



Associate Professor Dr. Abdul Adam Abdullah
Director
Automotive Engineering Centre

ASIA JOINT SYMPOSIUM: "MOULD & DIE IN AUTOMOTIVE ENGINEERING"

■ *By: Baharudin Basiron* ■

The Asia Joint Symposium: Mould & Die in Automotive Engineering (AJS) is a conference at the Asian level which has been organised since two years ago with the involvement of consortium members under the memorandum of understanding 'Asian International Education and Research Consortium on Die and Mould Technology'.

This time, the organisation was the first by UMP which was held from 18 to 19 August 2015 at Zenith Hotel, Kuantan involving 27 delegates/representatives from Dalian University of Technology (China), Hanbat National University (South Korea) and Iwate University (Japan). Besides, it was also participated by Universiti Kuala Lumpur (UniKL), GIFU Univerisity, Tianjing University of Technology & Education and industries specifically related to the field of engineering technology and mould and die automotive engineering.

The first conference was held at Dalian University of Technology (China) on 25 to 27 September 2013 while the second conference was organised by Hanbat National University (Korea) on 16 to 17 September 2014. This conference provides a strong platform for UMP researchers to cooperate with Asian researchers for the purpose of international grant applications and undergraduate education mobility under the internationalisation agenda of the university. This time, the conference also involved industries from each country of the consortium and eight Asian universities which comprised four universities of consortium members and three invited universities from each member country.

With the increase of consortium members, a room for discussion, sharing and generating ideas and also experts among researchers in Mould & Die will be produced in the effort of strengthening the field of automotive engineering in Malaysia.

Basically, the conference aims to share information and generate ideas among UMP researchers and countries of the consortium in strengthening the field of mould and die in automotive industry. Moreover, from this conference, collaborations among UMP researchers and countries of the consortium can be improved in targeting international grants as well as generating income for Automotive Engineering Centre in order to achieve the UMP Strategic Planning KPI under NKRA 2 which is Financial Sustainaibility.

The topic of the conference which emphasizes the field of mould and die in automotive engineering will help the development of Malaysian industries specifically automotive and parallel with the aim of the implementation of Industry Centre of Excellence (ICoE) in UMP which is led by Automotive Engineering Centre with the production of mould and die industry-oriented research.

ADVANCED INNOVATION & ENGINEERING EXHIBITION (AiNEX 2015)

■ *By: Baharudin Basiron* ■

Advanced Innovation & Engineering Exhibition (AiNEX) held on 18 August 2015 was the first exhibition organised by Automotive Engineering Centre which aimed to initiate efforts towards technology and innovation development as well as tightening the relationship between UMP with educational institutes, external agencies and industries. This programme has attracted 100 exhibitors from various institutes of higher education, training centres and secondary schools as well as Mara Junior Science College (MRSM). Among exhibitors which took part were UMP, Universiti Pertahanan Nasional Malaysia (UPNM), Universiti Teknikal Malaysia Melaka (UTeM), Universiti Malaya (UM), Universiti Teknologi MARA (UiTM), Universiti Teknologi PETRONAS (UTP), International Islamic University of Malaysia (IIUM), POLYTECHNICS, Kolej Kemahiran Tinggi MARA (KKTM), Penang Skills Development Centre (PSDC), Institut Kemahiran Belia Negara (IKBN) and International College of Automotive (ICAM). Besides, this programme was also participated by 31 secondary schools and MRSMs from Pahang and other states.

Besides that, the purpose of this programme was to nurture the culture of creative ideas in the production of saving and environmentally friendly products through projects exhibited by the researchers among students from schools, public universities, private universities and other educational institutes as well as UMP staff. The exhibition indirectly enhanced the efforts of AEC specifically and UMP generally in creating and maintaining a good network between UMP and community, external agencies and industries. The programme held has supported the mission of UMP: "We provide high quality education, research and services in engineering and technology in a culture of creativity and innovation".

ASIA JOINT SYMPOSIUM (AJS 2015) AND ADVANCED INNOVATION & ENGINEERING EXHIBITION (AiNEX 2015) POST MORTEM MEETING

■ *By: Baharudin Basiron* ■

Automotive Engineering Centre has organised two significant programmes which took place at the same time. They were Asia Joint Symposium: "Mould & Die in Automotive Engineering" (AJS 2015) and Advanced Innovation & Engineering Exhibition (AiNEX 2015) on 18 to 19 August 2015 at Zenith Hotel, Kuantan, Pahang.

The post-mortem meeting was held on 21 to 22 September 2015 at D'Ark Resort, Janda Baik, Pahang which aimed to obtain feedbacks from all staff and parties involved directly in the organisation of AJS 2015 and AiNEX 2015.

Other than that, this meeting was also held to acquire detailed information from all members namely the project presenter, coordinator and all committee members of AJS 2015 dan AiNEX 2015 in order to improve the quality of programme organisations, identify weaknesses and limitations in maintaining and enhancing collaborations between the university and international and external parties, identifying future suitable programmes especially in sharing expertises and ideas with external parties as well as targeting international research grants.

From this meeting, the weaknesses, needs and limitations of the programmes were identified for future planning of big impact programmes especially in generating Automotive Engineering Centre income as to ensure the UMP Strategy KPI under the NKRA 2 which is Financial Sustainabilty can be achieved successfully.

