IJASETR
Vol. 02. Issue 01. Article No. 02
www.setscholars.org/index.php/ijasetr

Design and Development of a Dual Solar Water Purifier

S. O. Ismail[1*], S. J. Ojolo[1], J. I. Orisaleye[2], A. O. Alogbo[1]

[1]Department ofMechanical Engineering, University of Lagos, Lagos, Nigeria
[2]Department of Mechanical Engineering, Lagos State University, Epe Campus, Lagos, Nigeria

***Author for correspondence:** isikiru@unilag.edu.ng, ismailrotimi@yahoo.com

Article History

Received: 26-04-2013
Accepted: 11-07-2013
Published: 16-07-2013

Keywords:
Dual solar water purifier, solar still, SODIS, purified water, affordable total costs, maintenance.

ABSTRACT

In this work, dual solar water purifier was designed and developed using locally available engineering materials. Using the sun as the principal source of energy, a cheap low technological method was used to produce small quantities of safe drinking water. The sun provides heat and ultraviolet (UV) light as the two key elements that destroy pathogen in water. They aided the formulation of the water purifying models. Two popular methods of purifying water were combined to create new purifiers' design models. This design comprises of two already existing methods of purifying water, the Solar Still and the SODIS (Solar water Disinfection). The addition of the two methods creates the intended dual water purifier. They both aided each other in that Solar Still produced much more purified water but at a lower volume while the other, higher volume at a shorter period when exposed to the same solar intensity. The materials used for this design played an important part in the performance evaluations of the purifier. The percentage of the mount of purified water was evaluated after various days of testing whereby efficient results were achieved and discussed. The amount of purified water and efficiencies from a total volume of 8litres and 500ml for each bottle for both Solar Still and SODIS bottles after various days of testing were 5.5litres, 4.8litrres, 5.0litres and 68.75%, 60%, 62.5% respectively. The efficiency of the dual purifier is dependent on some variables such as the amount of water to be purified, the solar intensity and other thermal quantities. An affordable total costs of production of fifty four thousand and four hundred naira (₦54,400=00) was spent, an equivalent of $346.50 or £209.00) at conversion rate of ₦157 = $1 and ₦260 = £1. This paper presents an efficient and effective dual purifier, which is affordable for household use and requires little or no training for operation and maintenance.

Citation: S. O. Ismail *et al., Design and Development of a Dual Solar Water Purifier*, IJASETR 2(1): p. 8 – 17.

1.0 Introduction

It is known that the sun is the only most reliable source of energy were radiant light and heat emitting from it, is being harnessed by humans since ancient times using a range of ever-evolving technologies and practices. Such practices may include the removal of undesirable chemicals, materials and biological contaminants from contaminated water, which is known as the purification of water. The goal is to produce water fit for a specific purpose. Most water is purified for human consumption (drinking water) but water purification may also be designed for a variety of other purposes, including meeting the requirements of medical, pharmacology, chemical and industrial applications (Conroy et al, 1999). The purification process of water may reduce the concentration of particulate matter including suspended particles, parasites, bacteria, algae, viruses, fungi; and a range of dissolved and particulate material derived from the surfaces that water may have made contact with after falling as rain (Helfferich, 1962). The standards for drinking water quality are typically set by governments or by international standards. These standards will typically set minimum and maximum concentrations of contaminants for the use that is to be made of the water.

It is not possible to tell whether water is of an appropriate quality by visual examination. Simple procedures such as boiling or the use of a household activated carbon filter are not sufficient for treating all the possible contaminants that may be present in water from an unknown source. Even natural spring water that is considered safe for all practical purposes in the 19th century, must now be tested before determining what kind of treatment, if any, is needed. Chemical analysis, while expensive is an efficient way to get the information necessary for deciding on the appropriate method of purification. Distillation is one of many processes available for water purification, and sunlight is one of several forms of heat energy that can be used to power that process. Sunlight has the advantage of zero fuel cost but it requires more space (for its collection) and generally more costly equipment. To dispel a common belief, it is not necessary to boil water to distil it. Simply elevating its temperature, short of boiling, will adequately increase the evaporation rate. In fact, although vigorous boiling hastens the distillation process it also can force unwanted residue into the distillate, defeating purification. Furthermore, to boil water with sunlight requires more costly apparatus than is needed to distil it a little more slowly without boiling (Conroy et al, 1999).

