26 - 28 Novembre
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EnerSol-WSEF 2014
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Energies Renouvelables & Efficacité Energétique

EnerSol
Work Sustainable Energy Forum

26 - 28 نوفمبر - تونس
بمقر الاتحاد الدولي للصناعة والتجارة والصناعات التقليدية بتونس
المنتدى-المعرض الدولي
للطاقات المستديمة 2014
الطاقات المتجددة و النجاعة الطاقية

2nd Edition of
The World Sustainable Energy Forum
EnerSol WSEF Tunisia 2014

Science and Technology Forum Program

(27th -28th November 2014)

Conference General Chairs

Pr. Jamel Belhadj (LSE-ENIT/ENSIT, University of Tunis, Tunisia)
Pr. Samia Charfi-Kaddour (FST, University of Tunis El Manar, Tunisia)
Pr. S. Yamaguchi (University of Chubu, Japan)

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Thursday 27th November 2014

PV, LSPVP, Material for energy

Chairs :

Pr. Jamel Belhadj (LSE-ENIT/ENSIT, University of Tunis, Tunisia)
Pr. Samia Charfi-Kaddour (FST, University of Tunis El Manar, Tunisia)
Pr. S. Yamaguchi (University of Chubu, Japan)

9.00 - 10.00 *Plenary Session*

Mr. André Joffre, Vice President, IMEDER, France
Mr Eric Noir, Director, Green By Design, South Africa Green Building Council, South Africa
Prof. Ali Sayigh, Director General, World Renewable Energy Network, United Kingdom

10.00 -10.30 Networking Coffee Break- Poster Session I

10.30- 11.00 **Prof. Ali Sayigh,** World Renewable Energy Congress / Network (WREC/WREN), **United Kingdom**

Renewable Energy will supply 50% of Global Electricity by 2030

11.00-11.30 **H. Koinuma,** K. Itaka, S. Yamaguchi, A. Stambouli and S. Hannachi Sahara Solar Breeder Foundation, International (SSBI) and Tokyo University/Hirosaki University/ Chubu University, **Japan** and University of Science & Technology of Oran (USTO), **Algeria**

Sahara Solar Breeder plan as Stem technology initiative for global energy future

11.30- 11.45 **A.S. Shikoh,** A. Popelka, Z. Zhu, T. Mankowsk, K. Balakrishnan, F. Touati, M.A. Benammar, M. Mansuripur and C.M. Falco Qatar University, **Qatar** and University of Arizona, Tucson, Arizona, **USA**

rGO/CuNWs Based Flexible Transparent Electrodes for Thin Film Solar Cells

11:45- 12:00 **N. Ihaddadene,** R. Ihaddadene and A. Betka
University of M'Sila, **Algeria**
Effect of Glass Thickness on the performance of The ET200 Solar thermal Collector

12:00- 12:15 **Z .Kadachi,** M. Ben Karoui, T. Azizi, **R.Gharbi**
Ecole Supérieure des Sciences et Techniques de Tunis, University of Tunis and Centre de Recherche et des Technologies de l'Energie, Technopole de Borj Cedria, Tunis, **Tunisia**
Electrical and morphological properties of TiO2 thin films prepared by sol gel method

12.15-12.30 **M. Haggui,** W. Rouis, L. Sfaxi and P. Fumagalli
Freie Universität Berlin, Institut für Experimentalphysik, Arnimallee Germany and College of Sciences at Monastir/ High School of Sciences and Technology-Hammam Sousse, **Tunisia**
Scanning Near-field Optical Microscopy: Principles and Application to Studying Electronic and Photonic Devices

12.30-12.45 **S. Aouida,** R. Benabderrahmen, S. Jaidene, N. Bachtouli, B. Bessais.
Centre de Recherches et des Technologies de l'Energie, Tunis, **Tunisia**
Minority carrier lifetime measured by Sinton WCT-120 lifetime tester in QSS-mode and silicon surface treatments

12.45-14.00 **Lunch break- Poster Session I**

Energy prod, Trans, Distrib, Storage and efficiency / Smart Grids, Micro Grids, and Energy Management

Chairs :

Pr. Samia Charfi-Kaddour (FST, University of Tunis El Manar, Tunisia)
Pr. S. Yamaguchi (University of Chubu, Japan)

14.00- 14.45 **Prof. Satarou Yamaguchi,** Chubu University, **Japan**
Superconducting Power Transmission line as the most efficient energy transport

14.45- 15.00 **A. Esseghir** and L. Haouaoui Khouni
Higher Institute of Management of Tunis, Laboratory of UAQUAP, Tunis, **Tunisia**
Energy efficiency in the Union for the Mediterranean countries: Trends and implications

15.00-15.15 **R. Khama,** F. Aissani and R. Alkama
Kasdi Merbah Ouargla University and A. Mira Bejaia University, **Algeria.**
Indirect solar drying :
Theoretical study and experimental validation

15.15-15.30 **Y. Abdellaoui,** H. Chaouch, S Elgaied and M. Krarti
Higher Institue of Technological Studies of Sidi Bouzid and Higher Institute of Technological Studies of Mahdia, **Tunisia** and University of Colorado, **USA**
Design and development of
a self-adjusting solar dryer prototype

15.30-15.45 **N. Y. Mansouri** and A. F. Ghoniem
Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA, **USA**
Optimizing a Sustainable Desalination System: A Comparison between CPV-RO and CSP-MED Cogeneration Plants in Saudi Arabia

15.45-16:00 **S. Elouaer Mrizak,** K. Cabaret and F. Picard
University of Technology Belfort Montdéliard and IRTES-RECITS, Belfort, France
European Smart Grids Projects Development and Geographical Proximity: Evidence from Network Analysis

16.00-16.30 **Networking Coffee break- Poster session I**

16.30-16.45 **M. Khelif,** A. M'raoui and L. Hassaine
Centre de Développement des Energies Renouvelables, CDER, **Algeria**
A detailed modelling, optimizing and evaluating process for a 3 KWp, 50 Hz, 3x 380v regulated voltage, stand-alone photovoltaic power supply.

16.45-17.00 **S. Nemsi,** L. Barazane and S. Diaf
Centre de Développement des Energies Renouvelables CDERAlgiers and University of Sciences and Technology Houari Boumediene, Algiers, **Algeria**
Modeling, Simulation and analyses of a photovoltaic system using two MPPT algorithms

17.00-17.15 J. Abu Hamad, N. A. Chowdhury, **F. Touati** and M. Al. Al-Hitmi
Qatar University, Doha, **Qatar**
Wirelessly Monitoring, Investigating and Overcoming the Effects of Harsh Environment on the Performance of Solar PV Technologies in the State of Qatar

17.15-17.30 **J. Shen,** C. Jiang and Y. Liu
Department of Electrical Engineering, Shanghai Jiaotong University, **China**
Optimal Operation of Microgrid Considering Regulation of Grid Tie-line Power Fluctuations

17.30-17.45 **K.Y. Lim,** Y.S. Lim, J. Wong and K.H. Chua
University Tunku Abdul Rahman, Kuala Lumpur, **Malaysia.**
Energy Storage with Fuzzy Controller for Power Quality Improvement on Distribution Network with Renewable Energy

17.45-18:00 **A.H. Almukhtar**
University of Technology Baghdad, **Iraq**
Study and Implementation Photovoltaic Cell Efficiency at Evaluated Temperature

Friday 28th November 2014

Wind Energy / Biofuel -Biomass

Chairs :

Pr. Jamel Belhadj (LSE-ENIT/ENSIT, University of Tunis, Tunisia)
Pr. Samia Charfi-Kaddour (FST, University of Tunis El Manar, Tunisia)

9:00- 9:15 **Othman Hasnaoui**
ENSIT and (LSE-ENIT) Research Centre, Tunis-**Tunisia**
Back-to-back Inverters: Common Mode Voltage Mitigation in Variable Speed Wind Energy Conversion Systems

9:15- 9:30 **H. Atia,** A. Ilinca, A. Snoussi, R. Boukchina and A. Benbrahim University of Gabes, National Engineering School of Gabes and Arid Regions Institute (IRA), Gabes, **Tunisia** and Wind Energy Research Laboratory, Université du Québec à Rimouski, Rimouski, **Canada**
Effects of collector slope on solar chimney power plant performances

9:30- 9:45 **M. Dali** and J. Belhadj
National Engineers School of Tunis (ENIT), University of Tunis El Manar, Tunis, **Tunisia.**
Design and Control of a Hybrid Wind/PV System for Grid-Integration

9.45-10.00 **H. Chaouch,** Y. Abdellaoui and M. Krarti
Higher Institue of Technological Studies of Sidi Bouzid, **Tunisia** and University of Colorado, **USA**
Automated Solar Water Pumping Systems for Agricultural Irrigation Applications

10.00-10.15 **A. Haddad,** F. Fayala, S. BenLtoufa and A. Jemni
National School of Engineering of Monastir (ENIM), Monastir University, **Tunisia**
Acoustic Study of Insulators Manufactured from Textile waste : The case of the Tablecloth Structure

10.15-10.30	**S. Takali,** F. Fabry, V. Rohani, F. Cauneau, L. Fulcheri Centre PERSEE- MINES ParisTech, Sophia Antipolis, **France** A 100 kW Three-Phase Plasma Torch for Biomass Valorization and Other Applications
10.30-11.00	**Networking Coffee Break- Poster session II**
11.00-11.15	A. Bianchini, **M. Pellegrini,** C. Saccani University of Bologna, Department of Industrial Engineering, Bologna, Italy Solar steam reforming of natural gas integrated with a gas turbine power plant: economic assessment
11.15- 11.30	**F. Meguellati,** Z. Aouachria, S. Bougoul and A. Messaoudène Centre de Developement des Energies Renouvelables, CDER and Batna University, **Algeria.** Numerical Simulation of a Modified Savonius Wind Turbine Based on a Commercial Software
11.30- 11.45	**C. E. Ilochonwu,** I. U.Onyenanu and P. N. Atanmo Scientific Equipment Development Institute Enugu and Anambra State University, **Nigeria.** Extraction of High Purity Silica from Rice Husks Ash for Reduction to Silicon.
11.45-12.30	**Poster session II**
12.30-14.00	**Lunch Break**

Posters sessions

Poster session I: 27th November 2014

Poster N°.1 Optical, electrical properties and OH group adsorption with deposits electrolysis

N. Bouazizi, A. Azzouz, B. Chaouchi and R. Ben Slama.
University of Gabes, **Tunisia** and University of Quebec at Montreal, **Canada**

Poster N°.2 The temperature variation in the soil at shallow depths in the region of Noumerat in Ghardaia

N. Chenini and S. Chabou
Unité de Recherche Appliqué en Energies Renouvelables, URAER, Centre de
Développement des Energies Renouvelables, CDER, 47133, Ghardaïa, **Algeria**

Poster N°.3 Numerical study of heat transfer in solar receivers for CSP

S. Lecheheb, A. Bouhallassa, M. Mammar, S. Bouaichaoui and A. Hamidat
Centre de Développement des Energies Renouvelables Algiers and University of Sciences and Technology Houari Boumediene, **Algeria**

Poster N°.4 Optical and electrical behavior of MACE silicon nanowire structures

R. Benabderrahmane Zaghouani, S. Aouida, M. Rawefi, N. Bachtouli and B. Bessais.
Centre de Recherches et des Technologies de l'Energie, Tunis, **Tunisia**

Poster N°.5 Optimal Design of a Hybrid Systems for GSM Radio Base Station in Tataouine, Tunisia

A.H. Gabsi and M. Krarti
ISET Tataouine, **Tunisia** and University of Colorado, **USA**

Poster N°.6 Theoretical study of a solar-assisted ejector cooling system with refrigerant ammonia

Z.Saadi, H.Soualmi and A. Rahmani
1 Research Unit for Renewable Energies in the Saharan Medium, B.P 478, Road of Reggane - Adrar. **Algeria.**

Poster N°.7 Design of an Optimal Cogeneration System for a Brick Manufacturing Facility in Tunisia

F. Guemri, Y.Kang and M. Krarti
ISET Tataouine, **Tunisia** and University of Colorado, **USA**

Poster N°.8 Estimation of Solar Global Irradiation towards Solarization of Rural Communities

F. Antonanzas-Torres, J. Antonanzas, R. Urraca, F.J. Martinez-de-Pison
University of La Rioja, **Spain**

Poster N°.9 Linke turbidity prediction for improving solar radiation forecasting

F. Antonanzas-Torres, F. J. Martinez-de-Pison, O. Perpinan, R. Nunes, Carlos Coimbra
University of La Rioja and EUITI-UPM- Madrid, **Spain** and University of California, **USA**

Poster N°.10 Effect of the Sandstorms on the Solar Panels Efficiency: finding and remedy

A. Marouani, H. Laouamri, **N. Bouaouadja** and M. Kolli
University Sétif 1, **Algeria.**

Poster session II: 28th November 2014

Poster N°.1 Design and construction of sun tracking systems for solar parabolic concentrator displacement

S. Skouri, S. Bouadila and S. Ben Nasrallah
he Research and Technology Center of Energy-Tunis and National engineering school of Monastir, **Tunisia.**

Poster N°.2 Experimental study of an evacuated tube solar water heater for heating a tunnel greenhouse at night

S. Bouadila, M. Lazaar and A. Farhat
The Research and Technology Center of Energy, Tunis, **Tunisia**

Poster N°.3 Modeling of Thermal Storage System for Solar Energy

N. Ibrir, D. Haddad and Z. Aouachria
University of Batna, **Algeria**

Poster N°.4 Optimisation of The Rear Surface Passivation Layer of In-terdigitated Back Contact Silicon Heterojunction photovoltaic IBC/SHJ Solar Cell.

K. Benyelles, A. Zerga and H. Benmansour
Materials and Renawable Energies Research Unity URMER, University Abou Bekr Bel-kaid-Tlemcen, **Algeria.**

Poster N°.5 Determination of critical micellar concentration in binary system: Cationic surfactant-Glycerol

A. Hamel, C. Chanay and K. Guerfi
University B.M Annaba, **Algeria** and Institute Charles Gerhardt. Montpellier, **France**

Poster N°.6 Optimisation of Screen Priting Process For Hight Efficiency Multicristalline Silicon Solar Cells.

A. Zerga and K. Benyelles
Materials and Renawable Energies Research Unity URMER, University Abou Bekr Bel-kaid-Tlemcen, **Algeria.**

Poster N°.7 Enhancement of Tilted Absorption Columnns in Offshore Projects using Reinforced Materials

M. Atigi, **A. Elalem, H. Alakramy** and A. Zrouga
Nalco Company, University Of Tripoli and Higher Institute of Comperhensive Profession, **Libya**

Poster N°.8 Kinetic study for the adsorption of Ethanol on Activated Carbon

K. Hajji, F. Mhiri and A. Ben Lamine
University of Monastir and Preparatory Institute for Engineering studies of Monastir, **Tunisia**

Poster N°.9 In situ transesterification of wet marine microalgae to biodiesel using supercritical methanol

S. Jazzar, P. Olivares-Carrillo, I. Smaali, M.N. Marzouki, F.G. Acién-Fernández, J.M. Fernández-Sevilla, E. Molina-Grima, A. Pérez de los Ríos and **J. Quesada-Medina**
University of Murcia and University of Almería, **Spain** and University of Carthage - INSAT, Tunis, **Tunisia**

Poster N°.10 Design of a Grid-Connected PV System For a company (SICEM) in Tataouine - Tunisia

A. Guemri and M. Krarti
ISET Tataouine, **Tunisia** and University of Colorado, **USA**

Oral Presentations

Renewable Energy will supply 50% of Global Electricity by 2030

Prof Ali Sayigh
Chairman of World Renewable Energy Congress, Chairman of IEI and Director General of WREN
P O Box 362, Brighton BN2 1FD, UK
Tel: 44-1273-625-643, Email: asayigh@wrenuk.co.uk, Web: www.wrenuk.co.uk

Abstract

During the last 10 years, the yearly increase in photovoltaic (PV) application has been more than 30%. Similarly, the same annual growth for wind energy has been achieved. Presently, there is more than 74 GW installed PV around the world equivalent to more than 60 nuclear reactors of 1100 MW. As for Wind Energy, there are more than 340 GW power installations globally. Solar thermal applications in heating, cooling, processed heat and desalination are all widely spread. The most effective small system is the evacuated tube collector. China and Taiwan accounted for more than 70% of the global market. Regarding concentrating solar power (CSP), Spain and USA are leading the market. Again more than 200 CSP already have been built or are in the process to being built ranging from a few MW to 500 MW. In terms of employment and the job market, renewable energy in the USA contributes 13.5% employment growth compared with 2.4% national growth. The cost of electricity generation is on a par with that of oil and gas electricity in most countries in Europe and America. The Philippine Minister of Energy on the 7th of September 2014 declared that the electricity generated from roof mounted PV is cheaper than that generated by coal.

