20.12.2021

From

Dr. E. K. Mohanraj

Dean - Academics

Nandha Engineering College -Erode,

To

The Secretary

Nandha Educational Institutions

Through

The Principal

Nandha Engineering College

Dear Sir,

Subject: Financial Reimbursement of NPTEL Course Completion (2021-22 Odd Sem) - reg.

With regards to the academic year 2021-22, I would like to bring to your kind notice that 11 Faculty members (List and fees are enclosed) have completed NPTEL online courses successfully and as a motivation, I request for financial reimbursement of their exam fees.

Thanking You,

Yours Faithfully,

Forwarded to the Secretary

20/12/2021

N. Nagarajan.

20/12/21

D. Muthu.

NA..DHA ENGINEERING COLLEGE (Autonomous), ERODE - 638 052

NPTEL ONLINE COURSE COMPLETED DETAILS FOR FACULTY MEMBERS (July - December 2021)

S.No	Name of the Faculty	Dept.	Course Title	Duration in weeks		NPTEL Mark	Certificate Grade (Elite, Silver, Gold, etc)	Fees Paid
1	Dr S KAVITHA	ECE	Accreditation and Outcome based Learning	July - Sep 2021	8 WEEKS	48	-	1100
2	S.MAHESWARI	CSE	Accreditation and Outcome based Learning	July - Sep 2021	8 WEEKS	63	ELITE	1000
3	Dr.S.PRABHU	CSE	Accreditation and Outcome based Learning	July - Sep 2021	8 WEEKS	70	ELITE	1100
4	S.HEMALATHA	CSE	Problem solving through Programming In C	July - Oct 2021	12 WEEKS	76	ELITE + SILVER	1100
5	D.KIRUTHIKA	IT	Programming in Java	July - Oct 2021	12 WEEKS	86	ELITE + SILVER	1100
6	N.ABINAYA	IT	Introduction to Machine Learning	July - Sep 2021	8 WEEKS	60	ELITE	1100
7	Dr K SHARMILEE	ECE	Microelectronics: Devices To Circuits	July - Oct 2021	12 WEEKS	54	-	1000
8	T. JAYACHANDRAN	ECE	Digital Circuits	July - Oct 2021	12 WEEKS	60	ELITE	1000
9	S.THANGAMANI	IT	Programming in Java	July - Oct 2021	12 WEEKS	77	ELITE + SILVER	500
10	Dr. M. EASWARAMOORTHI	MECH	Design Thinking - A Primer	July - Aug 2021	4 WEEKS	87	ELITE + SILVER	1100
11	Dr.C.SIVA	IT	Accreditation and Outcome based Learning	July - Sep 2021	8 WEEKS	76	ELITE + SILVER	500
							Total =	Rs.10,600/-

20/12/2021

20/12/2021

T. Vithya

20/12/21

To A.O -

Permitted to Re-fund -

S. T. 2

7/2/2022 -

21-22 (1)

This certificate is computer generated and can be verified by scanning the QR code given below. This will display the certificate from the NPTEL repository, https://nptel.ac.in/noc/

Roll No: NPTEL21MG53S13410012

To
DR M EASWARAMOORTHI
NANDHA ENGINEERING COLLEGE
ERODE - PERUNDURAI ROAD, VAIKKAALMEDU
ERODE
TAMIL NADU - 638052
PH. NO :9842472828

Score	Type of Certificate
>=90	Elite+Gold
75-89	Elite+Silver
>=60	Elite
40-59	Successfully Completed
<40	No Certificate

No. of credits recommended by NPTEL:1
An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.

Elite

NPTEL Online Certification

(Funded by the Ministry of HRD, Govt. of India)

This certificate is awarded to

DR M EASWARAMOORTHI

for successfully completing the course

Design Thinking - A Primer

with a consolidated score of **87** %

Online Assignments	22.75/25	Proctored Exam	63.75/75

Total number of candidates certified in this course: **667**

Devendra Jalihal

Prof. Devendra Jalihal
Chairman
Centre for Continuing Education, IITM

Jul-Aug 2021
(4 week course)

Prof. Andrew Thangaraj
NPTEL, Coordinator
IIT Madras

Indian Institute of Technology Madras

FREE ONLINE EDUCATION swayam

Roll No: NPTEL21MG53S13410012 To validate and check scores: https://nptel.ac.in/noc

11.07.2022

From

Dr. E. K. Mohanraj

Dean - Academics

Nandha Engineering College -Erode,

To

The Secretary

Nandha Educational Institutions

Through

The Principal

Nandha Engineering College

Dear Sir,

Subject: Financial Reimbursement of NPTEL Course Completion (2021-22 Even Sem) - reg.

With regards to the academic year 2021-22 (Even Semester), I would like to bring to your kind notice that 15 Faculty members (List and fees are enclosed) have completed NPTEL online courses successfully and as a motivation, I request for financial reimbursement of Rs. 15,200/- as their exam fees.

Thanking You,

Yours Faithfully,

11/07/22

Forwarded to the Secretary / NEI

11.7.22

NANDHA ENGINEERING COLLEGE (Autonomous), ERODE - 638 052

NPTEL ONLINE COURSE COMPLETED DETAILS FOR FACULTY MEMBERS (January - April 2022)

S.No	Name of the Faculty	Dept.	Course Title	Duration in Weeks		NPTEL Mark	Certificate Grade (Elite, Silver, Gold, etc)	Fees Paid
1	N.ABINAYA	IT	Python for Data Science	Jan - Feb 2022	4 WEEKS	81	ELITE + SILVER	1100
2	P.KAVITHA	English	Speaking Effectively	Jan - Mar 2022	8 WEEKS	80	ELITE + SILVER	1000
3	Dr. C. SIVA	IT	NBA Accreditation - Teaching and Learning in Engineering	Jan - Apr 2022	12 WEEKS	77	ELITE + SILVER	500
4	Dr.S.PRABHU	CSE	NBA Accreditation - Teaching and Learning in Engineering	Jan - Apr 2022	12 WEEKS	68	ELITE	1000
5	D. KIRUTHUKA	IT	Introduction to Machine Learning	Jan - Apr 2022	12 WEEKS	49	-	1000
6	T. ARUNKUMAR	AI&DS	Python for Data Science	Jan - Feb 2022	4 WEEKS	69	ELITE	1100
7	Dr.K.SARAVANAN	English	Speaking Effectively	Jan - Mar 2022	8 WEEKS	64	ELITE	1000
8	Dr.N.SUBRAMANIAN	Chemical	Physico-Chemical Processess for Waste Water Treatment	Jan - April 2022	12 WEEKS	63	ELITE	1100
9	M.BHARATHI	MATHS	Computational Mathematics with Sagemath	Jan - April 2022	12 WEEKS	60	ELITE	1100
10	M.PRIYADHARSINI	MATHS	Computational Mathematics with Sagemath	Jan - April 2022	12 WEEKS	47	-	1100
11	Dr.S.MAGIBALAN	MECH	Inspection and Quality Control in Manufacturing	Feb - Mar 2022	4 WEEKS	48	-	1100
12	K S PUNITHAASREE	ENGLISH	Speaking Effectively	Jan - Mar 2022	8 WEEKS	75	ELITE + SILVER	1000
13	S SUGANTHI	ENGLISH	Speaking Effectively	Jan - Mar 2022	8 WEEKS	71	ELITE	1000
14	Dr. M. EASWARAMOORTHI	MECH	Inspection and Quality Control in Manufacturing	Feb - Mar 2022	4 WEEKS	65	ELITE	1100
15	R. RAJKUMAR	MECH	Advanced Thermodynamics and Molecular Simulation	Jan - Apr 2022	12 WEEKS	57	-	1000
							Total	15200

Dean (Academics)

11/07/2022

Principal

Director 11/07/2022

28/7/22

21-22
TSR

Roll No:NPTEL22ME53S24491527

To DR M EASWARAMOORTHI
NANDHA ENGINEERING COLLEGE
ERODE - PERUNDURAI ROAD, VAIKKAALMEDU
ERODE
TAMIL NADU - 638052
PH. NO :9842472828

