

ISBN: 978-93-86291-88-2

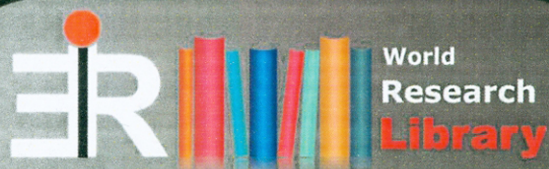


PROCEEDINGS OF
The IRES
INTERNATIONAL CONFERENCE



Date: 19th-20th March, 2017 | Venue: Oxford, United Kingdom

In Association With



World
Research
Library

PROCEEDINGS OF
THE IRES
64th INTERNATIONAL CONFERENCE
OXFORD, UNITED KINGDOM

ISBN- 978-93-86291-88-2

Organized by



Date of Event:
19th-20th March 2017

Event Co-Sponsored by



Corporate Address

Institute of Research and Journals
Plot No- 161, Dharma Vihar, Khandagiri, Bhubaneswar, Odisha, India
Mail: info@theires.org, www.iraj.in

Publisher: **IRAJ**

© 2017, The IRES International Conference, Oxford, United Kingdom

No part of this book can be reproduced in any form or by any means without prior written permission of the publisher.

ISBN- 978-93-86291-88-2

Edtn: 14

Type set & printed by:

R. K Printers
Bhubaneswar, India

About IRAJ Research Forum (IRF):

The *IRAJ Research Forum* is an International non-profit academic association under 'Peoples Empowerment Trust' with the stated goals of promoting cooperation among scientists, defending scientific freedom, encouraging scientific responsibility, and supporting scientific education and science outreach for the betterment of all humanity. It is the one of the world's largest and most prestigious general scientific society.

Objective of IRF:

- ❖ To provide a world class platform to researchers to share the research findings by organizing International/National Conferences.
- ❖ To use the research output of the conference in the class room for the benefits of the students.
- ❖ To encourage researchers to identify significant research issues in identified areas, in the field of Science, Engineering, Technology and Management.
- ❖ To help dissemination of their work through publications in a journal or in the form of conference proceedings or books.
- ❖ To help them in getting feedback on their research work for improving the same and making them more relevant and meaningful, through collective efforts.
- ❖ To encourage regional and international communication and collaboration; promote professional interaction and lifelong learning; recognize outstanding contributions of individuals and organizations; encourage scholar researchers to pursue studies and careers in circuit branches and its applications.
- ❖ To set up, establish, maintain and manage centers of excellence for the study of /on related subjects and discipline and also to run self supporting projects for the benefit of needy persons, irrespective of their caste, creed or religion.

About TheIRES:

The Institute of Research Engineers and Scientists (TheIRES) is a **non-profit organization** that promotes the Engineering and Technology, related latest developments and issues to be discussed and experimented through interactions amongst the researchers and academician across the globe at a common platform in association with The IIER, Academics World & ISER.

Conference Committee

Program Chair:

Dr. P. Suresh

M.E, Ph.D. Professor and Controller of Examinations,
Karpagam College of Engineering.,
Coimbatore, India

Weera Chotithammaporn

SuanSunandhaRajabhat University,
Thailand

Somkiat Korbuakaew

Suan Sunandha Rajabhat University,
Thailand

Somsakul Jerasilp

Suan Sunandha Rajabhat University,
Thailand

Conference Manager:

Mr. Bijan Kumar Barik

Mob: +91-9776047497

Conference Convener:

Miss. Priyanka Yadav, TheIRES

Mob: +91-7205807246

Publication and Distribution Head:

Mr. Manas Ranjan Prusty, IRAJ, India

INTERNATIONAL ADVISORY MEMBERS

Prof. Goodarz Ahmadi,

Professor, Mechanical and Aeronautical Engineering,
Clarkson University, USA

Dr Chi Hieu Le,

Senior Lecturer, University of Greenwich. Kent ME4 4TB.
United Kingdom

PROF. (ER.) Anand Nayyar

Department of Computer Applications & I.T.KCL Institute of Management and Technology, Jalandhar
G.T. Road, Jalandhar-144001,Punjab, India.