OFFICIAL VISIT OF RESEARCH & HUMAN CAPITAL DEVELOPMENT COLLABORATION PROGRAMME TO HANBAT NATIONAL UNIVERSITY AND BENCHMARKING VISIT TO KEYSIGHT TECHNOLOGY AND HANYANG UNIVERSITY, SOUTH KOREA

■ *By: Baharudin Basiron* ■

Through a memorandum of understanding (MoU) signed on 25 September 2013 between UMP and Hanbat National University (Korea), UMP advances strategically by maintaining a strong collaboration with Hanbat National University by organising a research conference, Asia Joint Symposium (AJS) in the field of mould and die on 18 to 19 August 2015.

Additionally, the collaborative visit was also an effective step in enhancing the research collaboration network between UMP and Hanbat National University by conducting collaborative research programmes in research projects and industrial as well as international research grants which have the potential to be developed and focused by AEC.

In order to strengthen the network, autonomy and governance in AEC, a benchmarking visit also took place at Keysight Technology, Korea and Hanyang University. A discussion on a two-way collaborative network with Keysight Technology and Hanyang Univerisity will help AEC in initiating its step in the implementation of training development programmes, research and management as well as an automotive centre.

The sharing of management and operation methods at Keysight Technology and Hanyang Univeristy was an exposure to all AEC staff to improve the current facilities and services in making AEC a High Impact Research Centre of Excellence (HICoE) in relevant automotive engineering research in 10 years' time. Besides that, staff were also able to learn and share their experiences in the development of engineering technology and high quality automotive expertise research to fulfil the challenging industrial demands.

The visit strengthens the collaborative understanding (MOU) UMP-Hanbat, in order to provide wider opportunities to discuss about student exchange, possibility of sending lecturers for PhD in Hanbat University, collaborative research and relevant issues which can benefit both parties. The strategic collaboration between the university and industries helps the university to widen its collaborative network with automotive industry internationally and attract interests of industries to participate in AiGEV 2016 which will be held in August 2016. Smart collaborations with international universities is a discourse stated in the UMP Strategic Planning 2011-2015 in the university key performance indicator (KRA) which is the improvement of academic quality and strategic branding.

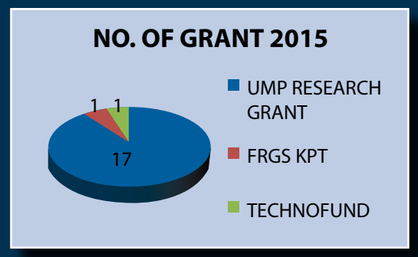
INCOME GENERATION

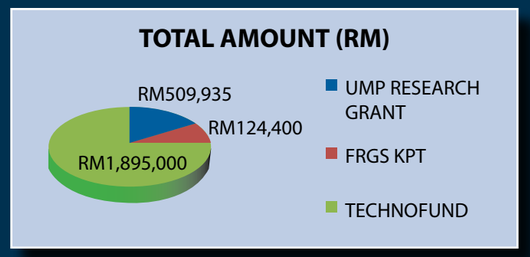
■ *By: Baharudin Basiron* ■

NO.	ITEM	TOTAL (RM)
1	Exhibition (AiNEX 2015 & AJS 2015)	58,215.00
2	Course/Training (Short Term)	34,200.00
3	Automotive Service Centre	237,948.70
	GRAND TOTAL	330,363.70

AEC RESEARCH GRANTS 2015

■ *By: Danial Mohamed* ■





In 2015, Automotive Engineering Centre (AEC) offered internal grants starting from February and 34 applications were received. However, only 17 succeeded after going through three evaluations in March, August and October. The total amount of internal grants applied was RM509,935.00. The applicants were lecturers from Faculty of Mechanical Engineering, Faculty of Electrical & Electronics Engineering, Faculty of Manufacturing Engineering and Faculty of Chemical and Natural Resources Engineering. In April 2015, during the visit of the visiting professor, Prof. Horizon Gitano to AEC, he evaluated five research grants for *Science Fund* before they were submitted to MOSTI. Only two grants had the potential of being forwarded to MOSTI and the rest were submitted for other research grant applications.

For applications of external and international grants, AEC succeeded in receiving one FRGS (MOHE) grant of RM124,400.00 from a total of three applications submitted. The external grant applications submitted in 2015 consisted of three FRGS grants, one MYLAB grant, one PRGS grant, one RAGS grant, one *Science Fund* grant and one TWAS international grant. For international grants, *Science Fund* and MYLAB are still under evaluation. However, AEC has received a good news in December 2015 where MOSTI has approved the application of the *Technofund* research grant of RM1.895 million.