No. of weeks of NPTEL Courses	Equivalence of NPTEL course with regular FDP
4	$\frac{1}{2}$ FDP of one week
8	Full FDP of one week
12	$1\frac{1}{2}$ FDP

Duration of NPTEL course: 4 Weeks

NPTEL-AICTE
Faculty Development Programme

(Funded by the MoE, Govt. of India)

This certificate is awarded to

DR M EASWARAMOORTHI

for successfully completing the course

Inspection and Quality Control in Manufacturing

with a consolidated score of **65** %

Prof. Andrew Thangaraj
NPTEL Coordinator
IIT Madras

(Feb-Mar 2022)

Prof. Dileep N. Malkhede
Advisor-I (Research, Institute & Faculty Development)
All India Council for Technical Education

Roll No: NPTEL22ME53S24491527

The candidate has studied the above course through MOOCs mode, has submitted online assignments and passed proctored exams.
This certificate is therefore acceptable for promotions under CAS as per AICTE notifications dated 24th July 2018, similar to other refresher / orientation courses.
F.No. AICTE / RIFD / FDP through MOOCs / 2017-18

NPTEL-AICTE
Faculty Development Programme

(Funded by the MoE, Govt. of India)

This certificate is awarded to

DR S MAGIBALAN

for successfully completing the course

Inspection and Quality Control in Manufacturing

with a consolidated score of **48** %

Prof. Andrew Thangaraj
NPTEL Coordinator
IIT Madras

(Feb-Mar 2022)

Prof. Dileep N. Malkhede
Advisor-I (Research, Institute & Faculty Development
All India Council for Technical Education

oll No: NPTEL22ME53S14490013

The candidate has studied the above course through MOOCs mode, has submitted online assignments and passed proctored exams.
his certificate is therefore acceptable for promotions under CAS as per AICTE notifications dated 24th July 2018, similar to other refresher / orientation courses
F.No. AICTE / RIFD / FDP through MOOCs / 2017-18

102

21-22

This certificate is computer generated and can be verified by scanning the QR code given below.

Roll No: NPTEL22CH30S34500750

To
RAJKUMAR R
ASSISTANT PROFESSOR,MECHANICAL
NANDHA ENGINEERING COLLEGE
ERODE
TAMILNADU - 638052
PH. NO :9655552181

Score	Type of Certificate
>=90	Elite+Gold
75-89	Elite+Silver
>=60	Elite
40-59	Successfully Completec
<40	No Certificate

No. of credits recommended by NPTEL:3
An additional 1 credit may be awarded if the University deems it fit, based on the actual student effort involved.

NPTEL Online Certification

(Funded by the MoE, Govt. of India)

This certificate is awarded to

RAJKUMAR R

for successfully completing the course

Advanced Thermodynamics and Molecular Simulations

with a consolidated score of **57** %

Online Assignments	20.63/25	Proctored Exam	36/75

Total number of candidates certified in this course: **10**

Prof. Sanjeev Manhas
Coordinator, Continuing Education Centre
IIT Roorkee

Jan-Apr 2022
(12 week course)

Priti Maheshwari

Prof. Priti Maheshwari
NPTEL Coordinator
IIT Roorkee

Indian Institute of Technology Roorkee

FREE ONLINE EDUCATION swayam शिक्षित भारत, उन्नत भारत

NANDHA ENGINEERING COLLEGE
(Autonomous)
ERODE-638 052, TAMILNADU

SEED MONEY REQUEST FORM

Application No. : **Date:** 31.12.21

1. Name of the Faculty (Write in BLOCK LETTERS) : B. ASHOK KUMAR
2. Name of the Department : Mechanical Engineering
3. Reason for requesting the seed money : To enrich the knowledge in research area
4. The amount requested under seed money in (Rs) : 5000/-
5. Whether the fund request is comes under Research policy : Yes (or) No
6. If NO, justify how this request is useful for Research :
7. Expected outcome of this seed money Grant : Journal Publication in WOS

Ashok 31/12/21 — Signature(s) of the faculty

31/12/21 — HOD

31/12/21 — Dean (R&D)

31/12/21 — Principal

PRINCIPAL
Nandha Engineering College
(Autonomous)
Erode - 638 052.

JMEPEG
https://doi.org/10.1007/s11665-021-06181-6

1059-9495/$19.00

Microstructural, Mechanical and Wear Properties of Friction Stir Welded AA6061/AlN$_p$ Composite Joints

B. Ashok Kumar, I. Dinaharan, and N. Murugan

Submitted: 28 October 2020 / Revised: 25 July 2021 / Accepted: 12 August 2021

Friction stir welding (FSW) process is an appropriate welding process to successfully join the aluminum matrix composites (AMCs) reinforced with ceramic particles. In this study, AA6061 AMCs reinforced with 10 and 20 weight percentages of aluminum nitride particles (AlN$_p$) were welded by FSW process. The effect of FSW on microstructure, microhardness and tensile strength of AA6061/AlN$_p$ composite joints as well as wear behavior of the weld zone (WZ) was analyzed. It was found that reinforcement particles were broken and fragmented in the weld zone of FS-welded composite joints. Microhardness of the weld zone was higher compared to other metallurgical zones. Average microhardness at the WZ of AA6061/20 wt.% AlN$_p$ composite was 134 HV which is 36% higher than that of its base composite. It was observed that grain size of the AA6061 matrix was refined at the WZ. Average grain size of AA6061 alloy was 138 µm which was reduced to 3.8 µm at the WZ of AA6061/20 wt.% of AlN$_p$ composite joint. Around 90% of the particles size in the WZ was reduced to less than 5 µm from the relatively large size existed in the base composite. Ultimate tensile strength of FS-welded AA6061 alloy was 151 MPa which increased to 231 MPa in FS-welded AA6061/20 wt.% AlN$_p$ composite joint. Wear rate of FS-welded composite joints was less than that of its corresponding base composites under the same wear testing conditions. Average coefficient of friction at the WZ of FS-welded AA6061 alloy and AA6061/10 and 20 wt.% AlN$_p$ was found to be 0.41, 0.33 and 0.22, respectively. Wear mechanism of FS-welded joint was characterized to be abrasive.

Keywords aluminum matrix composite, AlN particle, friction stir welding, tensile strength

1. Introduction

Aluminum matrix composites (AMCs) reinforced with particulate form of ceramic reinforcements are extensively employed in various engineering applications because AMCs exhibit superior mechanical and tribological properties at room and elevated temperature. However, it is necessary to develop a welding procedure for AMCs to achieve widespread industrial applications because fabrication of virtually any complex structure requires joining of its components. Both conventional and modern fusion welding processes were applied to join AMCs by several researchers (Ref 1-4). Unfortunately, joints made by fusion welding processes possess many defects and were not suitable to serve its purposes (Ref 5-7). The problems are attributed to heating of aluminum matrix above its melting point during fusion welding process. Thus, it is essential to develop a procedure to weld AMCs without affecting its superior properties so that AMCs can be efficiently employed in various critical engineering applications.

B. Ashok Kumar, Department of Mechanical Engineering, Nandha Engineering College, Vaikkaal Medu, Erode, Tamil Nadu 638052, India; **I. Dinaharan**, IDM-Joint Lab, Department of Mechanical Engineering, Tsinghua University, Beijing 100084, China; and **N. Murugan**, Department of Robotics and Automation Engineering, PSG College of Technology, Coimbatore, Tamil Nadu 641004, India. Contact e-mails: ashokbkumar@yahoo.com, dinaweld2009@gmail.com, and drnmurugan@gmail.com.

Solid state welding process is an appropriate process for joining AMCs to avoid the above said problems. Among various solid state welding processes, friction stir welding (FSW) is a low energy, autogenous, hot shear, green technology that is most suitable for joining AMCs (Ref 8). As the quality of joints made by FSW process under optimized process condition is almost compatible with base composite (Ref 9, 10), it is currently employed in ship building industries, aerospace applications and so on where there is no compromise in weld quality (Ref 11, 12).

