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BOOK OF ABSTRACTS

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Book of Abstracts

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Smart greenhouse prototype powered by solar energy: Case study of Madinah City, KSA

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Abstract

Monitoring, supervision and control of environmental parameters inside greenhouses are essential. To reach high crops an appropriate environment (e.g. air temperature, relative humidity, CO2, etc) inside the greenhouse should be provided. Recently, the integration of clean energy sources (such as solar photovoltaic energy), and internet of things (IoT) playing very important role in the development of smart greenhouses. The main aim of this work is to design a smart greenhouse powered by a photovoltaic (PV) system in Al-Madinah city, Saudi Arabia. The integrated PV system is used to supply a DC-air conditioning, two water pumps, two fans, and a data-acquisition system, whichused to monitor essential parameters inside the greenhouse. The measured data have been then uploaded on a Web page (Cloud) for eventual online surveillance and controlling of the greenhouse. Results demonstrate the capability of the designed prototype to monitor and control the greenhouse remotely.

Keywords: Greenhouse, smart monitoring, IoT, photovoltaic, control and supervision.

Hybrid solar desalination system: Case study of Madinah City, KSA

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Abstract
In this work a hybrid solar still water desalination prototype was designed. A monitoring system has been developed and integrated to the solar still system in order to control online its efficiency, as well as the quality of the provided water by checking sensing parameter such as PH. Experiments showed that the daily yield of the solar still system depends mainly to its capacity, size and environment parameters (such as solar irradiance and air temperature). Furthermore, by adding a solar preheater system, the evaporation process has been accelerated and consequently the daily yield has been improved and reached about 12 L/m^2/day. The whole system including preheater, water pump, valve, electronic boards are powered by a small stand-alone photovoltaic system.

Keywords: Solar still, hybrid solar still, photovoltaic, monitoring

Analysis and optimization of the CIGS/ZnS structure for photovoltaics Applications

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Abstract

In the present work we studied, simulated and optimized the solar cell thin film structure made of CuInGaSe semiconductor on a metallic substrate. The main idea is to replace the buffer layer consisting of CdS by another layer consisting of ZnS in order to avoid toxicity. The temperature effect on both bandgap energy and efficiency was taken into account. In addition, the output parameters of the ZnS/CIGS based solar cell were simulated and optimized. The optimal efficiency of the solar cell is around 22.6%, it is given for a gallium composition of 30% where the bandgap energy is 1.16 eV and the fill factor FF=83%. In perspective another buffer layer can be used, such as ZnSe. Also, we can use double buffer layers to improve the performance of the solar cell.

Keywords: New Material, thin film, solar cell, optoelectronics.

Comparison between ranking and rating weighting methodologies in GIS baseds

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Abstract

Despite that, the energy consumed in the last years was primarily non-renewable (fossil fuels, gas…etc.) there is a global trend for constructing new projects to use renewable resources like wind energy and solar power and these projects are controlled by international legislation. Geographical information systems and multi-criteria analysis have proved to be effective and efficient tools in selecting the suitable locations of large Photovoltaic Solar Panel sites (PV sites) based on multiple criteria with different weights. In this work, the efficiency of ranking and rating weighting methodologies was assessed using a case study of finding the most suitable locations for building large PV sites in Chania and it was found that both methods are able to discriminate the importance of each criterion. However, the ranking method is not able to give the same weight to more than one criterion. Moreover, the ranking method has a smaller number of suitable areas with higher means and smaller standard deviation which can reduce the choices for the decision-makers.

Keywords: multicriteria analysis, PV site suitability mapping, ranking and rating weighting methodologies

Modeling and Improvement of Nanostructures for Optoelectronic Components

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Abstract
In this paper, quantum well nanostructures based on InGaAsSb quaternary materials grown on GaAs substrate were studied, simulated and improved. We considered the effect of the concentrations of indium (In), antimony (Sb) and temperature (T), on the optical properties such as optical gain (G) and the corresponding emission wavelength (λ). The well width (L_w) and strain (s) effects were also taken into account. Near-infrared light (NIR) photodetectors can be realized. In the future, we will optimize a mid-infrared (MIR) ultrafast high-frequency photodetectors.

Keywords: III-V-Sb semiconductors, Nanostructures, Laser Diodes, VCSELs, photodetectors.

Night natural ventilation and energy saving in high thermal mass historical building in hot dry climate

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Abstract
The thermal comfort and air quality inside buildings spaces is much recommended in Nowadays for human's health and environmental protection, especially if the inside comfort conditions are assured by passive systems means. In the hot dry climate such Laghouat city in the south of Algeria, the first consideration in architectural design is given to the building envelope, referring to the vernacular architecture in the region. The buildings with high thermal inertia envelope ensure the inside thermal comfort while it is properly closed during day time when the outside air temperature is high, in hot dry region the night outside air temperature varies between 15 and 20°C, the night natural ventilation through windows properly orientated and dimensioned can lower the inside air temperature during night and evacuate the polluted inside air. The low inside temperature during night leads to a low inside temperature during day time, which has a good effect on energy saving during summer period where air conditioning is needed for more than seven months per year in this region.
This paper aim was to examine the impact of night natural ventilation in high thermal inertia buildings on energy saving, first a field work was carried out by measurements of inside air temperatures in two identical rooms of an old hotel called Marhaba with high thermal inertia envelope built with local materials. In the first room the night natural ventilation was allowed when the outside temperature was lower than the inside one by opening windows and the other room was closed around the clock. Second, a numerical simulation was conducted to evaluate the field measurement results to choose the accurate software for further simulations to find the appropriate windows orientation, dimensions and positions can give high energy saving performances in buildings with high thermal inertia envelope in a hot dry climate.

Keywords: Thermal comfort, **A**ir quality, **T**hermal mass, hot dry climate, **N**ight ventilation.

Design of CSP-PV Hybrid Solar Plant for Low LCOE and Round the Clock Power Generation

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Abstract
The utilization of solar energy for clean power production is gaining much popularity and wide acceptance in a shorter period than other renewables. Still, to satisfy the growing exigency and commercialize to the fullest extent, several improvements on a larger scale must be made both in concentrating solar power (CSP) and photovoltaic (PV) technologies. This work demonstrates a novel CSP-PV hybrid solar power technology wherein the demerits of both systems are alleviated. The key hindrance restricting the installations of CSP systems is its high electricity costs when compared to PV. But the advantage of CSP systems over PV is the incorporation of cost-effective thermal energy storage (TES) systems by which dispatchable electricity is available anytime. CSP with TES is highly flexible to meet the peak energy demand. On the other hand, a PV system without storage fails in supplying a continuous output. Hence a novel CSP-PV hybrid system is conceptualized, where the CSP system is designed to deliver power through TES during off sunshine hours and the PV system takes care of the requirement during the daytime. The simulations are carried out using Greenius software. A comprehensive LCOE analysis is performed to deduce the viability and stability of such a hybrid system, and it is found that that the LCOE of the proposed system is slightly lower than the CSP system. The major benefits that could be obtained using the system are its increased capacity factor, increased power production and decreased electricity cost. It is also quite evident from the study that the TES can penetrate PV based hybrid systems also.

Keywords: CSP, PV, Thermal energy storage

Examination of the Effect of Different Window Types on Energy Use in Turkish Apartment Buildings

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Abstract

In this study, the effect of different window types on energy use in Turkish apartment buildings is investigated. The example building is calibrated and used for analyses according to Turkish Insulation Standard TS 825 for the 5 different climate zones. In this study,, twelve different glazing types are selected for analysis. Also, the frame type changed to a PVC frame which is mostly used frame type in Turkey. As a result, the minimum heating loads are calculated for the W12 glazing type and the minimum cooling loads are calculated for the W1 glazing type. Thus, the U value is not the only value that affects the energy use intensity, solar heat gain coefficient (SHGC), and visible transmission (VLT) values are also important. Finally, the effect of glazing on the amount of CO2 emission is examined.

Keywords: Glazing, SHGC, Apartment Buildings, CO_2 emission, TS 2164, TS 825

Treatment of Pharmaceutical Liquid Effluents by biosorption using a vegetable biomaterial

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Abstract
The pharmaceutical industry is an important source of pollution. It uses a number of processes related to water use. Wastewaters are found with huge quantities of harmful substances and there elimination is the subject of much research using different biosorbents. *Luffa Cylindrica* plant, commonly called sponge gourds, belongs to the cucurbitaceae family. The fruits have a network of fibers surrounding a large number of flat blackish seeds. This work concerns the study of the possibility of using *Luffa Cylindrica* for the treatment of industrial liquid effluents. A study of the adsorption kinetics of contaminants, measuring the discharges parameters of pharmaceutical liquid effluents (pH, turbidity, conductivity et biological oxygen demand) was performed. The pH values found (pH=7.5) are significantly lower than the initial pH value of the output effluent (pH=7.87). Turbidity is decreased of 12 % than the initial value (16.48 NTU). The conductivity is reduced considerably (from 1.5 to 0.4 ms). However, treatment with *Luffa Cylindrica* has no effect on the $D.B.O_5$. following these results, Luffa Cylindrica can be considered as a promising biosorbant for the treatment of liquid effluents. İt is an economic biodegradable and ecofreindly material.

Keywords: Biosorption, Discharges parameters, Liquid effluent, Luffa Cylindrica

Removal of Zinc ions Zn (II) from aqueous solution by biopolymer membranes

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Abstract
This study focuses on the development of biosorption systems based on two biopolymers namely chitosan and pectin and their uses for the binding of Zinc ions Zn (II) from aqueous solution. The chosen form is the membrane form prepared by the gelation method. The membranes were also produced by the complex Pectin / Chitosan biopolymers. The membranes formed are smooth and transparent films. The study of the biosorption kinetics of Zinc ions Zn (II) on the membranes produced shows that the complexation of chitosan by pectin improved its biosorption capacity from 0.05 g / g for chitosan alone to 0.16 g / g for the Pectin / Chitosan complex.

Keywords: Biopolymers, Membrane, Biosorption

Selective hydrogenation of 2-methyl-3-butyn 2-ol in microcapillary reactor for fine organic synthesis. Effect of support doping on stability and kinetic parameters

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Abstract

The purpose of this work is to present our latest achievements in the design, synthesis and development of a new catalytic microreactor for the processes of selective and continuous synthesis of substances with added value, used in fine organic synthesis and pharmaceutical industries. In this advanced reactor device, metal nanoparticles are embedded in mesoporous materials, which are deposited in the form of highly active and selective catalytic films on the walls of capillary microchannels with diameters of 530 μm. Potentially the most stable coatings are crystalline or amorphous titania-based mixed metal oxides synthesized by the sol-gel method and containing embedded catalytically active PdZn nanoparticles. The catalytic properties of $PdZn/Ti_xM_{1-x}O_{2\pm y}$ (x = 0; M = Ce, x = 0.95; Zr, x = 0.8) for the liquid phase hydrogenation of 2-methyl-3 butyn -2-ol are tested with an emphasis on the stability of the catalyst during the reaction. The initial activity of the microcapillary reactor increases for cerium doped titania, which is related to the adsorption properties and activity of the active site. The surface of the active site changes under the reaction conditions. Residues of O_2 lead to decomposition of selective Pd-Zn centers and oxidation of palladium. The modification of the morphology and the electronic structure of active component by titania doping with Ce and Zr are accompanied with a decreased stability. The developed $Pd_{50}Zn_{50}/TiO_2$ coating was the most stable and showed a higher activity (1.5 $g_{MBE} \cdot g_{Pd}^{-1} \cdot sec$) and selectivity (96.7%) in comparison with the coatings described earlier in the literature and with the industrial Lindlar catalyst, and retained high catalytic performance after 88 hours of reaction.

Keywords: capillary microreactor, selective hydrogenation, 2-methyl-3-butyn-2-ol, PdZn nanoparticles, multicrystalline coatings, titanium oxide.

Rapid and direct DNA Detection by Biosensor based on Localized Surface Plasmon Resonance

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Abstract

Herein, we have systematically investigated the sensing performance of silver nanoparticles (AgNPs) deposited on silicon nanowires (SiNWs) nanohybrid systems for label free and direct detection of various DNA samples. The microstructures of the fabricated nanocomposites of AgNPs/Si and AgNPs/SiNWs have been investigated in detail as function of composition of metal precursor solution and deposition time. Surface enhanced Raman spectroscopy (SERS) enhancement of composite substrates was analyzed and correlated to the corresponding micro-structural features of hybrid structures. At optimum deposition time 30s, highest SERS performance was achieved with excellent reproducibility. Rapid, cost-effective, highly sensitive, label free detection of DNA was demonstrated with 4 x 10^{-8} M solutions using the developed hybrid substrates which showed sharp Raman peaks corresponding to various DNA constituents.