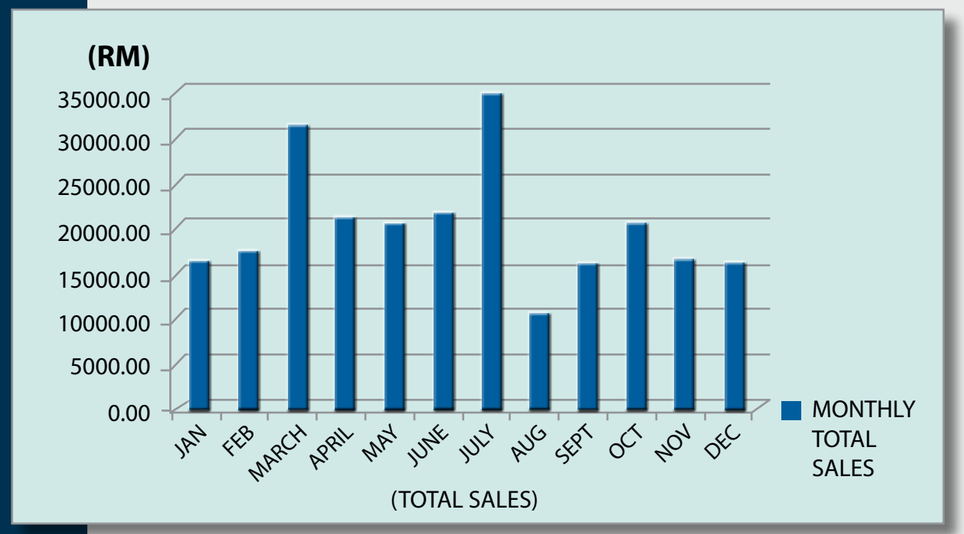
AEC AUTOMOTIVE SERVICE CENTRE REPORT 2015

■ *By: Kamarliah Selamat* ■

AEC Automotive Service Centre provides vehicle services and maintenance for university vehicles, UMP staff and students as well as public with a reasonable charge for spare parts and services. AEC service centre is handled by two assistant teaching engineers, three skills assistants and an administrative assistant (operations) under the supervision of AEC management.

In 2015, the management of AEC targeted 500 vehicles for service and maintenance with RM150,000.00 sales. The service centre has succeeded in achieving more than the target with the number of vehicles serviced of **996** and the total of sales was **RM237,948.70** that year.

TOTAL OF SALES FOR 2015	
MONTH	TOTAL (RM)
JANUARY	15,793.00
FEBRUARY	17,422.00
MARCH	31,126.00
APRIL	20,730.30
MAY	19,150.00
JUNE	21,803.00
JULY	34,084.00
AUGUST	9,991.00
SEPTEMBER	16,012.00
OCTOBER	19,027.40
NOVEMBER	16,572.00
DECEMBER	16,238.00
GRAND TOTAL	**237,948.70**



BASIC COURSE FOR VEHICLE MAINTENANCE (LEVELS 1 & 2)

■ *By: Mohd Aminuddin Ayob* ■

The organisation of the Basic Course for Maintenance & Ethical Driving for Levels 1 & 2 for the second session in 2015 by Automotive Engineering Centre took place at the AEC UMP Automotive Service Centre, Pekan campus on 26 to 27 August 2015 and 1 to 2 September 2015.

The courses were participated by 20 UMP staff and also participants from external agencies. The number of participation of Basic Maintenance Course Level 2 was impressive as most of the participants were from the Level 1 course. The participants were able to learn and understand better the continuation from the previous module as well as the implementation of continuous practical method.

From the course, the participants experienced 'hands on' teaching method for each module. The participants were also exposed to identifying problems and overhauling automotive systems which include the suspension system, breaking system and changing timing belts for single cam and double cam engines. The participants also learnt the basic of managing an engine system which involved identifying sensors and other engine operations.

During the course, the participants received excellent mentoring from trained instructors from time to time. At the end of the course, the participants were assessed through a questionnaire regarding the effectiveness of participant understanding throughout the course.

REPORT ON MOTORSPORTS ACTIVITIES WITH STUDENTS

■ *By: Mohd Idzwanrosli Mohd Ramli* ■

AEC has participated in local and international motorsports that comprise formula events for students and races organised by motoring clubs in Malaysia. The involvement of AEC in motorsports aims to promote UMP AEC as an automotive centre in Malaysia as well as improving knowledge and experience in the automotive field among UMP students and staff. The team from UMP is named UMP RACING TEAM. Among the participations by AEC were EimaRace Student Formula 2015 organised by UTM in Kuantan, Shell Ecomarathon organised by SHELL in Manila, Philippines, and Formula Varsity orgnaised by UTeM in Sepang. AEC has also took part in SpeedWar 2015 organised by *PHANTUS RACING* for five rounds where two rounds were in Melaka and 3 rounds were held in Pasir Salak, Perak.

The best achievement in 2015 was in the speed war event at 4th place for the first round, 5th place in the second round and also 5th place for the fourth round. For the student formula, AEC was disappointed as the racing machine had some technical problems during the race and also financial problems faced in order to change the spare parts besides difficulties in getting spare parts for the race which were quite expensive.

ICoE PROGRAMME 2015

■ *By: Rosidah Mohd Norsat* ■

NO.	PROGRAMME	DATE
1.	Junior Engineering Programme Module 3 Batch 2	18 January - 14 February 2015
2.	Polytechnics (Short Course) Phase 3	24 April - 3 May 2015
3.	MECHAPRO Courses	18 - 26 April 2015
4.	Graduate Short Course UMP July 2015	29 June - 3 July 2015
5.	Blow On Blow Mould Plastic Technology Course	21 September - 30 October 2015
6.	Seminar on Final Year Project Preparation (FYS)	30 September 2015
7.	Short Course for CATIA Software	10 - 11 October 2015

JUNIOR ENGINEER PROGRAM (JEP)

■ *By: Rosidah Mohd Norsat* ■

The *Junior Engineer Programme (JEP)* was a programme involving five core modules in the *Structured Intenship Program (SIP)* components under ICoE Automotive Cluster Human Capital Development designed together with various institutions and industries. The Module 3 JEP programme was held on 18 January until 14 February 2015 at Sapura Industrial Bhd and Miyazu Malaysia Sdn Bhd.