Dinaharan and Murugan (Ref 13) studied the influence of tool rotational speed, welding speed and axial force on tensile strength on AA6061/10 wt.% ZrB_2 composite joints. The maximum tensile strength was obtained with tool rotational speed of 1155 rpm, welding speed of 48.8 mm/min and axial force of 5.9 kN. Defects were found in the joints produced on either side of these parameter values. These patterns were further confirmed by few other researchers (Ref 14-16). In addition to tool rotational speed, welding speed and axial force, FSW tool geometry is another significant process parameter to influence the material flow and joint properties (Ref 17).

Faradonbeh et al. (Ref 18) investigated the effect of different tool pin profiles (viz., cylindrical, triangular, square and hexagonal), tool transverse and rotational speed on the microstructure and mechanical properties of FS-welded Al-2 vol.% B_4C composite which was fabricated by accumulative roll bonding process. The joint made with square profile pin revealed better microhardness and tensile strength as B_4C particle dispersion in the weld zone was homogeneous and finest in size. Elangovan and Balasubramanian (Ref 19) studied the influence of tool pin profile and tool shoulder diameter on joint strength of FS-welded AA6061 alloy of thickness 6 mm. They reported that the 18 mm shoulder diameter made defect free welds regardless of pin profiles. Similarly, the joints made

Published online: 01 September 2021

31/12/21

PRINCIPAL
Nandha Engineering College
(Autonomous)
Erode - 638 052.

NANDHA ENGINEERING COLLEGE
(Autonomous)
ERODE-638 052, TAMILNADU

SEED MONEY REQUEST FORM

Application No. :

Date: 31-12-2021

1. Name of the Faculty (Write in BLOCK LETTERS) : M. MANIKANDAN
2. Name of the Department : MECHANICAL
3. Reason for requesting the seed money : ENRICH THE RESEARCH KNOWLEDGE
4. The amount requested under seed money in (Rs) : 15,000/-
5. Whether the fund request is comes under Research policy : Yes (or) ~~No~~
6. If NO, justify how this request is useful for Research : NIL
7. Expected outcome of this seed money Grant : PUBLICATION OF RESEARCH WORK IN SCOPUS INDEX JOURNAL

Signature(s) of the faculty	HOD	Dean (R&D)	Principal
31/12/2021	31/12/21		31/12/21

PRINCIPAL
Nandha Engineering College
(Autonomous)
Erode - 638 052.

Mechanics & Industry 21, 521 (2020)
© AFM, EDP Sciences 2020
https://doi.org/10.1051/meca/2020066

Mechanics & Industry

Available online at:
www.mechanics-industry.org

REGULAR ARTICLE

Experimental investigations of vibration and acoustics signals in milling process using kapok oil as cutting fluid

Subramaniam Shankar[1,*], Murugasamy Manikandan[2], Gunasekaran Raja[3], and Alokesh Pramanik[4]

[1] Department of Mechatronics Engineering, Kongu Engineering College, Erode 638 060, Tamil Nadu, India
[2] Department of Mechanical Engineering, Nandha Engineering College, Erode 638 052, Tamil Nadu, India
[3] Department of Mechanical Engineering, Kongu Engineering College, Erode 638 060, Tamil Nadu, India
[4] School of Civil and Mechanical Engineering, Curtin University, Bentley, WA, Australia

Received: 30 September 2019 / Accepted: 27 July 2020

Abstract. Vegetable oils are found as the feasible alternative for conventional minerals oils. There has been many environmental and health issues which are spotted with the use of conventional cutting fluids. There has been a great demand for developing new environmentally friendly vegetable based cutting fluids to reduce these harmful effects. In this present study, vegetable based kapok oil is used as a cutting fluid during milling to study its consequences over other conventional oils. The process parameters such as spindle speed, depth of cut and feed rate were optimized with respect to the flank wear (V_b) and surface roughness (R_a) respectively with the use of central composite design in response surface methodology (RSM). Further an attempt has been made to monitor the tool condition by measuring the cutting force, vibration and sound pressure simultaneously. Three different tool conditions such as dull, fresh and working were analyzed and their consequences were also reported. Also, the performance of the kapok oil is compared with the palm oil and mineral oil (SAE 20W 40). The feed rate has the major contribution for surface roughness and flank wear. It is found that the cutting force (F), sound pressure (p) and vibration (V) increases with the tool wear.

Keywords: Cutting fluids / kapok oil / surface roughness / flank wear / tool condition monitoring / RSM

1 Introduction

Milling is the basic machining process which tends to have high metal removal rate and mostly used for complex machining shapes. Cutting fluids have been used in the machining process to improve the tribological characteristics of the work piece and tool involved [1]. Cutting fluids assists in carrying away the heat produced and debris ejected during machining [2]. These aspects will help to diminish the tool wear and energy consumption during machining [3]. Cutting fluids improves the efficiency of machining process by enhancing tool life, surface finish of the workpiece, reducing cutting force and vibrations. Conventional mineral, synthetic and semi-synthetic cutting fluids involved in the ecological cycle with air, soil and water and their toxicity leads to environmental pollution [4]. Many research works have been undertaken on the application of vegetable based cutting fluids for machining applications and most of them were used as a straight cutting oils [5,6]. It is reported that 320 000 ton per year of metal working fluids were consumed by European Union alone of which at least two-third need to be disposed as wastage into the environment [7]. The disposal of waste is expensive and also it affects the environment. Cutting fluid processing involves waste treatment as well as pre-treatment. The cost for the treatment of fluid is higher than purchasing of new cutting fluids in most cases [8]. Thus, to reduce the mass usage of conventional mineral oil cutting fluids and also to minimize their effects on environment and operators, several alternatives are being extremely explored such as solid lubricants, dry machining, cryogenic cooling, minimum quantity lubrication (MQL) [9] technique and also by the application of vegetable oils [10–12]. Vegetable based cutting fluids minimizes the health and environmental effects as compared to the petroleum based oils which are biodegradable [13]. They possess good lubrication capability as compared to other conventional oils.

The effect of vegetable based cutting oil on cutting forces and power shows that they were equal or dominant than conventional mineral oil [14]. Vegetable based oils are considered as environmentally friendly because they are renewable, less toxic and holds high biodegradability. The vegetable based cutting fluids have been used for various mechanical processes such as drilling, turning,

* e-mail: shankariitm@gmail.com

Received: 1 August 2020 | Revised: 3 September 2020 | Accepted: 14 October 2020

DOI: 10.1049/mna2.12045

Micro & Nano Letters

The Institution of Engineering and Technology WILEY

ORIGINAL RESEARCH PAPER

Experimental studies on viscosity, thermal and tribological properties of vegetable oil (kapok oil) with boric acid as an additive

Subramaniam Shankar[1] | M. Manikandan[2] | G. Raja[3] | G. Suganya Priyadharashini[4] | Alokesh Pramanik[5]

[1] Department of Mechatronics Engineering, Kongu Engineering College, Erode, Tamil Nadu, India

[2] Department of Mechanical Engineering, Nandha Engineering College, Erode, Tamil Nadu, India

[3] Department of Mechanical Engineering, Kongu Engineering College, Erode, Tamil Nadu, India

[4] Department of Mechanical Engineering, Coimbatore Institute of Technology, Coimbatore, Tamil Nadu, India

[5] School of Civil and Mechanical Engineering, Curtin University, Bentley, WA, Australia

Correspondence
Subramaniam Shankar, Department of Mechatronics Engineering, Kongu Engineering College, Erode 638052, Tamil Nadu, India.
Email: shankarmtm@gmail.com

Abstract

Non-renewability and damage caused to the environment while using mineral based and synthetic based lubricants become the greatest concern of this century. Disposal issues initiated a global trend to utilize vegetable based lubricants in industries. Vegetable oils are environmental friendly, have low toxicity and highly biodegradable in nature. The main objective of this work is to improve the viscosity and reduce the friction and wear rate of Kapok oil using boric acid as an additive. The tribological properties of kapok oil with three different concentrations (1, 3 and 5 wt%) of boric acid is evaluated and compared with pure kapok oil using pin on disc tribometer. The worn out surface of the pin are analyzed using the optical microscope after the wear test. The viscosity and thermal properties of kapok oil with 5 wt% of boric acid possess the better performance compared to other samples. Boric acid particles suspension exhibits reduction in friction and wear when compared with pure kapok oil. Overall, the kapok oil combined with 5 wt% of boric acid acts as the better bio lubricant oil which would help to reduce the global demand of petroleum-based lubricant sustainability.