Keywords: Surface enhanced Raman spectroscopy, Biosensor, Silicon Nanowires, DNA.

Photocatalytic properties enhancement of Silicon Nanowires/ZnO composite by metal nanoparticles decoration

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Abstract

Water pollution is emerging as a serious ecological threat due to the rapid increase in population and industrialization. Almost 20% of global water contamination has reported to be contributed by discharge from textile industries, which mainly contained various organic dyes. In this work strong photocatalytic properties enhancement for water purification has been demonstrated using hybrid system based on Si Nanowires (SiNWs) and ZnO composite decorated with metal nanoparticles (Ag NPs, Ni NPs). Microstructure, surface morphology, phase composition and optical properties of the prepared structure were characterized using X- ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). The results indicate that thermal treatment favours the transformation of amorphous ZnO into wutrize phase. MNPs with a size in the order of □ 20 nm are uniformly distributed in the SiNWs/ZnO composite without damaging the ordered structure. The loading concentration of the MNPs was finely controlled by the immersion time. Compared to untreated SiNWs, the SiNWs/ZnO hybrid shows strong photocatalytic activity toward Methylene blue (MB), Alizarine and atrazine pollutants. Under UV and visible light 95 % of pollutant removal is obtained after addition of H2O2 solution (Fig. 1).

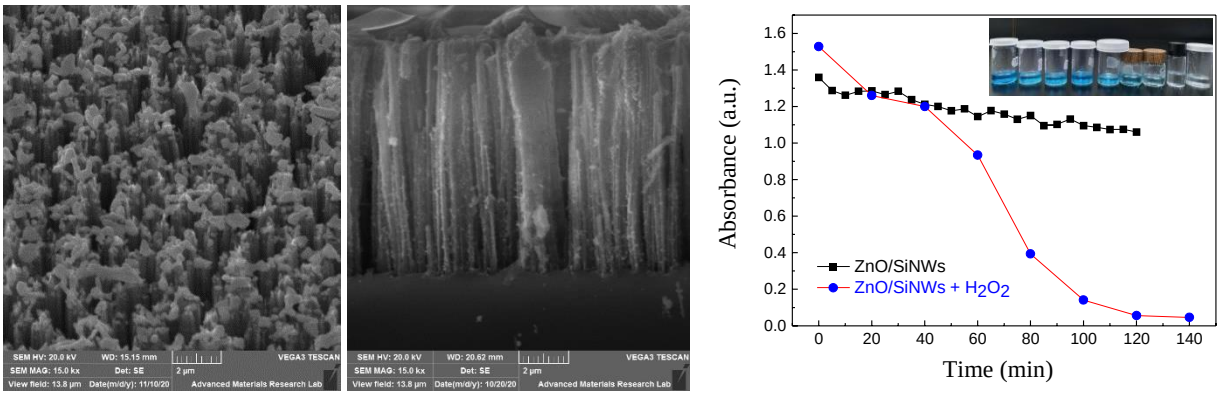

Figure 1: Scanning Electron Microscopy (SEM) images of SiNWs/ZnO composite: (a) top view and (b) cross-section view. (c) Variation of the absorbance of MB with irradiation time for SiNWs/ZnO: effect of H_2O_2 addition.

Keywords: SiNWs, Silver nanoparticles, Methylene Blue degradation, Nickel Nanoparticles

Optimal Design for Minimization of Entropy Generation of Flows Through Treelike Network

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Abstract
The widespread use of power systems technology is a growing need, and a reduction in the scale of their size, requires a special attention not only on heat flux performance, but also on performance of the fluid flows that carry the heat. The structure of networks that provide optimal transport properties has is recurrently found to be a tree where a tube branching into two daughter tubes is the fundamental building block of the tree. This study addresses the problem of how to connect a parent tube to two daughter tubes, under size constraints, using straight smooth tubes or corrugated tubes for nanofluids. Optimal designs of Y-tubes are obtained based on entropy generation minimization for turbulent flow. Every geometric aspect of this fundamental building block of the tree is obtained based on an analytical model.

Keywords: smooth tubes, corrugated tubes, nanofluid, optimal design, entropy generation minimization, constructal design.

Techno-Economic Feasibility Study of integrating Solar Heated Feed Water to a Conventional Steam Power Plant

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Abstract
Technical and economic feasibility of heating feed water of a co-generation power plant through integrate parabolic trough solar collectors has been provided in this work. The extracted steam from steam turbine to the highest-pressure feed water heater is saved by assistance of solar energy, thus decreasing fuel consumption in steam boiler. The study is based on a 62 MW Heavy fuel oil fired power plant for Shoaiba weather conditions. A numerical simulation model was created by TRNSYS simulation software to find the annual performance of the power plant integrated with solar system. The results are validated with the measured data of the conventional power plant. The annual performance of the system is estimated as the average solar power generation and solar fraction in FWH. It was found that Optimum at which the system the maximum LCS was obtained and equal 41.5
$M at 150,000 m2. It can achieve an annual solar fraction of about 28% which 1.72E+11 kJ. Economic feasibility analysis is considered in this work to estimate the life cycle savings (LCS), levelized cost of energy (LCOE) and amount of fuel saved. Based on the economic study, the payback lifetime is about 14.6 years. An economic advantages of reducing the fuel consumption and reducing the CO2 emissions are the main benefits of this study. This study summarized that total of 4,619 tons fuel can be saved and 777.34 tons CO2 can be avoided. It can be concluded that, the integration of higher-pressure feed water heater with solar energy is found feasible in terms of LCS. Same methodology can be applied on other plants around the globe to estimate the economic feasibility.

Keywords: “Solar aided power generation system, Direct steam generation DSG, conventional power plant, solar parabolic trough collector; TRNSYS simulation software.”

Evaporation of a binary liquid film flowing down a vertical plate covered with a thin porous layer

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Abstract
This paper summarizes the numerical study of coupled heat and mass transfer during evaporation of binary liquid film. The binary film is falling down on one plate of a vertical channel under mixed convection. The first plate of a vertical channel is covered with a thin porous layer of thickness δ and externally subjected to a uniform heated flux q1 while the second one (y=d) is dry and isothermal. The binary liquid consists of water (the more volatile component) and ethylene glycol while the gas mixture has three components: dry air, water vapour and ethylene glycol vapour. The results discuss the effects of liquid film composition, porous media characteristics and of the inlet parameters on the heat and mass transfer performance and on the liquid film evaporation.

Keywords: Porous medium, film evaporation, binary liquid film, Mixed convection, Coupled heat and mass transfer

The challenge in damage claim in Brazilian energy sector – customers and service providers responsibilities

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Abstract

The scenario: Brazilian electric policies and regulations define customers' reimbursement by possible damages caused by the energy distribution services. Some kind of events could cause possible damages to users´ appliances connected to the grid, as unsafe and unprotected private energy network and/or energy grid disruption, non-compliance energy services, operational intervention, environmental or climate occurrences into a provider or home grids. Moreover, there are no standardized or audited regulated procedures in the country to guarantee better energy home installations and regular inspections to avoid obsolescence and detect co-responsibilities.

Considering the historical customer claims requiring reimbursement (judicialized or not), damage claims quantification and qualification indicators were defined, and money and controls dispended were analyzed as a big data processing. An analytical and AI tool was developed to support operational strategies to avoid or decrease the number of claims and customers' appliance damage.

The solution: analytical process dealt with around 11 million energy installations at an energy distribution company over 5 years of grid and relationship information (2 Terabytes of data). It provided support to appliances energy fragilities analysis and metrology evaluation by lab-specific studies, as well as grid simulations to understand the quality of energy service offered, possible interferences of distributed energy generation, and digitalization currently aggregated to the grid. This approach also concerned with grid events analysis; maintenance and investments strategies; improving business; human resources, and leadership competencies to deal with customers' claims; and workflow scope review, from attendance effectiveness from the multi-channel relationship to regulated/nonregulated process operationalization. The tool deals with the possible events' causes; climate correlations; and operational and organizational interferences from the regional and local grid.

Procedure's review and better practices in a dynamic way with the world market reinforce the necessary Brazilian regulatory updating to accommodate the grid digitalization, robustness, and service quality, rethinking and evolving services providing.

Keywords: Energy policies, Damage claims, energy grid, customer relationship, customer co-responsibility

Analytical Studies for Thermo-Physical Properties of Nanofluids Based Water with Different Nanoparticals Concentrations

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Abstract

Thermo-physical properties of current nanofluids are tremendously improved by suspending nano-sized solid particles with specific diameters are considered as potential working fluids for the applications such as solar collectors, heat pipes, nuclear reactors, cooling systems, automobile radiators etc. Nanofluids is the resulted fluid after adding nanoparticles to a base fluid which will alter the thermos physical properties of the base fluid and obtain new properties under each concentration. Numerical results obtained from many references were examined and analyzed to establish the basis of calculation. As in water–Al_2O_3 mixture, studies have clearly shown that the inclusion of nanoparticles into the base fluid has produced a considerable augmentation of the heat transfer coefficient that clearly increases with an increase of nanoparticle concentration. Therefore, in this paper, the analysis will be carried out to obtain newly induced thermos physical properties under the effect of different particle concentrations and different nano materials such as Al_2O_3, CuO, TiO_2 and SiO_2. As a result, useful correlations were observed upon increasing the volume fraction of each nanofluid, positively improving their thermal conductibility. In addition, upon suspending over 0.5% of nanofluid particles on water based nanofluids, a linear correlation of thermal conductibility enhancement by the increment of thermal conductivity with the increment of suspension of nanofluid particle. That is, 0.14% increase of themral conductivity increments for each 0.1% Aluminum Oxide (Al_2O_3) suspended on the water-based nanofluid.

Keywords: Nanofluids, Thermos-Physical Properties, Volume Fraction, Water-Based Fluid.

Analysis of a co-generation parabolic trough solar power plant using reheat Rankine power cycle

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Abstract
This paper examines the energetic and exergetic performance of a co-generation solar power plant that uses parabolic trough collectors (PTC) produce electricity and heat utilizing a reheat Rankine power cycle. The co-generation plant produce 50 MW electricity and 104.6 MW of thermal energy as heat at temperatures of 50 – 80 C. The integrated solar co-generation plant is designed to overcome the intermittent nature of solar energy and extend hours of operation by using a 12 hours Thermal Energy Storage (TES) system. The analysis results showed that the PTC's is capable of producing a useful energy rate per single collector of about 596.09 kW and a temperature of 654.7 K with an efficiency of 78.5%, while the power cycle energy and exergy efficiencies are found to be 55.5 and 32.3%, respectively.

Keywords: Solar energy, Energy, Exergy, Parabolic trough collector, efficiency

Radiant Floor Heating Using Different Phase-Change Material Configurations: A Comparative Study

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Abstract

Globally, more than 40% of electrical energy consumption is associated with the residential sector. The utilization of phase-change materials (PCMs) in building components and building service equipment is gaining significant attention worldwide. Owing to their high energy storage capacities, these materials regulate the indoor temperature and reduce energy consumption. In the present study, a finite element heat transfer analysis of radiant floor heating is presented. Performance values for radiant floor heating with and without PCMs are predicted. The effects of the shape and spatial location of a PCM on the thermal performance of radiant floor heating are also determined through different finite element models. The predictive capability of the finite element model is validated using experimental data.

Keywords: Finite element modelling, thermal analysis, phase-change material (PCM).

Numerical Investigation of the Morphological Characteristics of Nighttime Thermo-Electric Generators

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Abstract
An efficient and effective way of nighttime electricity generation is by the use of thermoelectric generators (TEGs) through Seebeck effect. Unavailability of sunlight at night make the photovoltaic systems non-functional thereby rising the need of an electricity generation by means of TEGs. A significant improvement in the performance of to date TEGs is required while drawing electricity based on the temperature gradient available at night between the earth and the atmosphere. In this regard, a numerical investigation has been carried out to study the morphological characteristics of TEGs. The geometrical model includes a TEG sandwiched between a circular plate, placed on its top, whereas an insulated block with another circular plate on the bottom. The numerical model used a combined thermo-electric module similar to the experimental setup of Raman et al (Raman et al., 2019). After the model is validated with the experimental results, morphological study was conducted at first by changing the material type of the two plates and the insulated block were varied from aluminum to copper. Then, the effects of thickness of the plates was also investigated on the performance of TEGs. Results revealed that assigning copper as a material in the setup enhanced the output power. Moreover, it was observed that a reduction in thickness of the plates decreased the maximum output power from TEG increased. The findings of the study hinted at potential of performance improvement of TEGs using heat transfer improvement techniques.