This paper will demonstrate the importance of renewable energy applications in generating electricity and creating employment for the green economy in many parts of the world.

Sahara Solar Breeder plan as Stem technology initiative for global energy future

Hideomi Koinuma[1,2], Kenji Itaka[3], Sataro Yamaguchi[1,4],
Amine Stambouli[1,5], Salah Hannachi[1]
[1]Sahara Solar Breeder Foundation, International (SSBI);
[2]Tokyo Univ.; [3]Hirosaki Univ. [4]Chubu Univ., [5]Univ. of Sci. & Tech. of Oran (USTO)

Abstract(EnerSol 2014)**:** In terms of chemistry and thermodynamics, the earth is in such oxidative conditions (20 % oxygen concentration in air) that fossil-fuel combustion inevitably results in accumulation of CO_2 and water (H_2O). Human life is also sustained by the oxidation of food into CO_2, H_2O, and digested mass of carbohydrates proteins and lipids.. In addition, almost all the metallic elements exist in the form of oxides (MO_x) in nature. Since these oxides are energetically stable under terrestrial conditions, we cannot extract effective energy from them, thus making them zero-exergy (that is, no energy available for conversion to useful work) materials. We can argue that the current energy and environmental crisis results from the accumulation of oxidized wastes at a rate much faster than photosynthesis can convert them back to carbohydrates to preserve the energy and material balance of the earth. Conversion of CO_2, H_2O, and MO_x as stem material by new science and technology could be the key for solving the global energy and environment problem.

Every living thing preserves its life in a pseudo-steady state flow of energy and material to form a universal loop for regenerating its origin from the final product in the life cycle essentially with the aid of sun light energy. People start thinking about a serious problem caused by losing the energy-material balance due to the rapidly growing fossil fuel combustion. We propose SSB (Sahara Solar Breeder plan) as the stem technology initiative for recovering the balance in our future world by developing a clean global energy supply system coupled with smart energy transmission system. The first step has been taken with Algeria for converting desert sand to Si for solar cell as illustrated in the Fig.. This process is presumed to be far more efficient than photosynthesis in nature. Our strategy for the second step: global transmission of solar PV electricity from Sahara is planned to start from MENA and stretched out to central Asia, Gobi, east Asia, and Japan through new super silk road. This clean energy superhighway prototyped at Chubu University can be lower loss and more cost-effective than the conventionally available technology.

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rGO/CuNWs Based Flexible Transparent Electrides for Thin Film Solar Cells

Ali Sehpar Shikoh†, Anton Popelka†, Zhaozhao Zhu‡, Trent Mankowski‡, Kaushik Balakrishnan‡, Farid Touti†, Mohieddine A. Benammar†, Masud Mansuripur‡, Charles M. Falco‡
†Department of Electrical Engineering, Qatar University, Doha, Qatar
‡College of Optical Sciences, University of Arizona, Tucson, Arizona, USA

Abstract: Thin film organic solar cells are becoming an attractive approach as compared to crystalline silicon solar cells, owing to their shorter payback time (Ting-Gang Chen, 2012). Currently, Indium Tin Oxide (ITO) is the most widely used, transparent conducing electrode (TCE) in the photovoltaics industry. The reliability and cost price of organic photovoltaic devices gets limited by the presence of ITO, because of its brittleness and high end cost (Yulia Galagan, 2011). The main objective of our work is to develop a transparent, ITO free electrode that is highly conductive, flexible and can be easily integrated in thin film solar cells. To this end, we herein demonstrate the fabrication and characterization of flexible TCEs that are based on copper nanowires (CuNWs) and reduced graphene oxide (rGO) platelets.

In this work, a solution based approach is demonstrated for the synthesis of high aspect ratio CuNWs (Guo et al, 2013). Initially, 20ml Oleylamine was pipetted into a flask (containing Argon gas) with temperature maintained at 80°C. Later, after adding 1.6mm Copper Chloride and 0.8 mmol Nickel (II) acetylacetonate, the solution was vigorously stirred for 30 minutes. After the full dissolution was achieved, the temperature was increased and kept constant at 175 °C, until complete synthesis. Later, the solution was cooled down and excess hexance was added to the flask to precipitate the nanowires from the solution. The nanowires were separated from the solvent and transferred into Tolunene.

The fabrication of TCEs, initially required spraying the CuNWs onto a substrate. Later graphene platelets were separated from GO solution, diluted and sprayed onto the substrate. Finally annealing was done, in order to improve the conductivity and reduce graphene oxide.

Structural characteristics of the electrodes were measured with the help of various tools, including Four-Probe, Spectrophotometer, Scanning electron Microscope (SEM), Transmission Electron Microscope (TEM) and Atomic Field Microscopy (AFM). In addition to that, durability tests involving exposure to various environmental conditions and bending of electrodes, were also carried out. As it can be seen in Figure 1, CuNW/rGO electrode exhibited a transmittance of 84% and a sheet resistance of 22 Ω/sq. Furthermore, while conducting the durability tests, the electrodes showed no notable loss in performance.

The results suggest that the CuNW/rGO based TCEs are a promising Indium Tin Oxide (ITO) replacement and present a great opportunity to accelerate the mass development of devices like high-efficiency hybrid silicon photovoltaics via simple and rapid soluble processes.

Keywords: transparent conducting electrode, thin film solar cells, graphene, nanowires

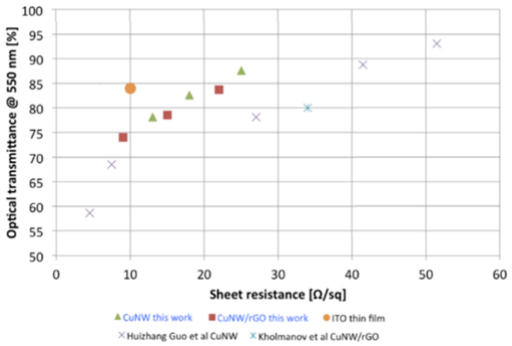

Figure 1: Graph between sheet resistance (Ω/sq) and optical transmittance, comparing the performance of fabricated CuNW/rGO electrodes with ITO thin film and other electrodes, previously reported

References:

Ting-Gang Chen, Bo-Yu Huang, Hsiao-Wei Lui, Yang-Yue Huang. (2012) Flexible Silver Nanowire Meshes for High-Efficiency Microtextured Organic-Silicon Hybrid Photovoltaics, ACS Appl Mater. Interfaces, 4.

Yulia Galagan, Jan-Eric J.M. Rubingh, Ronn Andriessen. (2011) ITO-free flexible organic solar cells with printed current collecting grids, 3rd Internation Summit on OPV Stability, volume 95, Issue 5.

Guo, Huizhang, Na Lin, Yuanzhi Chen, Zhenwe Wang, Qingshui Xie, TongchangZheng, Na Gao et al. (2013) Copper nanowires as fully transparent conductive electrodes, Scientific reports 3.

Effect of Glass Thickness on the performance of The ET200 Solar thermal Collector

N. Ihaddadene,[1] R. Ihaddadene,[1] A. Betka[1]
[1]University of M'Sila, Department of Mechanics, M'Sila, Algeria

Abstract: Solar energy available across the globe, obviously at different intensities, is a clean, sustainable and inexhaustible energy. It is the alternative to conventional energy sources. Solar thermal panels, called solar thermal collectors, convert solar radiation into heat recovered and used in the form of hot water. Several studies have been devoted to ameliorate the performance of solar water heating systems (Ihaddadene *et al*. 2014, Ihaddadene *et al*. 2014, Hazami *et al*. 2005). This paper aimed to study glass thickness effect of a solar collector on it's efficiency. Experiments were performed on an active solar energy demonstration system (ET 200), illuminated with a halogen lamp. This latter is coposed of water storage tank , a flat plate solar collector, a high-power lamp and a control and command cabinet. The flat plate solar collector consists of essentially four major components fabricated as a 'sandwich'; the glazing, air gap and insulation layers act to prevent heat loss from the solar collector to the environment, while the absorber plate coupled with the heat transfer tubes actively remove heat from the solar collector to water storage tank.
Commercial glass panes having the same properties but with different thicknesses (3mm, 5mm, 6mm, and 8mm) were used. Trials were done at a fixed water flow rate of 5.9 l/h, taking the whole surface of the collector maintained at an horizontal position.
Glass thickness of the solar collector has a negative effect on the performance of ET 200 Solar collector (Figure1). Glass thickness acts as a thermal resistance to heat transfer from the halogen lamp to the absorber, located inside the solar collector, and then to water tank. Indeed, useful power transmitted to water decreases linearly with the glass thickness according to the following mathematical relationship:
$Pu = - 3.495 * E + 69.125$ (R^2=0.9826).
The results showed that radiation intensity received by the glazed surface of the solar collector increases linearly with its thickness according to the empirical relationship: $G = 0.0243 * E + 0.6567$ (R^2=0.9324).
It is necessary to use thin glass to improve the efficiency of the cited apparatus.

Keywords: solar energy, solar collector efficiency, glass thickness, radiation intensity.

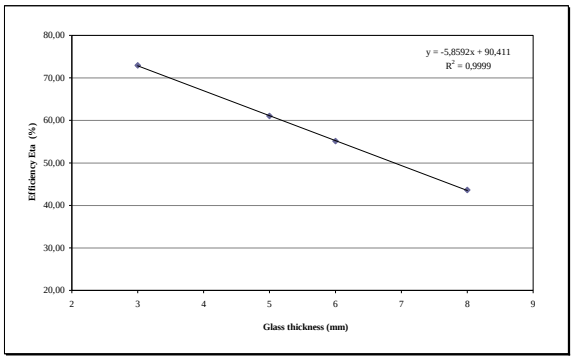

Figure 1: Effect of glass thickness of the collector on its efficiency. It is observed that the lower value of the performance of the solar collector is recorded for the thickest glass (about 44%), in contrast to the thinner glass where this value is the highest one (in the order of 73%). We also note that the performance of the thermal collector decreases with the thickness of its glazing surface. This result is in agreement with the energy carried by the water and transmitted to the water tank.

References:

Ihaddadene, N., Ihaddadene, R., Mahdi, A. (2014) . Effects of double glazing on the performance of a Solar thermal collector. *Appl. Mech. Mater. J.*, 492, 118-122.

Ihaddadene R., Ihaddadene N., Bey M., Hamidibacha F. Z. (2014), The effects of volumetric flow rate and inclination angle on the performance of a solar thermal collector, *Energ. Conver. Manage*., 78, 931-937.

Hazami, M., Kooli, S.,. Lazaar, M., Farhat, A., Belghith, A.(2005), Performance of a solar storage collector, *Desalination*, 183,167-172.

Electrical and morphological properties of TiO_2 thin films prepared by sol gel method

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Abstract: Titanium dioxide (TiO_2) has an attract properties which include a high refractive index, a wide band gap (3.2 eV), and resistance to chemical and physical impacts. In addition, titanium dioxide has very good semiconducting properties, which generated significant enthusiasm from scientists for various applications, including photocatalysis, antireflection coatings [1], photonic crystals [2], photovolatic applications as dye sensitized solar cells [3].
In this work, structual, morphological and electrical properties of thin films of TiO_2 as a function of the annealing temperatures have been studied.

We have prepared by sol-gel spin coating method TiO_2 films with one and two layer for various annealing temperatures. We notice that increasing the annealing temperature influences on film morphology, the surface topography is composed of varying particles sizes, with irregular shapes. When the annealing temperature increased the well separated nanoparticles in films are getting larger and starting to agglomerate and then forming clusters. We also note that the roughness of the layers increases with increasing the temperature. This increase of the surface roughness with the temperature is strongly correlated with an increase of the grain size in our films (Fig.1). Indeed, when the grains become increasingly large, the density of grain boundaries decreases (higher compactness) which results higher surface roughness values. For example, the roughness increases from 27 nm to 31 nm and from 17 nm to 26 nm for one layer and two layer respectively when the temperature annealing varies from 400°C to 600°C.
Electrical measurements that we are made are essentially current-voltage characteristics (I-V) that showing ohmic comportemnt. Measurement of the slope of the current-voltage characteristic gives the value of the resistance, which shows a decrease from 0.66 10^5 Ω to 0.45 10^5 Ω for one layer samples depend on the temperature of the annealing which increase the electrical conductivity that reaches its maximum value of 0.81$(\Omega\ cm)^{-1}$.We can conclude that, increase in the annealing temperature contributes to the improvement of the crystallinity of the layers, showing the decrease of the defect density and the grain boundaries in the crystalline structure of the materials. In fact, the grain boundaries acts as traps for free carriers and as barrier against the transport of electric charges.

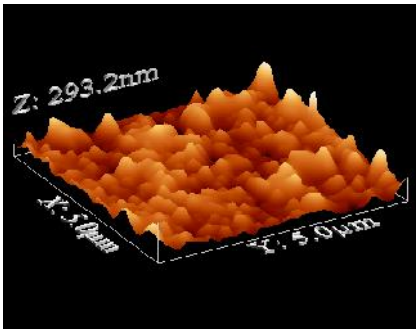

Fig. 1. AFM surface morphology images of the TiO2 thin films for 600°C,two layers

Key words: TiO_2, Sol-gel , morphological properties, electrical characteristics.

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Scanning Near-field Optical Microscopy: Principles and Application to Studying Electronic and Photonic Devices

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Scanning Near-field Optical Microscopy (SNOM) (J. W. P. Hsu, 2001) is a powerful technique that scans a tapered optical fiber across the sample, illuminating only that area of the sample that lies directly under the tip aperture (~100nm). Kept within few nanometers of the surface, the tip illuminates the sample in the near field allowing the collection of optical information of the surface of the sample, with a resolution better than the diffraction limit of the operating light. Topographic information are equally obtained. In addition, this technique could be used in order to perform spatial resolved photocurrent measurements on photovoltaic devices (Feron *et al*., 2013). The immergence of SNOM opened up fields of studies that were inaccessible.

The basic principles behind the enhancement of the optical resolution by SNOM, especially the detection of the high spatial frequencies that are very confined in the near field regions, are going to be discussed during this presentation.

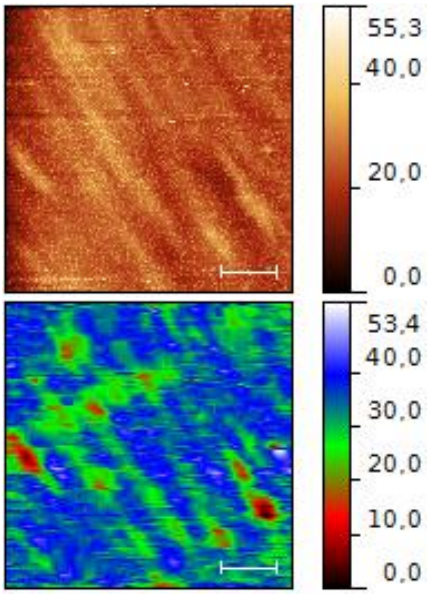

Figure 1: SNOM topographic (top) and Photocurrent (bottom) images of the studied photovoltaic device. The scale bar is 2µm.The color scales are in *nm* and *nA*, successively.