1 | INTRODUCTION

Generally, lubricant plays a vital role in industrial and as well as in the machine components which are used to reduce the friction between the two contacts surfaces and also used to minimize the heat between the two surfaces [1]. The viscosity of the lubricant has a great influence on the quality of the lubrication of the machine components [2]. The liquid lubricants are classified into three types that is, synthetic, mineral and vegetable oil. The synthetic oil is the chemical composition of the artificial made, is manufactured using the chemical reformation from the petroleum component rather than the complete crude oil. Mineral oils are mostly used in the motor and engine applications, which are also obtained from the petroleum-based crude oil. The mineral oil is harmful to the environment which causes more toxicity and non-biodegradable [3]. The mineral oil lubricants have hydrocarbons which cause those effects and the natural lubricants are obtained from esters [4]. Vegetable oil is mostly an environmental friendly lubricant, easily biodegradable and non-toxic [5, 6]. Vegetable oil has good lubricant properties but limited in thermal stability and oxidation stability properties [7, 8]. While comparing with the mineral oil, vegetable oil has a high pour point, enhanced better viscosity index, and low evaporation loss [9]. In this work, one such vegetable oil (kapok oil) is considered and its change in properties are studied using boric acid as an additive. The friction and wear rate characteristics of kapok oil possess minimum when compared with mineral oil (SAE 20W 40) and Palm oil [10].

Lot of works were carried out using Nanoparticles and Nanomaterials as an additive with lubricant oil [11, 12]. Depending upon the characteristics of nanoparticles such as size, shape and concentration, the friction and wear between the two contacting surfaces were reduced [13]. The lubricating properties of boric acid (H_3BO_3) were studied which was commercial available in the market and environmentally safe [14]. The environmental protection agency act established that boric acid does not cause any harm or pollution. In order to reduce friction and wear, various additives were added in the lubricating oil [15].

Original Article | Published: 04 March 2021

Investigations on the tribological behaviour, toxicity, and biodegradability of kapok oil bio-lubricant blended with (SAE20W40) mineral oil

S. Shankar, M. Manikandan, D. K. Karupannasamy, C. Jagadeesh, Alokesh Pramanik & Animesh Kumar Basak

Biomass Conversion and Biorefinery (2021)

Abstract

Vegetable oil becomes a viable alternative to mineral or synthetic oils due to its biodegradable nature. In this work, one such vegetable-based non-edible oil (kapok oil) is blended with a mineral-based oil (SAE20W40) at 15 and 30% ratio (by volume), and its changes in thermal, tribological, and corrosive properties were evaluated. Four-ball tribometer is utilized to assess its dynamic friction coefficient and the wear scar diameter of the worn out area on the ball. Biodegradability and toxicity test of kapok oil were examined and compared with the palm and mineral oil through bacterial growth and brine shrimp assay methods, respectively. The results showed that the dynamic friction coefficient and specific wear rate of the blended oil were lesser than the mineral oil. The mineral oil produced a higher roughness average (R_a) value than that of the blended oil. Kapok oil shows an adequate tribological properties (anti-friction and anti-wear) in contrast to the other vegetable oils. Overall, kapok oil had a high biodegradability nature and lower toxicity than the mineral oil.

NANDHA ENGINEERING COLLEGE
(Autonomous)
ERODE-638 052, TAMILNADU

SEED MONEY REQUEST FORM

Application No. : **Date: 30.12.2021**

1. *Name of the Faculty (Write in BLOCK LETTERS)* : Dr. N. SENNIANGIRI
2. *Name of the Department* : MECHANICAL ENGINEERING
3. *Reason for requesting the seed money* : SCI & SCOPUS INDEXED JOURNAL PUBLICATION
4. *The amount requested under seed money in (Rs)* : 5,000/-
5. *Whether the fund request is comes under Research policy* : Yes
6. *If NO, justify how this request is useful for Research* : -
7. *Expected outcome of this seed money Grant* : International Journal paper is published

Signature(s) of the faculty **HOD** **Dean (R&D)** **Principal**

PRINCIPAL
Nandha Engineering College
(Autonomous)
Erode - 638 052.

Silicon
https://doi.org/10.1007/s12633-021-01243-9

ORIGINAL PAPER

A Study of Added SiC Powder in Kerosene for the Blind Square Hole Machining of CFRP Using Electrical Discharge Machining

PV Arul Kumar[1] · J. Vivek[2] · N. Senniangiri[3] · S. Nagarajan[4] · K. Chandrasekaran[5]

Received: 26 March 2021 / Accepted: 28 June 2021

Abstract

Carbon Fiber Reinforced Polymers (CFRPs) have been applied potentially for various application components owing to their lightweight and better mechanical properties. However, the machining of CFRP has been observed to be poor machinability due to the properties of the CFRP composites. Micro-feature fabricating on CFRP macro-component is a challenging task due to the selection of inadequate process parameters and machines. However, micron-level blind square holes are required in CFRPs for proposing the applications of micro-robotics, micro-vibration measurements, and micro-detection of cracking. These square holes produced on CFRP have the difficult task of being machined using the Electrical Discharge Machining (EDM) process. In this research, the effects of concentration of silicon carbide, pulse duration, duty cycle, and current on squareness, hole depth, and surface roughness of CFRPs are analyzed using Electrical Discharge Machining (EDM) with the square copper electrode. The input parameters, the various percentage of concentration of silicon carbide, pulse duration, duty cycle, and current for EDM are selected. The responses, squareness, hole depth, and surface roughness are considered. Also, an electrode wear length and surface defects have been analyzed. The modeling has been performed for selected responses. Additive Ratio Assessment (ARAS) is used for obtaining optimum parameters. The overall analysis found that the silicon carbide concentration and pulse duration are greatly affected all the responses. Also, the square electrodes produced unstable spark phenomena in the EDM process.

Keywords CFRP · EDM · Silicon carbide · Squareness · Depth

1 Introduction

Carbon Fiber Reinforced Polymers (CFRPs) are used in aerospace, satellite, electronic field, and commercial parts. The reasons for using these CFRPs are low density, high strength, low friction coefficient, high toughness, and good wear resistance. Square holes are required in CFRPs for proposing the applications of micro-robotics, micro-vibration measurements, micro-detection of cracks, micron-level relative humidity measurements, micron-level - thermal strain measurements, micro - level -temperature measurements, detection of micro - delamination, and micro-fiber optics. Thereby, the square holes were fabricated on CFRP by using EDM [1–3], laser machining [4], mechanical drilling [5, 6], and micro-EDM [7]. Also, the square hole is mostly used in the precision manufacturing sector for manufacturing the micron-level square in the 3D micro-components for microfluid transportation purposes and

PV Arul Kumar
arulkumarveera@gmail.com

J. Vivek
vivekdynamech18@gmail.com,

N. Senniangiri
senniangirinatarajan1987@gmail.com

S. Nagarajan
arsnagarajan@gmail.com

K. Chandrasekaran
kchandrusekaran1984@gmail.com

[1] Department of Mechanical Engineering, Bharath Niketan Engineering College, Aundipatty, Tamil Nadu 625536, India

[2] Department of Mechanical Engineering, Solamalai College of Engineering, Madurai, Tamil Nadu 625020, India

[3] Department of Mechanical Engineering, Nandha Engineering College, Erode, Tamil Nadu 628052, India

[4] Department of Mechanical Engineering, College of Engineering and Technology, Mettu University, Post Box. No 318, Mettu, Ethiopia

[5] Department of Mechanical Engineering, MAM School of Engineering, Trichy, Tamil Nadu 621105, India

Published online: 09 July 2021

NANDHA ENGINEERING COLLEGE
(Autonomous)
ERODE-638 052, TAMILNADU

SEED MONEY REQUEST FORM

Application No. : **Date:** 31-12-2021

1. Name of the Faculty (Write in BLOCK LETTERS) : DR: M.MUTHUKUMAR
2. Name of the Department : MECHANICAL ENGG.
3. Reason for requesting the seed money : JOURNAL PUBLICATION
4. The amount requested under seed money in (Rs) : Rs. 20000/-
5. Whether the fund request is comes under Research policy : Yes (or) No
6. If NO, justify how this request is useful for Research : –
7. Expected outcome of this seed money Grant : SCI/SCOPUS INDEXED JOURNAL PAPERS ARE PUBLISHED.

