

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

|            |  |
|------------|--|
| Chapter 15 |  |
|            | Turbulence model for axial mixing impeller in unbaffled vessel..... 97   |
|            | <b>A.K.M. Mohiuddin, Nabeel Adeyemi and Muhamad Husaini</b>  |
| Chapter 16 |  |
|            | Optimization and economic analysis of a solar assisted heat pump drying system..... 103                                  |
|            | <b>M.N.A. Hawlader, S. M. A. Rahman and K.A. Jahangeer</b>   |
| Chapter 17 |  |
|            | A solar heat pump water heater for rural hospitals ..... 117   |
|            | <b>M.N.A. Hawlader and M. Zakir Ullah</b>  |
| Chapter 18 |  |
|            | A solar heat-pump system for air-conditioning, water heating and drying ..... 126  |
|            | <b>M N A Hawlader, K A Jahangeer, Ye Shaochun and Choy Tack Hoon</b>   |
| Chapter 19 |  |
|            | Engineering design – An approach to the development of creativity ..... 132  |
|            | <b>M.N.A. Hawlader</b>   |
| Chapter 20 |  |
|            | Analysis of Engine Performance with NGV ..... 140  |
|            | <b>Sany Izan Ihsan, Nabila Sulaiman, AKM Mohiuddin and Maizirwan Mel</b>   |
| Chapter 21 |  |
|            | Analysis of Engine Performance with Enhanced Fuel..... 147   |
|            | <b>Sany Izan Ihsan, Khairussani Farid, Maizirwan Mel, and AKM Mohiuddin</b>  |
| Chapter 22 |  |
|            | CFD analysis of an evacuated solar still..... 156  |
|            | <b>Ahmad F. Ismail, Mirghani I. Ahmed, Yousif A. Abakr</b>   |
| Chapter 23 |  |
|            | Developments on Solar Operated Water Desalination..... 163   |
|            | <b>Mirghani I. Ahmed, Yousif A. Abakr and Ahmad F. Ismail</b>  |
| Chapter 24 |  |
|            | Theoretical and experimental evaluation of LPG as refrigerant for domestic refrigerators and freezers ..... 169          |
|            | <b>M.M. El-Awad, M.I. Ahmed</b>  |
| Chapter 25 |  |
|            | Preliminary investigation of biodiesel reactor optimization using combine CFD-Taguchi method ..... 179                   |
|            | <b>A.K.M. Mohiuddin and Nabeel A Adeyemi</b>   |
| Chapter 26 |  |
|            | Alternative mixing strategy for biodiesel production: mixed flow impeller characterization ..... 188                     |
|            | <b>A.K.M. Mohiuddin and Nabeel Adeyemi</b>   |
| Chapter 27 |  |
|            | Experimental Investigation of a Multistage Evacuated Solar Still ..... 197   |
|            | <b>Yousif. A. Abakr, Ahmad F. Ismail and Mirghani I. Ahmed</b>   |
| Chapter 28 |  |
|            | Modelling of electronics heat sink – Influence of the wake function generation on the accuracy of CFD analysis ..... 203 |
|            | <b>M. I. Ahmed, A. F. Ismail, Y. A. Abakr</b>  |
| 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 31

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

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### Abstract

Three different types of photovoltaic solar cells were installed and connected in grid-tie inverters to run a blower or pump under the meteorological conditions of Singapore. Experiments were performed over a period of time, where all three types of cells, each type having a rated power of 360W, were exposed to same environmental conditions. For a day with a maximum irradiation of about  $760\text{Wm}^{-2}$ , analyses of data to determine the performance of solar cells revealed an average efficiency of mono crystalline, poly crystalline and tandem cells of about 10.4%, 9.5% and 8.8%, respectively. The maximum efficiencies recorded were 14.5% for mono-crystalline, 13.5% for polycrystalline and 11% for tandem cells. Although tandem cell has the lowest average efficiency, it shows the highest Solar Fraction (SF) compared to mono and poly crystalline cells. The electricity production of mono crystalline, poly crystalline and tandem cell for 30 consecutive days shows that tandem cell has the highest production with an average value of 1.7KWh. The total production of mono and poly crystalline cell is approximately the same. Both of them have the average daily value of about 1.5 kWh. On a day, with irradiation of about  $760\text{Wm}^{-2}$  and without any cooling, the surface temperature of mono-crystalline, poly-crystalline and tandem cell were  $59^{\circ}\text{C}$ ,  $58.4^{\circ}\text{C}$  and  $57.7^{\circ}\text{C}$ , respectively. On the other hand, the surface temperature has only reached  $35.5^{\circ}\text{C}$ ,  $35.1^{\circ}\text{C}$ ,  $33.6^{\circ}\text{C}$ , respectively, when the first data was recorded in the early morning, when the irradiation was about  $450\text{Wm}^{-2}$ . As the efficiency of the cell is dependent upon operating temperature, appropriate measures should be undertaken to maintain low operating temperature, particularly, when the irradiation is high.

**Keywords:** PV performance; mono-crystalline, poly-crystalline, tandem cells; power generation; conversion efficiency; solar fraction.

### INTRODUCTION

The sun is an immense source of power emitting a large amount of electromagnetic energy in the form of irradiation. On the average, the Earth's surface receives approximately  $1.2 \times 10^{17}$  W of solar energy. The