Water purification involves removing waterborne pathogens (disease-carrying organisms) and making any water source not contaminated by dangerous chemicals safe to drink. The sun provides two key elements that destroy pathogens: heat and ultraviolet (UV) light (Webb, 1995). A solar water purifier is a cheap, low-technological method of producing small quantities of safe drinking water (Donahue, 2001). Solar energy has been a major help in the creating of new innovations in the 21st century but it also has its setbacks. Arid regions, especially deserts that have scorching sun blazing the environment, would not find it new to be associated with less amount of water and even places with abundant water would be contaminated with desert sand and other dust particles. Let us not forget rural areas that are in need of hygienic and clean water, places like this are faced with severe contamination of water (Conroy et al, 1999). Even bringing it home to the urban areas, little contaminations that are harmful to an individual and his household is not farfetched. This and many more scenarios can be seen where water contaminations occur in our environment.

Due to all these, purifier comes into play. Much cannot be said about the urban areas with the presence of electricity. For places with constant electricity supply, the solar water purifier can be used as an alternative source. But this is a different thing with the rural areas; it would surely be more effective and efficient and may save rural areas from various domestic misfortunes. The aim of this design is to build an improved solar water purifier that would be able to improve the efficiency of the already existing purifier, minimize the cost of production of clean water and its purifier and ease the operational techniques of the already existing purifier.

The impact of this kind of research project to the rural areas will be tremendous. One of the greatest problems facing the villages is that of drinking water. Water ranks very high on the United Nation's list of scarce commodities that need urgent conservation measures. In the desert and other semi-arid regions, this design will prove to be a great life saver. It would also help in the creation of awareness in the use of the solar energy in countries or areas where it is rarely used or where little is known about solar power.

Water purification through solar power is one of the best inventions to save energy and to have uncontaminated water. An electric purifier system requires more power and costs a lot more too. A convectional water purifier can also be at a disadvantage in places of no or little electrical power source. This is where the solar design gets high credibility due to the ever-presence of the sun as the source of its own energy.

2.0 Related Research

There are a number of technologies that have been explored over the years to effectively and inexpensively provide clean water. Among them have been solar-based technologies many of which fall under the category of solar distillation. Solar distillation uses the heat of the sun directly in a simple piece of equipment to purify water. The equipment, commonly called a solar still, most often consists primarily of a shallow basin with a transparent glass cover. The sun heats the water in the basin, causing evaporation. Moisture rises, condenses on the cover and runs down into a collection trough, leaving behind the salts, minerals, and most other impurities, including germs (Donahue, 2001). Although it can be expensive to build, a solar still can be both effective and long-lasting. It can produce purified water at a reasonable cost if it is built, operated, and maintained properly. In recent years, new technology has become available that uses the ability of ultraviolet light to kill harmful pathogens.

The first practical solar distillation device was reported in 1561. It was reported that Arabs using a concave mirror focused on a clear water-filled vase with certain types of flowers submerged. The concentrated so heat caused the essence of the flowers to distill into the water, creating perfume. A glass-covered cauldron served as the boiler. A propped curved metal sheet acted as the heating device. Solar energy concentrated on the boiler and heated the wine to a vapour. The vapour was collected in a conventional condenser where it cooled into brandy (Gordes et al, 1985). Modification of the previous solar stills into small scale models by undertaking the design of a solar still that was capable of desalinating seawater to potable water was carried out (Telkes, 1944). It looked like a balloon with a dark inner section and a clear plastic outer section. It was filled with salt water in the outer section and was said to be able to produce up to one quart of potable water per day.