Prof. R. M. Khair,

Professor, Dept. Of Elex. and Telecommunication,
B, V University, India

Dr. P. Suresh,

Professor, Karpagam College of Engineering, Coimbatore,Tamilnadu

Mark Leeson

Associate Professor (Reader)
Area of Expertise: nanoscale communications,
evolutionary algorithms, network coding and communication systems

Dr. P. K. Agarwal

Professor, Deptt. of Civil Engineering, MANIT Bhopal ,Ph. D: IIT Kanpur
M.E: Civil Engg.IIT Roorkee, Membership: Indian Road Congress (IRC), Institute of Urban Transport (IUT)

Shahriar Shahbazpanahi

Islamic Azad University, Department of Civil Engineering, Sanandaj, Kurdistan, Iran,
PhD (Structural Engineering),
University Putra Malaysia, Malaysia, 2009-Present

Harun Bin Sarip

Head of Research and Innovation Dept, UniKL-MICET
Doctorate: Université de La Rochelle, France, Member:
International Society of Pharmaceutical Engineer, Singapore Chapter

Dr. Bilal Ali Yaseen Al-Nassar

The World Islamic Sciences and Education University (WISE)
Faculty of Business and Finance
Department of Management, Information System (MIS), Amman- Jordan

Dr. Md. Al-Amin Bhuiyan

Associate Professor
Dept. of Computer Engineering
King Faisal University
Al Ahssa 31982, Saudi Arabia

Prof. (Er.) Anand nayyar

Department of Computer Applications & I.T.
KCL Institute of Management and Technology, Jalandhar
G.T. Road, Jalandhar-144001
Punjab, India

Prof. Aleksandr Cariow

institution or Company: West Pomeranian University of
Technology, Szczecin

Dr. P. K. Agarwal

Professor, Deptt. of Civil Engineering, MANIT Bhopal ,Ph. D: IIT Kanpur
M.E: Civil Engg.IIT Roorkee, Membership: Indian Road Congress (IRC), Institute of Urban Transport (IUT)

Dr. VPS Naidu

Principal Scientist & Assoc. Prof., MSDF Lab, FMCD
CSIR - National Aerospace Laboratories, Bangalore, India

Mr. P. Sita Rama Reddy

Chief Scientist ,Mineral Processing Department, CSIR - Institute of Minerals & Materials Technology
Bhubaneswar, India, M.Tech. (Chem. Engg., IIT, KGP)

Dr.P.C.Srikanth,

Professor & Head, E&C Dept, Malnad College of Engineering, Karnataka
Senior Member IEEE, Secretary IEEE Photonics Society,
M.Tech: IIT, Kanpur, Ph.D: In IISc Photonics lab

Prof. Lalit Kumar Awasthi,

Professor, Department of Computer Science & Engineering
National Institute of Technology(NIT-Hamirpur),
PhD, IIT, Roorkee, M. Tech, IIT, Delhi

Dr. Chandra Mohan V.P.

Assistant Professor, Dept. of Mech. Engg., NIT Warangal,
Warangal. Ph.D : Indian Institute of Technology(IIT),Delhi
M.B.A: Alagappa University

Prof. I.Suneetha,

Associate Professor, Dept. of ECE, AITS, Tirupati, India

Dr.s. Chandra Mohan Reddy,

Assistant Professor (SG) & Head, Dept. of Electronics & Communication Engineering, JNTUA College of Engineering, Pulivendula,
Ph.D,J.N.T. University Anantapur, Anantapuramu