Keywords: Thermoelectric generators, Thermoelectric module, Renewable energy, Radiative cooling,Power generation

Thermodynamic performance assessment of a solar-driven tri-generation system for use in Saudi remote areas

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Abstract
In Saudi Arabia, the need to develop multi-generation energy systems that produce, simultaneously, power, cooling and desalted water with less energy consumption and high overall efficiency is desirable mainly when driven by sustainable energy source such as solar energy. This study presents a thermodynamic analysis on the performance of an innovative tri-generation system for simultaneous production of power, cooling and fresh water. The proposed system, driven by solar energy, comprises an organic Rankine cycle (ORC), for power generation and a combined adsorption cooling/desalination system, for cooling and fresh water production. The main objective of the study is to simulate and evaluate the productivity and the overall efficiency of the tri-generation system under Saudi weather conditions using different indicators. Besides, a comprehensive parametric analysis to assess the effect of different parameters such as inlet turbine temperatures on the overall system performance will be conducted. With a moderate small scale system, it was demonstrated that such trigeneration systems are feasible and capable to deliver, in average, around 70 kW of electrical power, 30 kW of cooling rate, and 45 $kg_{(fresh\ water)}$/h.

Keywords: Solar energy, Trigeneration, ORC, Adsorption cooling, Desalination

Adding Chilled Water Storage System for Load Enhancement of Chiller Plants in a Local Establishment

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Abstract
Chilled water storage system is a storage medium that is charged (filled) during periods of low chilled water demand (off-peak) and discharged during on-peak periods, to meet air conditioning load. The system consists of a storage medium, a packaged chiller, interconnecting piping, pumps and controls (Hilal Al Quabeh, 2020). The main reason, which justifies such system, is that it significantly cuts operating costs by cooling with cheaper off-peak energy and reducing or eliminating on-peak demand charges. This study is conducted in a local establishment cooling system that has two chiller plants; each has six chillers. Each chiller has a capacity of 600-ton refrigeration full load with a daily electricity consumption of 800 KW. The chillers operate at full load during peak hours from 7AM to 7PM. It has been observed from historical data that the upper limit of cooling capacity of the efficient chillers was 3,225.3 KW, with a plant capacity of 16,587.42 KW. Chilled water storage system is implemented with optimal operation using 4 chillers with base operation of 12,901.2 KW cooling capacity. In addition, tank storage system volume was calculated to be 490 m^3, with dimension of 19 m length, 10 m width and 3 m depth.

Keywords: Air conditioning load, Chilled water, Storage system, Off-peak, On-peak.

Three-dimensional thermal interaction model of ultrafast-laser train focused beams with human skin tissues

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Abstract

A three-dimensional thermal modeling of model human skin tissues subjected to pulse train irradiation for killing the skin cancers is carried out. In fact, the treatment of the focused beam is formulated using the FTn Finite Volume Method (FTn FVM) to solve the combination of the ultrafast radiative heat transfer and transient bioheat transfer in skin embedded with a small tumor. Accurate predictions of tissue temperature have been obtained. The impacts of absorption and scattering coefficients of tumor has been investigated. The results show that the increase of the absorption coefficient of tumor increases the rate of temperature rise, and is maximum value is obtained for the highest absorbing inhomogeneity due to the increased amount of absorbed laser energy. However, the temperature rise is not significantly different from that homogeneous tissue when there is a variation of the scattering coefficient of the tumor. The results showed, also, that as the scattering coefficient of the tumor increases, the maximum of temperature decreases due to the major chunk of laser energy is scattered away from the tumor. Therefore, the proposed 3D thermal modeling is significant for getting suitable laser properties for any thermotherapy of the tumor. The model can accurately predict the temperature distribution in the whole 3D human skin tissue at any time instant.

Keywords: 3D ultrafast radiative heat transfer; transient Pennes bio-heat equation; the FTn finite volume method; thermal therapy of the tumor.

Large-scale Fire Tests in Makkah' King Abdulaziz Road Tunnel

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Abstract

Tunnel fires is one of the most dangerous catastrophic events which may endanger human life and causes costly damage to infrastructure due to the tunnel limited space, the littleness of escape facilities and difficulty arriving of intervention forces to fire position, especially in the high crowding areas such as Makkah in Hajj season. Consequently, it is necessary to study tunnel fire impact and introduce new safety regulations and standards to limit the tunnels fires disaster and preserving human life and the property. Unfortunately, the possibility of performing experimental tests in tunnel fire safety is particularly challenging due to the prohibitive cost, the limited possibilities and the losses that these tests may cause. Therefore, large-scale modeling using fire dynamic simulation is one of the best techniques used to limit these costs and losses. In the present work, a fire scenario in Makkah' King Abdulaziz road tunnel has been anlyzed using Fire Dynamics Sinulator (FDS). The effects of the heat released per unit area (HRRPUA) and the soot-yield on the gas temperature, the radiation, the concentrations of the combustion products CO and CO_2, the air velocity and the flame lengths have been examined. The results demonstrated that it is crucial to address tunnel safety. In addition, this issue could extend to influence the tunnel structure as this requires conducting other comprehensive research and studies.

Keywords: Tunnel fire, heat release rate, gas temperature, ventilation of road tunnels, smoke control, Fire Dynamics Simulator (FDS).

Latent heat storage in a random porosity metal foam filled with a phase change material

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Abstract

This work aims to study the enhancement of a latent heat thermal energy storage system LHTESS using a phase change material PCM by integrating a solid structure (metal foam) of a high thermal conductivity inside the PCM. The metal foam is integrated in order to increase the effective thermal conductivity and then to accelerate the storage process. The storage medium obtained is treated as a porous medium. Most of previous similar studies consider the medium having a constant porosity. Nonetheless, a random porosity could be more realistic. In the present study a random porosity distribution between 0.4 and 1 will be considered. The volume-averaging technique and the Darcy-Brinkman model are adopted for the mathematical formulation. The control-volume-based-finite element method VCEF is used to numerically solve the governing equations. A pseudo-random generation procedure was applied to generate different configurations of random structures. The PCM melting (storage stage) of different samples of random porosity distributions will be compared to the case of a constant porosity. Results will be presented in terms of isotherms, streamlines of the flow induced by natural convection and liquid-fraction.

Keywords: Latent heat storage, porous media, random porosity, enhancement of storage efficiency,

INFLUENCE OF POLYETHYLENE COVER DEGRADATION UNDER SEMI-ARID CLIMATIC FOR GREENHOUSE

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Abstract
The covering material is the most important aspect used on greenhouse influences the productivity and performance of a structure. Covering materials impact on the level and quality of light available to the crop. Low density polyethylene LDPE is one of the most frequently used materials in plasticulture and its utilization as agricultural greenhouse covers is the most applicable. The main objective is to investigate the impact of degradation of low-density polyethylene film, used as greenhouses covers, under semi-arid simulated climatic conditions on their thermal stability, and the influence of condensation and cover dirt smudge on thermal effect of polyethylene plastic tunnel greenhouse in Ghardaïa region has been evaluated. The results show that, according to the material used to cover the greenhouse, a gradual decrease of transmissivity is conditioned by the daily variations of dirt smudge and condensation which are influenced by the chemical composition of the cover materials and consequently the greenhouse microclimate.

Keywords: Greenhouse, Solar energy, Transmissivity, Polyethylene film.

Thermodynamic analysis of Maisotsenko cycle (M-cycle) under weather conditions of Jeddah

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Abstract

This paper deals with analyzing the performance of a Maisotsenko cycle (M-cycle) in Jeddah, the Kingdom of Saudi Arabia (KSA). The average hourly temperature and relative humidity (ϕ) of the extreme summer weather conditions of Jeddah are considered. Theoretical models using mass, heat, and exergy transfer are developed. The results are expressed in terms of dew-point effectiveness (s_{dew}), wet-bulb effectiveness (s_{wet}), coefficient of performance (COP), cooling capacity (Q_c), exergy efficiency (5_{II}), sustainability index (SI), and exergetic COP (COP_{ex}). Results indicated that the M-cycle reduces the temperature significantly during July. The M-cycle is an alternative to HVAC systems.

Keywords: Maisotsenko cycle (M-cycle); Dew point cooling; Energy analysis; Exergy analysis; Jeddah KSA

Speed control of induction motor for pump supplied by photovoltaic generator

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Abstract
The increasing cost of conventional energies on the one hand, and the limitation of their resources on the other hand, mean that renewable energies are more and more essential as a solution among the promising energy options. Among these renewable energies, we mainly find photovoltaic energy with advantages such as abundance, absence of any pollution and availability in varying quantities in all regions of the world Electrical characteristic of a photovoltaic cell. In this work, we study the dynamic behavior of a pumping system consisting of a photovoltaic generator, a DC-DC converter (boost), an inverter, an induction motor and a centrifugal pump. The objective of the present work is to studie a photovoltaic pumping system contains a centrifugal pump, which is driven by a three-phase asynchronous motor. To extract the maximum power of the photovoltaic generator we use Perturb and observ algorithm and to control the speed of this motor (meaning water flow), we use the field-oriented control. The control system is applied with a sudden variation of solar irradiation to evaluate their performance. The results obtained by simulation show the efficiency of the proposed control method.

Keywords: Maximum Power Point Tracking (MPPT), Perturb and Observe algorithm, photovoltaic generator, induction motor, Speed control, Field-oriented control, centrifugal pump.

On the Enhancement of the Aerodynamic Behavior of Savonius Turbine by Using Auxiliary Blades

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Abstract
The recent race between countries is to solve the energy crisis caused by the vast human development. Renewable energy is considered the most optimum solution for that, and it has proved its importance among traditional sources of energy. Wind energy is one of the renewable energy sources available and predictable. Savonius turbine is a vertical axis wind turbine that is considered an effective solution in harvesting kinetic energy from low wind speeds. The aim of the current work is to improve the performance of the three-dimensional conventional Savonius turbine numerically by improving the aerodynamic behavior of the flow in the overlap region by using straight auxiliary blades. The unsteady Reynolds Averaged Navier–Stokes equations (URANS) are solved using ANSYS software to perform the numerical simulation. Then, the flow characteristics through the turbine are resolved by using $SST\ k-\omega$ Turbulence model. The current investigation results showed that the maximum power coefficient of the Savonius turbine augmented with straight auxiliary blades increased by 9 % at a tip speed ratio (λ) of 0.8 compared to the conventional Savonius turbine.

Keywords: Wind turbine – Savonius rotor- Conventional type - Auxiliary Blades

A comprehensive study of the effects of various operating parameters on the performance and emission indices of a biogas-diesel dual fuel engine

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Abstract

In this study, various aspects of operating a conventional CI engine on simulated biogas (a mixture of CH4 and CO2 in variable proportions) and diesel in dual fuel mode are investigated experimentally. The effects of biogas flow rate, composition (expressed as methane fraction), intake temperature and torque on various engine performance and emissions are studied using the full factorial approach involving more than 320 experiments. It was established that biogas can provide up to 90% of the total energy input in dual fuel mode. Compared to baseline operation, smoke and NOx emissions can be reduced by up to 67%, 75% and 55% respectively in dual fuel mode by inducting large quantities of biogas. Lower Biogas flow rates tend to enhance brake thermal efficiency and reduce HC & CO emissions. Raising the intake temperature to 100^{o}C provides up to 2% increase in thermal efficiency, lowers diesel consumption (~35%) and mitigates all emissions except NOx.

Keywords: Dual fuel, Biogas, Performance, Carbon dioxide, Emission, Methane fraction.