This programme was conducted to complete the *Structured Intenship Program (SIP)* module components which will realise and improve the marketability and expertise of graduands. This programme was participated by 15 UMP students, four Universiti Malaysia Perlis (UniMAP) students and 20 UiTM students.

SHORT COURSES FOR POLYTECHNICS

■ *By: Rosidah Mohd Norsat* ■

The automotive cluster ICoE has collaborated with 14 polytechnics around Malaysia to organise a short course on *hardskills* and *softskills* for 2015. This programme was a platform which offered courses for professional skills certificates in improving the quality and competency of mechanical, manufacturing and design engineering final year diploma students in polytechnics.

The programme was a continuation of the first and second phase programmes which were held in 2014. The short courses for polytechnics were conducted on 24 April to 3 May 2015 for the third phase with 22 courses while on 2 to 11 November 2015 for the fourth phase with 27 courses. A total of 1198 final year students were trained in the third phase while 1330 final year students were trained in the fourth phase.

GRADUATE SHORT COURSE

■ *By: Rosidah Mohd Norsat* ■

Graduate Short Course (GSC) programme was one of the components for Talent Development under ICoE Automotive Cluster Human Capital Development Programme. The aim of the programme was to provide a platform to offer courses for professional skills and soft skills expertise in order to enhance the quality, competency and added value among students who have finished their final semester and future graduands in the fields of mechanical and manufacturing engineering.

The GSC programme was held on 29 June until 3 July 2015 at Faculty of Mechanical Engineering and Faculty of Manufacturing Engineering, Pekan campus which comprised nine courses. A total of 416 future graduands from UMP, Terengganu Advanced Technical Institute University College (TATIUC) and Universiti Tun Hussein Onn Malaysia (UTHM) participated in this programme.

FINAL YEAR PROJECT PREPARATION

■ *By: Rosidah Mohd Norsat* ■

The ICoE of Automotive Cluster has offered a preparation programme for final year project to UMP final year students. This programme aimed to provide an early exposure to the students by focusing thoroughly on theory and practical regarding techniques and methods in preparing proposals as well as technical exposure (hands-on) on effective and high impact final year project preparation. Besides, the programme was designed to improve graduate employability and give support and direction to UMP students and future graduands.

The programme was held on 30 September 2015 for a proposal preparation session while on 21 untill 22 November 2015 the practical session was carried out. This programme focused on the involvement of 432 students from Faculty of Mechanical Engineering and Faculty of Manufacturing Engineering.

ICoE INDUSTRIAL TRAINING

■ *By: Rosidah Mohd Norsat* ■

The implementation of Industrial Training Programme is one of the components for ICoE Human Capital Development Programme 2015. This programme involved collaborations with various industries like Sapura Industrial Bhd, Miyazu Malaysia Sdn Bhd and 28 other industries all over Malaysia. This programme was held on 29 June to 6 September 2015 which involved 15 UMP students, four Universiti Malaysia Perlis (UniMAP) students and 20 Universiti Teknologi MARA (UiTM) students. The organisation of this programme enables the realisation and completion of ICoE Automotive Cluster Human Capital Development Programme in line with the Ministry of Higher Education regulations and information to increase marketability of graduands and local expertise.

SOFTWARE SKILLS COURSE

■ *By: Rosidah Mohd Norsat* ■

The ICoE Automotive Cluster with a collaboration with Mechanical Students Society (MECHAPRO) has designed and offered a course which focused on the skills in software. This programme provided a chance and exposure to UMP students in strengthening their skills and mastering latest and highly technological softwares depending on the needs of engineering industry as well as developing students who own various expertise besides technical skills. The programme was held in April, October and November 2015 which involved 236 second and third year students from Faculty of Mechanical Engineering.

IMPROVEMENT OF HIGH BLEND PALM BIODIESEL-DIESEL FUEL PROPERTIES USING ETHANOL ADDITIVE

By: Dr. Obed M. Ali

INTRODUCTION

Biodiesel has received a great deal of attention because of the advantages associated with its biodegradability and its classification as a resource for renewable energy [1]. Biodiesel is composed of fatty acid methyl esters (FAME) and is synthesized usually via vegetable oils (triacylglycerols) trans esterification with low-molecular-weight alcohols [2]. The current mandates regarding the use of biodiesel around the world are mostly based on a biodiesel-diesel blend up to 20% biodiesel. The additive is the most visible option to introduce the biodiesel-diesel blended fuel at hight biodiesel blending ratio as alternative fuel for mineral diesel.