One of the powerful application of SNOM is to providing spatial resolved measurement of photocurrent. An example will be given. It consists of the investigation of an intermediate band solar cell containing multistacked Indium Arsenide / Indium Gallium Arsenide / Gallium Arsenide (InAs/InGaAs/GaAs) quantum dots (Rouis *et al*., 2013). An example of the obtained results is depicted in Figure 1. It displays the topographic and photocurrent maps obtained under illumination of the sample in the near field with a wavelength of 800nm. The topographic image (Figure 1a) shows the morphology at the top surface of the sample. The Figure 1b highlights the corresponding photocurrent images. It shows that the current flowing in the GaAs-containing regions is higher. This is logically explained by the fact the used wavelength corresponds to the GaAs band gap.

We also changed the operating light wavelength to 1150nm. This wavelenght is far from the GaAs band gap and within the emission band of the quantum dots. That had shown an increase of the current produced by the regions that contains the quantum dots.

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Minority carrier lifetime measured by Sinton WCT-120 lifetime tester in QSS-mode and silicon surface treatments

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Abstract: Minority carrier lifetime (MCL) in semi-conductor materials, presents a basic parameter for material quality characterization. Sinton WCT-120 Photoconductance lifetime tester presents a robust tool for effective MCL (τ_{eff}) determination in silicon wafers without the need of metallic contact or sample preparation. The measurement is based on the recombination dynamics of optically generated excess carriers. The excess carrier density is directly monitored via the photoconductance, which is inductively measured. Two different modes can be used in the evaluation of τ_{eff} which vary on the dependence time of the illumination: transient mode and quasi-steady-state (QSS) mode. The transient mode involves a sharp pulse of illumination that is rapidly turned off and a subsequent determination of the excess carrier density without illumination.
For QSS mode, the illumination intensity is slowly reduced to zero over several milliseconds, the decay being long enough to ensure that the sample remains in steady state in terms of the recombination processes (S. Rein, 2004, R.A. Sinton et al., 1996). Effective MCL is then evaluated by measuring simultaneously the photoconductance variation in the sample and the generation rate via a reference cell. The reference cell or the calibrated light sensor and silicon samples under test have not the same absorption behaviour. To correctly estimate the generation rate in silicon sample, this requires the determination of optical constant k_g associated to each silicon surface.
In this presentation we focus on the dependence of lifetime measurements with the variation of silicon sample optical constant.
Figure 1 presents the impact of optical constante value on photoconductance MCL measurments.
We determine this parameter for SiO_2 coated silicon samples, porous silicon, textured silicon surfaces and silicon surface with silicon nanowires. We found that this parameter is sensitive to surface reflectivity and cannot be neglected in the evaluation of MCL.

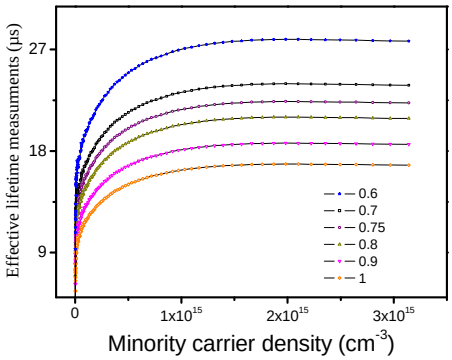

Fig. 1: Impact of optical constant value on effective lifetime measurments.

Keywords: silicon, minority carrier lifetime, quasi-steady state, Sinton WCT-120 lifetime tester.

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Superconducting Power Transmission line as the most efficient energy transport

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In the present time the gas pipe line and LNG tanker are used widely to transport energy in the world. These systems are common technologies, however it cannot be improved because the technologies are saturated from the engineering points of view. The share of electric power in the energy is increasing, and it is 20% as the world average, and 40% for the OECD countries. The output of the renewable energy is electricity mainly, therefore in this century electric power is the key of the energy. In this meaning, we should consider the transport of electric power that is electric power transmission line. In this presentation, three different energy transport systems are discussed for their efficiency and cost. And finally we discuss the potential of superconducting power transmission line. This work was supported in part by SATREPS, JST and JICA of Japanese government.

Energy efficiency in the Union for the Mediterranean countries: Trends and implications

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Abstract:
Energy efficiency has become an essential component of the energy strategy in the fight against climate change and the move to a green economy, translation of sustainable development. Indeed, improving energy efficiency has often been recognized as one of the most effective ways that can save energy consumption and reduce carbon dioxide emissions. Several performance indicators have been developed (Ang et al. (2010), Wang (2011), Zhou et al. (2012), Stern (2012)) to asses and compare trends in energy efficiency over time in a country or region.
In this paper we survey the Union for the Mediterranean (UfM) countries energies efficiencies levels and trends in the last decades (1980-2010) to find out the energy efficiency determinants and study the impact of energy efficiency on energy consumption and carbon emissions. For that purpose we devise a model based on a new energy distance function approach to define and measure energy efficiency. Then, we use a stochastic function of explanatory variables to model the countries energies efficiencies differences. The production frontier is defined as the minimum of energy consumed per unit of production. First results showed that-overall- the energy efficiency of the region is in progress, it is positively affected by the increase in the total factor productivity and trade openness but it is negatively affected by the corruption and the social inequality.

Keywords: Sustainable development, energy efficiency, distance function, stochastic frontier analysis (SFA).

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Indirect solar drying : Theoretical study and experimental validation

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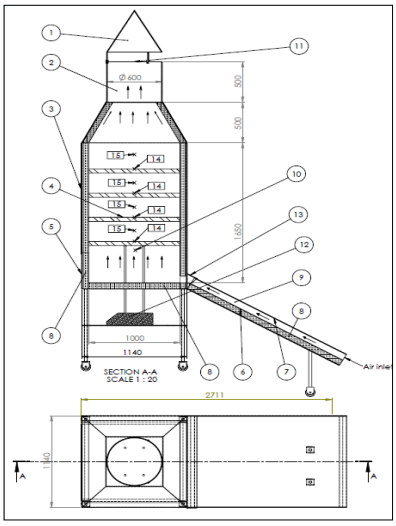
Abstract: In this paper, we present a numerical simulation of a unidimensional study of food drying by using indirect solar drying technique, which combines environmental protection, energy control and use of a renewable natural energy: the sun. The apparatus considered is an indirect solar dryer, it consists of a separate solar collector with a transparent cover on the top and a drying unit with an opaque cover on the top (S. Janjai and B. K. Bala, 2012). The wet product is deposited in thick layer and is exposed to air convection, its geometry changes during process so the shrinkage must be considered. The media is porous and then transfers equations in porous media describe the coupled heat and mass transfers. The study relates to two mathematical models, the first one is for the solar collector and is based on all its energy balances (Smitabhindu R. and al., 2008) and the other relates to the drying chamber and is based on equations of mass and energy balances (Arnaud G. and Fohr J.-P.,1988). The theoretical analysis gives two systems of differential equations which are difficult to solve using analytical method. These systems of equations are solved implicitly using the finite difference method. A computer program in FORTRAN is developed to simulate the indirect solar drying. The study highlighted well the effect of ambient air parameters on temperatures and efficiency of the solar collector. Air velocity in the porous medium is not constant during drying and consequently shrinkage effect is largely happening during process. The drying kinetics study confirmed the importance of this phenomenon and show a very short adaptation phase followed by a dominant falling drying rate phase. The simulation models are validated by comparing some simulation results with the experimental results. In addition, the computer program developed in this study can be used with similar solar drying systems.

Keywords: Indirect solar drying - Simulation - Solar collector - Drying chamber - Porous media – Heat and mass transfers - Shrinkage - Kinetics.



(1)Top hood
(2)Chimney
(3)Door
(4) tray
(5)Drying chamber
(6)Absorber
(7)Cover
(8)Insulator
(9)Air duct

Figure 1 is a schematic diagram of the simulated indirect solar dryer, mainly made up of two parts: flat-plate solar collector and drying chamber; it is also, the apparatus used in experimental validation. (Khama R. et al., 2013).

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Design and development of a self-adjusting solar dryer prototype

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Abstract:
In Tunisia, several processing and preservation of food products techniques are utilized. Among these techniques, natural drying of agricultural products is commonly practiced in rural areas by exposing the products to direct sunlight. However, this natural drying method has several shortcomings that can be potentially to human health including:

- Collection of dust and other contaminants
- Formation of mold
- Infection associated to direct exposition to flies and insects

Moreover, the drying time using natura; exposition method varies depending on the season and the availability of direct solar radiation sunlight as well as on the type of agricultural products. It may be generally several days for drying vegetables like tomatoes and peppers. Moreover, the amounts of products that can be processed by conventional drying methods are generally limited with available open drying space.

Under a partnership between ISET Sidi Bouzid and Colorado University, and to promote the use of renewable energy technologies for agricultural applications, a prototype solar dryer suitable for a wide range of agricultural products is developed, built, and tested with the main goal to increase the capacity and the performance of solar drying as well as to:

- Reduce exposition to outdoor environment including dust and insects
- Improve the quality of the finished product
- Reduce drying time
- Be easy to build and have low maintenance cost

In this paper, the design specifications and testing results of the solar drying system are discussed. Moreover, the paper outlines the refinements and adjustments to the specifications of the solar dryer for different types the agricultural products to dry.

Keywords: Agricultural products, Ambient temperature, solar dryer, solar radiation

Figure 1: Photo illustrating the prototype of the proposed low cost solar dryer.

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Optimizing a Sustainable Desalination System: A Comparison between CPV-RO and CSP-MED Cogeneration Plants in Saudi Arabia

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Abstract: Water scarcity is a global crisis; the MENA region is one of the most water-stressed regions. Saudi Arabia currently burns approximately 1.5 million barrels of crude oil equivalent daily to produce water, through desalination, and electricity generation (World Bank, 2012). If business-as-usual continues, it is expected that Saudi Arabia will burn over 8 million barrels per day of crude oil equivalent by 2040 (World Bank, 2012).

Solar irradiance is favourable in the MENA countries as it receives approximately %22-26 of total solar irradiance reaching Earth's land, this could reach 1700 kWh/m^2/y in some areas in Saudi Arabia (World Bank, 2012). Saudi Arabia's DNI is classified in the range between 2001-2600 kWh/m^2/y (World Bank, 2012). Indeed, the Empty Quarter desert is believed to receive enough solar radiation to power two Earths. This abundant resource makes it only natural to consider utilizing solar energy for various applications.

Per capita renewable water in Saudi Arabia is about 200-500 m^3/cap/year and is expected to be under 200 m^3/cap/year between 2020-2030 (World Bank, 2012), that is much below the threshold for water poverty, which is at 1000 m^3/cap/year (World Bank, 2012).

Freshwater demand in MENA countries is escalating and is expected to grow fivefold over the next five decades, half of the global desalination capacity is already done in MENA which reached 9.2 Bm^3/y in 2010 (World Bank, 2012). Saudi Arabia's water shortages are expected to increase by 20–40 km^3 yearly. Similarly, electricity demand is also escalating in these countries and with the forecast of water desalination demand, this is expected to escalate further (World Bank, 2012).

There are many drivers for Saudi Arabia to launch solar-desal projects, this includes [(World Bank, 2012), (Food and Agriculture Organization of the United Nation , 2009)]: Water demand, Financial strength of Saudi Arabia, Experience with existing desalination facilities, Climate change mitigation and adaptation efforts, Reducing carbon emissions, Escalating local energy demands and therefore limited availability of fossil fuels, Political will – introduce solar to energy mix at 10% by 2020, 20% by 2030 (King Abdullah City for Atomic and Renewable Energy, 2013).

Coupling desalination with renewable energy sources has a great potential in MENA, this is particularly a necessity in Saudi Arabia given all the challenges tied with escalating energy demand, water demand, water scarcity, escalating carbon dioxide emission and virtually unlimited solar irradiance. Saudi Arabia has the largest CSP desalination potential, estimated at 23.7 Bm3/y where the average DNI at coastal desalination is projected to reach DNI > 2300. Therefore, for Saudi Arabia, CSP-powered seawater desalination is the way forward (World Bank, 2012).

The King Abdullah Initiative for Solar Desalination has launched plans to utilize solar energy in desalination plants. Starting with a capacity of 30,000 m^3/day to meet water demands of Al Khafji using CPV-RO in the first phase, and building up to 300,000 m^3/day in the second phase, with the aim to reach 100% solar desalination of the entire plants by 2019.

The proposed study aims to research ways for Saudi Arabia to select the optimum coupling of a solar desalination co-generation plant, given its DNI geographical location, seawater salinity and best choice of technology. By comparing the current choice of CPV-RO to CSP-MED, the work proposes to find an alternative design to create innovative design optimization for integrating desalination with solar technologies.

Keywords: Seawater desalination, Solar desalination, sustainable desalination, PV-RO, CSP-MED, Saudi Arabia.

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European Smart Grids Projects Development and Geographical Proximity: Evidence from Network Analysis

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Abstract: The far-reaching transformation of electricity system is a major challenge to energetic transition. Current electricity sector is often considered as locked into a carbon-intensive system (Unruh 2000) due to different barriers like renewable energy generation, grids and storage, and demand responses (Lehmann et al. 2012). Security of supplies, competitiveness, and sustainable development are the three outlooks of European Energy Policy (EC 2007) and Climate Policy. Meeting these objectives will require the emergence of a new socio-technical system based on the transformation of the overall electricity system through the integration of renewable energy generation, enhancing grid security, developing the internal energy market and realizing energy saving and efficiency.

Smart Grids Systems are acknowledged as key tools to support the process of transition to a low-carbon economy. The new grids architecture is aiming to favor the introduction of new technological applications (like electric vehicles), the optimal management of consumption and production for energy efficiency and the introduction of renewable energy sources (Battaglini et al. 2010). Based on Information and Communication Technologies, Smart Grids technologies are used to integrate intelligence in the generation, transmission, distribution grids as well as storage and demand response.This new technological system is associated with new actors' entrance (Erlinghagen and Markard 2012)and participates to the transformation of the value chain and the introduction of consumer as producer. In the last few years, Smart Grid projects have been growing in number, size and scope throughout Europe.

The spatial dimension in these processes is often neglected (Coenen et al. 2012, Binz et al. 2012). In this paper we are interested by the spatial dimension of the Smart Grids innovation system in its very emergence phase. Using a network analysis approach we may highlight the space dimension of TIS emerging process cross-cutting the established sectoral or spatial (national, regional) delimitations.

Without deniable that national or regional institutional structures contribute to innovation success (as mentioned in National or Regional innovation system approaches) we consider that the network of actors in Smart Grids Projects creates a new space none systematically territorially embedded. This space may be more a construction resulting from a cognitive proximity than a physical proximity and will be analysed with a network analysis in order to address the following questions: What is the structure of the network in Smart Grids Projects? Could we identify central actors in the network? What kind of networks participates to the build-up process of this emerging TIS? How do we characterize the space of this network? Do they go beyond territorial boarders? Do the results of spatial network analysis of Smart Grids Projects change according to the stage of maturity (research, experimentation, and implementation) or to the nature of the project (smart meters, storage, management…)?

We question the spatial configuration of Smart Grids European using social network analysis techniques. Indeed, network analysis methods have an important potential to enrich the literature on the diffusion of innovation and the development of new technologies (Binz et al. 2012). To achieve this goal we will adopt a two steps methodology. At a first stage, we will provide a description of the network of the European Smart Grids Projects. At a second stage, we will focus on motives behind the participation to these networks and focus particularly on the geographical dimension of this formation process. In the second stage of this study we will adopt exponential random graph models (ERGM) as Broekel and Hartog (2011).

Our data come from the Joint Research Centre Report, a house service of European Commission. In 2011, the JRC launched the first comprehensive inventory of Smart Grid projects in Europe. It has presented a review of 219 Smart Grid projects Europe-Wide, the level of investments amount to around €5.5 billion.

