

Alternative Energy

Edited by

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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 13

Flow Characteristic of Mixing Impeller for Liquid-Liquid Mixing

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INTRODUCTION

A considerable number of industrial processes take place in stirred vessel and are characterized by features such as geometry of the impeller, presence of baffle, speed of the impeller during mixing processes. As a mean to attain effective mass transfer between and within liquids, impellers in vessels (with or without baffle) are used to increase interfacial contact and their suitability depends on their capability to induce certain fluid flow pattern in the vessel. Mixing of viscous fluids is mainly carried out in the laminar and transition regimes; fast chemical reactions where one of the reacting species is limiting takes place at turbulence. For industrial purpose impellers are generally classified according to the direction of pumping (axial, tangential or radial), power consumption, rheology related to important dimensionless parameters such power number, flow number, and Reynolds number, and shear force (Zlokarnik, 2000). For instance, axial impellers induce flow in the axial direction and have low shear force with down- and up-pumping action. Radial impellers induce flow in the radial direction of the impeller. Other types of impellers are mixed flow impellers which convey flow in the radial and axial flow direction of the discharge stream. The Pitch Blade turbine (PBT) is an example and particularly popular where increase in viscosity is predominant. As there has been considerable amount of information on viscous mixing in laminar and transient region (Mavros, 2001), the focus will be on turbulent mixing especially relating to fast chemical reaction (Farmer, Pike, & Cheng, 2005). Details of a PIV experiment to map velocity profile of the impeller are discussed.

METHODOLOGY

Physical dimension of reactor

A 2 L acrylic tank, 150mm in height, 65 mm diameter, and impeller 55 mm diameter and 45 mm blade height was used with a liquid volume of 500 ml.

Flow measurement by PIV

The 2-D velocity data of the liquid flow fields were obtained using PIV equipment at high spatial resolution using a full frame interline transfer CCD camera. A Nd:YAG laser was the illumination source