Gurudatt Anil Kulkarni,

I/C HOD E&TC Department, MARATHWADA MITRA MANDAL'S POLYTECHNIC

★ ★ ★

TABLE OF CONTENTS

SI No	TITLES AND AUTHORS	Page No.
01.	Traditionals Bills of Lading V. Electronic Bills Of Ladings: Pros and Cons and The Way Forward ➤ <i>Kamal Alawamleh</i>	1-3
02.	Solar Water Pumps For Agriculture ➤ <i>Chonmapat Torasa, Nichanant Sersri</i>	4-8
03.	The Impact on The Community Using Biogas Technology In The Community ➤ <i>Nuttida Chanhom, Prungsak Uttaphut, Tanaporn Pantuprecharat</i>	9-12
04.	Guidelines For OTOP Producer Development To The Standard System Of Environment Management ISO 14001 ➤ <i>Amon Lasomboon, Witthaya Mekhum, Chananchida Yuktirat</i>	13-18
05.	Rooftop Solar PV Systems ➤ <i>Ratchasak Sannok</i>	19-22
06.	The Sustainable Development Of Community Product And Packaging By Creative Economy For Angthong Province ➤ <i>Suraphan Rattanavadi</i>	23-26
07.	Integrating Relationship Of The Five Elements In Creating Product Design Of Interior Decorative Souvenirs ➤ <i>Somsakul Jerasilp, Jong Boonpracha</i>	27-30
08.	Study Of Product Design: Perception Of Product Users In Functionality And Ability Of Products To Control Calories From The Elders' Meals ➤ <i>Patinya Sang-Aroon, Pakinsittiloetprasit</i>	31-33
09.	The Study Of South East Asian Carbon-Tapping Techniques And Kiln Design On Contemporary ➤ <i>Jiravut Doungin</i>	34
10.	Factors Affecting The Learning Achievement Motivation Of 4th Year Students In Mathematics, Faculty Of Education, Suan Sunandha Rajabhat University ➤ <i>Tanawat Srisiriwat</i>	35-37
11.	Differentiation Of Aroma And Mood On Packing Design ➤ <i>Preechaya Krukaset</i>	38-40
12.	Design Guidelines For Mascot Of Northeast Of Thailand ➤ <i>Supatra Lookraks</i>	41-43

13. **Examination Of Service Quality Performance In The Social Insurance Service Business- A Case Study Of Suansunandharajabhat University, Bangkok, Thailand** **44-47**
 - *Ganratchakan Ninlawan, Sudapornarundee*
14. **Study On Design A Vacutainer Needles Disposal Device** **48-50**
 - *Palang Wongtanasuporn, Raja Ahmad Azmeer Raja Effendi, Rosjana Chanthasa*
15. **Effect Of Aquaerobic Exercise On Body Weightof The Overweight During Menopause** **51-53**
 - *Wadee Pramkratok*
16. **The Study Of Exercise Behavior Of Suan Sunandha Rajabhat University** **54-56**
 - *Jarosporn Pussakham*
17. **The Effect Of Combined Exercise And Meditation On Physical Fitness And Autonomic Nervous System** **57-59**
 - *Thanadej Posri*
18. **Thai Wisdom Regarding Herbal Medication In Prevention, Care And Rehabilitation In Muay Thai (Thai Boxing) Fighter’s Physical Body** **60-63**
 - *Vichit Suvonnopast*
19. **The Study Of 21st Century Classroom Requirement To Accomodate With Design Lighting In State Classroom With “RELUX”** **64-67**
 - *Jitravadee Roongin Kunkar, Piti Anontapant, Pongpol Jaithiang*
20. **Development Of Printing Ink Made From Corn Flour And Coffee Powder For Screen Printed On Paper** **68-71**
 - *Weera Chotithammaporn*
21. **Quality Analysis On Vegetable Oil-Based Offset Printing Ink** **72-74**
 - *Krairop Charoensopa*
22. **Study Of Professional Need For Printing Technician Personnel As Required By Business Organizations In Bangkok Thailand** **75-78**
 - *Wat Ploysri*
23. **Problems Within Printing Business Operations In Thailand** **79-81**
 - *Apinya Mungaomklang*
24. **Development Competency-Based Training Course In Paper Packaging Design For Designer In Bangkok, Thailand** **82-84**
 - *Suppawan Pankohlerng*

25. **The Readiness Of The Suan Sunandha Rajabhat University Education Personnel For The Edpex Quality Assurance** 85-88
 ➤ *Somkiat Korbuakaew*
26. **Building Trust And Globally Promoting Bangkhonhi Indigenous Knowledge Using Information Technology And Advanced Media** 89-92
 ➤ *Kwanruan Rasmee*
27. **The Application Of Data Mining Techniques As A Diagnostic Tool In Forecasting The Learning Ability Of Students Through Electronic Media** 93-96
 ➤ *Sirilak Ketchaya*
28. **The Efficiency Of Using Mobile Application For Encourage Culture Tourism Of Sculpture And Architecture 9 Temples In Bangkok, Thailand** 97-101
 ➤ *Kittikhun Meethongjan, Nisanart Tachpetpaiboon, Narisara Kaewsakul*
29. **Managing Strategic Alliances Of Thai Professional Football Clubs With Their Foreign Counterparts** 102-103
 ➤ *Komkrit Rattamane*
30. **A Case Study Of The Contention Between Government And Community In “Mahakarn Fort” Conservation Project For Tourism** 104-107
 ➤ *Supakit Mulpramook*
31. **Creating The Viewpoint Map To Support Tourism In Taling – Chan District, Bangkok** 108-110
 ➤ *Kunyaphat Thanakunwuthirot*
32. **Geographic Information Tourism System With Community Participation In Taling – Chan District, Bangkok** 111-114
 ➤ *Morakot Worachairungreung*