Analysing these phenomenon contributes to our understanding of Smart Grids innovation system emerge. Moreover, our empirical analysis will highlight to the following question: is this emergence spatially localized (measuring by the actor centrality) and mobilizing local resources of actors or is this emergence more spatially diffuse and resulting from a real network effect? In this paper, the answer focuses on the organizational resources coming from network members.

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A detailed modelling, optimising and evaluating process for a 3 KWp, 50 Hz, 3x 380v regulated voltage, stand alone photovoltaic power supply.

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Abstract: As a synthetic work, this paper deals with the complete design process, in a Matlab/Simulink environment, of the entire photovoltaic energy conversion system, consisting of a standard stand alone, (50Hz, 3x380 V_{eff} phase to phase) electrical power supply (3 Kwp). Starting from the basic schematic of an off-grid PV system (Fig-1), the first step is dedicated to the identification of each stage main external electrical characteristics, in order to build up a homogenous conversion chain, responding to the fixed objective. This is done without ignoring many of the practical sizing constraints to make the final design as near as possible to its detailed field realizable configuration. A progressive modelling process is then inaugurated with the chosen structure of the PV array (GPV). As a result, the external established characteristics of the latter are presented in presence of the main field perturbations such as solar irradiance intensity, temperature and shading variations. A maximum power point tracking stage (MPPT), based on the "perturb & observe" (P&O) approach as a control strategy of a boost DC-DC converter is then introduced, implemented and optimised. Its behaviour is investigated under a multitude of the various working conditions quoted above, along with the load constraints which are related, at this level, to the battery pack mainly sized to fulfil DC bus voltage considerations. Significant results in this scope are presented, before introducing a three-phase Voltage Source Inverter (VSI), which direct control circuits are based on the analog PWM technique. An output voltage regulation loop is then designed to assure optimum static and dynamic performances in presence of the main user AC load perturbation profiles. At the end, significant and realistic operating conditions are introduced to evaluate the overall performances of the installation as a whole, before conducting some of the most representative validating tests which related results are presented and discussed.

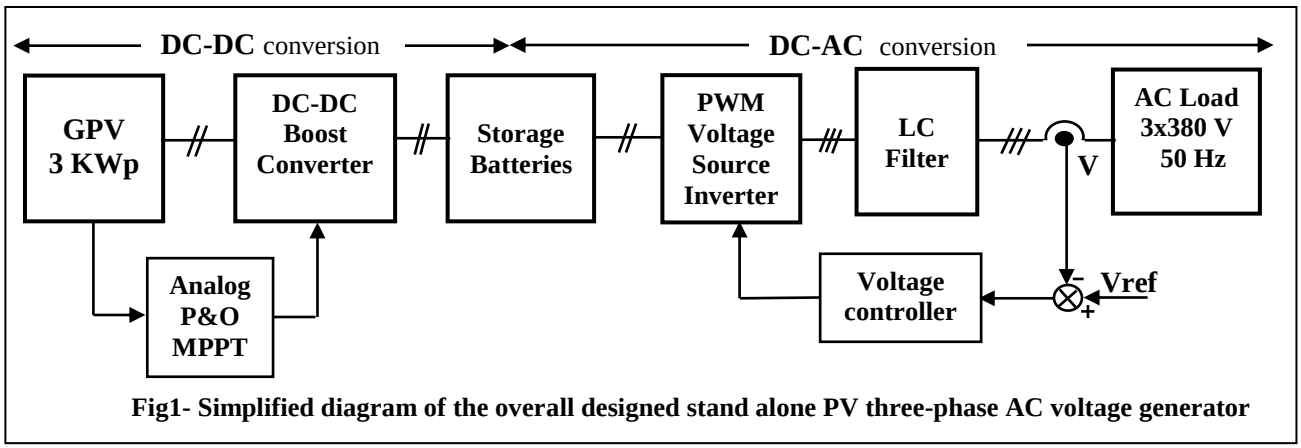

Fig1- Simplified diagram of the overall designed stand alone PV three-phase AC voltage generator

Keywords: *Photovoltaic Generator (PVG), Solar irradiance, Maximum Power Point Tracking (MPPT), Perturb & observe (P&O), PWM Voltage Source Inverter (VSI), Voltage controller, Analog control circuits.*

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Modeling, Simulation and analyses of a photovoltaic system using two MPPT algorithms

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Abstract: The inevitable costs of using fossil fuels to generate electricity have led to attracting lots of interests to the green energy sources recently. Among these green energy sources the solar energy may be the most important one because it is available almost everywhere unlike wind, geothermal, sea waves, etc and offers several advantages such as clean, no noise, and free. However, the performance of photovoltaic (PV) device (cell, module and array) is influenced by variety of factors such as temperature and insolation. So a maximum power point tracking (MPPT) technical is necessary for optimum power. It plays an important role in photovoltaic (PV) power systems because they maximize the power output from a PV system for a given set of conditions, and therefore maximize their array efficiency.
In this context, the purpose of this paper is to study and compare two maximum power point tracking (MPPT) algorithms in a photovoltaic simulation system, which are incremental conductance (INC) and perturb and observe (P&O). For both algorithms, MATLAB-SIMULINK software is applied to view the behavior of integration such system to a photovoltaic installation.

Keywords: Photovoltaic (PV), cell, module, array, maximum power point tracking (MPPT), incremental conductance (INC), perturb and observe (P&O), MATLAB-SIMULINK.

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Wirelessly Monitoring, Investigating and Overcoming the Effects of Harsh Environment on the Performance of Solar PV Technologies in the State of Qatar

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Abstract: According to the International Energy Agency (IEA), by the year 2050 it is estimated that photovoltaics (PV) will provide around 11% of global electricity production thereby avoiding 2.3 Gt of carbon dioxide (CO_2) emissions per year (IEA, 2010). Daylight in Qatar is about 4449hr/year in which 70% of it is sunshine. This results in receiving solar radiation of more than 6kWhr/m^2/day (Aksakal & Rehman, 1999). High ambient temperatures, high relative humidity, dust deposition and high solar radiation levels are examples of practicalities that may considerably degrade the efficiency of solar PV panels. This paper aims to effectively study the performance of solar PV panels of different technologies under the effect of Qatar's harsh environment and climatic conditions. To this end, a system which features a wireless remote monitoring thus allowing access of recorded data ubiquitly from anywhere on the web (Figure 1), wass successfully developed. This monitoring is achieved by recording long term data of P-V and I-V curves of the panels along with the surrounding environmental factors (time, solar radiation, ambient temperature, relative humidity, panel's surface temperature and dust). Nevertheless, the work aims at providing empirical models of PV panels to help solar PV installers in predicting the performance and energy yield for a certain PV technology under different climatic conditions. With such information, operating schedules for best PV performance could be made resulting in the highest reachable efficiency. Furthermore, this research aims to propose technical solutions and recommendations to reduce the harmful effects of these climatic factors.

Keywords: PV efficiency, effect of harsh environment, P-V and I-V curves, wireless monitoring, harsh climatic factors, empirical models, PV performance prediction.

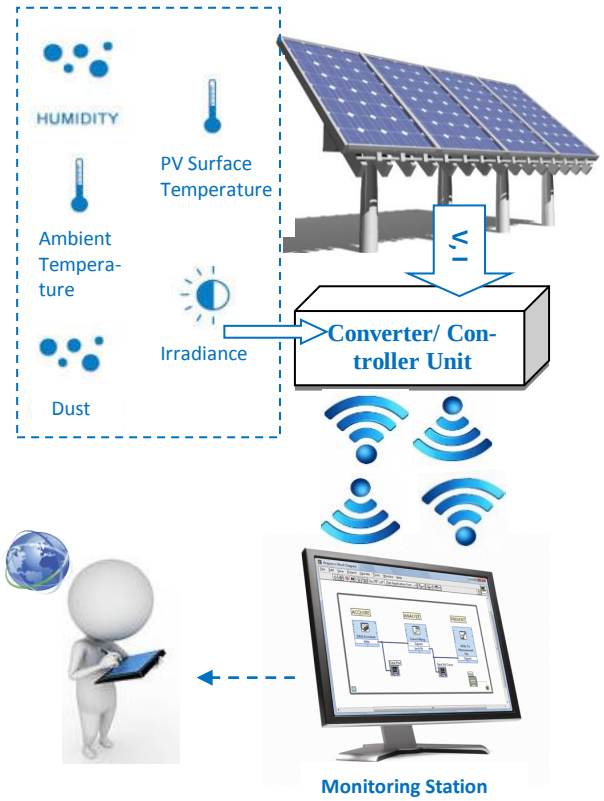

Figure 1: a general overview of the proposed wireless monitoring system. Sensors read various environmental parameters and the panel's current and voltage. These readings are sent to the controller unti where the readings are processed and sent wirelessly to the base monitoring station. The user can view and monitor the panel's performance from the web.

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Optimal Operation of Microgrid Considering Regulation of Grid Tie-line Power Fluctuations

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Abstract: Microgrid,as a part of smart grid, compries various diesel generators, storage devices, controllable loads and reneable generation. The microgrid operates usually connected to the grid.The microgrid adjusts power balance of supply and demand by purchasing power from the grid or selling power to the grid tomaximize operational benefits. Increasing penetration of the variable renewable resources such as wind and solar energy in microgrid will increase the challenge to not only microgrid with optimal coordination control but also grid tie-line power with more fluctuation. It is exigent to smooth the tie-line power profile between microgrid and grid. In this paper, an optimal scheduling strategy for a microgrid is proposed under various contraints on tie-line power fluctuations. The control of tie-line power fluctuation is studied to analyze its impact on the operational of microgrid.The tie-line power of defferent control level is shown in Figure 1. The diesel genetrators and batteries are scheduled to optimizate coordination control of the microgrid. Demand response is also considered with transferable load management to optimizate the microgrid operation. The simulation results impliy that the energy management strategy of demand response both achieves the optimal schedule of microgrid and increases the flexibility of regulation on gird tie-line power to reduce fluctuation influence on the grid.

Keywords: microgrid,optimal operation, demand response, energy management, tie-line power, controllable load, load management, renewable energy.

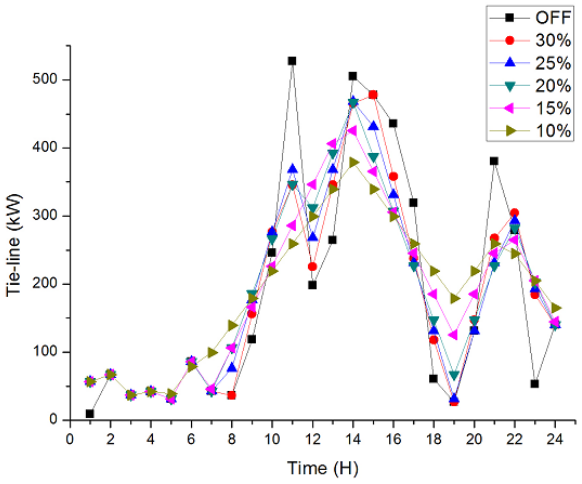

Figure 1: Figure illustrates the tie-line power fluctuations of defferent control contratints. It is shown that the tie-line power profile is more smooth with more strict contratint.

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Energy Storage with Fuzzy Controller for Power Quality Improvement on Distribution Network with Renewable Energy

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Abstract: The integration of renewable energy sources (RE) into the low voltage (LV) networks can create a number of power quality issues. RE can cause voltage unbalance and low power factor when it injects real power into the network (Roberto Caldon, 2012). Energy storage system can be connected to the network to accommodate the excess energy from RE with the supply of reactive power as a complementary support, hence correcting the voltage unbalance and power factor effectively without wasting any generated energy (Ferry A. Viawan, July 2008). To be able to correct the voltage unbalance and power factor effectively under the intermittent power of RE, a novel fuzzy controller is developed and implemented in the energy storage such that the energy storage is able to manipulate the flow of real and reactive power between the energy storage and the network based on the network conditions (Wong, Lim, & Morris, 2014). The fuzzy controller is able to reduce any voltage excursions with the use of real and reactive power from the energy storage, hence reducing the voltage unbalance and improving the power factor.

The effectiveness of the fuzzy controller is verified by building an experimental distribution network and three single-phase energy storage devices. The experimental network is a three-phase four-wire network integrated with a 7.2 kW photovoltaic system. The energy storage system consists of three 5 kW bi-directional inverters integrated with three sets of 460 Ah battery bank. A supervisory computer is used to control the operation of the bi-directional inverters. The fuzzy control algorithm is developed in LabView in the computer. The fuzzy controller instructs the energy storage to supply or absorb real and reactive power for the improvement of voltage unbalance and power factor.

Numerous experiments have been carried out to verify the effectiveness of the fuzzy controller. The experimental results show that the voltage unbalance and power factors are constantly maintained below the thresholds under the high intermittent power output of the photovoltaic systems.

Keywords: Renewable energy; Energy storage; Voltage Unbalance; Power factor; Fuzzy Controller;

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Study and Implementation Photovoltaic Cell Efficiency at Evaluated Temperature

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Abstract

In order to determine what type of photovoltaic solar cell could best be used in a thermoelectric photovoltaic hybrid power generator; we test the change in efficiency due to higher temperature s of three types of solar cells: a polymer cell, an amorphous silicon cell and a CIS cell. Using an AM1.5 G solar simulator at 973W/m^2 we took the I-V curve of each of the three cells at increasing temperatures. We used the I-V curve to find the maximum power and determine the efficiency of each cell with respect to temperature. We found that the CIS cell had an efficiency of 10% and the performance decreased with respect to temperature in a non-linear manner. The efficiency at 83^o C was a peak and the same efficiency as at 40^o C. We found that the amorphous silicon cell test had an efficiency of 4% at 45 C that decreased with respect to temperature in a linear manner such that 80^o C increases in temperature resulted in an efficiency of 3%. We further found that the polymer cell efficiency decreased from 1.1% to 1 % with a 60^o C increase in temperature, but that the polymer cell is destroyed at temperatures higher than 100^o C. We determined that CIS or amorphous silicon could be suitable materials for the photovoltaic portion of the hybrid system.

Keywords

Photovoltaic cell; PV efficiency; Temperature; energy losses.

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Back-to-back Inverters: Common Mode Voltage Mitigation in Variable Speed Wind Energy Conversion Systems

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Abstract: Many industrial applications such as large variable speed wind energy conversion systems need power electronic inverters like back-to-back configuration in order to optimize the integration of power coming from wind and to deal with transmission or distribution systems operator requirements [1,2,3].

The main issue regarding back-to-back inverters used in Permanent Magnet Synchronous Generators (PMSG) or Double Fed Induction Generator (DFIG) are high dV/dt (fast switching transients) so an unwanted electromagnetic interferences (EMI) are generated and can affect wireless systems, malfunction of electronic equipment, so it's necessary to find a mitigation techniques to solve this problem and avoid costly equipment failure.

In the other hand, a common mode voltage (VMC) is generated by a pulse width modulation strategy (PWM) which can lead to shaft voltage and resulting bearing current escaping to the earth through stray capacitors inside wind generators [4,5,6].

In this paper we'll investigate the origin of electromagnetic interferences by a simulation and experimentation of DC/AC converter on time domain; an experimental bench mark is used to investigate conducted emissions generated by an AC motor Drive. Results show the compliance of such switching converter with international EMC regulations.

Even, we'll investigate the origin of common mode voltage and we'll present a complete matlab Simulink model of an induction motor powered by a variable speed SVPWM two-level three-phase asynchronous machine and its high frequency model.

A bench mark is made to illustrate the presence of VMC for two modulation techniques which is in accordance with theoretical results.

Finally, we'll propose some technical solutions to mitigate the effect of VMC based on a good choice of modulation techniques or an adequate passive filter.

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Effects of collector slope on solar chimney power plant performances

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Abstract:

A CFD analysis using ANSYS Fluent software was conducted to study the effects of collector slope on solar chimney's performances[Cao et al.,2013; Koonsrisuk, 2013, Fasel et al, 2012; Ming et al, 2012; Ansys, 2011]. Three solar chimney configurations, named A, B and C, which correspond to a slope of 0°, 2.5° and 5°, respectively, were studied. Both collector Radius and chimney height were fixed to 495m in all cases. For the three studied configurations, the pressure ratio was fixed to 0.9 and the solar radiation was varied from 200 W/m² to 1100 W/m².

