

Alternative Energy

Edited by

A.K.M. Mohiuddin

Asif Hoda



IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

A.K.M. Mohiuddin and Asif Hoda
Alternative Energy
A.K.M. Mohiuddin and Asif Hoda
Include index
Bibliography: p.

ISBN 978-967-418-158-1

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN. BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan

Table of Contents

Table of Contents	v
Preface	viii
Chapter 1	
The Impact of energy utilization on environment.....	1
M.N.A. Hawlader	
Chapter 2	
Desalination of Seawater to provide fresh water	9
M.N.A. Hawlader	
Chapter 3	
A solar assisted desalination system using heat pump.....	16
M.N.A. Hawlader, Leong Chiing Yang	
Chapter 4	
An experimental study of a phase change storage system.....	23
M.N.A. Hawlader and Smita Panga	
Chapter 5	
Moisture migration in a grain column subjected to drying	30
M.N.A. Hawlader and Md. Shafique J. Chowdhury	
Chapter 6	
Solar Drying of Guavas, Papayas and Apples	38
M.N.A. Hawlader and Lee Hwee Peng	
Chapter 7	
Drying under inert environment: the quality of Mango and Rockmelon.....	47
M.N.A. Hawlader and Pan Jiahe	
Chapter 8	
A low temperature flat plate solar collector	53
M.N.A. Hawlader, M. Zakir Ullah and Maung Than Htut	
Chapter 9	
Optimization of an integrated solar heat-pump system.....	60
M N A Hawlader and Ye Shaochun	
Chapter 10	
Comparative study of performance characteristics using <i>Jatropha</i> Oil Methyl Esters Biodiesel and Diesel.....	69
A.K.M. Mohiuddin and Azan Mohd	
Chapter 11	
Comparative Study of Emission Characteristics using <i>Jatropha</i> Oil Methyl Esters Biodiesel and Diesel	74
A.K.M. Mohiuddin and Azan Mohd	
Chapter 12	
Waste Cooking Oil Utilization for Biodiesel Production.....	79
A.K.M. Mohiuddin and Nabeel Adeyemi	
Chapter 13	
Flow Characteristic of Mixing Impeller for Liquid-Liquid Mixing	85
A.K.M. Mohiuddin and Nabeel Adeyemi	
Chapter 14	
Solar Energy Management for Poverty Alleviation and Income Generating Activities.....	91
A.K.M. Mohiuddin	

Chapter 15	
	Turbulence model for axial mixing impeller in unbaffled vessel..... 97
	A.K.M. Mohiuddin, Nabeel Adeyemi and Muhamad Husaini
Chapter 16	
	Optimization and economic analysis of a solar assisted heat pump drying system..... 103
	M.N.A. Hawlader, S. M. A. Rahman and K.A. Jahangeer
Chapter 17	
	A solar heat pump water heater for rural hospitals 117
	M.N.A. Hawlader and M. Zakir Ullah
Chapter 18	
	A solar heat-pump system for air-conditioning, water heating and drying 126
	M N A Hawlader, K A Jahangeer, Ye Shaochun and Choy Tack Hoon
Chapter 19	
	Engineering design – An approach to the development of creativity 132
	M.N.A. Hawlader
Chapter 20	
	Analysis of Engine Performance with NGV 140
	Sany Izan Ihsan, Nabila Sulaiman, AKM Mohiuddin and Maizirwan Mel
Chapter 21	
	Analysis of Engine Performance with Enhanced Fuel..... 147
	Sany Izan Ihsan, Khairussani Farid, Maizirwan Mel, and AKM Mohiuddin
Chapter 22	
	CFD analysis of an evacuated solar still..... 156
	Ahmad F. Ismail, Mirghani I. Ahmed, Yousif A. Abakr
Chapter 23	
	Developments on Solar Operated Water Desalination..... 163
	Mirghani I. Ahmed, Yousif A. Abakr and Ahmad F. Ismail
Chapter 24	
	Theoretical and experimental evaluation of LPG as refrigerant for domestic refrigerators and freezers 169
	M.M. El-Awad, M.I. Ahmed
Chapter 25	
	Preliminary investigation of biodiesel reactor optimization using combine CFD-Taguchi method 179
	A.K.M. Mohiuddin and Nabeel A Adeyemi
Chapter 26	
	Alternative mixing strategy for biodiesel production: mixed flow impeller characterization 188
	A.K.M. Mohiuddin and Nabeel Adeyemi
Chapter 27	
	Experimental Investigation of a Multistage Evacuated Solar Still 197
	Yousif. A. Abakr, Ahmad F. Ismail and Mirghani I. Ahmed
Chapter 28	
	Modelling of electronics heat sink – Influence of the wake function generation on the accuracy of CFD analysis 203
	M. I. Ahmed, A. F. Ismail, Y. A. Abakr
Chapter 29	
	The effect of the operating conditions on the apparent viscosity of crude palm oil during separation..... 213