The availability and sustainability of biodiesel feedstocks will be the crucial determinants in the popularization of biodiesel [3]. The oil palm is a tropical perennial plant and grows well in lowland with humid places. Compared with other biodiesel feedstocks, oil palm is the highest oil yield crop, producing on average about 5950 litre of oil per hectare annually. Sunflower, canola, soybean, and jatropha can only produce up to 952, 1190, 446, and 1892 litre of oil per hectare annually, respectively [4]. From the literature, it has been found that feedstock alone represents 75%-80% of the overall biodiesel production cost [5]. Therefore, selecting the high oil yield feedstock is vital to ensure low production cost of biodiesel.

Fuel injection systems measure fuel by volume, and thus, engine output power influence by changes in density due to the different injected fuel mass [6]. Thus, density is important for various diesel engine performance aspects. The use of fuel with a high kinematic viscosity can lead to undesired consequences, such as poor fuel atomization during spraying, engine deposits, wear on fuel pump elements and injectors, and additional energy required to pump the fuel [7]. The fuel energy content has a direct influence on the engine power output [8], [9].

The biodiesel energy content is less than that of mineral diesel, therefore using of additive most not worsen the energy continent of the POME fuel. Use of additive that have less energy continent with blended fuel usually causes the energy content of the fuel to decrease depending on the additive energy continent and portion. Currently, the energy content is one of the major technical issues in the use of biodiesel–diesel blends, as it relates to the engine power. The conducted researches on measuring the energy content very little and didn't indicate the methods and equipment's used for measurement. However, information concerning the energy content of palm oil biodiesel and its blending with additive remains scarce.

Studies [10], [11] on blended of ethanol and biodiesel prepared from Madhuca indica oil (MME) and poultry fat (PFME) exhibited better fuel properties versus unblended biodiesel. Where the reduction in cloud point and pour point was 4°C and 3°C for MME and 6°C and 4°C for PFME respectively, when blended with 20% of ethanol, with reduction in CO, lower NOx emissions and decrease in smoke emissions on an average without affecting the thermal efficiency.

Other experimental investigations [12], [13] were conducted to evaluate the effects of using ethanol as additives to soybean biodiesel/diesel blends on the performance, emissions and combustion characteristics of a direct injection diesel engine. The tested fuels denoted as B20E5 (20% biodiesel and 80% diesel in vol.) with 5% ethanol and (B30E5) 30% biodiesel and 70% diesel in vol.) with 5% ethanol. The results indicate that, compared with blended fuel, there is slightly lower brake specific fuel consumption (BSFC). Drastic reduction in smoke is observed with ethanol at higher engine loads. Nitrogen oxide (NOx) emissions and hydrocarbon (HC) emissions are slightly higher for blended fuel with ethanol, but carbon monoxide (CO) is slightly lower. However, the blended fuels with ethanol could lead to reduction of both NOx and HC emissions of a diesel engine [14], where biodiesel was blended with 5%, 10% and 15% by volume of ethanol and tested in a 4-cylinder direct-injection diesel engine.

Palm biodiesel-diesel blends up to B30 can be directly used in the diesel engines with little or no engine modifications [15]. Therefore, the objective of this study was investigated the ability of using the blended fuel B40 as alternative fuel for mineral diesel through characterize the properties of (POME)-diesel blends fuel (B40) with ethanol (E) as additive, including the energy content and law temperature flow properties.

RESEARCH METHODOLOGY

There were five samples of fuel used in this study which includes, blended fuel (B40) (biodiesel 40% blend with 60% mineral diesel), B40-E1, B40-E2, B40-E3 and B40-E4. Fig. 1 illustrates different analytical apparatus to measure the fuel properties. All the test methods conform to the strict ASTM procedures as recommended by manufacturers. Those tests were conducted under controlled room temperature, pressure and relative humidity to ensure that the result is not influenced from environmental errors.

Figure 1. *Analytical instruments used to measure fuel properties; (a) Magnatic stirrer, (b) Density meter, (c) Viscosity bath, (d) Acid value & acidity tester, (e) Oxygen Bomb Calorimeter, (f) Cloud and pour point measuring equipment .*

RESULT AND ANALYSIS

Viscusity

The viscosities of blended fuel vary in the range of 3.56 and 3.97 mm2/s for B40-E4 and B40 respectively. All B40-E blends, as well as B40, satisfied the kinematic viscosity specification contained in ASTM D6751. The viscosity of the blend decreased linearly as the E portion increases in the fuel mixture as observed from Fig. 2. It clearly shows that the viscosity of B40-E4 was 10% lower than the blended fuel B40. This because the effect of E additive on free fatty acid (FFA) concentration in biodiesel. As a comparison, the small amount of ethanol dilution in the biodiesel blend fuel is proven to reduce the viscosity of the fuel.

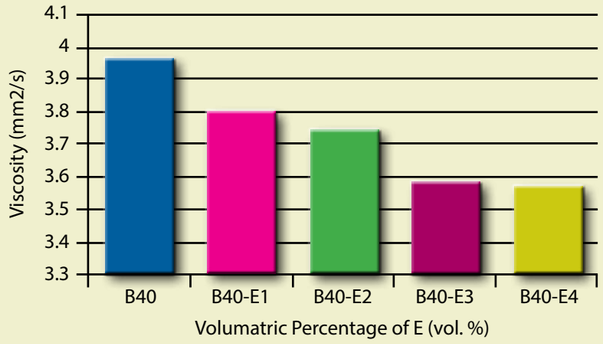


Figure 2. *Variation of viscosity.*

Density

The densities of B40-E blended fuel produced in this study are very close to each other and in the range of 857.2–860 kg/m3 for B40-E4 and B40 respectively. They are suitable for the ASTM and EN standards and slightly higher than those of the diesel fuel 847 kg/m3. Fig. 3 presents the variation of density values for B40 with E portion. It is clear that the density of the B40-E blend decreased linearly with a higher volumetric percentage of the E, indicating that the additivity for the volume.