The results show that the thermodynamic performances of the solar chimney were enhanced by increasing the inclination angle of the collector roof. For instance, the work extracted from configuration A, B and C were, respectively, 2.33, 8.46 and 10.11 MW. The thermal efficiency increases from 0.3% to 1.25%, while, the exergetic efficiency vary from 0.69% to 1.82% when the inclination angle is varied from 0 to 5°.

Keywords: solar chimney, collector roof slope, thermal efficiency, exergetic efficiency, work extracted.

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Design and Control of a Hybrid Wind/PV System for Grid-Integration

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Abstract: The objective of this paper is the design and the control of hybrid system for grid connected application based on renewable energy sources (wind and photovoltaic). The proposed system consists of a wind and photovoltaic (PV) generators and a controlled interconnection to the grid. Both the Wind generation unit and the PV generation unit are connected to the weak AC grid via a three-phase inverter. Power control strategy is to extract the maximum energy available from varying condition of wind speed and solar irradiance while maintaining power quality at a satisfactory level. The paper provides a technical description of the Hybrid system devices and of the energy management. Modeling and simulation study on the entire control scheme is carried out using a power system transient analysis tool, 20-SIM.The simulation results show the performance and dynamic behavior of the Grid-connected Hybrid wind/PV system.

Keywords : Hybrid Wind/PV system, Power Control, micro-grids, grid-connection.

The architecture of the studied Grid-connected hybrid Wind/PV system is represented by the figure 1. The wind subsystem is a 600W wind generator equipped of a direct driven permanent-magnet synchronous generator (PMSG), a diode rectifier and a booster converter for the tracking of the maximum power point. The photovoltaic subsystem is composed by a 400W PV array interfaced with the DC bus via a boost converter used for the tracking of the maximum power point and for raises the array voltage to a higher level, equivalent to the common DC voltage level (Dali *et al*., 2010).

The grid-side inverter changes DC power from wind subsystem and PV subsystem into AC power of which voltage and frequency is required for being supplied into the three phase grid. The inverter has a LC harmonic filter at its terminal to reduce the current and voltage distortion. Proposed power control scheme of the hybrid system is addressed and modeled.

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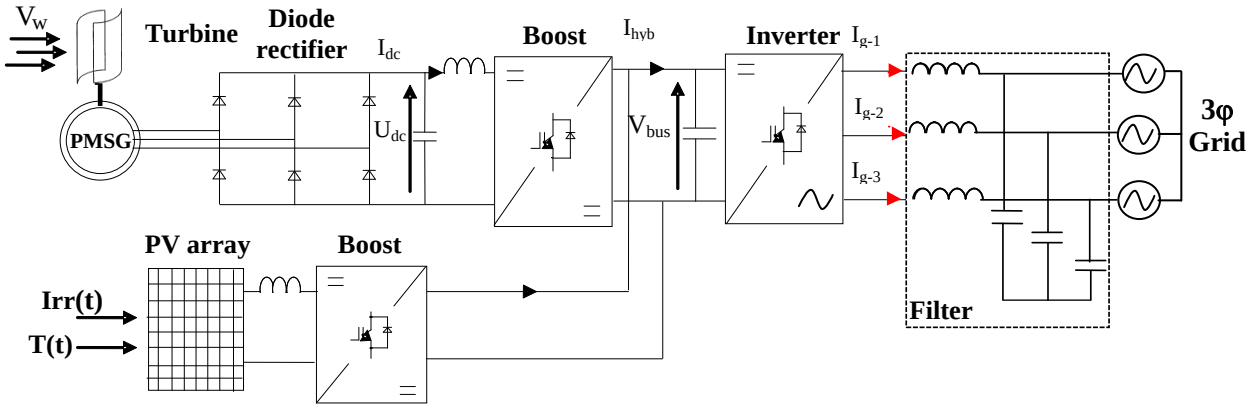

Figure 1 : Architecture of the hybrid wind/PV system interconnected to the grid

Automated Solar Water Pumping Systems for Agricultural Irrigation Applications

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Abstract:
Throughout Tunisia, farmers employ diesel powered systems to pump irrigation water. Due to the increasing fuel costs especially in the last few years, operating diesel powered systems is directly impacting the profitability and viability of operating small farms that relie heavily on pumping water to irrigate agricultural crops. For these farms, utilizing properly designed and controlled solar water pumping systems can be economically cost-effective.

In this paper, a solar powered water pumping system with automatic controls is described. In particular, the design specifications of the solar pumping system are outlined for a specific set of agricultural irrigation needs. Automatic control strategies of the solar water pumping system are also presented to eliminate the need for using diesel fuel.

Moreover, the paper estimates the potential energy cost savings that the automated solar water pumping system can achieve relative to the conventional diesel powered pumping system for common irrigation needs in farms within the region of Sidi Bouzid. Possible financing options for the solar water pumping systems suitable for small farmers are discussed. Finally, some recommendations of mechanisms are suggested for facilitating installation of solar water pumping systems in the region of Sidi Bouizid.

Keywords: Agricultural crops, automatic controls, irrigation system, solar water pumping

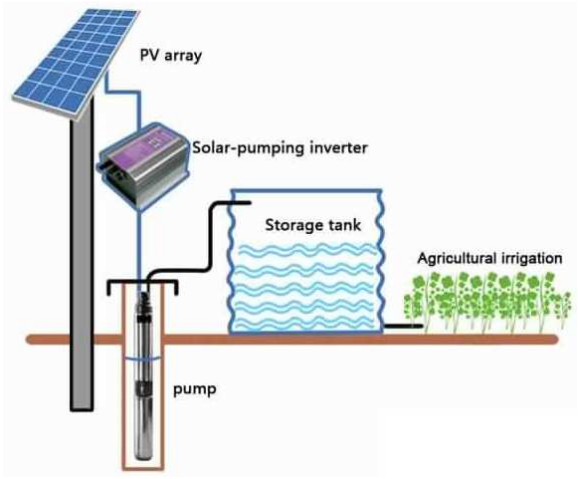

Figure 1: Figure illustrating the automated solar water pumping system for agricultural irrigation

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Acoustic Study of Insulators Manufactured from Textile waste : The case of the Tablecloth Structure

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Abstract: Textiles are one of the fastest growing waste product (In Europe and America, it is estimated that 10 million tonnes of textiles are discarded every year[1]. In China the total annual production of pre and post-consumer textile waste is estimated to be over 20 million tonnes[2]) and the wastes cause both health and environmental problems, so that, this has forced governments to search solutions and develop laws for recycling. The first approach to our waste challenge is to cut the creation of waste in the first place, it's the **R**eduction; the second approach is the **R**euse and the third approach is the **R**ecycling. This work is the following study of thermal insulation of a manufactured material of textile waste shredded in two structures: tablecloth and linters, which can provide thermal and sound insulation of buildings. In this section, we measure the sound settings precisely its sound absorption coefficient **α**, its coefficient acoustic reflection **R**, its impedance **Z** and the parameters in conjunction; porosity, **Φ**, and air permeability, **P**. A comparative study with other civil building materials was thus carried out.
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Keywords: Textile waste, acoustic insulation, sound absorption coefficient, sound insulation in building, coefficient acoustic reflection, building materials, acoustic impedance.

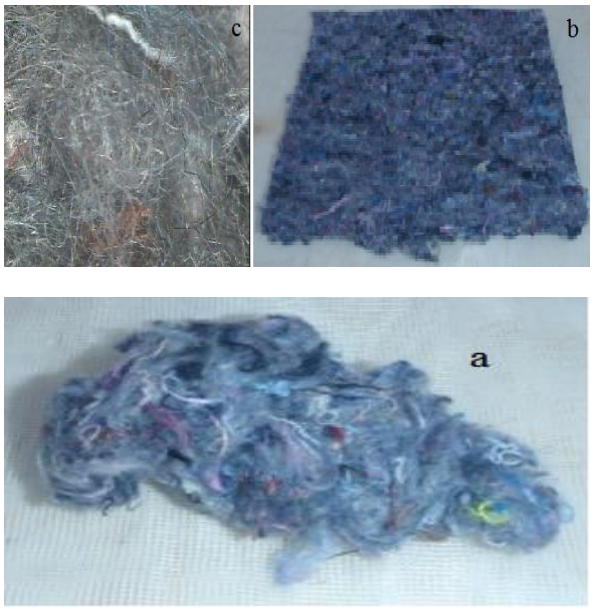

Fig.1, above: Presentation of the material to be examined

a Sample Textile Waste: linters structure
b Sample textile waste: tablecloth structure
c Sample textile waste: enlarged image

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A 100 kW Three-Phase Plasma Torch for Biomass Valorization and Other Applications

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Abstract: High density power supply is valuable in great number of industrial applications such as material processing and lean mixtures combustion enhancement. The most common technology used for these applications is actually fossil fuel burner with all what it implies as limited efficiency and high operating expenses. Another alternative consists in plasma torches and in particular those with three phase current supply. In addition to its instantaneous response, security of use and low cost maintenance, Three-phase Plasma Torch (TPT) with graphite electrodes is able to provide high efficiency thermal conversion and deliver dense radical formation at high temperature.

In this work, the development of a new 100 kW plasma torch with graphite electrodes is detailed. This water cooled plasma torch is working with atmospheric air as plasma gas and has three-phase current supply at 680 Hz. The nominal air flow rate is at 60 $Nm^3.h^{-1}$ and the gas outlet temperature is above 2500 K.

At the beginning, graphite electrodes erosion in oxidizing medium was studied and controlling parameters were identified through parametric set of experiments and then tuned for optimal electrodes life. Then, specifications were defined and first design was suggested and simulated in multiple iterations until mechanical and thermal constraints were acceptable and plasma flow characteristics were satisfactory. Here, we used SolidWorks Flow Simulation for first iterations of simulation and then ANSYS Fluent platforms for accurate results and final optimization. In fact, multiple assumptions have been taken for the CFD Fluent simulation concerning plasma radiation and arc discharge modelling. The following step consisted in building a detailed mechanical design respecting mounting and security requirements and taking into account the importance of a sincere reproduction of theoretical boundary conditions assumptions. When manufacturing was finished, the turn was for validation tests. In this part, a special attention was dedicated to efficiency evaluation through some precise measurements of the power supply, the thermal power throughout the exit conducts and heat losses to the cooling system. The electrode erosion was also evaluated in multiple operating conditions.

Keywords: three phase plasma torch, plasma assisted combustion, low heating value fuels, biomass, municipal wastes, graphite electrodes, thermal power plants.

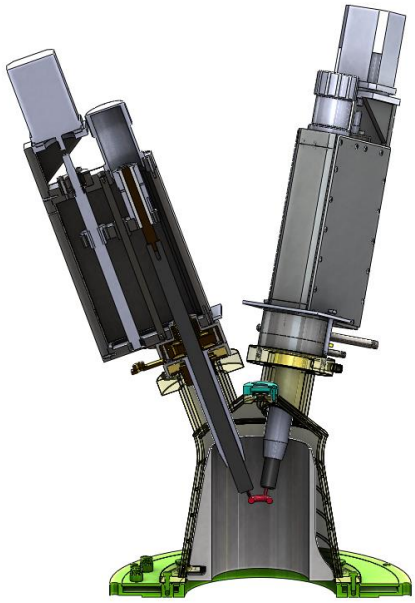

Figure 1: Cross-section of the 100 kW three-phase plasma torch.

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Solar steam reforming of natural gas integrated with a gas turbine power plant: economic assessment

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Abstract: Important technological barriers, like dilution, intermission and unequal distribution, often impede the realization of renewable energy potential. In particular, Concentrating Solar Power (CSP) technology is one of the most promising industrial scale power plants fed by renewable energy.
Solar thermochemical processes convert solar radiant energy into chemical energy (Pregger e*t al.*, 2009). Syngas production by steam reforming of natural gas wherein concentrated solar radiation is the energy source of process heat for driving methane steam reforming (MSR) is a process called "Solar MSR". Solar MSR makes it possible to produce energy from a renewable source and to reduce CO_2 due to the decrease in fossil fuel consumption.
An hybrid power plant wherein solar steam reforming of natural gas and a steam injected gas turbine power plant are integrated for solar syngas production and use has been developed (Bianchini *et al.*, 2013). In this plant the gas turbine is fed by a mixture of natural gas and solar syngas, which is mainly composed of hydrogen and water steam, from mid-low temperature steam reforming reaction whose heat duty is supplied by a parabolic trough CSP plant (Figure 1).
The paper shows an economic assessment of the proposed solution if applied in a North-African Country: a comparison is made between a traditional system and the innovative proposed one. The paper also shows how solar syngas can be considered as an energy vector consequent to solar energy conversion effectiveness and the natural gas pipeline as a storage unit, where solar syngas can be stored and then used as feeding fuel in existing power plants without relevant adaptations needed.

Keywords: Steam reforming; Concentrating Solar Power; Solar syngas; Smart grid; Economic assessment.

Figure 1: Figure illustratin a parabolic trough concentrating solar power plant.

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Numerical Simulation of a Modified Savonius Wind Turbine Based on a Commercial Software

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Abstract: Along the last century, nuclear and fossil fuels were the most powerful and important energy resources in the world. The appearance of some environmental problems such as nuclear accidents, acid rain, global warming and marine pollution, etc ..., led to look for alternative energy resources. Among these latter, wind energy (Ahmed *et al.,* 2013) is a clean and inexhaustible energy source which can be converted into a useful form of energy, such as producing electricity using wind turbines. However, the most familiar wind turbines models are horizontal and vertical axis wind turbines (Mohamed *et al.,* 2011). The first model is the most famous one well known for its high power coefficient and contrarily needs hard criteria such as a sophisticated technology, a high cost, a complicated fabrication process and specified operating conditions. Otherwise, the second one has a low power coefficient (Ahmed *et al.,* 2013) in comparison to the first one, but havs some advantages like an average technology process, economical design, accept the wind from any direction and simpler to use in any place (D'Alessandro *et al.,* 2010, Kamoji *et al.,* 2009). In this context, a new shape called the Modified Savonius design (blades composed of straight segments) is proposed and investigated to improve the power coefficient of the conventional design. Moreover, the numerical modeling of our design has also described and simulated using the commercial software fluent to determine its characteristics. Our results show a good enhancement in terms of cost and fabrication process. Our new design can be considered as attractive alternative candidate for future wind turbine applications.

Keywords: Savonius, wind turbine,Fluent, Sliding mesh technique, drag force, tip speed ratio

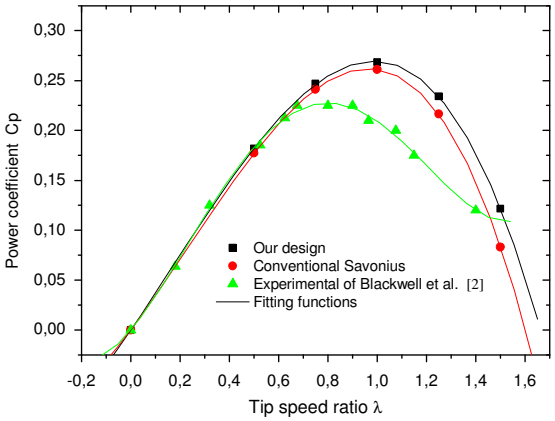

Figure 1: Power coefficient versus tip speed ratio .

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Extraction of High Purity Silica from Rice Husks Ash for Reduction to Silicon.