Signature(s) of the faculty	HOD	Dean (R&D)	Principal
31/12/21	31/12/21	31.12.2021	31/12/21

PRINCIPAL
Nandha Engineering College
(Autonomous)
Erode 638 052.

Biomass Conversion and Biorefinery
https://doi.org/10.1007/s13399-020-01209-8

ORIGINAL ARTICLE

Effect of nanoparticles on the droplet combustion of rice bran oil biodiesel

Muthukumar M[1] · Senthil Kumar A P[2] · Sasikumar C[3] · Yuvaraj S[4] · Thokchom Subhaschandra Singh[5]

Received: 28 September 2020 / Revised: 2 December 2020 / Accepted: 11 December 2020

Abstract
The present study is dealt with the phenomenon of combustion for rice bran oil (RBO) methyl ester blends with diesel along with nanoparticles of magnelium. Nanoparticles composition of 25 ppm, 50 ppm, and 75 ppm are added to blends of B20, B40, and B60 in the study. A conversion rate of 89.64 ± 2.8% is observed during the transesterification reaction performed at 5 wt% of potassium hydroxide (KOH) catalyst, 10:1 alcohol to oil ratio (methanol), 75 °C reaction temperature, and 60 min reaction time. During the combustion study, few samples displayed the puffing characteristics, which are caused by popping of bubbles at lower pressure. The summary of the present study suggested that blend B20 with 25 ppm nanoparticles has the potential to be used as fuel and further proposed that the fuel will be more economical if the injection droplet diameter is 0.77 mm. Other blends like B20 with 75 ppm are also likely to be used as fuel due to its exhibition of lesser threat towards combustion. Bubble formation followed by micro-explosion is observed in B60 with 25 ppm blend. The present study hoped to enrich future researchers working in similar area for signifying the importance of understanding droplet combustion of biofuels.

Keywords Droplet combustion · Biodiesel · Rice bran oil · Magnelium · Nanoparticles

Abbreviations

RBO	Rice bran oil
B20	20% methyl ester with 80% diesel
B40	40% methyl ester with 60% diesel
B60	60% methyl ester with 40% diesel
KOH	Potassium hydroxide
ppm	Parts per million
Al_2O_3	Aluminum oxide
SiO_2	Silicon dioxide
TiO_2	Titanium dioxide
K	Kelvin
B	Boron

Highlights
- Rice bran oil (RBO) is transesterified using KOH to produce methyl esters and the conversion rate is achieved to be 89.64 ± 2.8%
- Rice bran oil methyl ester is blended with mineral diesel to produce B20, B40, and B60 blend.
- Magnelium nanoparticles are added to the blend at 25 ppm, 50 ppm, and 75 ppm.
- Droplet combustion study of the fuel mixtures are conducted, and the summary of results are obtained.
- The characteristics of puffing, which are caused by the popping of bubbles at lower pressure are observed in few samples.

✉ Muthukumar M
muthupsgtech@gmail.com

[1] Department of Mechanical Engineering, Nandha Engineering College, Erode 638052, India

[2] Department of Mechanical Engineering, PSG College of Technology, Coimbatore 641004, India

[3] Department of Mechanical Engineering, Bannari Amman Institute of Technology, Sathyamangalam 638401, India

[4] Department of Aeronautical Engineering, Sri Ramakrishna Engineering College, Coimbatore 641022, India

[5] Department of Mechanical Engineering, National Institute of Technology Manipur, Imphal West 795004, India

Published online: 06 January 2021

Contents lists available at ScienceDirect

Environmental Technology & Innovation

journal homepage: www.elsevier.com/locate/eti

Performance and ecological parameters of a diesel engine fueled with diesel and plastic pyrolyzed oil (PPO) at variable working parameters

Thokchom Subhaschandra Singh [a], Upendra Rajak [b], Abhishek Dasore [b], M. Muthukumar [c], Tikendra Nath Verma [d,*]

[a] Department of Mechanical Engineering, National Institute of Technology Manipur, Imphal, Manipur 795004, India
[b] Department of Mechanical Engineering, RGM College of Engineering and Technology Nandyal, Andhra Pradesh, 518501, India.
[c] Department of Mechanical Engineering, Nandha Engineering College, Perundurai Main Road, Erode Tamil Nadu, 638052, India
[d] Department of Mechanical Engineering, Maulana Azad National Institute of Technology Bhopal, Madhya Pradesh, 462003, India

ARTICLE INFO

Article history:
Received 10 February 2020
Received in revised form 3 March 2021
Accepted 9 March 2021
Available online 13 March 2021

Keywords:
Biofuels
Energy from waste
Plastic pyrolyzed oil
Nitrogen oxide
Ecological parameters
Performance

ABSTRACT

Plastics are one of the major pollutants to the environment. An investigation is carried out in converting low density polyethylene (LDPE) to oil by pyrolysis method with the aid of catalyst for the use in internal combustion engines. Experiments were conducted at different speeds (1200, 1500 and 1800 rpm) and variable loads (low, medium and full) with constant compression ratio engine to evaluate the performance and ecological parameters. Plastic pyrolyzed oil (PPO) is blended with diesel fuel in 20:80 volume proportion to get D80PO20 blended mixture which is employed in engine in order to assess its characteristics. Encouraging outcomes have been obtained as cylinder pressure in combustion is of same order as that of diesel fueled engine. The results showed that increasing engine speeds resulted in higher cylinder pressure and brake thermal efficiency. Also, high nitrogen oxide (NO_X) and low brake specific energy consumption (BSFC) has been identified. Lower smoke (BSN) and NO_X emissions are noticed from engine tail pipe with D80PO20 blended mixture.

1. Introduction

Diminishing of plastic pollution has been consistently one of the major strategies for many central bodies and climate authorities since last two decades. In the modern society, lack of awareness about the increasing pollution caused by plastics, the general population continues to practise irresponsible dumping to the environment. Although there are various policies adopted for controlling waste, a popular method includes solid waste management through rigorous collection from respective households and correspondingly landfill. This eventually cause pollution of land and contamination to the water and environment. From the various methods of plastic waste handling, pyrolysis technique has been found to be a potential one as this method is able to perform with and without the aid of catalysts. This method transforms left-over plastic to oil (liquid), gases and char (solid residue) with the aid of high temperatures (300–900 °C).

An investigation is carried out to pyrolyze empty fruit bunch (EFB) with activated carbon by utilizing microwave heating. The outcome of this investigation has enhanced bio-oil portion by 36.37 wt. % at 500 °C (Idris et al., 2021).

* Corresponding author.
E-mail address: verma.tikks@gmail.com (T.N. Verma).

https://doi.org/10.1016/j.eti.2021.101491
2352-1864/

Materials Today: Proceedings 45 (2021) 1181–1187

Contents lists available at ScienceDirect

journal homepage: www.elsevier.com/locate/matpr

The development of fuel cell electric vehicles – A review

M. Muthukumar [a,*], N. Rengarajan [b], B. Velliyangiri [a], M.A. Omprakas [a], C.B. Rohit [a], U. Kartheek Raja [a]

[a] Department of Mechanical Engineering, Nandha Engineering College, Erode 638052, India
[b] Department of Electrical and Electronics Engineering, Nandha Engineering College, Erode 638052, India

ARTICLE INFO

Article history:
Received 11 November 2019
Received in revised form 22 March 2020
Accepted 26 March 2020
Available online 11 April 2020

Keywords:
Emission
Electrical powered
Fuel cell
Automobile
FCEV
Performance

ABSTRACT

The natural petroleum by-product will come into in-existence and unavailable in future. The emission from IC engine vehicles is also a critical problem. So the new technologies depending on electrical powered conveyance are developing. In that way, a fuel cell concept has been introduced for various applications along with electric vehicles. The various efforts are being taken to implement the fuel cell systems in automobiles. Still there is a technological gap in success of such fuel cell electric vehicles due to the problem in handling hydrogen, high cost of battery and fuel cell components, water management etc. In this paper, the type of fuel cell used in automobile, various supporting components and flow diagram of fuel cell systems, the implementation of fuel cell systems in automobiles, the design and development of Fuel Cell Electric Vehicles (FCEV) by various automobile companies are discussed. Further the related issues in FCEV and the methods to improve performance of FCEV are discussed.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Advances in Materials Research – 2019.