★ ★ ★

EDITORIAL

It is my proud privilege to welcome you all to the TheIRES International Conference at Oxford, United Kingdom. I am happy to see the papers from all part of the world and some of the best paper published in this proceedings. This proceeding brings out the various Research papers from diverse areas of Science, Engineering, Technology and Management. This platform is intended to provide a platform for researchers, educators and professionals to present their discoveries and innovative practice and to explore future trends and applications in the field Science and Engineering. However, this conference will also provide a forum for dissemination of knowledge on both theoretical and applied research on the above said area with an ultimate aim to bridge the gap between these coherent disciplines of knowledge. Thus the forum accelerates the trend of development of technology for next generation. Our goal is to make the Conference proceedings useful and interesting to audiences involved in research in these areas, as well as to those involved in design, implementation and operation, to achieve the goal.

I once again give thanks to the Institute of Research and Journals, TheIIR, TheIRES & University of Management and Technology (Sialkot) for organizing this event in Oxford, United Kingdom. I am sure the contributions by the authors shall add value to the research community. I also thank all the International Advisory members and Reviewers for making this event a Successful one.

Editor-In-Chief

Dr. P. Suresh

M.E, Ph.D. Professor and Controller of Examinations,
Karpagam College of Engineering.,
Coimbatore, India



SOLAR WATER PUMPS FOR AGRICULTURE

¹CHONMAPAT TORASA, ²NICHANANT SERSRI

¹Faculty of Industrial Technology, ²Faculty of Fine and Applied Arts, SuanSunandhaRajabhat University, Thailand
Email: ¹chonmapat.to@ssru.ac.th, ²nichanan.se@ssru.ac.th

Abstract: Occupations in Thailand were mainly related to agriculture. Most Thais were agriculturists. Agriculture was heavily crucial to the development of the economy and the country. The incomes in Thailand densely came from agricultural products. Agriculture had a long-standing history in Thailand from the old days till now. Water was utilized for farming, planting, and livestock. Taking natural water from natural resource for agriculture at times required water pumps. In general, agriculturists used a petrol or diesel engine for swivel the shafts of a reciprocating pump. Alternatively, they deployed an electric pump which obtained electricity from a current transmission system, which was rather costly, and caused high product manufacturing costs. Nevertheless, at present, solar energy was being extensively promoted in Thailand, as it came from natural energy that was environmentally-friendly.

The researcher came up with an idea of inventing a solar water pump for agriculture. A 250 watts, 24 VDC, speed 2,750 RPM (rounds per minute) to rotate the shaft of the piston stroke which was installed on a piston pump. The piston pump size was roughly 1 inch and it came with a flow rate of 2,800 liters per hour. The 2 connecting in parallel 150 watts, 12 volts solar cell panels for the piston pump and it was generated 300 watts of electric power. The solar cell panels were an electricity distribution source for the DC electric motor which came with a solar battery charger system. Such solar battery charging system with a 100Ah, 12 V battery for uninterrupted power supply when there was no sunlight to the operations of the water pump. When the solar cell panels of the designed and invented solar water pump were at 300 watts, 17 - 20 volts of electricity were produced which indicated that they could transmit sufficient current to the DC motor. Therefore, it was able to pump up water without being connected to a battery. A DC motor used 5.9 - 6.2 A, the speed was approximately 1,348 - 1,353 RPM which allowed the flow rate of 888 liters per hour. When the DC motor pump was used together with a 100 Ah, 12 Volt battery, the flow rate of pumping water lasted for 6.5 hours during the non- sunlight period.

Keywords: Water pump, Piston pump, Solar energy, Solar cell.