It wasn't efficient till 1980 that another low technological and conventional means of purifying water was found. Professor Aftim Acra discovered the effectiveness of the SODIS (Solar water Disinfection) by placing plain plastic bottles under intense sunlight for a long period of time (SODIS, 2002). Various other researchers carried out Substantial follow-up research and clinical trials. Water purification system that uses ultraviolet light to kill pathogens was developed (Wegelin et al, 2007). The aim was to be able to make it easy enough to use it at the rural village level yet make it durable and inexpensive (Wegelin et al, 2002). The result was a prototype named the UV Waterworks by a McCracken & Horace in 1985 (Gordes et al 1985). Many more inventors and researchers were able to modify the solar still by adding other components to enhance the efficiency. A system that consists of a solar still coupled with solar central receiver and a number of heliostats arranged around it in three arrangements were created (Abdelkader, 2006). The system seems to be suitable to provide drinking water for population or remote arid areas. Also, famous Jonathan Liow (2011) created the solar ball which consists of a clear plastic sphere which the user would fill with water and wear on their head. It could produce 3litres of clean water per day. Sunlight passes through a transparent layer and vapourizes dirty water. In the other side, water vapour condenses to form clean water.

3.0 Materials and Methods

The designed dual water purifier could yield up to 5 to 6 liters of purified drinking water on a sunny day. The fabricated apparatus can be divided into two parts, namely; the solar stills system and the SODIS.

3.1 The Solar Still System

Solar stills is a simple way of distilling water, using the heat of the sun to drive evaporation, and ambient air to cool a condenser film.

Materials Needed

1. Aluminum Sheet metal enclosure: the formation of a microscopic film of aluminum oxide on the surface of the metal protects it against the corrosive influence of water. Also, it is a good material for thermal conductivity. Aluminum is easy to fabricate and can be finished with a variety of coating and finishes.
2. Iron metal frame: iron metal was used to hold firm and frame the aluminum sheet metal to be fabricated. So as to make the fabrication strong and firm and prevent it from collapsing.

3. Reflective material e.g. stainless steel: this was used in this design as the base because apart from this metal sheet being reflective to the UV rays produced from the sun, it makes a good base placement for the water to be purified so as not to intoxicate the water if other metal is used. This is due to it being also corrosive resistant.
4. Black paint: the body of the design would be painted black so as to make it a blackbody being able to absorb 100% radiation from the sun in other to heat the water to be purified.
5. Insulation (or fiber: Glass Wool): Glass wool was selected for this design because it is a good insulator in heat absorbing. It would be placed in between the side of the wall of the solar still and under the base of the purifier.
6. Sheet of perpex glass (polymethyl methacrylate): for sunlight to pass through into the purifier, glass was considered but later excluded because of it being easily breakable and heavier than perpex.
7. Glue (silicon sealant or similar weather-resistant material): to seal the places in the purifier that may be prone to leakages when water is put in it.

3.2 The SODIS – Solar water Disinfection

Solar water disinfection uses infrared energy and heat to disinfect water but does not distillate (evaporate and condense water)

Materials needed

1. Aluminum sheet or Aluminum foils.
2. PET bottles (Polyethylene Terephthalate bottles)

The aluminium sheet could even be not included just as long as the aluminium foil is there and vice versa. This is used because of it high reflectivity to the sun. It would be out at the base of the water holding medium. Whereas, the PET bottle used must be colorless and transparent. Also, it must not hold more than 3 liters of water so that effective UV radiation may take place. All heavily scratched bottles were avoided. The PET bottles are washed, the first time it's being used. They are now filled with water to be purified and closed well with the lid. They are now placed in the metal enclosure specified for the SODIS where it is exposed to the sun. It must be placed where the sun intensity is very high so as to increase the efficiency of the design.

3.3 Thermal analysis

The efficiency of the purifier is dependent on a number of variables. The length of time the still is in the sun is critical, and one may wish to make the length fixed at around 5 or 6 hours to make the final judgment of the most efficient still easier. Other factors are more subtle, but also important. Like the solar intensity of the sun and also the amount of water added to the purifier.

Solar constant (Isc) = 1353 W/m^2

Also, the solar intensity; $I = \text{Isc} + 0.33\cos\frac{360(n-2)}{365}$ (Janjai, 2009 and Jin, 2005) ……………………1

Where n = the total sum of days in a year in which thermal analysis was carried out.