1. Introduction

The fuel cell is producing the electricity. It consists of anode and cathode where the chemical reaction takes place. The basic fuels mainly hydrogen and oxygen are required that produce electric energy with very less amount of pollution. The current produced from the fuel cell is Direct Current (DC). If we require Alternate Current (AC), a conversion device called inverter is required. The fuel cell electric vehicles are having fuel cell system, DC-DC converter, charging system, energy storage device, motor, drive systems and control systems. The battery is used to manage the dynamic response of the vehicle under varying load conditions. The DC/DC converter is used to convert the output of fuel cell into required voltage and current to supply to battery/motor. Brushless DC motor is used to run the vehicles. As there is no moving part in fuel cells, the noise and heat generations are very less compared to internal combustion engine vehicles (ICEV). A Ragone chart (Fig. 1) is comparing the performance of various energy devices such as fuel cell, battery, SC etc. The fuel cell is having much higher energy density than other types of energy storing devices. As the Energy density of fuel cell is higher than other type energy-storage devices, the fuel cell can be used for long time applications. Due to many advantages, the fuel cell electric vehicles are under developments by various automobile companies and are successfully tested. Even though many advantages are in the fuel cells, due to some practical issues, there is a gap in the implementation of the fuel cells in on-road vehicles.

In this paper, the development of the fuel cell electric systems and their supporting components for two wheeler and four wheeler applications by various automobile companies and educational institutions are reviewed. Further the advantages, issues and applications of FCEV are discussed.

Working principle of the fuel cells the working principle of the fuel cell is following electrolysis technique. The fuel cells have two electrodes where the electrolyte process takes place between

Abbreviations: 4WDEV, four wheel drive electric vehicle; AC, alternate current; APFCT, Asia Pacific fuel cell technology; BEV, battery electric vehicles; cc, cubic centimeter; DC, direct current; SVM-DTC, space vector modulation-direct torque control; EMS, energy management strategy; FC, fuel cell; FCHEV, fuel cell hybrid electric vehicles; FCE, fuel cell engine; FCEV, fuel cell electric vehicles; FCS, fuel cell systems; FES, flywheel energy systems; FCV, fuel cell vehicles; IC, internal combustion; ICE, internal combustion engine; ICEV, internal combustion engine vehicles; PEM, proton exchange membrane; PEMFC, proton exchange membrane fuel cell; PFCEV, plug-in fuel cell electric vehicles; MDIBC, multi-device interleaved boost converter; MHV, Mingdao hydrogen vehicle; UC, ultracapacitor.

* Corresponding author.
E-mail address: muthupsgtech@gmail.com (M. Muthukumar).

https://doi.org/10.1016/j.matpr.2020.03.679
2214-7853/
Selection and peer-review under responsibility of the scientific committee of the International Conference on Advances in Materials Research – 2019.

Effects of Different Membranes on the Performance of PEM Fuel Cell

M. Muthukumar, A. Ragul Aadhitya, N. Rengarajan, K. Sharan, and P. Karthikeyan

Abstract Nowadays, air pollution prevails as one of the major problems all over the world. Fuel cell is the recently developed technology to counteract air pollution. Fuel cells are electrochemical devices that produce electricity by the reaction of two gases such as hydrogen and oxygen. Proton exchange membrane (PEM) fuel cell is the most economical one. The advantage of using PEM fuel cell is that they can operate at low temperature of about 50 °C to 80 °C, and there is no emission of harmful gases to the atmosphere, thereby maintaining eco-friendly environment. The performance of the fuel cell is mainly influenced by various factors like material properties of components (like gas diffusion layer, membrane, catalyst layer), flow channel designs, operating conditions and water management. The main function of membrane which is made of polytetrafluoroethylene is to allow only the protons from anode to cathode and not allows electrons. So the membrane is called as PEM. The performance of the fuel cell is affected by different types of membranes. In this paper, the performance of PEM fuel cell with two different membranes such as Nafion 117 and Nafion 212 is analyzed. The serpentine flow field is chosen on both cathode and anode sides. The PEM fuel cell having active area of 11.6 cm^2 is designed and analyzed with best-operating conditions. The results show that the PEM fuel cell with Nafion 212 membrane generates more power.

Keywords Emission · Eco-friendly · Membrane · Nafion · Power

M. Muthukumar (✉) · A. Ragul Aadhitya · K. Sharan
Department of Mechanical Engineering, Nandha Engineering College, Erode 638052, India
e-mail: muthupsgtech@gmail.com

N. Rengarajan
Department of Electrical and Electronics Engineering, Nandha Engineering College, Erode 638052, India

P. Karthikeyan ·
Department of Automobile Engineering, PSG College of Technology, Coimbatore 641004, India

M. R. Nalim et al. (eds.), *Advances in Automotive Technologies*, Lecture Notes in Mechanical Engineering, https://doi.org/10.1007/978-981-15-5947-1_10

NANDHA ENGINEERING COLLEGE
(Autonomous)
ERODE-638 052, TAMILNADU

SEED MONEY REQUEST FORM

Application No. : **Date:** 31-12-2021

1. Name of the Faculty (Write in BLOCK LETTERS) : DR. M. MUTHUKUMAR
2. Name of the Department : MECHANICAL ENGG.
3. Reason for requesting the seed money : JOURNAL PAPER PUBLICATION
4. The amount requested under seed money in (Rs) : Rs. 15000/-
5. Whether the fund request is comes under Research policy : Yes (or) ~~No~~
6. If NO, justify how this request is useful for Research : —
7. Expected outcome of this seed money Grant : SCI/SCOPUS INDEXED JOURNAL PAPERS ARE PUBLISHED

31/12/21 31.12.2021 31/12/21

Signature(s) of the faculty **HOD** **Dean (R&D)** **Principal**

PRINCIPAL
Nandha Engineering College
(Autonomous)
Erode 638 052.

Personal Account

THE CHEMICAL RECORD

DOI: 10.1002/tcr.202000138

Performance Studies of Proton Exchange Membrane Fuel Cells with Different Flow Field Designs – Review

Muthukumar Marappan,[a] Karthikeyan Palaniswamy,[b] Thiagarajan Velumani,[b] Kim Byung Chul,[c] Rajavel Velayutham,[c] Praveenkumar Shivakumar,[d] and Senthilarasu Sundaram*[e]

Abstract: Proton Exchange Membrane Fuel Cell (PEMFC) is majorly used for power generation without producing any emission. In PEMFC, the water generated in the cathode heavily affects the performance of fuel cell which needs better water management. The flow channel designs, dimensions, shape and size of the rib/channel, effective area of the flow channel and material properties are considered for better water management and performance enhancement of the PEMFC in addition to the inlet reactant's mass flow rate, flow directions, relative humidity, pressure and temperature. With the purpose of increasing the output energy of the fuel cell, many flow field designs are being developed continuously. In this paper, the performance of various conventional, modified, hybrid and new flow field designs of the PEMFC is studied in detail. Further the effects of channel tapering, channel bending, landing to channels width ratios, channel cross-sections and insertion of baffles/blockages/pin-fins/inserts are reviewed. The power density of the flow field designs, the physical parameters like active area, dimensions of channel/rib, number of channels; and the operating parameters like temperature and pressure are also tabulated.