I. INTRODUCTION

Agriculture was the main livelihood for the majority of Thai people. It was at no doubt immensely important to the development of the country and its economy. Water was utilized for farming, watering various kinds of plants, feeding cattle, etc. Taking out adequate water from various water resources in a purposeful manner was in fact essential. Presently, most farmers used water pumps which their power engines were driven by gasoline. At times electricity was employed to power up the engines. Nonetheless, it was not accessible in remote areas particularly at the locations situated miles away from electricity transmission lines. Using gasoline and electricity caused extensively high manufacturing costs in agricultural products. With this reason, the promotion of renewable energy had been vastly enhanced in Thailand such as solar power, wind power, and so forth. Solar power never ran out; moreover, it was clean energy generated no pollution to the environment. Thailand was geographically located near the equator and therefore received extensive volume of solar energy throughout the year. It was wise to take advantage of such free and clean energy to utilize purposefully through the invention of solar cells. They directly altered solar energy to electricity power. Solar energy was one of the worthy options that supplied electricity for agricultural water pumps. There were 2 types of solar cells categorized by the type of semiconductors;

1) Silicon solar cell: silicon was the cheapest semiconductor due to its boundless availability throughout the world. Electronic-relating industries extensively utilized silicon in their shop floors. The silicon solar cells were grouped by their characteristics of the crystalline as follows.

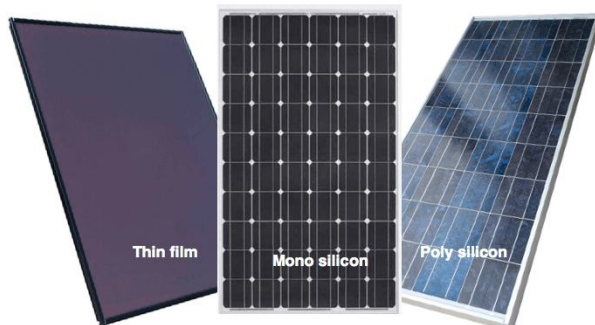
1.1) Crystal: it was classified into 2 subgroups including single crystalline silicon solar cell and poly crystalline silicon solar Cell. Both were the most used solar cells these days owing to their 12-15% high efficiency which sufficed for the need in electricity generation.

1.2) Amorphous silicon solar cell; it was a thin film, easy to produce, and low cost. Regardless of those attributes, the efficiency to alter the solar energy to electricity power was approximately 5-10%. It would be a good fit for low power consumption devices such as calculators, watches, etc.

2) A solar cell which was not made from silicon, but others like GaAs : Gallium Arsenide, CdS : Cadmium Sulphide, CuInSe₂ : Copper Indium Diselenide, to name a few. The efficiency was at 20-25%, and it was profusely used with high radiation intensity. Yet the price was 50% higher than that made from a silicon. Such solar cell was widely in use in satellite and space industry [1].

At present, a solar cell is applied for various functional purposes. For instance, it is used as a power source for a night insect trapping device-- electricity is produced by a solar cell during the day time and is stored in a battery which later releases the

power to a UV lamp to entrap insects at night time [2]. Another example is a solar water aerator -- which obtains electricity from a solar cell and distributes the power to a DC water pump to pump water upwards and then transform it to water spray or water drops that add up the oxygen level in the water [3]. Due to its cheap price, a solar cell is environment-friendly; moreover, it can be employed in remote areas where the electricity authority does not have the power distribution available yet.



From : <http://www.cleanenergyreviews.info/blog/pv-panel-technology>

Fig.1. Types of solar cells.

Water pumps were used for pumping and subsequently conveying water from one location to another. They had been part of the tools that helped to fulfill people's welling-being from the past till now. Many people inhabited near water resources as the locations were convenience for their living lifestyles. When water was constituted too much underneath the ground, it was not easy for people to get to them, they tried to invent tools like various types of pumps to capacitate them a chance to utilize water for their needs. Such tools helped them avoid living in a densely populated areas that were close to water resources. New-styled pumps had been evolved since 1840. The very first pump was a Reciprocating pump designed to connect directly to the steam engine. Ever since, unceasing evolution on water pumps was consistently increased in all aspects starting from sourcing water and dispatching it to users for consumption in agriculture, industrial operations, transportation, and medical science. Contemporary water pumps had been switched from using natural resources to power engine. The most common practice was using electricity to power up the engine as it was easy as falling off a log. Nowadays, there were quite a few types of pumps available in the market for consumers to choose from. The most common ones were the following 3 types of water pumps explained as follows;

1) **Kinetic pumps:** they derived power from rotation aimed to increase power level to water by the rotation of the rotors. When water was forced to move through the gaps between rotors, momentum of the water was lifted and altered to speed or kinetic energy or Velocity head. When the liquid was transferred from the rotors, it was then changed to Pressure head.