Also the transmissivity and absorptivity product$(\tau.\alpha)$ for the solar collector (perpex glass) = 0.8542
In addition the heat that reaches the absorber is trapped away by the fluid. This can be evaluated as:

$$Q_u = mc_p(t_c - t_f) \qquad \text{……………………………………………2}$$

Flat plate collector of surface area A, an incident solar radiation I and the amount of solar radiation received as heat from the sun, Qi is expressed as:

$Q_i = I \times A$

Due to the fact that part of the radiation is reflected back to the surrounding in some cases while another would be absorbed by the glazing material in this case the aluminium. Thus the percentage of the solar radiation that passes through the cover (transmissivity,τ) and that absorbed (absorptivity,α) by the glass is most important and would be accounted for. This percentage is given as the product ofτ and α. Hence the input into the system is given now as:

$$Q_i = I \times (\tau.\alpha) \times A \quad \text{(Robaa, 2009)} \quad \text{………………………………3}$$

Based on temperature difference between the surrounding, heat is lost to the surrounding. Therefore, the rate of heat loss (Q_i) depends on the glass collector temperature and the collector's overall heat transfer (or loss) coefficient (U_L). The heat transfer (or loss) coefficient is therefore given as

$$U_L = \frac{Q_i}{A \times (t_c - t_f)} \text{(Swartman, 1967)} \qquad \ldots\ldots\ldots\ldots 4$$

Where $c_p =$ specific heat capacity of the fluid (water),
$t_f =$ temperature supplied by the fluid,
$t_i =$ temperature of the upper surface of the absorber = inlet temperature of the fluid (t_c),
m = volume of the fluid and
A = cross sectional area collector.
In order to know efficiency of the water purifier, Calculation of the percentage of the water that was purified is done by the formula:

$$\%\text{ of purified water} = \frac{\text{volume collected}}{\text{volume added}} \times 100 \qquad \ldots\ldots\ldots\ldots 5$$

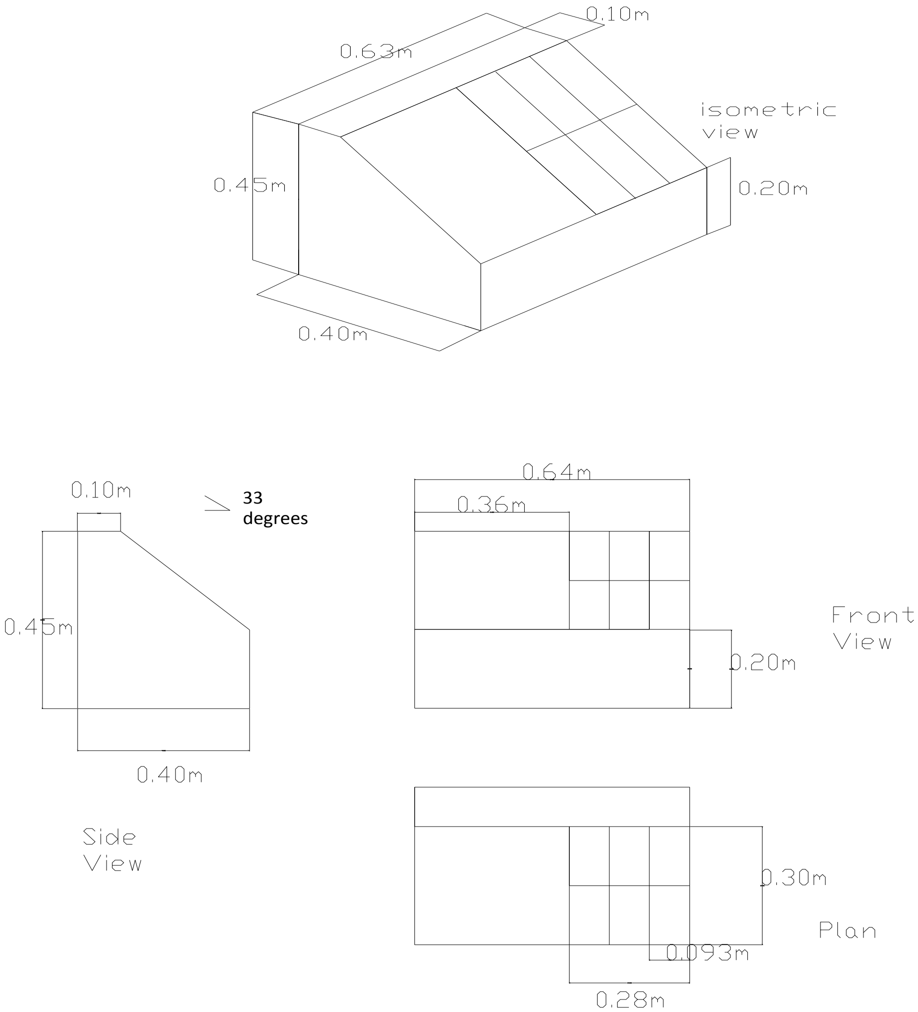

Figure1:Isometric and Orthographic views of the Dual Solar Water Purifier.