Sulaiman Al-Zuhair, Yousif A. Abakr and Mirghani I. Ahmed

Chapter 30

Thermal analysis of a micro device used for detection of colorectal cancer..... 220

Mirghani I. Ahmed, Meftah Hrairi

Chapter 31

Performance of different photovoltaic cells operating under the meteorological conditions of Singapore..... 229

M.N.A Hawlader, Lee Poh Seng and Chua Kok Kiang

Chapter 32

Analyses of motion and drag coefficient of water droplets in a natural draught cooling tower..... 240

Liu Baomin and M. N. A. Hawlader

Chapter 33

A solar assisted heat pump system for desalination..... 252

Zakaria Mohd. Amin, M N A Hawlader and Azharul Karim

Chapter 34

Comparative study of combustion characteristics using Jatropha oil methyl esters biodiesel and diesel..... 261

A.K.M. Mohiuddin and Azan Mohd

Chapter 35

Performance of evaporator collector and air collector in a solar assisted heat pump dryer.
..... 269

S. M. A. Rahman and M. N. A. Hawlader

Chapter 12

Waste Cooking Oil Utilization for Biodiesel Production

A.K.M. Mohiuddin and Nabeel Adeyemi

Department of Mechanical Engineering, International Islamic University Malaysia

INTRODUCTION

Vehicular emission effect has been targeted to be reduced by 2012 for most ASEAN countries as a result of fossil fuel. This, along with other ecological, political and economic concerns over fossil fuel, which is the single largest industry in terms of dollar value on earth, are factors shifting biodiesel production as an alternative energy source for automobile. The comparative advantage of biodiesel is as a result of the similarity in vegetable physio-chemical characteristic. Consequently, growth rate of plantations for vegetable oil is expanding, as much as 5% per year from palm oil. The growth of the oleo-chemical industry has also resulted in exponential growth and demand, creating an entire value chain to become one of the world's most valued crops. It has been suggested using food-oils for biodiesel/ biofuel production will have a negative consequence for human. Hence a reconsideration of the use of food-grade oil is being undertaken, particularly as the cost of biodiesel is about 70–75% of the total cost of raw material. Of the available sustainable raw materials been pursued for biodiesel production, waste cooking oil is seen as more versatile and less prone to high cost and scarcity. This work presents the use of WCO to produce high quality biodiesel by varying physical internal configuration of the reactor.

MATERIALS AND METHODS

WCO Characterization and Evaluation of FFA

Analysis of WCO for fatty acid and glycerides was carried out using reference standards of FAMES containing C16:0, C18:0, C18:1, C18:2 FAMES (2 to 4% relative concentrations = 0.2 to 0.4 mg/mL per FAME). The Triglyceride (T), Diglycerides (DG), Monoglyceride (MG) and free glycerin (G) were quantified using GC MS biodiesel (MSTFA derivatization kit, 10 x 1 mL ampoule) kit containing glycerin, monoolein, diolein, triolein (ASTM D6548 solutions), butanetriol and tricaprin (internal standard #1 & 2 #, 44918U) at concentrations specified according to ASTM D6584/ 6751. Laboratory grade Potassium hydroxide (KOH), Isopropyl alcohol and phenolphthalein were used for the FFA