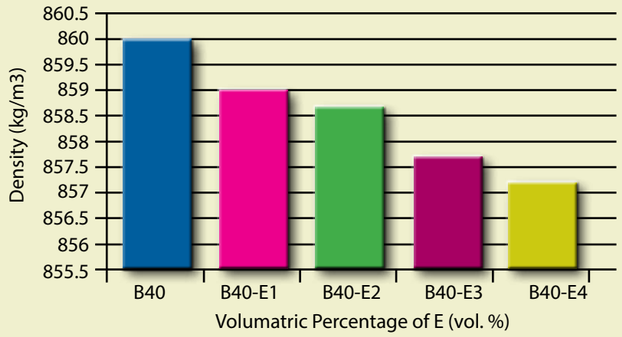


Figure 3. *Variation of density.*

From the figure it's obvious that the small amount of ethanol dilution in the biodiesel blend fuel is proven to reduce the density of the fuel closer to that of diesel fuel.

Acid Value

Acid value number is defined as the amount of potassium hydroxide (KOH) in milligrams that is necessary to neutralize free fatty acids (FFAs) contained in 1 gram of oil. It possesses as the vegetable oil quality indicator to monitor the oil degradation during storage period. According to ASTM D 6751 and EN14214, the maximum value of acid number is 0.5 mgKOH/g [16].

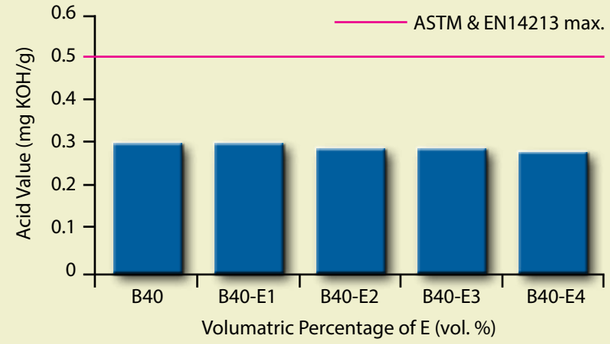


Figure 4. *Variation of acid value.*

Fig. 4 presents the acid value for the tested fuels. It can be seen from the figure that the number of acid value for B40 is the highest at 0.3 mg KOH/g. On the other hand, the number of acid value for B40-E4 is the lowest at 0.28 mg KOH/g. From figure it's clear that the acid value slightly improved by adding ethanol additive with the mentioned percentage. This was expected, as E will dilute the free fatty acids present in POME, resulting in a reduction in AV. The acid value of the B40-E blend satisfies the requirement of ASTM D6751-06 and EN 14104 Standard for all blending range.

Pour Point

B40-E blends improved low temperature operability compared to blended fuel B40 since the freezing points of E (-117.4 oC) are substantially below the temperature at which biodiesel typically undergoes solidification.

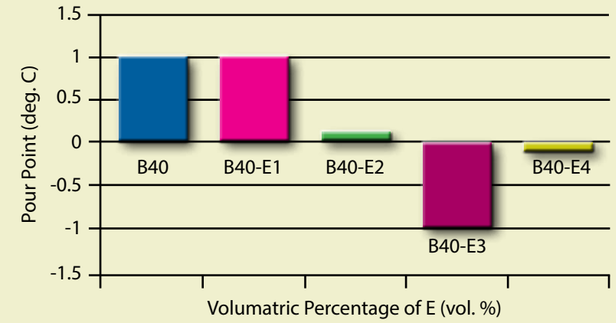


Figure 4. *Variation of acid value.*

Addition of E to blended fuel B40 slightly affected CP, while increasing E content from 0 to 4% resulted in a significant decline in PP. Fig. 5 shows the variations of the PP for POME with the volumetric percentage of the E. The maximum reduction of PP for blended fuel B40 was 3 oC when adding 3% E. The low-temperature properties of biodiesels not indicated in ASTM and EN standards as it related to climatic conditions.

Calorific Value

Due to its high oxygen content, biodiesel has lower mass energy values than petroleum diesel. Therefore, using low energy continent additive with blended fuel results in decreasing energy content of the fuel. The heating value is not specified in the biodiesel standards ASTM D6751 and EN 14214 but is prescribed in EN 14213 (biodiesel for heating purpose) with a minimum of 35 MJ/kg [17].