Plate 1: Dual Solar Water Purifier.

4.0 Results and Discussion

4.1 Results

Around afternoon by 11:24am, 8litres of water to be purified was filled into the base of the water purifier. Before placing water into the base, a thermometer was placed inside to check the temperature of the system (the still) which was 37^{0}C. After which the temperature of the water was taken too. This was given as 25^{0}c. Also the 6 (six) PET bottles were also filled up, knowing their various measurements to be 500ml for a bottle. This would be essential in getting the total amount of water that is to be purified.
Solar constant (Isc) = 1353 W/m^2
From equation 1, the solar intensity is evaluated as thus:

$$I = \text{Isc} + 0.33\cos\frac{360(n-2)}{365}$$

Where n = the total sum of days in a year in which thermal analysis was carried out.
n = 31 days (Jan, Mar, May, July, Aug), but 30 days (Apr, June, Sept), 29 days (Feb) and 5 days (Oct)
Therefore, n = (31×5) + (30 ×3) + (29) + 5 = 279 days,

$$I = 1353 + 0.33\cos\frac{360(279-2)}{365} = 1353.02\ \text{W/m}^2$$

The heat that enters into the perpex glass and absorbed into the fluid is calculated using:
$Q_u = mc_p(t_c - t_f)$
Where m = volume/mass of fluid = 8 litres
And 1 litre = 0.96kg
Therefore 8litres = 8 × 0.96 = 7.68kg
c_p= specific heat capacity of water = 4.187kJ/kgK
t_c= temperature of the system (the still) = 37^{0}C (37+273 =310K)
t_f = temperature of the water = 25^0 C (25+273 = 298K)

$$Q_u = 7.68 \times 4.187(310 - 298) = 385.88\ \text{W}$$

The amount of solar radiation received as heat from the sun, Qi:
Q_i = I × A = 1353.02 × 14.58 = 19727 W
The solar radiation that passes through the cover (transmissivity,τ) and that absorbed (absorptivity,α) by the glass is
Q_i =1353.02 × 0.8542 × 14.58 = 16850.8W
The heat transfer (or loss) coefficient is:

$$U_L = \frac{16850.8}{14.58 \times (310-298)} = 96.31\ W$$

Table 1: Summary of the Experimental Results Taken in the Month of October only.

	Day 1 Oct 5, 2012	Day 2 Oct 11, 2012	Day 3 Oct 13, 2012
Solar Intensity W/m^2	1353.02	1353.05	1353.06
Heat absorbed into fluid (Q_u) W	385.88	225.09	160.78
Solar radiation Entering purifier (Q_i) W	19727	19727	19728
Solar radiation (τ. α) (Q_i) W	16850.8	16851.2	16851.3
heat transfer (or loss) coefficient (U_L) W	96.31	165.11	231.15
Volume collected (litres)	5.5	4.8	5.0
% of purified water	68.75	60.00	62.50

Exactly after 6hrs 26mins of placing the purifier under the intensity of the sun which was calculated to be 1353.02W/m^2 from the above thermal analysis, the volume of water collected was approximately 5.5litres. The percentage of the purified water was calculated done as thus:

$$\%\ of\ purified\ water = \frac{volume\ collected}{volume\ added} \times 100$$

Where volume collected = 5.5litres and volume Added = 8litres

$$\%\ of\ purified\ water = \frac{5.5}{8} \times 100$$

= 68.75%

The same thermal analysis was done for other consecutive days to test the working efficiency of the design. Which were 11th of October by 10:43am with the temperature of the solar still till being 37^{0}C but the temperature of the water was different from what was taken previously, the new temperature is 30^{0}C. And also on 13th of October by 10:25am, with the temperature of the still not changing but for the fluid being 32^{0}C. With such parameters, consequent experimental results in the table 1 above were successfully obtained.