Numerical Simulation and optimization of an Innovative Solar Adsorption Ice-Maker

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Abstract

The system numerical simulation was established by MatLab programming to demonstrate the system annual performance with excellent successful installation under the weather conditions of Makkah city. Annual hourly data of global radiation and ambient temperature were estimated as an average of many years' data. The ambient temperature varies from 20 °C in winter to about 44°C in the summer. Similarly, the solar radiation varies from approximately 3.2 kW.h/d/m^2 in winter to approximately 6.8 kW.h/d/m^2 in summer. A novel design of the system was obtained, and the optimum mass was estimated of both the adsorbent and adsorbate keeping of constant ratio between them. As expected, increasing adsorbate mass can improve the system's coefficient of performance (COP). Besides, increasing solar collector area improves the COP as expected and ice production per day per square meter of the solar collector as well. It is found that the system using Activated carbon/Methanol YKAC(14-20 MESH)(carbon 1) can provide maximum solar system performance (SCOP) of 0.26 in the cold days and cycle COP reached (0.367) . Moreover, three types of collectors have been studied and the highest efficiency of 0.80 was obtained for flat plate where evacuated-tube ETC provided low efficiency throughout the year. The efficiency of the parabolic trough reached 0.79 at optimum collector area of 8.4 m^2. The optimum area of both ETC and flat plate are 3.50 m^2 and 3.15 m^2 respectively. Finally the optimum system results show that 22kg of ice can be produced daily per m^2 of solar collector under Makkah weather.

Keywords: *Solar adsorption; ice-maker; Methanol-Activated carbon; numerical simulation; optimization.*

Energy Analysis of an Integrated Plant based on Solid Oxide Fuel Cell, Metal Hydride System, Rankine Cycle and Absorption Refrigeration System

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Abstract
A global shift towards a more sustainable and eco-friendly future has prominently emphasized the need to develop cleaner and renewable energy sources for various applications in day to day life. A fuel cell is an electrochemical system that directly transforms the chemical energy of the fuel into electrical power without passing through any intermittent thermal layers. As a result, Carnot's performance has no bearing on it. High efficiency, low noise pollution and thermal pollution are some of the key advantages of fuel cells. Power generation from fuel cells can curtail costly transmission lines and minimize the losses during the transmission for a disturbed system. Moreover, the power plant size is independent of fuel cell performance. The utilization of the trigeneration system increases the efficiency of high-temperature solid oxide fuel cell because the heat dissipated by the fuel cell is now utilized for cogeneration. In this paper, energy analysis of an integrated system consisting of a solid oxide fuel cell coupled with Rankine cycle, metal hydride system and absorption refrigeration system for power generation, heating and cooling applications has been performed. The study shows a significant improvement in the performance of the integrated plant compared to the power generation of only the combination of the solid oxide fuel cell and the Rankine cycle. Furthermore, the influence of various operating parameters of the system on the efficiency of the fuel cell has been studied.

Keywords: Solid oxide fuel cell, Metal hydride, Rankine cycle, Trigeneration

Solar Energy Based Multigeneration System for Northern Pakistan

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Abstract

This paper studies a novel solar-powered multi-generation system for remote areas in Northern Pakistan consisting of a Rankine cycle, compound parabolic trough collectors, and vapor absorption chiller. These systems are integrated together to produce 4 useful outputs that include electricity, refrigeration for fruits, space heating, and domestic water heating. Thermodynamic assessment is carried out by performing a parametric study by changing system parameters such as solar irradiance, and ambient temperature setting up multiple parameters. System performance is conducted for different areas in the northern part of Pakistan by changing system parameters such as solar irradiance and ambient temperatures, and corresponding outputs and efficiencies are studied. The maximum overall efficiency comes out to be 56.3%.

Keywords: Energy, Multigeneration, Pakistan, Solar, Parabolic Trough Collector

Thermal performance evaluation of residential building in Makkah, Saudi Arabia

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Abstract

The residential sector's excessive consumption of finite energy resources, particularly in the summer months in Saudi Arabia is driven by the almost insatiable demand for air conditioning to alleviate the very hot outdoor temperatures. Cheap electricity tariffs also contribute to high consumption levels in residential buildings. At least 50% of electricity consumption is used in residential homes, with the air conditioning consuming approximately three quarters of total usage. This study will evaluate the thermal performance of low-rise residential buildings in Makkah, Saudi Arabia. The chosen building, newly constructed in 2020, has three floors. To explore the internal thermal performance of the chosen apartment, readings were taken in June 2021. The data gathered includes indoor air temperature values as recorded every fifteen minutes, over a period of one week, in two rooms in the case study building. Also, spot measurements of specific environmental variables were taken at selected times. On site readings were tabulated and analysed, and the findings present a more accurate measurement of the performance of the fabrics and the design of existing buildings, in particular the external walls, floors and ceilings, to gauge indoor thermal performance. The outcome illustrates the effectiveness of existing building fabrics used in the case study building.

Keywords: "Residential building, thermal performance, hot climate, physical measurement, environmental evaluation"

LEVEL OF KNOWLEDGE, PERCEPTION, AND AWARENESS REGARDING CLIMATE CHANGE AMONG THE PEOPLE OF DAMMAM, SAUDI ARABIA

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Abstract
The adverse impacts of climate change have been experienced across the world including the Dammam City in Saudi Arabia. While there are many efforts targeted to fight climate change, their success is dependent on the public having sufficient knowledge about the issue. Hence, the fight against climate change urgently requires increase in public awareness for effective mitigation measures. Thus, this study seeks to identify level of knowledge and awareness of the people of Dammam about climate changes, causes and impacts on humanity. The study involved 310 respondents who are residents of Dammam and gave their responses by completing an online questionnaire. The findings revealed that 90% of the respondents were aware about the contemporary climate change problem and they had acquired that knowledge from conventional sources like social media and 67% were very worried about the impacts of climate change. The results also showed that 40% had very little knowledge or no knowledge at all about the causes of climate change and its impacts. The study concluded that slightly above half of the residents of Dammam have moderate knowledge, understanding, and awareness of climate changes. The study recommends more efforts to be directed toward expanding public knowledge on climate change.

Keywords: Awareness, Climate Change, Saudi Arabia, Knowledge, Cause and Impacts.

A Decentralized Adaptive Power Sharing Control Algorithm for Multiterminal Direct Current (MTDC) System

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Abstract

This paper aims to develop an algorithm for adaptive remote monitoring used for active power sharing among MTDC systems, encompassing the availability of power and power management policies. In MTDC systems, power sharing depending on droop control, sequence or priority strategy restricts the use of available power because of the preset of the predefinde controller coefficient. Fixed power distribution control, on the other hand, does not have the ability to determine power availability at the rectification stations. By incorporating the proposed controller strategy, these problems are avoided, and the risk of overloading is diminished. As a result, the suggested adaptive wireless control for active division of power across multi-terminal HVDC systems is applicable to (n-slack) terminals. Based on three phase-two AC voltage level converter, the test system in this study includes five converter stations. A PSCAD/EMTDC simulation is used to test the suggested control approach for the multiterminal HVDC system. The new adaptive wireless method's simulation results clearly demonstrate the adaptability and utility of the suggested power sharing control.

Keywords: Active power control, Current control, Fixed power sharing; HVDC system; MTDC, Voltagesource converter, Power sharing control, adaptive wireless control.

Modelling and performance measurement of Makkah solar pond.

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Abstract
Solar pond is an effective way for collecting and storing solar energy. This study presents a mathematical modelling and a performance measurement of a solar pond located at Umm Al-Qura University, Makkah, Saudi Arabia. The pond has depth of 3.1 m and surface area of 113 m^2. Comparison between Theoretical and experimental data has been done to check the validity of the model and agreement has been obtained. The effect of radiation, convection, and evaporation loss on LCZ temperature has been investigated. It found that evaporation has the largest effect on LCZ temperature.

Keywords: Solar Pond, Heat extraction, Salt-gradient

NUCLEAR ENERGY: NECESSITY, SAFETY AND SECURITY

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Abstract

Expanded use of nuclear energy offers an immense potential to meet important development needs, to satisfy energy demands and to mitigate the threat of climate change, which are the two main greatest challenges that faces human. Comparing with other industries, nuclear energy records manifests the fact that it is, absolutely, the safest industry. International cooperation should be strengthened immediately to ensure that any possible expansion of nuclear energy will be safe and secure and will not contribute to nuclear weapons proliferation. The rapid increase as well as change in cost of fossil fuels and the impending threat of climate change, against which nuclear power is recognized as an important mitigating option, may make a renaissance of nuclear energy likely soon.
But opportunities of using nuclear energy pose complex and broad-ranging safety and security questions that must be addressed effectively. The potential risks of utilizing nuclear energy, whether as a result of the occurrence of reactor accidents, as a result of misuse, or because of its use for terrorist purposes and falling into the wrong hands is a real and growing international concern, which emphasizes the importance of strengthening nuclear safety, and nuclear security to avoid any nuclear disasters. In this paper, the authors present the key ideas regarding the necessity of nuclear energy, and the efforts that must be made by the countries and users to maintain security and safety to reduce risks associated with nuclear and radioactive materials.

Keywords: Nuclear Energy, Climate Change, Energy Demands, Nuclear Safety, Nuclear Security.

Thermoeconomic and Thermo-Environmental Analyses and Optimization of Energy Systems – A Critical Review

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Abstract
The rise in the consumption of natural resources by modern energy conversion systems and its negative impacts on the surroundings by the emissions, waste disposal and indications of an unnatural weather change has led to new techniques for appraisal and optimization of energy conversion processes from thermodynamic, economic and environmental perspective. Thermoeconomic is a viable method for analysing and optimization of energy systems combined with thermodynamics and economics analysis. Thermo-economic optimization assists with building up a balance between dispensing on capital expenditures and exergy expenses that will give the least expense of the energy system product. Upon the fact that exergy remains the sole cogent justification for allotting budgets and assessing ecological effects of various energy transmitters just as deciding shortcomings within thermodynamic systems, a procedure called thermo-environmental analysis emerged. The thermo-environmental investigation considers environmental deterioration by regarding the environment as a devoured resource. In this present review study, various strategies consolidating the second law of thermodynamic, economic and environmental analysis in evaluating execution and optimization of energy systems such as thermal power systems, integrated renewable energy systems, refrigeration, multi-generation systems, waste heat recuperation system utilizing Organic Rankine Cycle and Kalina cycle have been critically reviewed. It is anticipated that this all-inclusive review study is going to be invaluable to engineers engaged in design, modelling, analysis and performance assessment of energy systems

Keywords: Thermodynamics, exergy analysis, thermoeconomic, thermos-environmental, energy systems, optimization techniques, power cycle

Waste Management during COVID-19

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Abstract

The COVID-19 has changed the life and business style of all over the world. Beyond this fact, the precautions to prevent infection generate many more wastes. Single-use materials are being produced and consumed too much. These are not only medical and testing materials but also daily goods for eating & drinking and personal protection materials. Health care goods such as single-use masks, gloves, gowns, goggles are everywhere outside of hospitals, for this reason, they are often accepted as the normal types of wastes, however, this is a great mistake and certainly will increase the transmission of the virus, as the transmission does not require direct physical contact. Due to the pandemic, new facilities, clinics for testing and vaccination are opened everywhere, even at the recreation areas and parking lots. These facilities generate a tremendous amount of test kits, syringes, vials, masks, gloves, and cleaning agents & materials. Although they are not accepted as medical wastes, personal protection goods should also be disposed of separately and handled separately from daily wastes. In order to have long-term successful waste management, daily goods (wastes) and medical wastes should be handled separately. In normal periods also the management should be separate for medical wastes and the others. However, in this pandemic situation, this separation is much more important. Medical wastes from the hospitals, clinics, etc are accepted as already infected for this reason handling process has great care, however, personal protection goods are not accepted as infected and do not handle with that much great care, and this is the great reason to be spread in the society, easily. The achievement for handling these types of wastes will ensure our society wins the battle for spreading the COVID-19.

Keywords: COVID-19, integrated waste management, health hazard, pollution control, 4R, zero waste,circular economy, infectious waste, advanced thermal treatment (ATT) plants

Cyber-attacks and Measures in SCADA Systems on Smart Natural Gas Grids

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Abstract
Smart grids are a quick development along with the development of technologies in recent years. With the development of smart grids, many sectors have started to be smart as technological and digitalization. Smart natural gas grids are one of the sectors that quickly adapt to this development. The most important issue in smart natural gas grids is that the data in SCADA systems are collecting flow control and data online in data. These grids come to the forefront with the technologies developing in the networks. The use of secure communication and safe protocol when collecting and control data in the SCADA system is becoming an important issue. In recent years, there is a very rapid increase in cyber-attacks against smart natural gas grids. As a result of these attacks, the sectors are in great harm in terms of finance and data loss. Smart natural gas grids are in the most common cyber-attacks DDOS, APT, and Malware. In this study, a total of 8 cyber-attack methods were analyzed and evaluations are given on 12 measures to be taken against them. These cyber-attacks have differences in terms of construction methods. In this study, the most common cyber-attacks against the SCADA systems used in smart natural gas grids and the measures to be taken against these attacks will be examined. In addition, the measures to be taken against these attacks will be given in detail.