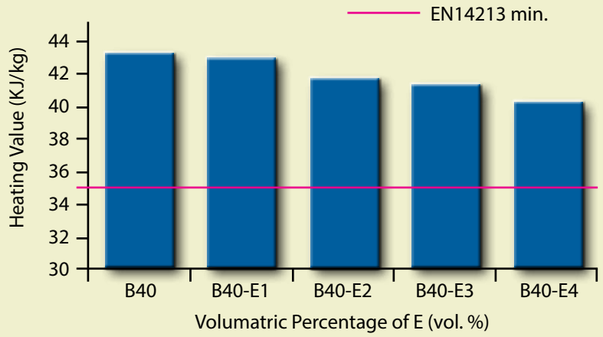


Figure 6. *Variation of energy content.*

Fig. 6, presents the calorific value of the fuels measured by Oxygen Bomb Calorimeter (refer to Fig. 1e). It can be seen from the figure that the calorific value of blended fuel B40-E4 is lower than that of blended fuel B40 by about 6.67%. From the figure it's obvious that the small amount of ethanol dilution in the biodiesel blend fuel is proven to slightly reduce the calorific value compare to that of Blended fuel.

CONCLUSION

The ability of using blended fuel B40 as alternative fuel for mineral diesel fuel was investigated through improving the blended fuel properties using small portion of ethanol as additive. From the study we have been concluded the following resultes:

1. An increase in ethanol additive concentration was linearly decreased the density and viscosity of the blend fuel closer to minerial diesel.
2. A small concentration of ethanol slightly improved the acid value of the blended fuel B40, where acid value decreased with the additive portion increasing.
3. In general, the heating value decreases slightly with increasing ethanol portion in the blends. The maximum decrease in heating value was about 6.6% at 4% ethanol additive compare to the blended fuel B40, which still satisfy the limits of the EN 14213 standard.
4. Increasing ethanol content in blended fuel B40 resulted in a significant difference in low temperature performance, with Maximum decrease in pour point by 2^{o}C for B40-E3 compare to B40.
5. Finally, B40-E3 blends exhibited slightly superior low temperature performance, acid value; viscosity and density with slight lower energy continent by about 4.3% compare to B40 and may be suggested as prudent choice suitable for diesel engine.

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WOOD BASED CELLULOSE NANO PARTICLES FOR AUTOMOTIVE RADIATOR

By: Dr. Devarajan Ramasamy

Wood based cellulose has abundant quantity in nature. It shows enhanced heat transfer and excellent physical properties, biodegradability, unique flow performance and liquid crystalline properties in suspensions and good heat-transfer property and optical transparency (Dufresne, 2013). High efficiency on heat transfer is achieved by collaborative effect between nanocarbon and metal nanoparticles.

The results show that the thermal conductivity of nanofluid is relevant to the type of filler and increases with the increasing of filler loading. A 27% enhancement in thermal conductivity is observed by adding only 0.5wt% of cellulose coated graphene nanoparticles in polyethylene glycol, and 49%, 40% and 30%.

The nano cellulose coated metal nanofluid exhibit better stability after 14 days and no obvious sedimentation is observed. Compared with carbon coated Al and Fe nanoparticles, cellulose coated Graphene nanoparticles nanofluids have best stability and dispersibility and can efficiently enhance the thermal conductivity of base fluid.

The usage in an automotive radiator system will enhance the heat transfer and has a potential to reduce the overall design size. Moreover, nanofluids stabilities are different when nanofluids were dispersed by three ways. Nanofluids dispersed by ball milling way possess the best stability, followed by nanofluids dispersed by ultrasonic dispersion way and magnetic stirring way.

INTRODUCTION

Heat transfer fluids have become more and more important and can be seen in a wide range of industrial applications such as energy, chemical industry, automobile, construction, microelectronics, and so on. Microelectronic devices, for example, can work more steadily and reliably even at high temperature if the heat transfer efficiency is enhanced. In 1995, Choi (1995) investigated a new class of heat transfer fluids named nanofluids in which nanometer-sized solid metallic or nonmetallic oxide particles, rods or tubes was added in traditional heat transfer fluids.

Compared with micron-sized particles, nanoparticles have huge advantage in heat transfer. Firstly, nanoparticles possess relatively larger specific surface area by which can significantly improve heat transfer capabilities. For instance, the specific surface area of particle with diameter of 10nm is 1000 times larger than that of particles with diameter of 10μm. Secondly, since the nanoparticles are very small in size, and thus chance of sedimentation is less, which makes nanofluids more stable.

Over the last decade, nanofluids of high thermal conductivity have attracted great interest in the development of energy-efficient heat transfer domain due to their potential benefits (Maïga, Nguyen, Galanis, & Roy, 2004). Estman, Choi, Li, Yu, and Thomson (2001) prepared the nanofluids by dispersing Al2O3 nanoparticles of different size in water, ethylene glycol and engine oil and found a 30% increase in the thermal conductivity for a filler loading of 5 vol. %. Li and Peterson (2007) reported a similar 28% increase in the thermal conductivity for a loading of 6 vol. % of Al2O3 (36~47nm) nanoparticles in water. Recently, Graphene have attracted many researchers because of its super high thermal conductivity of 2000~3000 W/m•K (Yang, Zhang, Grulke, Anderson, & Wu, 2005).

The thermal conductivity of carbon nanomaterials based nanofluids is much higher than present inorganic filler (Han & Fina, 2011). By dispersing MWCNT in polyisobutylene with ultrasonic dispersion method, (Zhu et al., 2010) found a 30% enhancement in thermal conductivity of MWCNTs/polyisobutylene-based nanofluids for MWCNTs mass fraction of 0.5%.