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Abstract:

Rice Husks (RHs) biomass waste is very much abundant in developing countries like Nigeria. This work shows how pure silica was derived directly from rice husks ash for reduction to Silicon (Si). Si is the second most abundant element in the Earth's crust, but the processes to form Si materials is usually complex, costly and energy-intensive. The silica in the ash undergoes structural transformations depending on the conditions (time, temperature etc.) of combustion. At 400^{o}C to 700^{o}C amorphous ash is formed and at temperatures greater than this crystalline ash is formed. A high purity silica was produce at 650^{o}C after burning the rice husk RH for up to 7 hours. We determined the purity of the silica by dissolving the rice husk ash (RHA) with alkali solution to form sodium silicate solution of pH 11.0. This was added to hydrochloric acid of pH 1.5 which lowered the pH of the solution to 4.0 to form silica gels which was promoted by incubating it at room temperature for overnight. The silica gels produced were crushed inside the beakers, dispersed in deionized water of 100ml and the slurry was centrifuged at 5000rpm for 10min to remove soluble salt, the supernatant were discarded and the gels were subjected to washing and then dried at 80 ^{0}C for 24 hours to obtain pure powder silica. The silica powder was characterized using XRD and EDX techniques. Silica yields from RHA was 99%. This study was done to reduce energy waste and environmental pollution in Nigeria as silicon is used to develop many materials.

Keywords: Rice Husk, silica, silicon, Rice Husk Ash

Figure 1: Rice plant, Rice Husk and Rice Husk Ash.

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Poster Presentations

Optical, electrical properties and OH group adsorption with deposits electrolysis

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Abstract:

An electrochemical method, using electrical energy, to decompose water into hydrogen and oxygen, is very important to pH values varying between the intervals {7.9 - 14} and {2-6 - 5}, a degree of salinity which is lower than 90 g/L and greater than 130 g/L (Figure 1). The formed film and the resultant powders were characterized by FTIR, UV-Visible and complex impedance. Thus we see that the electrolysis of water causes a change in the stretching vibrations υ_{OH}, namely the presence of Cu-O vibration (solid 520-630 cm^{-1}). A spectral shift in the OH absorption band, which is a positive indicator of the interaction of the metal particles, dispersed in the electrolyte (**A**drian et al, . 2013). Comparison of measurements of the value of pH of the electrolyte showed that acid pH values increase, which is not the case for basic media which shows a decrease. A peak of UV-visible absorption at 220 nm was recorded for the solution after production, pH = 8, and two bands at 320 and 360 nm due to hydroxyl compounds that are detected. Furthermore, the complex impedance diagrams show capacitive loops at the high frequency domain, and relaxation process of the electrolyte for different pH values.

Keywords: deposit, salinity, absorption, impedance diagrams.

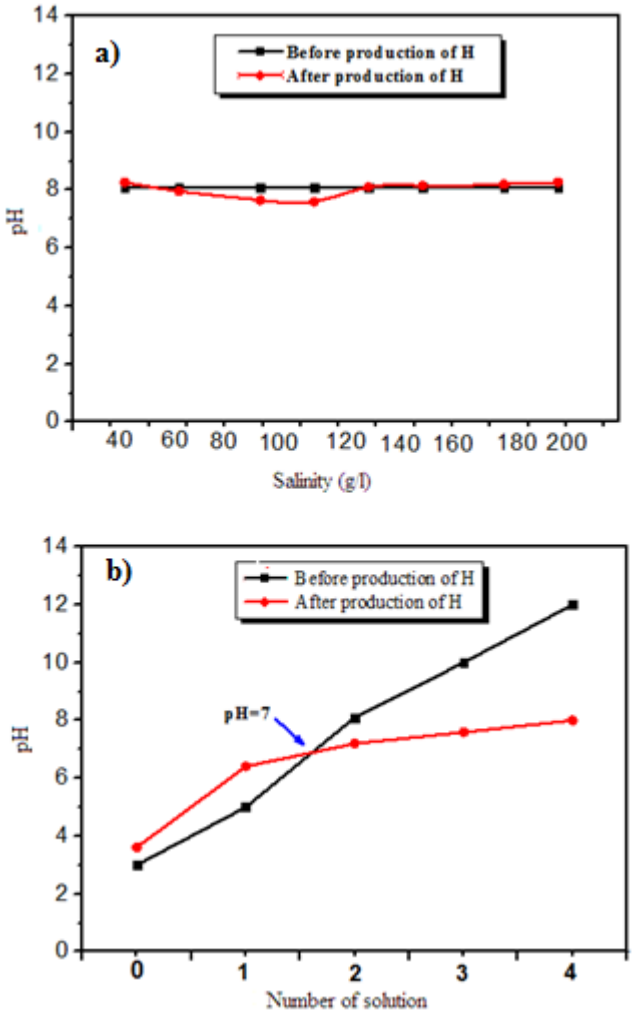

Figure 1: Figure illustrating the **(a)** Evolution of pH with the salinity of water before and after electrolysis and **(b)** Variation of pH versus solution before and after generation of hydrogen.

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The temperature variation in the soil at shallow depths in the region of Noumerat in Ghardaia

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Abstract:
The presence of thermal waters in the region of Ghardaïa, whose temperature is 41,5 °C **[1]** in Zelfana and 40 °C **[2]** in Guerrara, has led us to determine the variation of the temperature of the subsoil. In this geothermal study one is interested to the first meters below the ground surface. We used the data of soil temperatures and data daily ambient temperatures measured during 2013 representative of the radiometric station installed in Unit of Applied Research in Renewable Energy located in Noumerat (Ghardaïa), (latitude 32,36 °N, longitude 3,80 E et altitude 469 m). The model is developed from the instationary heat equation for a homogeneous medium.
The objective of this work is to determine the variations, during one year, of the soil temperature at shallow depths in the region to Noumerat for eventual use energy.

Keywords: geothermal, temperature, Ghardaïa, radiometric station, shallow depths.

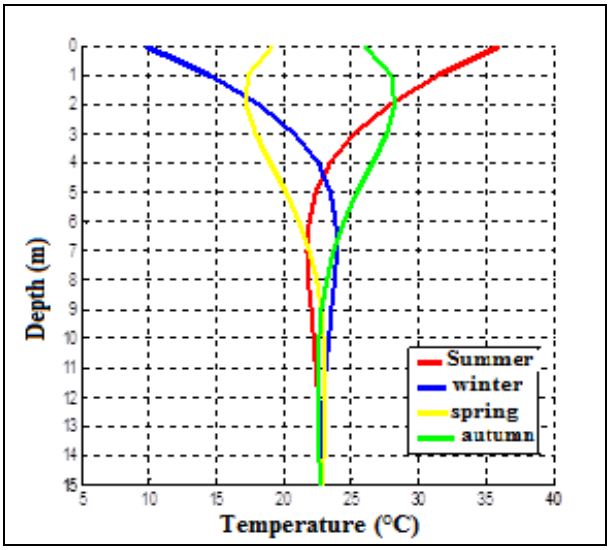

Figure 1: Evolution of the temperature of the subsoil a function of the seasons.

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Numerical study of heat transfer in solar receivers for csp

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Abstract: The aims of this study are to assess the position, design, properties and performance of solar receivers (material, coolant ...) in the CSP numerically.
Optimize the operating conditions for increasing the thermal efficiency, improving energy and environmental efficiency of different solar thermal as well as the development of solar concentrator and its components, especially in the" solar tower".
The establishment of a future innovation plan taking into account the results obtained previously and subsequently.
This investigation is explained by a constant research for efficiency in order to find a compromise between a good heat exchange coefficient from the receiver to the heat transfer fluid, the decreasing of radiative and convective heat losses and charges losses negligible or limited.
For that raison, it is necessary to make a receiver modeling (surface, volumetric, external, etc…) and a simulation of heat transfer at their level in order to identify the advantages and disadvantages of the considered receiver that should be the most efficient. We modeled the process to establish the properties related to heat transfer involved the volumetric receiver in the solar tower. Thus using a computational code based on finite volume method (Fluent CFD).

Keywords: solar tower, solar receiver, heat transfer fluid HTF, convective heat losses, radiative losses, efficiency, Fluent CFD.

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Optical and electrical behavior of MACE silicon nanowire structures

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Abstract: During the last decade, important efforts have been dedicated to the use of silicon nanowire structures (SiNWs) in photovoltaic applications (Yehua *et al.*; 2012). SiNWs deposited on the surface of silicon-based solar cells could act as an efficient antireflection layer. SiNWs present highly light absorption behavior which could attain 97% in UV-visible spectral region (Osminkina *et al.*; 2012) attributed to light confinement of incident light in the nanowire structures, as for porous silicon structures. In this work, we report on the elaboration of silicon nanowires by Metal Assisted Chemical Etching (MACE) technique using silver (Ag) as metal catalytic. Our research results show that the shape of reflectivity spectra of SiNWs is sensitive to experimental conditions of SiNWs elaboration especially the cleaning protocol. The reflectivity increases from ultra-violet to red wavelength for all samples (Figure 1). The comparison between samples with different cleaning protocol shows that in the UV spectral region samples more contaminated with Ag nanoparticles exhibit a pronounced decrease of the reflectivity. Such metallic nanoparticles which remain in the silicon nanowire structure present surface plasmon resonance energy in a vicinity of 3 eV (UV spectral region) (Razaa *et al.*; 2013). In the other hand, these nanoparticles could generate metallic defects acting as recombination centers affecting the carrier lifetime. In this communication, we try to explain the effect of Ag nanoparticles on SiNWs optical and electrical behavior. We evaluate absorption variation of SiNWs versus thermal treatment and different step of silicon solar cell elaboration.

Keywords: SiNWs, Reflectivity, Silver nanoparticles, Surface Plasmon resonance, carrier lifetime

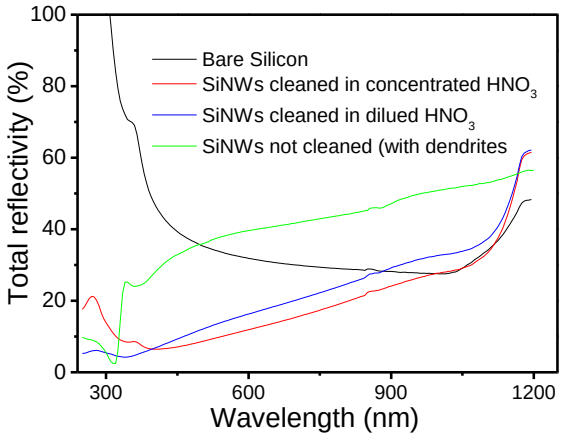

Figure 1: Reflectivity spectra of SiNWs structures with different cleaning protocol

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Optimal Design of a Hybrid Systems for GSM Radio Base Station in Tataouine, Tunisia

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Abstract: The study outlined in this paper presents the analysis approach and results for an optimal design to reduce the energy cost of operating remote GSM radio base station in Tataouine, Tunisia. The station is a critical part of the telecommunication network and needs uninterrupted electrical power supply. Currently, electricity is generated using diesel generator in order to operate remote radio base stations located in the desert of Tataouine in the southern part of Tunisia. In addition to the environmental impacts of using fossil fuel, the increasing costs of diesel in Tunisia makes the reliance on solely diesel generator an expensive option for providing electrical power to the radio base stations.

In this study, several options to generate the electricity power required for a single radio base station are investigated including combinations of hybrid systems made of photovoltaic panels, batteries, DC-AC converters, and diesel generators. Using a detailed economical analysis tool, HOMER, an optimal design for a hybrid system is determined based on levelized cost of energy and its performance is evaluated relative to the current system of only diesel generator. The optimal hybrid system suitable for supplying power for one radio base station, is made up of 4-kW PV panel, a 1500-Ah battery bank, a 2-kW DC-AC converter, and a 2-kW diesel generator. The optimal hybrid system relies on PV to produce 87% of the electricity needs and reduces the carbon emissions by over 86% relative to the case of only diesel generator system.

Keywords: Battery, Diesel Generator, HOMER, Hybrid system, Off-grid, Radio Base Station, Solar-PV, Tunisia

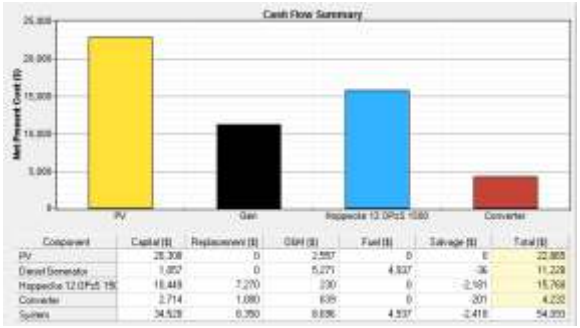

Figure 1: Figure illustrating the results of an analysis for a hybrid PV-generator system using HOMER optimization tool.

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Theoretical study of a solar-assisted ejector cooling system with refrigerant ammonia

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Abstract: A solar ejector cooling system is one of the most promising technologies because of its simplicity, its low initial costs and the use of a free heat source (solar energy). In this work, a theoretical study was carried out to evaluate the performances ejector cooling machine using a solar collector functioning with average temperature by using the constant pressure mixing ejector theory for the ejector where the working fluid is ammonia (NH3).
For a given refrigerating power of 10 KW, temperatures: generator, condenser, evaporator and for fixed and for superheat, Nozzle, entrainment and diffuser efficiencies were taken as 0.95, 0.75 respectively, entrainment ratio and the geometrical parameters of the ejector as well as the ejector cooling machine performance are calculated. By using meteorological year databases of the site Adrar in south of Algeria such as the solar irradiation and the ambient temperature.
The influence of the three levels of temperatures of the heat, intermediary and cold sources on the performance are analyzed. The results showed that the total COP reaches an optimal value according to the generator temperature for the three types of solar collectors.
Keywords: Ejector, cooling system, solar energy, COP, ammonia.

1. DESCRIPTION OF THE SOLAR EJECTOR OF REFRIGERATION CYCLE

The ejector (Figure 1) is a thermally driven compressor that operates in a heat pump refrigeration cycle. In a heat pump system, the ejector takes the place of the electrically driven compressor, but uses heat rather than electricity to produce the compression effect.

The solar ejector refrigeration cycle is shown in Figure 1 and in diagram P, h in figure 2. It comprises of two loops, one is solar collection loop which is the main energy source of ejector refrigeration system (ERS) and the other is ejector refrigeration loop which supplies useful cooling to the user. The solar collection loop is composed of collector, a hot water storage tank and a circulating pump

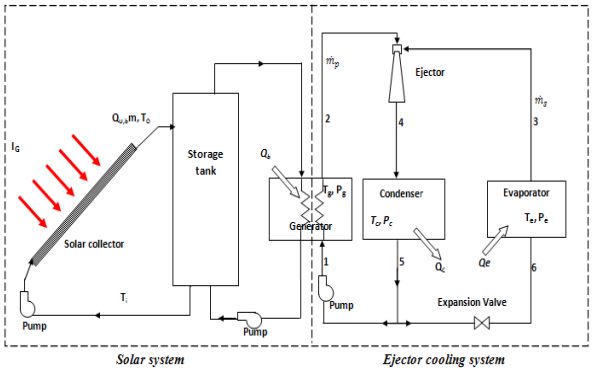

Fig. 1: Ejector cooling system assisted by solar energy.

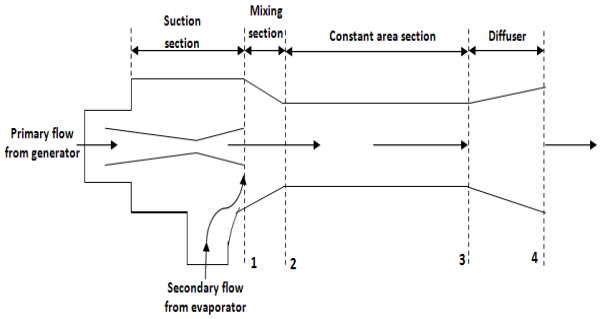

Fig.2: Constant-pressure mixing ejector.

2. CONCLUSION

In this work, a thermodynamic analysis of a solar ejector cooling system was presented by using a one dimensional model 1D for the ejector. The model presented calculate the entrainment ratio of ejector, ejector cooling cycle performance *COP* solar ejector cooling system *COPsys* for different operating condition. The results indicated that both *COP* and system efficiencies increased with generator temperature, within the range considered in this work. In order to obtain acceptable values, generator temperature should not be below *90°C*.This would require a collector output temperature of about *100°C*. Evacuated tube collectors are better suited for operating an ejector cooling system. Evaporator temperature of the evaporator lower than *10°C* results a low coefficient from performance.