Keywords: Cybersecurity, SCADA, Smart Natural Gas Grid, Cyber-attack, Smart Grids

Synthesis of Environmental-Friendly Cellulose

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Abstract

Cellulose is a biopolymer and has strong mechanical properties and having a long molecular chain making them earns rigidity. Biodegradation is a key rule of making advantage of these polymers which limits the emission of carbon dioxide and decompose to organic material after disposal.
In this work a plasticizer TA is added to cellulose to modify its mechanical properties as well as biodegradability. TA interacted with the chain of cellulose triacetate; a new composite material is accomplished with enhanced mechanical properties, and high flexibility. In this work, TA is used the as plasticizer of CTA to make it transparent and flexible.CTA/TA blends containing 0–60 wt% of TA are prepared, and their morphology, structure, physical properties, and biodegradability are investigated. infrared reflections properties, including the mass loss and decomposition temperature, mechanical properties. The biodegradability of the new composite material in water is achieved within 75% of the time needed to degrade pure cellulose triacetate, which needs about 90 days.

Keywords: Environmental-Friendly, Cellulose, plasticizer, Biodegradation, triacetin.

Preparation of carbon nanotubes with deposited bimetallic oxide nanoparticles: the effect of a metal precursor and a support on the stability to thermal decomposition

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Abstract
In order to develop new catalysts based on supported bimetallic oxide nanoparticles for oxidative transformations of sulfur compounds, a series of samples of the composition $M_1M_2O_x$/C (M_1M_2 = Ce, Mo, Cu, C= Sibunit, C@Al_2O_3, Taunit, oxidized Taunit) was prepared by incipient wetness impregnation. The effect of the nature of the metal precursor, support and the oxidative treatment of the support on the functional composition of the support surface and its thermal stability has been studied by means of FTIR spectroscopy and thermal analysis combined with mass spectrometry. Among the studied supports, the sample on Taunit was the most resistant to decomposition. The stability of the carbon nanotubes (CNT) Taunit support against thermal decomposition increases in the following series of samples: CuMo/Taunit <CeMo/Taunit <CeCu/Taunit <Taunit. The optimal precursors of bimetal oxides for the synthesis of a promising nanosized catalyst $M_1M_2O_x$/Taunit have been selected.

Keywords: carbon nanomaterial, bimetallic oxide nanoparticles, catalyst, thermal analysis, FTIR spectroscopy

An Economic Preventive Maintenance Policy for a solar Photovoltaic System

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Abstract
The aim of this paper is to develop an economic preventive maintenance (PM) policy for a solar photovoltaic system (PVS) made of several panels. When the efficiency drops below a predefined threshold or any electrical wiring elements are damaged, the PVS is considered in failed state. In such situation of failure, a minimal repair is performed. An analytical model is developed in order to find simultaneously the optimal PM period, T, and the optimal number of solar panels, n, to be replaced at each PM, in order to minimize the expected total cost of maintenance over a finite operating time span H. A numerical example and a sensitivity study are presented to illustrate the contribution of the proposed modeling approach.

Keywords:" preventive maintenance, solar pane, reliability, sustainability, optimization, minimal repairs.

Evaluation Quality of Drinking Water from Coolers of AL- Sabeel water in public places in Medinah, Saudi Arabia

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Abstract

Drinking Water Quality from Coolers of (AL- Sabeel water) in Madinah public places was investigated, to ensure that these coolers continuous supply of clean and safe drinking water for the public health protection. In this regard, a total of 66 water samples were collected and analyzed in accordance to standard water methods of analysis. Physicochemical and bacteriological parameters were tested for each sample and the obtained values compared with the Saudi Standards, Metrology and Quality Organization (SASO) and with World Health Organization (WHO) guidelines for drinking water. Results show that the, pH, total dissolved salts (TDS), electrical conductivity (EC), Total Hardness (T.H) and turbidity in most water samples, (95.5%) were found to be within the permitted limits of (SASO) and (WHO). Results also reveal that all investigated water samples (100%) were found to be within the safe limits of, nitrates, nitrites, sulfates and free residual chlorine. However, 68.2% of analyzed samples were containing fluoride lower than the standard value of (SASO) and (WHO). Heavy metals and Trace Element (Pb, Cd, Cr, Mn, Zn, Cu and Fe) were analyzed for all water samples. The obtained values show that all water samples analyzed have concentration within the safe limit of that standard set by (SASO) and (WHO). Except Fe in one cooler was found to be higher than the permitted limits (0.3mg/L). Test for the biological contamination, show that 4.5% of the coolers were contaminated with total coliform and 95.5% of samples safe were in terms of total coliforms. From this study, we recommend regular maintenance and cleaning measures of water coolers, re-chlorination and monitoring of water quality from coolers to avoid recontamination and safeguard public health.

Keywords: Drinking water quality, public water coolers, public health, drinking water standards

Optimal Decentralized Controller for Four-Area Power System Using Q-Parameterization Technique Based on Multi-Verse Optimization Algorithm

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Abstract
In this paper, a modern Multi-Verse Optimization (MVO) technique is adapted to generate optimal tuning of Q-Parameterization controller to Load Frequency Control (LFC) of four-area power system stability. Q-Parameterization technique is applied with plant inversion to completely change system eigenvalues to new predetermined ones. MVO-Q is generated to find the optimal compensator follows design objectives of eliminating frequency deviation with accepted presuggested specifications. The robustness of the proposed controller is evaluated at system nominal parameter values, and at ±40% parameter uncertainties. The simulation results demonstrate that the resulted controlled system has better performance compared to the conventional technique for the considered parameters perturbation.

Keywords: Power system stability, Decentralization control, Q-Parameterization control, Optimal control, Multi-verse optimization.

The effect of drying bagasse on its calorific value for bioenergy production

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Abstract

Agricultural co-products such as bagasse obtained from sugarcane industry has been considered as a potential source of producing thermal energy through combustion for power generation with less detrimental impacts on the environment. However, presence of high moisture content in bagasse more than 50% by dry weight, render it unattractive source of for bioenergy production and leads to reduction in combustion efficiency. This comparative study was conducted to evaluate the improvement in calorific value of bagasse by drying as pre-treatment using conventional oven and solar cabinet dryer. The calorific value and moisture content of raw bagasse were measured as 9.34 MJ/kg and 50.8 % respectively on wet basis. Oven drying treatment removed the moisture content by 31.34 %, yielding bagasse with calorific value 19.25 MJ/kg, while solar cabinet dryer improved the calorific value to 19.06 MJ/kg with lowering moisture content to 28.10% for 5 hrs treatment. The bulk density of bagasse after oven drying treatment was measured as 110.23 kg/m3, while with solar drying it was found 111.32 kg/m3, with 5 hrs treatments. The thermal analysis of oven treatment showed lower values of useful heat energy gain 1.187 kJ (for 1 hr treatment) and 0.926 kJ (for 5 hrs treatment) as compared to heat energy gain from solar drying treatment 1.621 kJ (for 1 hr treatment) and 1.081 kJ (for 5 hrs treatment). Statistical analysis showed that 4 hrs oven drying treatment had highest significant effect ($p<0.05$) on moisture content removal % against its corresponding calorific value as compared to solar drying treatment. Energy ratio of oven drying (0.546) was found lower as compared to solar drying method (96.75) for 5 hrs treatment. Based on calculated thermal analysis and energy balance ratios; it is recommended to use solar drying method for moisture content reduction from bagasse, which will provide significant improvement in the corresponding calorific values.

Keywords: Agricultural residues, Biomass, Calorific value, Bioenergy, Bagasse

Environmental Impact of Nuclear Energy Industry

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Abstract
The artificial creation of radionuclides may result from physical processes involving nuclear fission, nuclear fusion, and neutron activation. The most important source of artificially created radionuclides is the neutron-induced nuclear fission. The chemical and physical forms of the active species determine deposition, migration, and uptake of radioactivity by living organisms. The physical and chemical form of radionuclides may vary depending on the release and transport conditions in addition to the element properties. A general distinction can be made between gases, aerosols, and particulate material.
Fission products behavior has been studied for a long time via comprehensive studies that resulted in several models developed to express and explain this behavior. In this paper, a new interpretation will be introduced to present a more developed criterion to explain FP behavior inside the reactor and in the environment. The movement of radioactive materials from its source, inside reactor containment, to the environment has been studied with the principal objective of tracing the routes by which they accumulate in the food chain and become available for human consumption. Many studies and models were established to explain the nuclear fission products (FP) behavior within terrestrial and water ecosystems, but several behaviors were non understandable, which always attributed to unknown reasons. According to the interpretation, new almost all fission product behaviors in terrestrial and water ecosystems could be interpreted in wide coincidence. The nuclear reactor accident radiological impact in the environment is reduced. This also reduces the expected potential risk associated with nuclear energy industry, and, for faraway, the radiophobia. Radiation protection measures during and after major nuclear accident, like Chernobyl, (e.g. evacuation of affected people, providing relief, etc.) may be directed in a better way, and the expenses of these measures will be reduced.

Keywords: Nuclear Reactor, Nuclear Fission, Fission Products, Chernobyl, Radiophobia, Radioactivity, Environment.

Modeling and Analysis of a Geothermal-Wind Hybrid Multigeneration System: A 4-E, Steay-State, and Transient Performance Study

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Abstract
As the world continues to find a solution to carbon emission and transition towards a carbon-free future, the use of renewable energy sources is being explored more intrinsically. Due to this, the emergence and utilization of geothermal energy have grown in recent years. In recent years, the exploration, development, and utilization of renewable energy source like geothermal energy has increased as it offers a cleaner way of meeting energy demands. In this paper, the energy, exergy, economic, environmental, steady-state, and transient performance modeling/analysis of a hybrid renewable energy-based multigeneration system is presented. Wind energy is hybridized with geothermal energy resources to ensure the continual operation of the designed system. This novel method considers both the steady-state and the transient performance of the modeled system on hourly timesteps in order to determine the overall energy and exergy efficiencies. Beyond using Engineering Equation Solver for the steady-state analysis of the proposed system, the EnergyPLAN simulation program will also be used to analyze the process modeling of the system considering China as the case study. In the process modeling, hydrogen and freshwater production are integrated to balance the system in order to achieve 100 % load stability. The aim of the study is to check the performance feasibility of a geothermal-wind based system as this is the first step towards the development of this system for community application in different Province, China.

Keywords: Energy/Exergy Analysis; Geothermal Energy; Hydrogen Production; Multigeneration; Wind.

Aggregating Heterogeneous capacity of DERs through Virtual Power Plants (VPPs)

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Abstract

The grave threat in the form of climate change has led to the proliferation of distributed energy re- sources specifically solar PV and wind energy. This paper presents an all-inclusive understanding of Virtual Power Plants (VPPs) and optimal management of Distributed Energy Resources (DERs) in VPPs through aggregation, from the nascent concept to a complete business model including the communication protocols and standards as well. The first section provides the concept of creating Virtual Power Plants (VPPs). An outline of multifarious views and definitions of VPPs are provided in this section. The need for aggregation are discussed both at the macro scale and micro scale. The next section details the group creation part of aggregation. The next section then proceeds to provide an insight about the solutions for DER Aggregators that are present in the market and a case study of practical VPP implementation. This final section then offers an insight into the communication protocols/standards for interaction between VPP, DER owners and the grid. Later in this section the application of Electric Vehicles (EVs) as a DER is discussed (V2G application).

Keywords: Virtual Power Plant (VPP), Renewable Energy, DER Aggregator, DER Groups, Grid Modernisation, Grid Communication Standards.