Keywords: channel design, flow field, fuel cells, PEMFC, water management

[a] *M. Marappan*
Fuel Cell Research Lab
Department of Mechanical Engineering
Nandha Engineering College
(Autonomous Institution, Affiliated to Anna University)
Erode-638052, India
Tel: +91 9865923333
E-mail: muthupsgtech@gmail.com
[b] *K. Palaniswamy, T. Velumani*
Fuel Cell Energy System Lab
Department of Automobile Engineering
PSG College of Technology
Coimbatore-641004, India
E-mail: apk.auto@psgtech.ac.in
vthiagu90@gmail.com
[c] *K. B. Chul, R. Velayutham*
Electromaterials Science Lab
Department of Printed Electronics Engineering
Sunchon National University
Jungang-Ro 255, SunCheon-Shi, JeollaNam-Do, South Korea
E-mail: bckim@scnu.ac.kr
mek.rajavel68@gmail.com
[d] *P. Shivakumar*
Department of Mechanical Engineering
S.A. Engineering College
Chennai-600077, India
E-mail: sivapraveen09@gmail.com
[e] *S. Sundaram*
Environment and Sustainability Institute (ESI)
University of Exeter
Penryn Campus, Penryn
Cornwall TR10 9FE, UK
Tel: +44 (0)1326 259486
E-mail: S.Sundaram@exeter.ac.uk

molecules

MDPI

Article

Scaling up Studies on PEMFC Using a Modified Serpentine Flow Field Incorporating Porous Sponge Inserts to Observe Water Molecules

Muthukumar Marappan [1], Rengarajan Narayanan [2], Karthikeyan Manoharan [3], Magesh Kannan Vijayakrishnan [3], Karthikeyan Palaniswamy [3,*], Smagul Karazhanov [4,*] and Senthilarasu Sundaram [5]

1 Fuel Cell Research Lab & Department of Mechanical Engineering, Nandha Engineering College, Erode 638052, India; muthupsgtech@gmail.com
2 Fuel Cell Research Lab & Department of Electrical and Electronics Engineering, Nandha Engineering College, Erode 638052, India; rengarajan2412@gmail.com
3 Fuel Cell Energy System Laboratory, Department of Automobile Engineering, PSG College of Technology, Coimbatore 641004, India; mkk.auto@psgtech.ac.in (K.M.); vmk.auto@psgtech.ac.in (M.K.V.)
4 Department for Solar Energy, Institute for Energy Technology (IFE), 2027 Kjeller, Norway
5 Environment and Sustainability Institute (ESI), University of Exeter, Penryn TR10 9EZ, UK; S.Sundaram@exeter.ac.uk
* Correspondence: apk.auto@psgtech.ac.in (K.P.); smagul.karazhanov@ife.no (S.K.); Tel.: +91-944-368-2803 (K.P.)

Citation: Marappan, M.; Narayanan, R.; Manoharan, K.; Vijayakrishnan, M.K.; Palaniswamy, K.; Karazhanov, S.; Sundaram, S. Scaling up Studies on PEMFC Using a Modified Serpentine Flow Field Incorporating Porous Sponge Inserts to Observe Water Molecules. *Molecules* 2021, 26, 286. https://doi.org/10.3390/molecules26020286

Academic Editors: Andrew Nelson, Gonzalo García, Deepak Pant and César Augusto Correia de Sequeira
Received: 20 November 2020
Accepted: 5 January 2021
Published: 8 January 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract: Flooding of the cathode flow channel is a major hindrance in achieving maximum performance from Proton Exchange Membrane Fuel Cells (PEMFC) during the scaling up process. Water accumulated between the interface region of Gas Diffusion Layer (GDL) and rib of the cathode flow field can be removed by the use of Porous Sponge Inserts (PSI) on the ribs. In the present work, the experimental investigations are carried out on PEMFC for the various reaction areas, namely 25, 50 and 100 cm^2. Stoichiometry value of 2 is maintained for all experiments to avoid variations in power density obtained due to differences in fuel utilization. The experiments include two flow fields, namely Serpentine Flow Field (SFF) and Modified Serpentine with Staggered provisions of 4 mm PSI (4mm × 2 mm × 2 mm) Flow Field (MSSFF). The peak power densities obtained on MSSFF are 0.420 W/cm^2, 0.298 W/cm^2 and 0.232 W/cm^2 compared to SFF which yields 0.242 W/cm^2, 0.213 W/cm^2 and 0.171 W/cm^2 for reaction areas of 25, 50 and 100 cm^2 respectively. Further, the reliability of experimental results is verified for SFF and MSSFF on 25 cm^2 PEMFC by using Electrochemical Impedance Spectroscopy (EIS). The use of 4 mm PSI is found to improve the performance of PEMFC through the better water management.

Keywords: proton exchange membrane fuel cells (PEMFC); scaling up; porous sponge; MSSFF; EIS; water management

1. Introduction

Effective management of water produced as a product of Oxygen Reduction Reaction (ORR) on the cathode side is important to obtain maximum performance from PEMFC [1]. The cell performance is reduced due to the water flooding which effectively blocks the passage of protons through the membrane [2]. Increase in flooding of flow fields causes reduced performance in PEMFC at higher current densities. However, the low amount of water present causes the dehydration of the membrane which reduces the performance of the PEMFC [3]. Flow fields that produce uniform distribution of reactants and lower pressure drop due to shorter flow length yield better performance compared to serpentine flow channel [4–6]. The SFF produces non-uniform flow due to the presence of bends in the flow channel. The presence of bends causes a lower velocity near the bends compared to the central region of flow where the velocity is higher. Similarly, the length of the serpentine

Journal of Ceramic Processing Research. Vol. 22, No. 2, pp. 131~142 (2021)
(Received 30 November 2019, Received in revised form 24 March 2020, Accepted 14 April 2020)
https://doi.org/10.36410/jcpr.2021.22.2.131

JOURNAL OF
Ceramic
Processing Research

Experimental investigation on serpentine, parallel and novel zig-zag flow fields for effective water removal and enhanced performance on 25 cm^2 PEMFC

Muthukumar Marappan[a], Magesh Kannan Vijayakrishnan[b], Karthikeyan Palaniswamy[b,*], Karthikeyan Manoharan[b], Thanarajan Kumaresan[b] and Jyothis Arumughan[c]

[a]Fuel Cell Research Lab, Department of Mechanical Engineering, Nandha Engineering College, Erode-638052, India
[b]Fuel Cell Energy System Laboratory, Department of Automobile Engineering, PSG College of Technology, Coimbatore 641004, India
[c]Department of Mechanical Engineering, Assam Engineering College, Guwahati - 781013, India

Water management is decisive in the commercialisation of Polymer Electrolyte Membrane Fuel cells (PEMFCs) as poor water management leads to reduced performance and reliability. Hence, this work deals with effective water management and physically examines water removed at cathode outlet in 25 cm^2 PEMFC of land width by channel width of 2 × 2. Six combinations among flow fields such as parallel without slope, parallel with slope, serpentine and a novel parallel zigzag with slope are used for experimentation. Experimental results disclose that inducing cross flow among reactants, increasing exposure area of uncompressed MEA with reacting gases and backpressure increases the performance while slope at cathode increases the water removal rate of PEMFC. The novel flow field when used at the cathode with the serpentine flow field at anode accumulates advantages of the flow fields considered and enhanced the performance by about 23% than conventional serpentine flow fields due to the induced flow non-uniformity, under rib convection and better water removal rate. Additionally, to enhance the water removal and performance a silicon dioxide based ceramic ink is spray coated on the graphite plate to increase its hydrophobicity. As the electrical conductivity of silicon dioxide, a key constituent in the hydrophobic coating is limited, a blend of 2% graphene by weight with the ceramic ink is also attempted along with the durability of these flow fields for twelve hours of continuous operation.

Keywords: Zig Zag Flow Field, Back Pressure, Slope in Flow Field, Cross Flow in Reactants, Ceramic ink coating, Durability Studies.