Centrifugal, Regenerative turbine and Special Effect were the most commonly-used kind of kinetic pumps.

2) **Rotary Pumps:** they comprised flippers, rotors, and pump body installed inside the device. Rotors which swirled and drove the flippers to rotate together with them generated cavity among the 3 components. Then the air pressure dropped lower than the external climate, which triggered the flow of water which replaced the gaps. Afterwards the liquid was sealed and spurred so much that it was pushed out from the flippers, and then out from the pump to a higher-pressure location. The rotary pumps were categorized into 7 groups, as follow Vane, Piston, Flexible Member, Lobes, Gears, Circumferential Pistons and Screw.

3) **Reciprocating Pumps:** they were grouped in the Positive Displacement Pumps just like the rotary type. They were heavy duty pump driven by movement of the piston. This dropped the internal side of the piston to a lower pressure compared to the external pressure from the outside air. External pressure pushed the water up to the valves into the piston, and the piston pushed the water out from the pumps to a higher pressure location. There were 3 types of such pumps based on their external attributes --Piston pump, Plunger pump and Diaphragm pump [4]. In Thailand, Piston pumps were often utilized particularly in agriculture since they were cheap and uncomplicated; moreover, the maintenance cost was rather low.



Fig.2. Types of water pumps

II. RESEARCH OBJECTIVE

- To design and produce an agricultural solar pump.

III. RESEARCH PROCESS

3.1. Concept Design

In Thailand, variety of pumps was intentionally applied for agricultural utilization. The employment of various energy enabled the pumps to function. Such energy was mechanical energy from diesel or benzene. Alternating current and direct current were distributed to a motor to allow the pumps for functioning. In the conceptual design of an agricultural solar pump, it was broken down into 2 main parts including an electricity generated from solar power, which also acted as a condenser, and a water pump using a DC motor connected to a Piston

pump. The conceptual framework was demonstrated in the Figure 3. The conceptual design was heavily concerned to low manufacturing cost, ease of invention, ease of raw material and tool purchases, and potentiality of proper utilization. All of these factors were considered altogether for the researcher to come up with an agricultural solar pump prototype that farmers could learn from and make one on their own in the future.

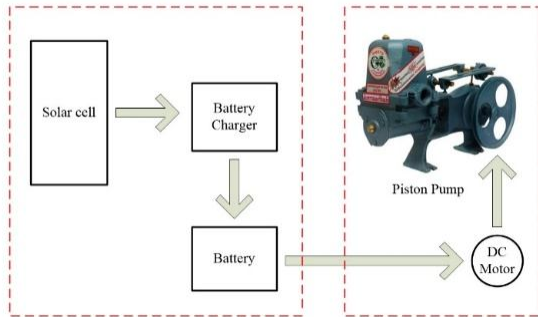


Fig.3. Framework of conceptual design

The selected water pump used for this designed prototype was a Piston pump as it was commonly used in an agriculture; in addition, it was cheap, durable, as well as uncomplicated in its functionalities, and low maintenance required. There were many inventors who made this type of pump. Wichit farming tool shop produced a DC pump using a 24 volts, 350 watts motor that came with a 1 inch 300 rpm reduction gear pre-installed on the pump. The pumping ratio was at 5,100 liter per hour. A 3 inches diameter pulley was inserted in the rotor of the motor. Another 2.5 inches diameter pulley was pre-installed on the spur gears of the pump to attain to the gear ratio of 1:1.2 which drove the shaft of the pump rotate at the 360 rpm. 2 pieces of 12 V, 80 Ah batteries were placed in series to obtain 24 V power distribution source for a DC motor [5]. The school of agricultural engineering, faculty of engineering, KonKhaenuniversity developed a solar pump by designing a 1 inch piston pump system adjoined to a 500W 12VDC motor which obtained solar energy from a 295W, 24V solar cell. A pulley with a rotation speed less than 400 rpm was deployed [6]. In addition, TheppakornLeelatam designed and built a cycling bicycle to replace an electric motor. A 7 inches sprocket was connected with 3 inches freewheels preinstalled with 20 inches pulley functioning like a bicycle wheel that was adjoined via cog belts to an 8 inches pulley of the water pump. The engine compression ratio was augmented by 6 times with 1 round of cycling, the piston was compressed for 6 times. From the implementation, the cycling time for 30 rounds per minute allowed the water pump to work efficiently [7].