Enhanced Extraction of Lead and Cadmium from Low Permeable Marine Sediments: A Case Study on the use of Electrokinetic Decontamination Process

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Abstract
This paper presents the results obtained from a systematic laboratory-scale electrokinetic treatment of marine soil contaminated with lead and cadmium. Effect of several operating parameters (soil temperature, pH of soil, current density, material of electrode, inter-electrode separation and initial soil moisture content) on the efficiency of electrokinetic treatment process investigated. It was found that, removal of lead and cadmium reached to 72.5% and 81.4% respectively utilizing titanium electrodes. Improvements in the removal efficiency observed when current density, soil temperature and initial soil moisture content increased. Initial remediation time found to be very important as almost 68.2% and 53.9% of lead and cadmium removal achieved within first 24 hours. Soil pH varied with time as well as location. pH value diminished from initial value of 6.6 to 2.5 near anode and buildup near cathode and reached to 12.5. While soil moisture content raised from 40% to 70% an increase of 30% in removal efficiency achieved. While inter-electrode separation between the anode and cathode increased results in decline in removal efficiency. Electrokinetic process demonstrated highest removal efficiency at a spacing of 15 cm however; by decreasing spacing from 15 cm the removal efficiency reduced. The optimum parameter found to be; current density of 9.3 mA/cm2, soil temperature of 35 C, initial soil moisture content of 70% and electrode spacing of 15 cm when utilizing titanium electrodes. Electrokinetic process found to be a robust method to enhance the lead and cadmium removal from marine sediments.

Keywords: Electrokinetic, marine sediment, metal contamination, operating parameters

Preparation and characterization of Activated carbon from *Acacia latea* tree branches by microwave induced phosphoric acid and low temperature phosphoric acid activation: A comparative study

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Abstract
Activated carbon from *Acacia latea* tree branches was produced, utilizing phosphoric acid chemical activation, and microwave radiation (AC-MWA). Activated carbon also produce by conventional phosphoric acid chemical activation and low temperature carbonization (AC-CA). Characterization of produced activated carbons performed by proximate analysis adopting ASTM standard procedures. BET-surface area, total ash content, bulk density, moisture content, pH, pore volume and iodine number were determined. Comparison of characteristics for both carbon (AC-MWA and AC-CA), with the characteristics of AC available in the literature and commercially available in the market performed. Comparison shows that activated carbon produced from *Acacia latea* tree branches is well comparable with the reported characteristics of AC in literature and commercially available in market. It was found that AC-MWA has higher BET-surface area than AC-CA. Results depict that there is an increase of 21.1% in microspores component and 20.8% BET-surface area obtained in AC-MWA as compared to AC-CA. It was also found that AC can be produced by microwave radiation in about 48% lesser time as compared to conventional low temperature heating. The adsorption study of produced ACs performed using methylene blue as a contaminant. Study showed that MB removal rate increased with increase in contact time initially, which decreases with time until steady state reached. Adsorption data of MB fitted to Freundlich and Langmuir adsorption isotherm models. Both models show reasonable correlation, however, Freundlich isotherm is best to describe the MB adsorption on AC-MWA. The results revealed the feasibility of microwave heating for preparation of high surface area activated carbons from *Acacia latea* tree branches.

Keywords: Waste material, Activated carbon, Chemical activation, Microwave radiation, Carbonization

Utilization of surplus power for Hydrogen production in case of the high share of renewable energy sources by EnergyPLAN model

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Abstract

Continuously increasing renewable energy sources (RES) in electricity generation can be a solution to reduce greenhouse gas (GHG) emissions that trigger climate change. Therefore, to achieve sustainable development goals, the restoration of sustainable energy sources is paramount. Thus, RES penetration is apprehended, but the inherent intermittency of renewable energy makes it complicated to accommodate at the grid level and requires the solution of several additional tasks. Nevertheless, energy storage technologies tackle power fluctuation and facilitate meeting peak demands. In this research, according to appropriate RES potential, significant renewable energy integration is planned by considering demand and supply balance. First, the EnergyPLAN modelling tool was employed accounting for legitimate and authentic data for long-term energy planning. Then technically most feasible renewable energy-based alternate scenario was built as a comprehensive foresight plan of the electricity system. To better visualize the system's operational flexibility, this study exhibits the effectiveness of hydrogen storage implementation. To enhance the resilience of an optimized energy system, surplus energy is utilized to produce hydrogen during excess energy production hours. Complete technical assessment of power to hydrogen (P2H) operation of future energy system scenarios analyzed according to EnergyPLAN findings. Thorough quantitative investigation validates that incorporating the power to hydrogen approach with RES integration improves system performance, decreases RE curtailment, and reduces fuel consumption and carbon emissions. The results may be adapted and support developing more sustainable power generation systems in developed and developing countries.

Keywords: Renewable Energy Sources, Power-to-Hydrogen, EnergyPLAN, Energy Storage

Opportunities for Recycling of Heavy Oil Fly Ash (HOFA) Generated in Power Stations

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Abstract

Heavy oil (named also residual oil) is used, to a large extent, as a fuel in many power stations in Saudi Arabia. The combustion of heavy oil generates large amounts of ashes, namely heavy oil fly ash (HOFA), that are collected and landfilled although the HOFA contains some pollutants of metal species in a significant amount. Vanadium and nickel are classified as two of the most hazardous elements in fly ash. However, vanadium and nickel are considered as two precious metals and have many and continuously increasing applications. Having contents of vanadium and nickel comparable to that of natural raw minerals, HOFA attracts researchers to study its recycling with the aim of recovery of vanadium and nickel. Thus, recycling of HOFA is of great interest from both economic and environmental aspects. This contribution presents a short review on available research results of leaching HOFA and recovery of vanadium and nickel. Moreover, preliminary results of our approach for recycling of HOFA samples are presented. The approach presented enabled recovery of vanadium oxide, and this approach was suggested to be promising for continuing research with the aim at recovery of nickel too.

Keywords: Recycling, Extraction, Fly ash, Vanadium, Hazardous materials.

Green Energy-Powered Multi-Edge Computing Networks; A Resource Allocation for Video Caching and Transcoding Approach

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Abstract

The massive data associated with video streaming applications and services overburden the current communication networks. As this data is projected to grow exponentially due to the vast technological advancement of mobile and computing devices, there is great academic and industrial research attention to manage and transmit network data efficiently. The information-communication technology (ICT) industry contributes highly to global carbon emissions. We propose an edge caching scheme in a Multi edge computing (MEC) network powered by green energy sources to mitigate the challenge posed. We introduce a resource-sufficient regionally organized cloud (ROC) for heavy computational tasks offloading and caching the videos. The MEC access nodes (MANs) handle light transcoding and caching tasks. We formulate the video placement problem as an Integer Linear Programming (ILP) problem for a constrained operational power and storage capacity at the MAN. Since all future video requests are unknown, a feasible solution to the formulated problem in real-time is unrealistic. We propose an efficient energy-aware heuristic part-based video caching for optimal cache content placement. Simulation results show the advantage of the proposed scheme over the least frequently used (LFU), first-in-first-out (FIFO), and least recently used (LRU) algorithms.

Keywords: Energy Efficiency, Green Communication, Edge Caching, Optimization

A Detailed Comparative Parametric Study of Nanofluid's Performance in Solar Flat Plate and Parabolic Trough Collectors

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Abstract
In existing literatures, the use of nanofluid has been considered for solar parabolic trough collectors, however, most of these studies only focused on the particular fluid that was fabricated in their study. Also, considering the vast utilization of parabolic trough collectors in different solar systems' applications, the temperature output and thermal energy output for these systems vary. Therefore, there is a need to compare nanofluid's performance in parabolic trough collectors in order to explicate the variation in thermodynamic performance and thermal energy outputs. Ditto, a detailed thermodynamic performance of analysis of five (mono and hybrid) nanofluids namely; Al_2O_3, SiO_2, CuO, Al_2O_3-ZnO, and Al_2O_3-Fe in two different solar collector types are presented in this study. In comparison to existing literature, this study is novel as it considers the application of this nanofluid for both low-temperature and high-temperature-based solar collectors. While parabolic trough collector is the solar technology considered for high-temperature application in this study, the use of these fluids to produce low-temperature thermal energy in flat plate collectors is also analyzed. It is noteworthy that solar flat plate collector is an integral part of most solar water heater designs, thereby, the enhancement of the flat plate collectors will improve the performance of solar systems (like solar water heaters). Furthermore, the comparison of these fluids with four common fluids in solar thermal systems is also presented in this paper. The base fluids include; water, Therminol_VP1, Dowtherm_Q, and salt ($7NaNO_3$_$40NaNO_2$_$53KNO_2$). The thermodynamic performance assessment will focus on the thermal energy output, collector outlet temperature, energy efficiency, and exergy efficiency. This study aims to elucidate and crystallize the differences between base fluids and nanofluids application in solar collectors.

Keywords: Energy/Exergy Analysis; Flat Plate Collectors; Nanofluids; Parabolic Trough Collectors; Solar.

Effect of butanol addition in biogas-biodiesel fueled engine for dual fuel, RCCI and HCCI modes

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Abstract

Stringent norms given to the automotive sector in the wake of curtailing harmful gases resulted novel engine designs, advancement in fuel properties, and other related technologies to come in force. In vehicle combustions, fuel blending is considered to be an effective choice since it ensures stability during combustion and doesn't prompt engine modifications. This economically viable technique must be investigated for optimal engine performance and minimal hazardous emissions. In the present research, impact of blending of butanol in to the secondary fuel on the performance of a CI engine under different mode of operations is studied. Under Reactivity Controlled Compression Ignition mode, the butanol-gasoline blend is injected at inlet port. Under Homogeneous Charge Compression Ignition mode and Dual fuel mode, butanol in the biodiesel is utilized for the study. Biogas is used as the primary fuel for all studies, which is supplied at constant flow rates. The engine is tested for input torsion moments ranging from 0 to 20 N-m. The study revealed that the butanol addition in the engine fuel can take control over the output performance of the CI engine and emission level of products resulting from combustion. Butanol blends injected for prolonged duration affects the efficiency at all loads of the RCCI mode of combustion, whereas it can significantly improve the engine brake thermal efficiency at engine loads up to 10 N-m under HCCI and dual fuel modes of combustion. The emission results proved that butanol can be a promising solution to reduce NOx level (RCCI), unburnt hydrocarbons, and Carbon monoxides (HCCI). Additionally, biogas utilized in the present work is found to be a supplement for butanol by reducing the emissions under each mode of combustion at all loads.

Keywords: Biogas, Dual fuel, RCCI, HCCI, Butanol, Performance

Facile Synthesis of High-yield Petroleum Coke Derived Activated Carbon for Supercapacitor Applications

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Abstract
Due to recent technological developments, energy demands are rising with time. Renewable energy resources provide a considerable alternative to meet global energy demands. But due to its time-dependent operations, a robust storage system is required, which can store vast amounts of energy in a short time. Energy storage has earned a key position in energy devices due to its viability compared to energy harvesting devices. Also, in the last few decades, energy crises forced scientists and researchers to search for novel materials that may have the potential for energy harvesting and storage devices. In this regard, supercapacitors based on carbon materials have recently received tremendous attention. A supercapacitor is an energy storage device with high energy and high-power densities and can be completely charged in seconds. By carefully selecting electrode materials and using cost-effective and simple preparation methods, supercapacitors can be developed to store renewable energy on a larger scale. Generally, biomass derived-activated carbon (AC) is a good candidate for supercapacitor applications. However, low yield due to low carbon content is a cause of their high price. Therefore, a byproduct of oil refining, petroleum coke with a high carbon content (~90 wt.%), could be considered an excellent raw material for the facile synthesis of porous AC with a high yield. Here, we present a high-yield synthetic strategy to prepare highly porous petroleum coke-derived AC (PAC). Following a comprehensive characterization of the prepared PAC, using X-ray diffraction, Raman spectroscopy, field emission scanning electron microscopy, X-ray photoelectron spectroscopy, thermogravimetry & differential scanning calorimetry, and Brunauer-Emmett-Teller analysis, its electrochemical performance as electrodes of the supercapacitor is investigated. The PAC-based symmetric supercapacitor's electrochemical performance exhibited a high specific capacitance with low equivalent series resistance and good energy and power densities. The fabricated PAC-based supercapacitor also shows high cycling stability and Coulombic efficiency.