They also observed that the more uniform MWCNTs being dispersed in nanofluids, the higher thermal conductivity the nanofluids would possess. Xie, Lee, Youn, and Choi (2003) prepared nanofluids by dispersing CNTs, which had hydroxyl groups on the surface by concentrated nitric treatment, in the water and ethylene glycol.

They noticed the thermal conductivity of ethylene glycol nanofluids was increased by 20% for only a small loading of 1 vol. % CNTs. However, the thermal conductivity of CNTs in axial direction is much higher than that of horizontal direction and the high theoretical thermal conductivity in axial direction still hard to be obtained in nanofluids on the whole.

The nanofluids loading CNTs of higher thermal conductivity are obtained depend on strict dispersion conduction. While that heat transfer occurs through the interface, carbon nanoparticles which are the spherical shape and have larger specific surface area compared with CNTs may be more favorable for heat transfer and can enhance effectively the thermal conductivity of base fluids.

As a kind of carbon-metal compound with typical core-shell structure, carbon coated metal nanoparticle possesses an outer layer of nanocarbon and a core of metal nanoparticle and it combines the good performances of single-component materials including carbon and copper or aluminum, and can be provided with other favorable performances such as good corrosion-resistance, oxidative stability, dispersibility and light weight.

While current correlative reports about carbon coated Fe and Ni nanoparticle focus on the magnetic property of material (Burke, Stöver, & Dawson, 2002; Lu, Salabas, & Schüth, 2007), very few reports take carbon coated metal nanoparticles as a kind of thermal conductivity filler and study their thermal properties.

In this study, different kinds of stable nanofluids are produced by dispersing different cellulose coated Graphene nanoparticles into polyethylene glycol, and the affecting factors of stability and thermal conductivity for these new types of nanofluids are also investigated.

TYPE OF WOOD CELLULOSE

Cellulose is a crystalline structural polysaccharide. The basic repeating unit consists of two anhydroglucose rings joined via the β-1,4-glycosidic linkage. In wood, 30-40 cellulose polymer chains aggregate into nanofibrils (also referred to as elementary fibrils or microfibrils) that are 3-5 nm wide. Within each of these nanofibrils, there are regions, where the cellulose chains are arranged in highly ordered crystalline structures, and regions that are disordered (amorphous). As is schematically illustrated in Figure 1, the nanofibrils agglomerate further into larger aggregates and these, together with hemicellulose and lignin, form the plant cell wall (i.e. wood fibre).

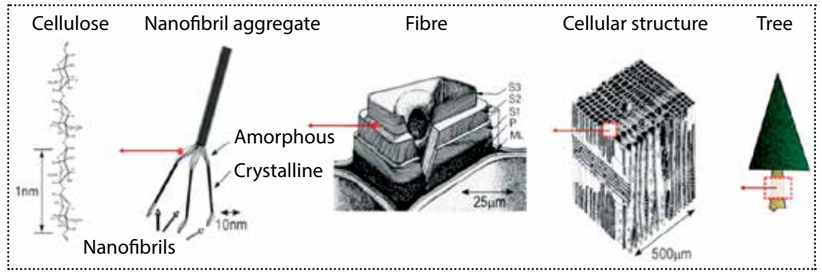

Figure 1. *Hierarchical structure of wood biomass and the characteristics of cellulose nanofibrils consisting of disordered (amorphous) and ordered (crystalline) regions*

It has been shown that cellulose nanofibrils can form nanopaper structures of high toughness. In these structures, the nanofibrils form a physically entangled network (also interacting through strong hydrogen bonds). The preparation route is inspired by conventional paper making process (Figure 2) and it involves careful dispersion of nanofibrils in water followed by vacuum filtration, which results in wet gel consisting of mechanically entangled nanofibrils. Remaining water is removed by drying. Nanopapers have been prepared from cellulose nanofibrils with hydroxyl groups, carboxylic groups and trimethyl ammonium groups. Moreover, their porosity could be controlled depending on the drying technique as discussed in the following section.

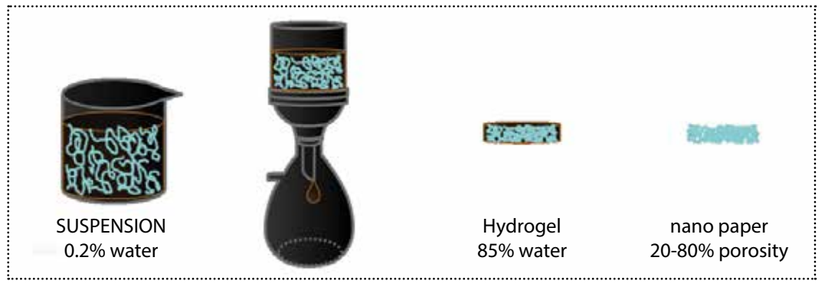

Figure 2. *Schematic illustration of nanopaper preparation*

Nanocelluloses have attracted great interest due to their unique properties such as high stiffness and strength, high specific surface area, low density, low coefficient of thermal expansion, optical transparency and self-assembly behaviour. Thanks to their ability to form a strong network, they can be utilized in bio/nanocomposites either as matrix or reinforcement.

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