Design of an Optimal Cogeneration System for a Brick Manufacturing Facility in Tunisia

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[2]University of Colorado, Building Systems Program, Boulder, Colorado, USA

Abstract:
For several industrial facilities, cogeneration can be a cost effective system to generate the energy needs (electricity and heat) required for various processes. In this paper, a detailed analysis is presented to design optimal cogeneration system from a brick manufacturing company located in Tataouine, Tunisia. In particular, the paper outlines the energy intensive processes and equipment within the facility and its current monthly and annual energy uses and costs. Using HOMER (Hybrid Optimization Model for Electric Renewable), an hourly micro-power optimization analysis tool, a series of analyses is performed to determine the various alternatives of utilizing a cogeneration system for the brick manufacturing facility. With the current energy prices and equipment costs, it is found that an optimal size for the cogeneration system is 1000 kW in order to minimize the life cycle cost and the levelized cost of energy.

Moreover, a sensitivity analysis has been conducted to account for changes in energy costs (i.e., electricity and diesel) as well as the costs of cogeneration system. It is found that the cogeneration cost-effectiveness is highly depending on the energy costs. Some governmental incentives may be needed to encourage large industrial facilities to adopt combined heat and power systems and improve the overall energy efficiency of the electrical power generation system in Tunisia.

Keywords: Brick Manufacturing, Cogeneration, HOMER, Life-Cycle Cost Analysis, Tunisia

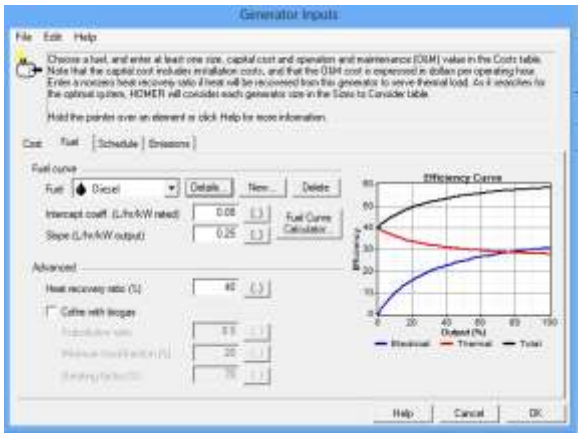

Figure 1: Figure illustrating the model for a cogeneration system using HOMER optimization tool.

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Estimation of Solar Global Irradiation towards Solarization of Rural Communities

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Abstract: Solar global irradiation is hardly registered in isolated rural areas of many regions in the world. The lack of access to the electricity grid in these areas presents an enormous potential for electrification via renewable energy sources and specifically with photovoltaic energy where high solar resource is available. Traditionally, the solar resource estimation was performed using parametric- empirical models based on the relation of solar irradiation with other atmospheric and commonly measured variables, such as temperatures, rainfall, sunshine duration, etc., achieving a relative high level of certainty (Antonanzas-Torres et al., 2013). The great improvement in soft-computing techniques, extensively applied in many research fields leads to improvements in solar global irradiation modeling (Antonanzas-Torres et al., 2014). A methodology based on support vector machines (Drucker *et al.*, 1996) with variable selection optimized via genetic algorithms is proposed and applied on a case study in four locations of a rural area in southern Spain. A striking mean absolute error reduction of 18.2% was achieved when compared to the well-known parametric model (Bristow & Campbell, 1984). The methodology was also proved useful when compared to solar global irradiation estimates from the Climate Monitoring Satellite Application Facility (Schulz *et al.*, 2009). The low errors obtained lead to the solar resource estimation and as a result a better energy yield planning in isolated rural areas.
This methodology is performed in free environment R software and released at www.github.com/EDMANSOLAR/rural for future replications of the study in different areas.

Keywords: solar resource assessment, solarization, solar global irradiation, support vector machines, photovoltaic.

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Linke turbidity prediction for improving solar radiation forecasting

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Abstract: Atmospheric aerosols are one of the most relevant factors affecting climate due to their attenuation effect on incoming solar irradiation. These aerosols stand for a wide range of airborne particles with different origins both natural and from human activity derived. Atmospheric aerosols and precipitable water vapor content account as first order filters of solar irradiation in clear sky days, being ozone and other gases second order factors. Deep knowledge in aerosol content estimation is thus fundamental for long-reliable solar resource assessments derived from satellite images and clear sky models for solar energy applications (Polo *et al*., 2014) and climate monitoring. The Linke turbidity factor was proposed in 1922 to simplify the atmospheric screening by accounting into a single variable the number of equivalent standard atmospheres (Linke, 1922). It is derived from the atmospheric optical depth at 550nm, the water vapor content and the air pressure (Ineichen, 2008), or also from solar direct normal irradiance measurements and certain clear sky models (Ineichen & Perez, 2002).

The forecasting of daily atmospheric turbidity by means of the Linke turbidity was modeled for up to 3 days ahead with different modeling techniques such as linear models, multilayer perceptron artificial neural network, regression tree (M5P), Instance based k-nearest neighbour regressor and support vector regression. These models were trained using different commonly measured and forecasted meteorological variables as inputs, such as maximum and minimum daily temperatures and rainfall, as well as the latest available data of Linke turbidity.
This study presents a valuable methodology to improve solar irradiance forecasting with clear sky models, such as the ESRA model. The Linke turbidity forecasting relative mean absolute error ranged a striking 3-6.3% with support vector machines. The study was performed in 4 meteorological stations in southern Spain with a high penetration of concentrated solar power technologies, requiring accurate direct normal irradiance forecasts. This area is known to have a high variability of atmospheric turbidity due to the effect of Saharian dust and oceanic moisture.

Keywords: aerosol, solar forecasting, Linke turbidity, clear sky models, short term forecasting

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Effect of the Sandstorms on the Solar Panels Efficiency: finding and remedy

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Abstract: In the south of Algeria, photovoltaic solar energy is an emerging technology which rises as good mean for providing electrification, water pumping and communications. The reason is the high light intensity and the long duration of sunshine during the year. Unfortunately this advantage is negatively affected by the influence of sandstorms on the solar panels efficiency (W. C. Sink, 1993). During a sandstorm, sand particles strike the glass sheets of solar panels and generate small defects which tend to be generalized on the entire exposed surface. These defects lead to a photovoltaic efficiency reduction (N. Bouaouadja et al., 2000).
The aim of this work is to correct the defects caused by sandstorms on soda-lime glass used as protective sheets of solar panels. For that, the samples were submitted to a thermal quenching to make the glass more resistant to erosive damage. Then, erosion tests were carried out in laboratory by sandblasting. The results show that the optical transmission drops significantly from 91.3 to 38.2% for a projected sand mass of 150 g, while the roughness increases sharply and tends toward a plateau (≈ 4.17 µm). In addition to sandblasting defects, small sand fragments or dust particles can be lodged in the impact sites (Bousbaa et al., . This, also, contributes to reduce the photovoltaic efficiency which decreases until 88.2% in the most unfavorable tests conditions (flux velocity 27 m/s, projected sand mass 150 g, impact angle 90°). To correct the surface defects and improve the optical transmission, a silica layer is deposited on the sandblasted samples using the sol-gel technique. After coating, the results show a clear improvement of the optical transmission which increases from 38.2% to 77.5% for the corrected state. As consequence, the relative photovoltaic efficiency is sensitively improved. It moves from 88.2% for the sandblasted state to 94.82% for the coated samples. By using a coating of acrylic resin, a supplementary improvement in optical transmission is obtained (~ 87.8%). Consequently, the recorded photovoltaic efficiency is clearly enhanced and reaches 98.44%.

Keywords: Saharan sandstorms, surface glass defects, solar panels, photovoltaic efficiency, silica and acrylic resin layers.

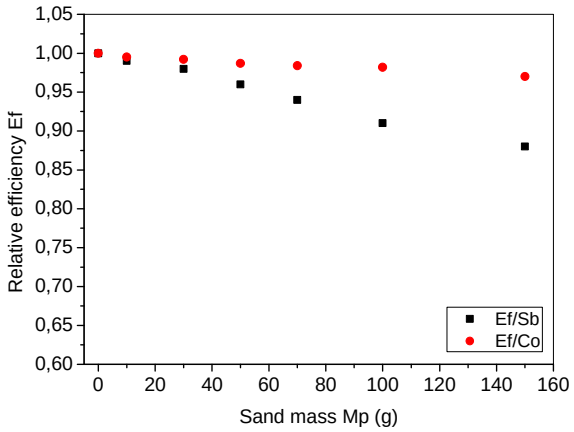

Figure 1: Variation of the relative efficiency Ef versus the projected sand masses for a sandblasted glass state (Ef/Sb) and and for a sandblasted and covered glass state with thin layers of silica

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Design and construction of sun tracking systems for sola parabolic concentrator displacement

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Abstract:

Sun-tracking system plays an important role in the development of high solar concentration applications that directly convert the solar energy into thermal or electrical energy. Several methods of sun following have been surveyed and evaluated to keep the solar panels, solar concentrators, telescopes or other solar systems perpendicular to the sun beam. We can classify sun tracker systems in first step to three categories one- axis sun-tracking system, two -axes and multi-axes sun-tracking system (Abu Khader et al., 2008) which differ related to the necessity of the solar technology that should be displaced .Single axis trackers have one degree of independence that move as an axis of rotation. These trackers track the sun on a daily basis from east to west or north to south (Sefa et al., 2009; Chong et al., 2009). In the present study, a comparative study of three pilot sun tracking system realized in CRTEn (Research and Technologies Centre of Energy in Tunisia)has been done in order to choice the most efficient one to be used . Three sun tracking systems for a solar parabolic concentrator are designed and constructed in the CRTEn (Research and Technology Center of Energy) in Tunisia. Those trackers could track the sun along both axes (azimuth and elevation angles). A comparative study of the three sun tracking systems with a commercial tracker has been done. The more economical and efficient sun tracking system is selected. The total price of this tracker is estimated to be equal to 1300 euro .and its tracking error is inferior to 0.2°. The good accuracy is due to the use of speed reducers which allow a best precision.

Keywords: Azimuth angle, elevation angle, solar irradiation, sun tracker..

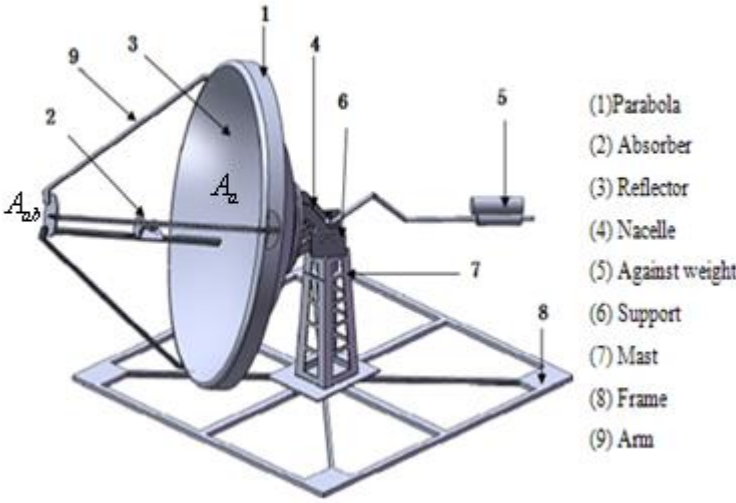

Figure 1. Mechanical structure of solar parabolic concentrator.

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Experimental study of an evacuated tube solar water heater for heating a tunnel greenhouse at night

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Abstract: The Alternate sources of energy like solar energy have been proposed for heating greenhouses and providing the optimum inside conditions during winter months. Solar energy is a universally available source, but its practical use still presents some technical, and most importantly, economic problems (Garcia *et al*.; 1998). The intermittent character of the solar energy overcomes improved the collection and storage technologies. Thermal energy storage is simply the storage of high or low temperature energy for later use (Faith; 1998). For the sensible storage energy, several systems were used such us the buried heat exchanger, the solar air and water collector and the geothermic system. Among the works we can mention that of (Bargacha *et al*.; 1999) who has made a study about the use of the flat plane collectors to improve the inside greenhouse microclimate in Morocco. Lazaar *et al*.; 2008, studied the storage of sensible heat in the soil of a tunnel greenhouse by capillary heat exchangers.

The aim of this study is to investigate the performance of an evacuated tube solar water heater for heating greenhouses. In order to reduce the energy consumption in agricultural greenhouses at night, two tunnel greenhouses, with 100 m² of area, are constructed and installed in the CRTEn (Research and Technologies Centre of Energy) in Tunisia. The first is equipped with a buried and suspended heat exchanger and the other not. We propose in this work to evaluate the performance of an evacuated tube solar water heater for a tunnel greenhouses heating in north Tunisia at night. The efficiency of the solar collector is determined and the effectiveness of the evacuated tube solar collector with a soil storage heat exchanger and with a water storage tank inside a tunnel greenhouse are also examined and compared with the one without heating system.

Keywords: tunnel greenhouse; solar energy; evacuated tube solar collector; heat exchanger

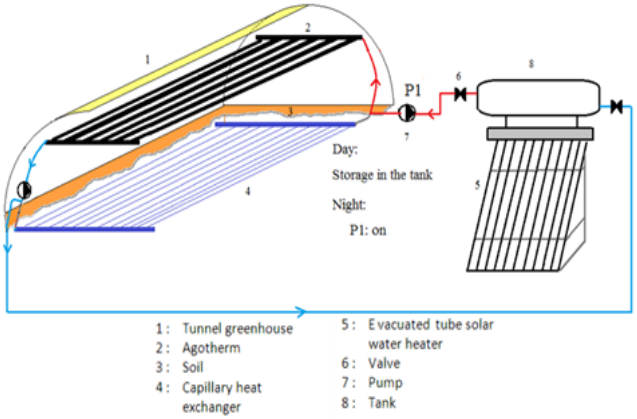

Figure 1. Experimental device: energy storage into the ground of the greenhouse.

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Modeling of Thermal Storage System for Solar Energy

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Abstract: The use of more solar and wind energy can lead to an imbalance between supply and demand. This imbalance can be managed by the production and storage of thermal energy when there is excess supply, and using the stored when demand is high energy. The use of thermal energy storage (TES) could lead to a reduction of the electric charge of the EU to (7.5%) and a reduction in the CO_2 emissions of (5.5%) (Arce, P et *al*.,2011). The obstacle to the use of solid-liquid phase change processes in energy systems is usually the low thermal conductivity of the PCM especially in organic matter (based on paraffin wax for example) having a high thermal inertia. Part of the research in this area focuses on finding ways to improve the thermal conductivity of existing PCM (A. Mills et *al*., 2006).
This work presents a numerical study of a latent heat storage unit (LHSU) (Figure.1).

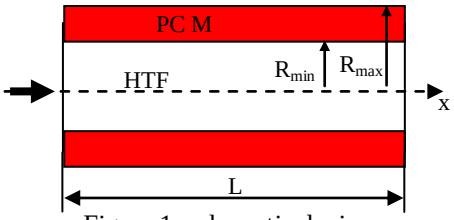

Figure 1: schematic devise

The working of latent thermal energy storage (LTES) involves the exchange of energy between the heat transfer fluid (HTF) and the material of phase change (PCM) through one of two cycles namely, charging and discharging. A mathematical model based on the enthalpy method was developed. In our computations, some simplifications which were considered in previous works (Hamid Ait Adine et *al*., 2009, Y.B. Tao et *al*., 2012,and Birol Basal et *al*., 2013) are eliminated.
Numerical investigations were conducted in order to examine the impact of the key parameters: the HTF inlet temperature which was considered a function of time delivered by the solar collector, the mass flow rate of the HTF and its velocity which was taken a Poiseuille velocity, on the charging and discharging processes of the PCM and on the thermal performances of the latent heat storage unit. Partial results show that when the flow heat transfer fluid is low gives a high temperature output which extends the storage period and thus delays the discharge cycle of PCM. (Figure 2.3).