Keywords: Petroleum Coke, Activated Carbon, High Yield, Supercapacitor, Electrochemical Energy Storage

Advantages and disadvantages of techniques used for water desalination methods

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Abstract
Water desalination techniques play very important role to provide potable water for drinking and irrigation in many countries. So, this paper is devoted to present advantages and disadvantages of different techniques used for water desalination and focus for the latest development and realization of a low cost and environmentally friendly water desalination systems. A comprehensive review of the latest literature on the most commonly used desalination process (Reverse Osmosis, Multi Stage Flash Distillation, Multi Effect Distillation, Electro dialysis) and solar energy production technology compatible with desalination is presented here.

Keywords: Water desalination methods, Reverse Osmosis, Multi Stage Flash Distillation, Multi Effect Distillation, Electro dialysis, solar desalination.

Energy-efficiency Estimation using Data Envelopment Analysis: A Comparative Study of Saudi Arabia and some African Countries

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Abstract
Energy efficiency, also known as efficient energy use, reduces the amount of energy required to provide goods and services. This study uses secondary data to conduct a comparative analysis of Saudi Arabia's and some African countries' energy efficiency.
The study uses three input and two output variables. In this study, a basic radial-model input-oriented with constant returns to scale estimates the said energy efficiency. The DEA methodology assists Saudi Arabia and some African countries in identifying ineffective measures and determine critical improvement activities. In addition, the study's findings suggest guidelines for making effective use of resources.
Using the DEA technique, the proposed study has drawn exciting conclusions about Saudi Arabia's energy efficiency compared to some African countries. These findings will expect to assist government agencies in identifying factors influencing the development of Saudi Arabia and some African countries, facilitating efficient policy-making.

Keywords: DEA, Saudi Arabia, African Countries, Energy efficiency, GDP, CO2

Sustainable Shape-Stabilized Phase Change Material for Thermal Energy Storage Based on Mg2+-Doped CaCO3 / PEG Composites

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Abstract

The present study investigates polyethylene glycol-6000 (PEG)/$MgCaCO_3$ as a low-cost shape selective phase change material (ss-PCM) for solar thermal applications. In this regard, nanosized porous MgO doped- $CaCO_3$ with molar concentrations of 5 %, 10 %, and 15 % (and balanced Ca) were synthesized by a hydrothermal technique. The prepared MgO- $CaCO_3$ matrices were then impregnated with PEG to obtain PEG/MgCaCO as ss-PCM. The prepared samples were identified as PEG-5Mg $CaCO_3$ (P-5-MCC), PEG-10Mg $CaCO_3$ (P-10-MCC) and PEG-15Mg $CaCO_3$ (P-15-MCC), respectively. Interestingly, P-10-MCC provided the smallest particle size together with a good porous structure as compared to the other two samples. The small particle size and porous structure facilitated the impregnation of about 69% of PEG into the 10-MCC matrix, as measured by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) analysis. The measured latent heat of PEG in the P-10-MCC sample was found to be 152.5 J/g, which was considerably higher than the available similar materials. A high energy storage efficiency value of 96.48% was obtained. The P-10-MCC's conductivity is improved, while the supercooling problem is minimized to some extent. The meso and macropores distributions of the P-10-MCC sample played a crucial role in retaining a large amount of PEG in its matrix, resulting in high latent heat. Its operating temperature is close to 35 ~ 57 °C. All these favorable characteristics indicate that the P-10MCC PCM could be a potential candidate for building applications in hot calimate.

Keywords: phase change material; shape-stabilized PCM; high latent heat; little supercooling; thermal energy storage; building comfort

Predictability of Wind Speed with Heights using Rrecurrent Neural Networks

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Abstract
Accurate wind speed prediction is important for wind energy integration into the power grid. While most wind turbines have hub heights of about 80-140 m, wind speeds are usually measured up to 40 mm and in exceptional cases up to 100m. This paper analyzes the predictability of wind speed with heights. To achieve this, a Laser Illuminated Detection and Ranging (LiDAR) system, ZephIR 300, was acquired and installed at the beach of King Fahd University of Petroleum & Minerals. The ZephIR 300 device is widely accepted for wind resource assessment and its wind speed measurements have been validated and found to be accurate for heights from 10 to 300 m. Wind speed data was collected at 20, 40, 50, 60, 80, 100, 120, 140, 160, and 180 m heights for three months. The collected data was used for training and testing the performance of RNN model for predicting the wind speed 12 hours ahead of time using 48 previous hourly values. Careful analyses of short-term wind speed prediction at different heights and future hours showed that wind speed is predicted more accurately at higher heights. For example, the mean absolute percent error decreased from 0.15 to 0.11 corresponding to heights 20 and 180 m, respectively.

Keywords: LiDAR wind speed measurements, predictability with heights, recurrent neural network

Performance Optimization of a Thermoelectric Air Conditioning System for Energy Efficient Building Application by Using Variable-Pulse Current Technique

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Abstract
The thermoelectric air conditioning system (TE-AC) is a small, noiseless alternative to standard vapour compression refrigeration (VCR) systems. The cooling characteristics of a TE-AC system operating under two conditions i.e. steady current and current pulses, are investigated in this study. This system consists of three thermoelectric modules, a heat sink, and an air circulation fan. The result shows that maximum temperature reduction in cooling side of TE-AC system was achieved at 6 A input current under steady state operation. The optimum performance of the TE-AC system under steady state operation depends upon the combined effect of the cooling load, Joule, Fourier and Peltier heat. In TE-AC pulse operation, both current width and cooling load applied on the cold side of the TEMs play an important role in achieving optimum cooling performance of the system. When normal input current operation (i.e., no current pulse) was compared to pulse-operated TE-AC system operation, it was found that pulse operation provides an additional average temperature reduction of 3-4 °C on the cold side of TEMs. While on the hot side, maintains a temperature in the range of 18-24 °C to reduce overshoot heat flux. The duration of operation is also important in determining pulse width and pulse amplitude. Mini-mum and overshoot peak temperature rises during each cycle for longer run operation. In the TE-AC system, the accumulated Joule heat during a current pulse frequently causes a tempera-ture overshoot, which lasts much longer.

Keywords: Thermoelectric cooler, Air condition, Pulse current operation, Building cooling

Role of Energy Policies in Development of Renewable Energy in Gulf Countries

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Abstract
For sustainable energy transition from conventional energy to renewable energy (RE), policies play a crucial role in any region. Recent developments and technological innovation in RE and economic policies such as globalization and RE deployment have motivated the researcher to attempt and investigate the Gulf Cooperation Council (GCC) countries, which have promulgated and adopted the RE policies to support and develop renewable energy in their country and to meet their targets, which includes renewable portfolio standard (RPS), Loans, tax incentives and feed-in tariff (FiT). This study reveals the impact of RE policies and their connection between electricity prices, economic growth, job creation, and CO2 emissions. It has been perceived that the policies adopted by the GCC countries were efficacious for a successful transition to renewable energy. This will help reduce carbon emission and have a positive correlation with economic growth to actively support renewable energy development and create a more competitive environment for investment in the renewable energy market and job creation in the region.

Keywords: Renewable Energy, Energy Policy, Incentives,

Functionalised Oil Fly Ash-Derived Carbon Nanoparticles Produced via High-Energy Ball-Milling for Different Applications

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Abstract
The reduction of oil fly ash waste in the environment has come to pose a considerable challenge. One of the most interesting technologies accordingly suggested for the conversion of fly ash into carbon nanomaterials is ball-milling. Therefore, in this study, carbon nanostructures were produced from oil fly ash via high-energy ball-milling, and they were then functionalised to tune their properties via mechanochemical treatment with nitric acid under a nitrogen atmosphere. The functionalised carbon nanoparticles (CNPs) were subsequently studied using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), X-ray diffraction (XRD), Raman spectroscopy (RS), X-ray photoelectron spectroscopy (XPS) and Fourier-transform infrared (FTIR) spectroscopy. The results showed that ball-milling is a cost-effective, eco-friendly, and sustainable technique for the production of CNPs. Furthermore, the wet milling process with nitric acid was shown to be essential for the introduction of oxygen-bearing functional groups on the carbon surface, thereby resulting in reduce the size and decrease the crystallinity of the carbon nanostructures relative to those in the dry milling process. The wet milling under nitrogen also produced hydroxylated CNPs. The presence of oxygen functional groups offers reactive sites, that could improve the chemical bonding of CNPs with other species and enhance their dispersion. This result suggests the applicability of functionalised carbon nanostructures for composites that could include reinforcement of rubber and other polymers, for use as lubricant additives, and for water treatment and energy conversion and storage.

Keywords: Oil fly ash, Carbon nanostructure, High-energy ball-milling, Functionalisation

Tracking system in concentrator photovoltaic (CPV): Specific design and performances issues

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Abstract
Concentrated photovoltaic (CPV) is one of the most promising PV technologies to produce solar electricity at competitive cost. The difference of CPV regarding PV stands in the addition of an optical system that focuses direct sunlight collected on large optics area onto a small size solar cell. In this context, several researches are moving fast to gain a strategic advantage in this emerging market.
CPV systems use only direct solar radiation and they should also permanently track the Sun's apparent daytime motion, hence incorporating an automatic sun-tracking structure is required in order to mount and position the concentrating optics in such a way that direct sunlight is always focused on the cells. Whenever CPV modules are used, sun trackers are put under severe requirements to insure keeping sun pointing error within a very narrow angle. Those specifications concern both the mechanical aspect as well as the installation. The already tracking solutions are not always designed for CPV panels, besides their structure mainly depend on local climatic effect on the mechanical structures which support the solar cells. Hence it is of importance to study and highlight the limiting factors of sun tracking for CPV solutions and try to come with easy solutions to ensure that.
This paper provides and presents an updated insight into the design and the specifications issues dedicated to the sun tracking system in photovoltaic concentrators, respecting both the electronic control unit and the mechanical structure. A deep research is performed to fix once a time this issue, generally considered as resolved by the well known algorithms for sun tracking but they are not well adapted.

Keywords: Concentrated photovoltaics (CPV), Sun tracking, Tracking accuracy;

Analysis and Optimization of Unbalanced Distribution Systems

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Abstract
In this paper, the IEEE 37-bus unbalanced distribution system (UDS) is modeled and analyzed to enhance its performance and operation. Both unbalance and mutual coupling between phases are considered in this study. The system has constant power, constant current, and constant impedance. The constant power load can be either concentrated or distributed. The backward/forward sweep method solves the distribution system efficiently compared to the published load flow solutions. Furthermore, the power losses are reduced by optimally allocating different distributed generation (DG) units using the Bald Eagle Search (BES) metaheuristic optimization algorithm. The optimization includes two cases of DG operation with unity (UPF) and optimal (OPF) power factors. It is found that the BES algorithm optimally determines the size and location of the DG devices efficiently and accurately. Furthermore, the power loss reduction with the OPF case is lower than the case with UPF. The corresponding total voltage deviation (TVD) and unbalance voltage factor (UF) are calculated for each case study.

Keywords: Distribution systems, DG units, BES algorithm, power loss, voltage deviation

Analysis Cyber-Attack Methods and Risk of Electric Vehicles in Smart Grids

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Abstract
Smart grids are a rapid development with the development of technologies in recent years. With the development of smart grids, many sectors have started to become as smart as technology and digitalization. In smart grids, electric vehicles, smart homes, solar panels, wind farms, factories, nuclear power plants, etc. exists. Smart grids are one of the sectors that rapidly adapt to technology development. The most important issue in smart grids is the flow control of data in SCADA systems and online data collection in data. It is a part of smart grids in electric vehicles and contains significant risks in terms of safety. With the widespread use of electric vehicles, safety problems and risks on these vehicles become important. Cyber-attacks that may occur on these vehicles may cause the vehicles to become completely unusable. The prevalence of electric vehicles is not only the safety problems in vehicles, but also the safety of charging stations, and their risks should be analyzed. This study, it is aimed to analyze the architecture, safety problems, and risks of electric vehicles. Also, this study, it is aimed to examine the security problems and analyze the risks in terms of cyber-attacks in electric vehicles, which are a part of smart grids. When analyzing risks, it can be revealed by examining and analyzing the security events that are or may be experienced. In this study, cyber-attacks will be detected and the measures to be taken will also be given.