3.2. Solar Water Pumps Design

The design of a solar water pump was segregated into 2 parts—electricity produced from solar energy with battery inclusive, and piston pump.

3.2.1 Electricity produced from solar energy with a battery inclusive consisted of 3 equipment—solar cell panel, a charge controller, and a battery. The 2 solar cells were 18 V, 150 W Poly Crystalline Silicon type. They were placed in series and together generated a total electricity of 300 W to the load. They distributed electric power at most for 16.67 A. A 250W DC motor was used together with the water pump, so as to obtain sufficient power for the motor. The voltage produced from the solar cells was dispatched and kept in a 12 V, 20 A charge controller. It stored the current within the 12 V, 100 Ah Deep cycle battery and was discharged to use with a water pump when there was no Sun light as explained in the Figure 4 below.



Fig.4. The components for electricity generation from solar energy and a battery charge controller

3.2.2 Piston pump: The design of this required a DC motor to power up the water pump. It was crucial to design the rpm of the motor to align with that of the shaft of the pump so that all operations worked harmoniously and proficiently. The study started out from the research on the important assets of a water pump and a DC motor such as the power required to rotate the shaft and the pulley of the water pump, the voltage of the motor, the watt of the motor, and rpm, etc. In the design, a 1/3,1/4Horsepower (HP) or 248.67, 186.5 Watts (W) water pump was selected, 1 inch of water pipe with a pumping ratio of 2,800 L/H, an 8 inch of pulley, and a 24V, 250W DC motor with 2,750 RPM were deployed. The important part necessary to calculate was the size of the pulley to be installed with the rotor of the motor in order to function the shaft of the motor to rotate for 300-400 rounds per minute. This was a practical RPM that a water pump worked best. The size of the pulley was derived from the following calculation.

$$X = \frac{RPM_{shaft} \times Pulley_{pump}}{RPM_{motor}}$$

X = The size of the pulley motor (inches)

RPM_{shaft} = Desired RPM of the shaft water pump (RPM)

$Pulley_{pump}$ = Pulley size of water pump (inches)

RPM_{motor} = RPM of the motor (RPM)

The size of the pulley was calculated. A 12 DC voltage was made to distribute the current to the motor, lowering its RPM less than half or about 1,375 RPM, and required the axis of the water pump at 400 RPM.

$$X = \frac{400 \times 8}{1,375} = 2.33 \text{ inches}$$

From the calculation, a 2.33 inches motor pulley was essential. Nevertheless the standard size available in the market was 2 inches as shown in the Figure 5 below. Using the standard size motor pulley with the 8 inches water pump pulley brought about 4:1 of gear reduction ratio, and the shaft of the water pump was at 343.75 RPM.



Fig.5. A 2 inches pulley for motor

3.3. Solar Water Pumps Production



Fig.6. Aluminum sheet and DC motor installed on the water pump

Aluminum sheet was set in place as a base cover of a DC motor. The motor was tightly contiguous to the aluminum sheet. A 2 inches pulley was installed with a motor axis. As illustrated in the Figure 6 a belt seamed a motor pulley with a water pump pulley, where the distance between the 2 was firmly belted as exhibited in the Figure 7.



Fig.7. A motor pulley was interlocked with a water pump pulley

3.4. Solar Water Pumps Evaluation

The test on the designed solar water pump was conducted based on the 2 perspectives in order to prove its functionality-- 1) Electricity generated from solar energy and distributed the current to the water pump 2) Water pump and its electricity power use. The test was done by installing a solar cell facing the Southern direction with an angle of 15 – 20 degree with the surface. The solar cell transmitted electricity current to a DC motor that was located on the water pump. The following measurements were judged— voltage, and volume of produced current from a solar cell throughout the day, current volume stored in an electric charger, the current distributed to the DC motor, RPM of the motor, and the test on the functionality of the water pump such as a water pumping ratio and a water pumping distance.