Table 2: Volume of water collected against percentage of purified water.

DAY	Volume Collected (litres)	% of purified water
1	5.5	68.75
2	4.8	60.00
3	5.0	62.50

4.2 Discussion

It was noticed that it was conducive to carry out the activity on a cloudless day, preferably over the mid-day period. The purifier works by letting the sun's rays warm the water. The sunlight entering the still is absorbed by the water and the container. The molecules and ions absorb the energy. Some of the water molecules absorb enough energy to break free from the liquid water and become gaseous molecules (speculated) flying about inside the container. Some of these flying molecules collide with the plastic film, lose energy to the film and stick to the film. The water molecules lose more energy as they join together forming droplets of pure water which run down into the output container. The water vapour turns back into liquid when it touches the perpex glass and the drops turn down to the pebble and fall into the outlet container. Though it takes longer time, but the amount of the collected water is directly proportional to the percentage of purified water.

For the SODIS, the UV rays emitting from the sun penetrate the PET (Polyethylene terephthalate)bottles and due to the reflecting of the aluminum base, the rays are trapped into this bottle and thereby purify the water and makes it fit for drinking and other domestic uses.

5.0 Conclusion

The aim and objective of this research study was achieved as an improved solar water purifier was designed and developed by improving the efficiency of the already existing purifiers. This is so because most purifier especially solar stills have efficiencies of between 46% and 52%. This is due to the time in producing purified water and also the small volume being produced. But this has been improved due to the combination of the SODIS, whereby the amount of purified water is increased.

The percentage of purified water for each of the days of testing has an average rate of 65%. This is a good and tangible result for a low technological machine model. The Sola stills could work better by starting with less water. It seems it would take a longer time for the first drops to form if it was a bit cloudy and the sun not being very hot, smaller amounts of water will heat up quicker.

Water purification through solar power is one of the best inventionsto save energy and to have uncontaminated water. A normal purifier system requires more power and costs a lot more too. A normal water purifier can also be at a disadvantage in places of no or little electrical power source. This is where the solar design gets high credibility due to the ever-presence of the sun as the source of its own energy.

References

[1] Conroy R. M., Meegan M. E., Joyce T. M., McGuigan K. G., Barnes J. (1999). "Solar disinfection of water reduces diarrhoeal disease: An update", US National Library of Medicine, National Institute of Health, Journal of Archives of Disease in Childhood, Vol. 81 (4), 337-338.

[2] Conroy R. M., Meegan M. E., Joyce T. M., McGuigan K. G., Barnes J. (2001). "Solar disinfection of drinking water protects against cholera in children less than 6 years of age, Journal of Archives of Disease in Childhood, 85(4):293-5.

[3] Helfferich, F., (1962). Ion Exchange Water purification, McGraw Hill, New York, Vol.6

[4] Donahue C., (2001). How to make Solar Water Purifier, Research Notes Printed and Posted on line, Dummies Cheat Sheet, Aiding Complex Practice Solved with Ease

[5] Gordes, J., McCracken H., (1985). Understanding Solar Stills, VITA Technical Paper.

[6] Telkes M., (1944). Solar Still Construction, Saktheivelm publisher, chapter 2, pp. 11.

[7] SODIS (2002), Solar water Disinfection: A guide for the application of SODIS, Swiss Federal Institutes of Science and Technology (EAWAG) Department of Water & Sanitation Developing Countries (SANDEC) Report No 06/02, Switzerland, ITDG Publisher, www.sodis.ch.

[8] Wegelin M., Stahel W. A. and Torrico E. (2007). Bacterial effects of solar water disinfection under real sunlight conditions, Journal of Water Supply: Research and Technology –Aqua, 42(2): 128-139

[9] Wegelin, M., Canonica, S., Mechsner, K., Fleischmann, T., Pesaro, F., and Metzler, A. (1994). Solar water disinfection: scope of the process and analysis of raditation experiments, Journal of Water Supply: Research and Technology - Aqua, 43(3): 154-169

[10] Abdelkader M., (2006). Design and testing of a solar still coupled with a solar central Receiver, 2nd International Conference on Water Resources and Arid Environment.