Keywords: Enthalpy method, Latent heat storage Phase change material, solar energy

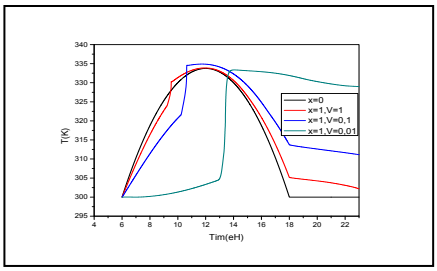

Figure2: Evolution of the outlet HTF temperature for different values of inlet velocity

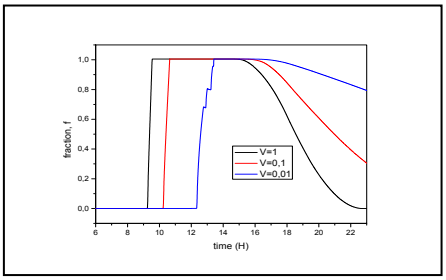

Figure 3: Evolution of PCM liquid fraction for different values of inlet velocity

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Optimisation of The Rear Surface Passivation Layer of Interdigitated Back Contact Silicon Heterojunction photovoltaic IBC/SHJ Solar Cell.

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Abstract: During the last years, the interdigitated back contact silicon heterojunction (IBC/SHJ) solar cell presents the most efficient and promising architecture in high efficiency silicon solar cells technology. Despite of this, the IBC/SHJ require more investigations to understand the physical phenomena and to reduce still the limiting factors like the front surface passivation (FSF), the interface quality a-Si:H/c-Si, the quality of contacts, the BSF and the emitter design, the doping and the band gap of rear surface passivation "intrinsic buffer layer". This last one constitutes our main objective in this paper.

For this, we have considered an n-type single crystalline silicon wafer (200µm, 4.8Ohm.cm). On the substrate, we deposit an crystalline silicon (20nm) followed by an antireflective layer SiN_x:H (n=2.03, 75nm). On the back side, an intrinsic amorphous silicon layer covered completely the rear surface. After, the back surface field $n^+(10^{19}cm^{-3})$ and the emitter regions are deposited and isolated by silicon oxide (gap=50µm). A numerical code was developed by using ATLAS-Silvaco package software to investigate the effects of the emitter design on the photovoltaic performances of this structure. The obtained results show that IBC-SHJ solar cells without intrinsic buffer layers proved robust nature of the structure. The cells with intrinsic buffer layer have shown VOC of 683 mV and JSC 36 mA, but with low FFs, and optimization to reduce this effect is undergoing.
addition, we will introduce new challenges of using this type of host matrices in microbiology (Djeribi *et al.*, 2012). This study will also permit us to discuss a new surfactant-free micropatterming process on the porous glass surface that we have enlightened with potential optical applications.

Keywords: protein Back contact, heterojunction photovoltaic solar cell, rear surface passivation, open circuit voltage, efficiency.

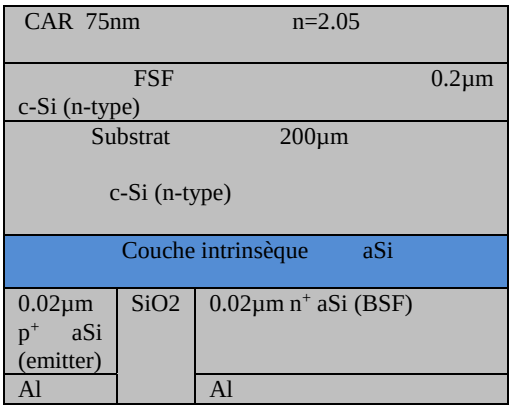

Figure 1: Structuire of heterojunction solar cells with interdigitated back contact (IBC/SHJ).

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Determination of critical micellar concentration in binary system:Cationic surfactant-Glycerol

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Abstract: The self-association of cationic surfactants dodecyltrimethylammonium bromide, tetradecyltrimethylammonium bromide, cetyltrimethylammonium bromide and the gemini 12-s-12 (s = 2, 3, 6) in pure glycerol solution has been studied at 21.3 °C. The critical micellar concentration (CMC) was determined by fluorescence spectroscopy; the determination of the excitation wavelength of pyrene in pure glycerol at 338 nm was found to be suitable for the determination of CMC. The results are compared with those reported in water for the same surfactants; the experimental evidence shows that the values of CMC increase considerably in glycerol media. This fact was attributed to two physical properties of glycerol compared with water: cohesive energy density and dielectric constant ε_r.

Keywords: Micellization; Nonaqueous media; Glycerol; CMC determination; Fluorescence technique; Pyrene.

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Optimisation of Screen Priting Process For Hight Efficiency Multicristalline Silicon Solar Cells.

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Abstract: During the last years, the interdigitated back contact In the PV industry, the metallization sequence constitutes a crucial step during the manufacturing of high efficiency multicrystalline mc-Si silicon solar cells. Indeed, the success of this sequence depends on the quality of the printing, the used metallic pastes and essentially the co-firing treatment. This last one presents a critical phase during the metallization process because the high thermal budget considered in the conventional belt furnace causes an important short-circuit of the emitter. Other hand, the low thermal budget not allows to silver particles to throughout the silicon nitride and the front metallic cannot be accomplished. To optimize the thermal budget, the co-firing temperature profile used in Tempress multi-zones infrared furnace (time, temperature) was intensively investigated during this study. The solar cells were analyzed by using lock-in thermography, Electroluminescence EL, Light Beam Induced Current LBIC and I-V characterization. The obtained results show the possibility to increase the 156x156 mm² multicrystalline silicon solar cells efficiency by 1.2%.

Keywords: silicon solar cells, screen printing, co-firing, contact resistance, characterization.

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Enhancement of Tilted Absorption Columnns in OffShore Projects using Reinforced Materials

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Astract—This research aims to compare reinforced packing absorption columns to conventional absorption columns using tray types. The efficiency of absorption columns under motion will be investigated and Counter current mode will be evaluated for tilt columns from packing efficiency point of view. By using different paking factors to reduce effects of the motions on the absorption columns, it was found that reinforced material with packing factors 20 f-1 and 22.5 f-1 have given the smallest diameters of the absorption column, it will be good option to reduce the effect of the tilt angles of the absorption column on the column efficiency.

Vapor/ liquid contact columns are used for a variety of purposes in oil and natural gas processing.

For example, oil may be fractionated in thermal distillation columns. In addition, sea water may be deoxygenated using vapor/ liquid contact columns prior to injection into an oil reserve for pressure maintenance. Further, air may be separated in a cryogenic distillation column system to produce oxygen which may then be used for a number of purposes including converting natural gas into synthesis gas.

In Oil and natural gas process and industrials usually used two types of vapor/ liquid contact columns (plate's columns and packed columns). The purpose of a packed bed is typically to improve contact between two phases in a chemical or similar process.

It is known in the art that the efficiency of a vapor/ liquid contact column is dependent on a number of factors including distribution of the liquid within the column. Optimum column performance may be achieved if liquid distribution in the column is uniform over the area of horizontal cross-section throughout the length of the column. This condition may be referred to as "steady state". Even small maldistribution of liquid can have a significant and adverse effect on columnmaldistribution due to tilt and motion caused by marine waves. Liquid and gas maldistribution could cause a severe reduction of performance even under tilt of a few degrees[2].

Offshore projects utilizing Absorption column will require more research to limit the effect of tilt.

Keywords: Tilt, Absorption column, Reinforced materials, Offshore projects, column efficeincy

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Kinetic study for the adsorption of Ethanol on Activated Carbon

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Abstract: Adsorption kinetics describes the rate of adsorbate uptake governing the contact time of adsorption reaction, which is an important characteristic defining the efficiency of adsorption (Zhen Peng Gao et al., 2013).The information on adsorption kinetics is also crucial to provide understanding on adsorption mechanism. This study is an important part of researches in adsorption because the mechanism of the process can be realized by kinetic constants. Knowledge about kinetic parameters provides valuable insight into the reaction pathway. As well the rate of adsorption which controls the resistance time is determined by kinetics (Hamideh et al., 2011). Adsorption of a gas in a microporous solid is probably a transport phenomenon. Gas transport in microporous solids is controlled by an active diffusion. In this case, the best mathematical model used to describe this phenomenon is Fick's law.

The physical model of kinetics adsorption of a gas by a microporous solid, proposed by (Mhiri et al., 2010) constitutes a base for the comprehension of the mechanism of this phenomenon we propose a new theoretical expression of simulation of gas quantity adsorbate in a microporous solid during time, in order to find a better correlation with the experimental (Figure1). This work proposes a physical sense of all terms appearing in this model. In this paper, we underscore the importance of the physical kinetic of gas adsorption by a microporous solid. Using a good choice of pairs, we have determined: the minimal distance from which the interaction forces adsorbate-adsorbent orients the adsorbate molecule to the adsorbent, the existence of a critical temperature and its effect on the relaxation time relative to the adsorbed matter quantity.

Keywords: Adsorption, Kinetics, diffusion, microporous solid, Fik's

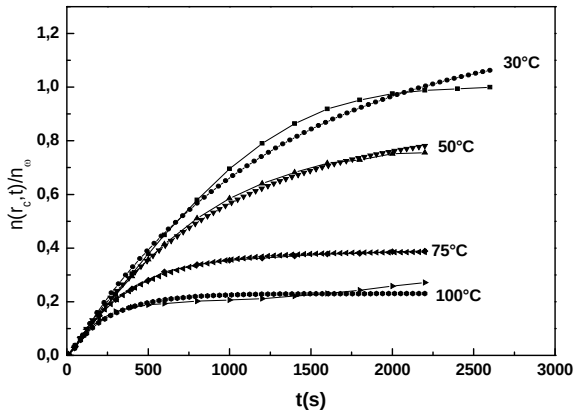

Figure 1: Evolution of relative quantity of ethanol adsorbed in activated carbon (----) theoretical curves (—) Experimental points.

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In situ transesterification of wet marine microalgae to biodiesel using supercritical methanol

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Abstract: In recent decades, the search for renewable and sustainable fuels is becoming necessary for the global energy demand. Currently, biodiesel has attracted public attention as a new alternative of renewable energy for replacing petroleum diesel. First and second-generation biodiesel is composed of fatty acid methyl esters (FAMEs) produced conventionally from the triglycerides present in vegetable oils. Nowadays, microalgae have been suggested as the most promising candidates for third-generation biodiesel production because of: (1) comparing with other energy crops, microalgae present higher biomass productivity, faster growth rate and higher lipid accumulation levels (Im *et al.*, 2014); (2) microalgae can grow successfully on degraded land unsuitable for food production in open ponds and variety of photobioreactors, avoiding the use of arable land and the competition with food crops (Wang *et al.*, 2013); (3) for their photosynthetic activity, microalgae use solar energy and atmospheric carbon dioxide as substrate, and they can also be coupled with the sequestration of waste CO_2.

In the present study, the direct supercritical methanol transesterification of the wet marine microalgae *Nannochloropsis gaditana* Lubián CCMP 527, cultivated in outdoor open raceways, was carried out. The process was conducted in only one step and without the use of catalysts. These microalgae, which have a lipid content of 22 wt% on dry and ash free basis, were directly used after cultivation and centrifugation, and any washing step was performed to remove residual salts. Experiments were conducted with 25 g of wet algal biomass (80 wt.% moisture) in a stainless steel cylindrical reactor of 83 ml capacity to study the influence of reaction temperature (245–290 °C) and reaction time (10–50 min) at a methanol to dry algae ratio of 10:1 (vol./wt.) (optimal ratio, internal communication). The reaction was monitored by gas chromatography to analyze FAMEs. The analysis of FAMEs was performed according to the standard UNE-EN 14105:2003. The pressures reached inside the reactor at 245, 255, 265, 275 and 290 ºC were 7, 13, 20, 26 and 34 MPa, respectively.

Keywords: microalgae, *Nannochloropsis gaditana*, *in situ* transesterification, biodiesel, supercritical methanol, fatty acid methyl esters, one-step catalyst-free process.

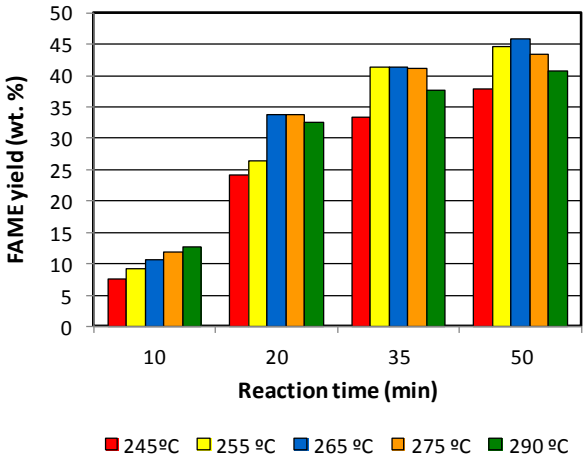

Figure 1: Effect of temperature and reaction time on the yield of fatty acid methyl esters (biodiesel) from wet *Nannochloropsis gaditana*.

Resuts showed that the FAME yield increased gradually with the reaction time at all the tested temperatures (see Figure 1). Likewise, the FAME yield increased gradually with the temperature at 10 min reaction time, while at 20, 35 and 50 min the yield increased up to 255-265 ºC and then decreased at higher temperatures, especially at 290 ºC. The clear decrease in yield at 290 ºC can be attributed to the thermal degradation of unsaturated fatty acids present in the algal biomass (Quesada-Medina and Olivares, 2011). Accordingly, the maximum FAME yield, reached in the optimal reaction conditions (265 ºC and 50 min), was 45.8 wt.%.

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Design of a Grid-Connected PV System For a company (SICEM) in Tataouine - Tunisia

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Abstract:
This paper summarizes the approach and the results of a feasibility analysis of a grid connected photovoltaic system specific for the Industrial Society Mineral Water Conditioning in Tataouine (SICEM) in Tunisia.

Three major factors justify the potential benefits a photovoltaic installation for the industrial facility of SICEM including:

- Significant electrical energy requirements to operate the facility. A PV system can provide a cost-effective alternative to the grid in order to generate electricity locally.
- Tataouine has one of the highes levels of direct solar radiation in Tunisia
- Potential significant reduction in carbon emissions associated to the reliance of PV system rather than fossil fuel to generate electricity.

Using hourly simulation analysis tool, HOMER (Hybrid Optimization Model for Electric Renewable),optimal design options for a PV system for SICEM company are evaluated. A series of optimization and sensitivity analyzes is carried out to determine optimal PV system size suitable for SICEM based on its current electricity needs.

Using the current STEG average electricity price of 0.210DT/kWh, it is found that the optimum size for the PV system is 900 kW allowing to generate over 47% of the total facility electrical energy needs. The cost of energy associated with the installation of the optimal PV system is found to be 0.207DT/kWh based on the current capitals costs of PV installations in Tunisia. The results of the sensitivity analyses indicate that the cost-effectiveness of the photovoltaic system is strongly depend on the price of the electricity that can be obtained from the STEG (i.e., the grid).

Keywords: Mineral Water Conditioning, Photovoltaic, Electricity, sensitivity, optimization,HOMER, Life-Cycle Cost Analysis, Tunisia.

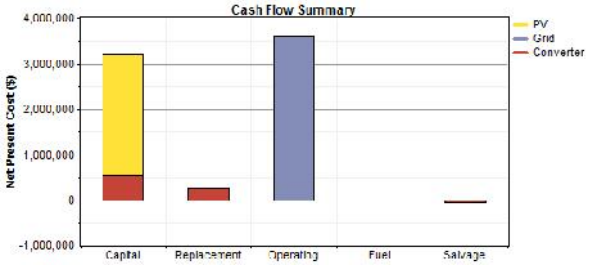

Figure 1: Figure illustrating the results of the economic analysis for a photovoltaic system using HOMER optimization tool.

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