Introduction

Diminution of conventional fossil fuels and ecological contamination has turned the focus of research on alternate power generation systems. A large number of researchers are working on alternate fuels and power generation systems like fuel cells. Fuel cells are capable of producing green energy with little pollution and hence can be considered as a potential power generation device. When weighed against other types of fuel cells, Polymer Electrolyte Membrane Fuel Cells (PEMFCs) are more efficient and have high power density. Additionally, they are easy to install, can operate on relatively low operating temperature and pressure, respond dynamically to load and have a longer lifetime however the cost of PEMFC [1] is a major hindrance to commercialization. Also, water formed as a by-product of the electrochemical oxidation and reduction reactions is to be balanced [2] reasonably to avoid flooding and dehydration of membrane as they cause a reduction in power (poor performance) of the PEMFC. Accumulation of water is due to electro-osmotic drag from anode to cathode vide the membrane and back diffusion of water from the cathode flow field to catalyst sites causes flooding. Proper water management ensures that the membrane remains fully hydrated and maintains good ionic conductivity [3] leading to enhanced performance. Considering these facts a few pieces of research relevant to this work are discussed below.

Parallel and serpentine flow fields are predominantly used in PEMFC, efforts are made to enhance their performance by modifying their land width, number of channels, the shape of the flow path, orientation, etc. Diverse techniques have been adopted to tackle water management issues, out of which the flow field design is most noteworthy. Innovative flow channels were designed and tested to improve water management in PEMFC and demonstrated that channel cross-section design can be used to improve their performance [4, 5]. The ill effect of water accumulation was established by visualizing oxygen distribution and water blockages in an operating 3 pass-parallel-serpentine PEMFC [6]. Studies on flooding cathode channels of PEMFC and concluded that water accumulation in the flow field significantly reduces the performance [7]. Despite these

*Corresponding author:
Tel : +91 9443682803
Fax: +91 422 2592277
E-mail: apkarthipsg@gmail.com; apk.auto@psgtech.ac.in

NANDHA ENGINEERING COLLEGE
(Autonomous)
ERODE-638 052, TAMILNADU

SEED MONEY REQUEST FORM

Application No. : **Date: 30.12.2021**

1. Name of the Faculty (Write in BLOCK LETTERS) : M.A.OMPRAKAS
2. Name of the Department : MECHANICAL ENGINEERING
3. Reason for requesting the seed money : SCOPUS JOURNAL PUBLICATION
4. The amount requested under seed money in (Rs) : 5000/-
5. Whether the fund request is comes under Research policy : Yes
6. If NO, justify how this request is useful for Research : -
7. Expected outcome of this seed money Grant : International Journal Paper is Published

M.A.Omp 30/12/2021
Signature(s) of the faculty

30/12/21
HOD

30.12.2021
Dean (R&D)

31/12/21
Principal

PRINCIPAL
Nandha Engineering College
(Autonomous)
Erode 638 052

Analysis of Shrinkage Defect in Sand Casting by Using Six Sigma Method with Taguchi Technique

M A Omprakas[1]*, M Muthukumar[1], S P Saran[1], D Ranjithkumar[1], C M Shantha kumar[1], S Thiruppathi Venkatesh[1] and M Sengottuvelan[2]

[1] Department of Mechanical Engineering, Nandha Engineering College, Erode - 638052, Tamilnadu, India.
[2] Department of Mechatronics Engineering, Bannari Amman Institute of Technology, Sathyamangalam - 638401, Tamilnadu, India

omprakasangappan@gmail.com

Abstract. Casting industries play a major role in the field of manufacturing. The production of complex shape and size products is manufactured in a single process, which cannot be produced in other manufacturing processes. Because the other process needs more than one step to convert a raw material into a product. When producing the casting, the quality of the casting should be maintained without defects. This is not possible as we can't produce a cent percentage of accuracy. But the percentage of defects can be reduced with the help of certain quality control tools and techniques. In this paper, the main focus is to reduce the shrinkage defect which occurs in the External Bearing Ring of ductile cast iron which is produced in the leading casting industry in Coimbatore. The data have been collected from the industry for the six months and the defects have been identified with the help of the Six-Sigma DMAIC (Define, Measure, Analyze, Improve, Control) technique. The quality control tools are applied in different stages of the DMAIC technique for identifying and controlling the defects. Also, the Taguchi technique is applied for creating the L9 orthogonal array from the Minitab software. Finally, the best possible solution is obtained and it is suggested to the industry for defects reduction.

Keywords: Casting defects; Six-sigma; DMAIC process; Taguchi; ductile iron.

1 Introduction

Casting is one of the oldest techniques in the days around 4000 B.C. The casting process was used for manufacturing of gold ornaments. Few years later, it was used for the production of weapons and tools with metals like copper as materials. Then after, the casting has been used for the production of products which were having different shapes from small to complex shape and size of products and different materials like cast iron and ductile iron, etc. Due to its major benefits and needs, the casting production plays a major role in the field of manufacturing. The occurrence of defects in the casting affected the casting industry economically. So, the defect occurrences should be reduced and the quality of the casting should be improved for which the application of some techniques like six-sigma and quality tools can be used. The defect in the particular area is identified and some changes are made to reduce the defects. In this paper, the External Bearing Ring made of ductile cast iron which is the one of the main components in the windmill is considered for analysis. The leading casting industry in Coimbatore are facing this shrinkage defect on this particular product as high in numbers. So, this shrinkage defects are reduced by applying the six-sigma technique and quality control tools, with the help of Minitab software.

PRINCIPAL
Nandha Engineering College
(Autonomous)
Erode 638 052

NANDHA ENGINEERING COLLEGE
(Autonomous)
ERODE-638 052, TAMILNADU

SEED MONEY REQUEST FORM

Application No. :

Date: 05.01.2022

1. Name of the Faculty (Write in BLOCK LETTERS) : RAJKUMAR.R
2. Name of the Department : Mechanical Engineering
3. Reason for requesting the seed money : Scopus Indexed Journal
4. The amount requested under seed money in (Rs) : 5,000/-
5. Whether the fund request is comes under Research policy : ✓ Yes (or) No
6. If NO, justify how this request is useful for Research : —
7. Expected outcome of this seed money Grant : To improve research work.

5/1/2022.

Signature(s) of the faculty

5/1/22

HOD

CN.Ma 5.1.22.

Dean (R&D)

5/1/22

Principal

PRINCIPAL
Nandha Engineering College
(Autonomous)
Erode 638 052

A comparative study of performance and emission characteristics of a diesel engine using various non-edible extracts

R. Rajkumar
Department of Mechanical Engineering,
Nandha Engineering College,
Erode, 638 052, India
Email: rajkumar1229@gmail.com

K. Gopi Kannan*
School of Mechanical Engineering,
Vellore Institute of Technology,
Vellore, 632 014, India
Email: gopimetier@gmail.com
*Corresponding author

M. Mohanraj
Logesh Ganga Power Looms,
Erode, 638 052, India
Email: mohanrajmathesh@gmail.com

Abstract: In this study, the performance and emission characteristics of a diesel engine fuelled with biodiesel such as cottonseed oil, castor oil, Calophyllum inophyllum oil and mustard oil by transesterification are investigated. All biodiesels are mixed together on mass basis and allowed to transesterification is named as totally mixed esterified (TMEx). Separately transesterified and mixed together on mass basis becomes separately esterified mixer (SEMx). The biodiesel samples are prepared by a volume proportions such as 10% (SEMx10, TMEx10) and 20% (SEMx20, TMEx 20). The experiment is conducted on a single-cylinder, water-cooled, direct injection diesel engine loaded by eddy current dynamometer at different loads. Result shows that brake thermal efficiency and specific fuel consumption of TMEx blends are closer to diesel compared with SEMx blends. Also, the emission characteristics of TMEx20 are less in comparison with other blends and it is suggested as a promising replacement for diesel without engine modification.

Keywords: biodiesel; methyl ester; diesel engine; exhaust emission.

Reference to this paper should be made as follows: Rajkumar, R., Kannan, K.G. and Mohanraj, M. (2020) 'A comparative study of performance and emission characteristics of a diesel engine using various non-edible extracts, *Progress in Industrial Ecology – An International Journal*, Vol. 14, No. 2, pp.91–103.

Biographical notes: R. Rajkumar is currently working as an Assistant Professor at Nandha Engineering College, Erode. He has an academic experience of three years and his areas of interest are IC engines, alternate fuels and heat transfer.