[11] Jonathan L. (2011), Invention of solar ball, www.abc.net.au/newinventors/txt/s3158420.htm

[12] Janjai S., Pankaew P., Laksanaboonsong J., (2009). A model for calculating hourly solar radiation from satellite data in the tropics, Applied Energy, 86: 1450-1457

[13] Jin Z., Yezheng, Wu, Gang Y., (2005). General formula for estimation of monthly average daily global solar radiation in China, Energy Conversion and Management, 46: 257-268

[14] Robaa, S. M., (2009). Validation of the existing models for estimating global solar radiation over Egypt, Energy Conversion and Management, 50: 184-193

[15] Webb J. (1995). By the light of the Sun, New science Journal, 121, 40

[16] Swartman R. K., Ogunalade O., (1967). Solar radiation estimates from common parameters, Solar Energy, 11: 170-172

Authors' Research Biography

S. O. Ismail hails from Ondo State, Nigeria. He is presently a PhD research student at the University of Lagos, Nigeria. He has obtained National Diploma from Ondo State Polytechnic, Owo, Ondo State; Bachelor of Engineering from Federal University of Technology, Akure, Ondo State; and Master of Science in Mechanical Engineering from University of Lagos, Akoka, Lagos, Nigeria in 1999, 2005 and 2010 respectively and with prestigious awards/prizes. Presently, he lectures at the Mechanical Engineering Department of University of Lagos, Akoka, Lagos, Nigeria. He has published articles in international journals on Design of a Jatropha Oil Expelling Machine; Design and Development of a Photovoltaic-Powered DC Vapour Compression Refrigerator with an Incorporated Solar Tracking System; Design and Development of a Continuous Fluidized- Bed Gari Dryer; Design and Development of an Improved Plantain Slicing Machine; Development of an Inverted Downdraft Biomass GasifierCookstove; Design and Development of a Load Triggered Belt Conveyor; to mention but a few. His interest is in Design and Production/Manufacturing in Mechanical Engineering with a bias in Renewable Energy Systems Design. Engr. Ismail S. O. is a member of Nigerian Institution of Mechanical Engineers [NIMechE], American Society of Engineers [ASME], Council for the Regulation of Engineering in Nigeria [COREN], Ergonomics Society of Nigeria [ESN], Nigerian Society of Engineers [NSE], among others.

S. J. Ojolo is a Nigerian and possesses a Doctor of Philosophy and Master of Science from the University of Ibadan, Nigeria. He had his Bachelor of Engineering from ObafemiAwolowo University, Nigeria. He is currently employed as a Senior Lecturer and Head of Department at the Mechanical Engineering department of the University of Lagos, Nigeria. He has worked with the Covenant University, Nigeria. He is also an External Examiner to some universities in Nigeria. His interests are in mechanical engineering design, production and manufacturing engineering, energy systems and environmental engineering. He has published widely in international journals and some of the published articles include design and development of a laboratory scale biomass gasifier, development of an inverted downdraft biomass cookstove and development of a laboratory scale updraft gasifier. Dr. Ojolo is a member of the American Society of Agricultural and Biological Engineers [ASABE], Nigerian Society of Engineers [NSE], Nigerian Institution of Mechanical Engineers [NIMechE]. He is also a reviewer for some reputable international journals.

J. I. Orisaleye is a Nigerian who is presently a research student at the University of Lagos studying for a Doctorate. He has acquired a Master of Science in Mechanical Engineering, specializing in design and production, from the University of Lagos, Nigeria in 2010. He has a Bachelor of Technology from LadokeAkintola University of Technology, Ogbomoso, Nigeria in 2006. He is a currently lecturer at the Mechanical Engineering department of Lagos State University, Nigeria. He has published articles on design of a laboratory scale biomass gasifier, development of an inverted downdraft biomass gasifiercookstove and design of a Jatropha oil expelling machine. His interests are in energy systems design, mechanical engineering design and production engineering. Engr. Orisaleye is a member of the Nigerian Institution of Mechanical Engineers [NIMechE] and the Nigerian Society of Engineers [NSE].

A. O. Alogbo is a Nigerian and young B.Sc. degree graduating student in Mechanical Engineering from University of Lagos, Akoka, Nigeria.