IV. RESULTS

The test to verify the electricity generated from the 2 connecting pieces of 12 V, 150 W solar cells demonstrated that they generally generated electricity during 7:30 – 16:30. The time when the maximum output was produced was between 11:00 – 14:00. Electricity for 17– 19 V, and 15 A was produced and it sent out power to a 12 V, 250 W DC motor of a water pump, which enabled its operation without a battery. When seaming the generated electricity with a charger control to charge the power to the battery, the water pump could work simultaneously while the charging process was underway. The test on the operations of the DC motor pointed out that the motor required the current for 5.9 – 6.2 A enabled the motor voltage for 74.4 W, and its rotation speed was between 1,349 – 1,353 RPM.

The measurement on the water pump operation found that it had a capability to pump water at the ratio of 888 liter/day, and it sucked up water from the ground level up to 8- meters. Moreover, when the pump was functioned together with a 12 V 100 Ah battery, the operations lasted for approximately 6.5 hours when there was no sunlight.

CONCLUSIONS

The comparison between the designed 24 V, 250 W DC motor with the solar water pump, there was not much difference between the 2—the RPM was the

research calculation was at 1,375 RPM, which was almost equal with the actual RPM which was between 1,349 – 1,353 RPM. The piston axis was rotated for about 337 – 338 RPM which was a good fit with how a piston pump was supposed to operate. The piston pump designed in this research required power for 1/4 HP or 1/3 HP (186.5 or 248.67 W) that allowed the pumping ratio for 2,800 liter/hour. Yet a DC motor needed power for only 74.4 W indicating the pumping figure for about 888 liter/hour. If the power in the motor was upgraded, the pumping ratio would become higher.

The designed solar pump was brought into use in a plantation to water the trees in the morning as well as in the evening everyday. It replaced the water pump used with electricity from the power grid. This helped to reduce the bill cost that farmers paid on a monthly basis. The researcher also did a training and publicity to farmers on how to make such solar water pumps on their own.

SUGGESTIONS

The designed solar water pump could be used in a real agricultural farming. It was suggested to use it during the sunlight time as the solar cells were triggered to generate electricity for the DC motor without using that from the battery. Such practice enabled farmers to store water in containers located at high level and then released it when needed.

Therefore, whenever there was no sunlight, they could still utilize the stored water without the need of the water pump. For the remote area where water was not available, a DC motor could be upgraded to higher power like 350 W, 500 W or even 750 W. Water transmission could be successfully conveyed to those remote areas. The battery to keep the power was required higher Ah so as to pump water for a certain period of time when there was no sunlight.

ACKNOWLEDGMENTS

We would like to show our deepest gratitude to Suan Sunandha Rajabhat University for giving us the opportunity and funding to conduct this research.

REFERENCES

- [1] RatchasakSannok. Solar cell. Information on http://www.teacher.ssu.ac.th/ratchasak/pluginfile.php/405/block_html/content/solar_cell01.pdf, 2016.
- [2] Chonmapat Torasa, and NichanantSermisri. Solar energy-based insect pest trap. *Procedia - social and behavioral sciences*, Volume 197, P 2548-2553, 2015.
- [3] Chonmapat Torasa, RatchasakSannok, WeeraChotithammarn, SomkiatKorbuakaew and NichanantSermisri. Solar energy aerator. Proceedings of the IRES55th international conference, 30-31 Dec 2016, Seoul, South Korea, 2016.
- [4] TherdsakYutseree. Classifications of pumps. Information on <http://industrialpumps-tsy.blogspot.com/2013/06/classifications-of-pumps.html>, 2013.
- [5] Wichit agricultural tools. Direct current water pump. Information on <http://wicht.lnwshop.com>, 2016.
- [6] School of agricultural engineering, Faculty of Engineering, Konkhaen university. The development of a solar piston water pump. Information on <https://www.en.kku.ac.th>, 2015.
- [7] TheppakornLeelatam. Water pumping bike. Information on <http://atc.snru.ac.th>, 2012.

★ ★ ★