Keywords: Cybersecurity, Risk Analysis, Electric Vehicle, Cyber-attack, Smart Grids

Minutes Time Interval Based Prediction of Solar Radiation Using Machine Learning Algorithms

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Abstract
The fast advancement and application of different technologies that are based on solar energy have precipitated research into the precise prediction of the availability of solar energy. In the piece of literature that is existing, both different models and methods have been put forward for the precise prediction of solar energy, yet, the need for the development of more precise algorithms to forecast solar energy is beckoning. Also, it is quite unclear in the existing piece of literature if a model can both precisely and consistently predict solar energy resources, especially when the application is to different data from various locations (with varying parameters). So, in this study, four different Machine Learning models are put into comparison for the purpose of long-term solar radiation prediction. These models include multilinear regression, polynomial regression, decision tree regression, and random forest regression. The choice of these models has been on the basis of their high performance on similar tasks in the existing piece of literature. These models' performances when applied for solar radiation prediction at various time intervals like hourly, daily, and 15 minutes, were evaluated and analyzed. Additionally, these models were applied by us to different datasets (including the typical meteorological year data) with input parameters that vary. The broad gauge goal of this research is to ascertain if a model can be consistent in outperforming others (when predicting solar radiation), not minding the variation in the input parameters, data size, as well as locations. The evaluation metric employed in the observation of the performance of the models includes root mean square error (RMSE), mean absolute error (MAE), and R.

Keywords: Accuracy, Machine Learning; Solar Energy Forecast/Prediction; Radiation; Regression.

Life Cycle Assessment of Various Energy Storage Systems for Renewable Energy Sources

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Abstract

Fluctuations regularly harm the use of renewable energy sources such as solar and wind due to insufficient sunshine or wind. Storing excess energy by using suitable energy storage techniques mitigates the intermittency issue as it makes energy attainable when required, especially for intricate climate; hot and arid. It is essential to consider suitable storage techniques to avoid extravagant casualties caused by extreme weather conditions. This study presents a life cycle assessment study to compare and evaluate the environmental impacts of various energy storage systems per kilowatt-hour (kWh), namely, vanadium redox flow battery, molten salt thermal storage, and compressed air energy storage. The results indicate that the redox flow battery has the global warming impact that is corresponding to 0.121 kg CO_2 eq./kWh. In comparison, the molten salt system has the most negligible impact of 0.0306 kg CO_2 eq./kWh, respectively. The compressed air storage is more favorable for the ozone layer impact than others, with a slight impact of 7.24×10^{-13} kg R11 eq.

Keywords: Emissions; Environment; Impact assessment; Renewable Energy; Solar Energy

Micro photovoltaic concentrators: Promises and challenges

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Abstract
Micro-Concentrator Photovoltaic (MCPV) systems are an unconventional method to respond to the Historic challenges of the CPV industry including a high-efficiency low-cost design, and demonstrating long-term reliability. Micro-CPV systems are based on the same principle as CPV modules, with only a reduction of the systems' dimensions (cells and optics). Typically, the multijunction solar cell does not exceed one millimeter a side; while the primary optics are the same order of magnitude as the thickness of the module of only a few centimeters. This miniaturization of the system dimension provides various benefits which can be potentially achieved. Namely, it enlarges their application field to rooftops, car roofs as well as in cramped spaces. Moreover, thermal management is easily controlled since the heat sink is no longer needed. The heat dissipation is done through the metal tracks that connect the cells. Furthermore, the efficiency is enhanced by using full lenses and omitting Fresnel lens losses from draft angles or tip rounding. Finally, micro CPV provides potentially low-cost manufacturing and assembly technologies by easily finding synergies with the fast-paced micro-fabrication and macro-electronic industries and micro-light-emitting diode (LED) technologies. Micro-CPV systems have many benefits than ordinary CPV, meanwhile, difficulties linked to the micro-scale size are ingrained and have to be taken into consideration during the manufacturing process.
The present work is mainly focusing on understanding this trend of photovoltaic concentrators. It represents an updated review of the main research projects and systems based on the use of this smaller systems. It includes as well the current requirements for Mico-CPV design. The recent achievements and the application fields will be also discussed. It will also discuss the main challenges for the Micro-CPV module technology and its components.

Keywords: “Micro photovoltaic concentrator; concentration; multijunction solar cell; Optical efficiency”

Controlling the rejection of protein during membrane filtration by adding polyvinyl pyrolidone (PVP)

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Abstract
Cellulose Acetate (CA) was blended with Polyvinylpyrrolidone (PVP) for the production of mixed matrix membranes. Diffusion induced phase separation technique was implemented for the synthesis of CA/PVP protein filtration membrane. The morphology, water permeation efficiencies and bovine serum albumin (BSA) rejection were studied to examine the influence of incorporating PVP in CA membranes. FTIR, contact angle and SEM were used to find out the surface morphology of membrane samples. SEM confirmed homogenous and significant mixing of PVP contents into pure CA matrix. Performance of blended membranes was measured in terms of water permeation and protein rejection percentage. The remarkable lessening of contact angle from 83° to 69° well illustrated the better hydrophilicity of CA/PVP membranes. All CA/PVP membranes rejected>90%. The hydrophilicity, water permeation and protein rejection % of CA membrane were improved by incorporation of 1% by weight PVP (M-1).

Keywords: Dialysis Membranes, Cellulose Acetate, Poly Vinyl Pyrolidone, Diffusion Induced PhaseSeparation, BSA Rejection

Optimization of Cefotaxime Loaded Nanoparticles for Invitro Drug Release Application

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Abstract
The aim of the present study was to optimized drug loaded antifouling formulation for in-vitro release application. Nanotechnology being the versatile tool for development and optimization of formulations was considered. For this purpose, nano-precipiation technique was employed to synthesize biodegradable Polycaprolactone (PCL) nanoparticles. Nano-encapsulation of cefotaxime as a core material inside PCL nanoparticles for slow and sustained release of antibacterial functionality was applicable for biomedicle applications. Optimization of stable formulation was achieved by varying process parameters, (stirring rate, stirring time, rate of injection of organic phase into aqueous phase, ratio of organic to aqueous phase, concentartion of surfactant, polymer, and drug). The resultant formulation was studied for surface morphology and surface characteristics. The average zeta size of blank and drug loaded nanoformulation was found to be 200 nm and 216 nm, while zeta potential of -16.8 mV and -11.2 mV, respectively. In-vito drug release studies were carried out at two different pH, 5.5 and 7.4 showed slow and sustained release. Thus, pH responsive bidegradable PCL nanoparticles for gradual release of antibiotic could remarably tune the antibacterial properties and pharmacokinetics of encapsulated antibiotic as compared to pure antibiotic.

Keywords: Cefotaxime, antifouling, nanoencapsulation, nanoparticles

Critical temperature effect at the wet working fluids in the subcritical ORC performance

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Abstract
The critical temperature is one of the important thermophysical properties of the working fluid, and it has a crucial effect on ORC (Organic Rankine Cycle) output parameters. Increasing the maximal cycle temperature is usually advantageous; concerning ORCs, the limit of the increase is the critical temperature (above that temperature, the cycle turns to Trans-critical Rankine cycle). Our previous study indicated that the thermal efficiency might have a maximum at subcritical temperature, and increasing the maximal cycle temperature close to critical temperature had a negative effect. In this study, thermodynamic analysis was performed for ideal and real ORC with various heat source temperatures and mass flow rates, using propane and R32 as working fluids. The output parameters: thermal efficiency, output energy, net earning, and payback period were studied. The results indicated that all the output parameters have higher values at certain subcritical temperatures, while they start to decrease with increasing cycle temperature close to critical temperature. At the real (non-ideal) cycle, it has been observed that the maximum efficiency is at the subcritical temperature of 360 K and 338.26 K for propane and R32, respectively, while it decreases with exceeding these values. Likewise, they have the maximum output energy at the mentioned subcritical temperature, and it was slightly above 281 MWh (for propane) and 251 MWh (for R32) at 0.8 kg/s mass flow rate.

Keywords: Thermal efficiency, subcritical ORC cycle, critical temperature, working fluids

A SURVEY ON SPACE CRAFT NUCLEAR REACTORS

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Abstract

The power supply system for spacecrafts must be small, compact, and light in order to reduce the transportation mass and costs. For mission periods exceeding few months and higher power requirements (> 20 kW_{el}), nuclear reactors will be far more superior than other power sources, such as, chemical fuel cells, solar cells, radioisotope generators, etc. Furthermore, a high reliability of the device is essential throughout the entire mission period. Hence, a static system is to be preferred to eliminate all possible sources of maintenance connected problems, such as, lubrication, sealing, kinematical disturbances on the space craft, etc.

An integrated nuclear electric power, nuclear thermal propulsion and nuclear electric propulsion system allows not only substantial cost and mass savings but also has the potential to accomplish several space missions which require high power, high orbit, high mass and propulsion capabilities in orbit. It is a strong candidate for applications for high power satellites, such as radar air traffic control and surveillance. In addition, it can contribute substantially to lunar base and Mars exploration for civilian missions, and for more far reaching outer planetary missions. A neutronic and thermo-hydrodynamic analysis for dual-purpose, fast, uranium carbide (UC) fueled in-core thermionic space craft nuclear reactor is conducted.

Keywords: Space craft reactors, Thermionic Reactors, Uranium fuel, Beryllium reflector, Reflector heating

Experimental Investigation of performance and emission characteristics of a gasoline engine fueled with HHO gas

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Abstract

HHO gas (Brown's gas / oxy-hydrogen), which can be produced by the electrolysis of water, is regarded as a promising renewable fuel. The present study focused on the investigation of a gasoline SI engine fueled with HHO gas as supplementary fuel. The effects of HHO injection position on the performance and emission characteristics were studied at variable load and speed conditions. Results showed that brake thermal efficiency and NO_x emission increased by 1.7% and 800 ppm respectively, while CO, CO_2 and HC emissions were lowered by 0.25%, 1% and 60 ppm respectively with port injection of 1.54 LPM of HHO at full load condition. This is found to be the ideal operating point for optimizing all engine output parameters except NO_x emissions. Changing the injection position from port to farther upstream did not have any significant effect on engine output parameters.

Keywords: Electrolysis, Oxy-Hydrogen, HHO, Supplementary fuel, Performance, Emission

Industrial Nuclear Hydrogen Production

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Abstract
Only major scale hydrogen production will be possible with a massive introduction of high temperature generation-IV reactors. The paper gives a comparative overview of Generation VI nuclear reactor types. Their potential for nuclear hydrogen production is discussed and given suggestions. For this purpose, basic principles of the Iodine-Sulphur Process for hydrogen production are outlined. The high temperature heat energy is supplied by a high temperature reactor. Operation temperature ranges for different process heat applications are addressed. Particularly, emphasis is focused on molten salt reactor. Major superiority of a molten salt reactor can be summarized as low operation pressure (~7 MPa), low coolant volume for the required heat transfer capacity, but very high coolant temperatures (>1100 ^{o}C if carbon composites are successfully employed).

Keywords: Nuclear hydrogen production, molten salt reactor, generation-IV reactors

Computational Analysis of an Electric Vehicle Battery using Modified Phase Change Materials

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Abstract

Since the introduction of Electric vehicles (EVs) into the consumer market barely a decade ago, they have rapidly grown in popularity as the most apt replacements for combustion vehicles. The main reasons for this rise in popularity are rapid decrease in toxic gas emissions in EVs. One factor that has plagued the industry for a long time is effective cooling of the Li-ion batteries which are used to power the vehicles. According to manufacturers Li-ion cells need to operate under an optimal temperature range of 20℃ - 50℃. Battery thermal management system (BTMS) is imperative to help maintain temperature range, enhance performance, and improve the service life and safety of the battery. As opposed to active cooling, passive cooling using Phase Change material (PCM) can be seen as the optimal choice for thermal management applications. This is due to the fact that they have high latent heat and help maintain uniform temperature. In this work, two PCMs are considered for passive cooling of the cell. Thermal enhancement using multiple fins, nanoparticles and a combination of both to improve the thermal performance of PCM have been analyzed. A numerical model for the BTMS based on modified PCM is performed using ANSYS FLUENT. Since the simulations are carried out for various conditions of thermal enhancements, Machine Learning (Regression study) is used to extrapolate the results for arbitrary inputs. The correlation between various properties of PCM and the measured outputs, namely Liquid Fraction and Mean Cell Temperature have been analyzed using a sensitivity study. Physical modelling tools in MATLAB have been used to analyze the ageing effects of the EV batteries under the application of the proposed BTMS solution, using parameters such as Capacity Fade and Battery Age.

Keywords: BTMS, PCM, EV, MATLAB, FLUENT, Machine learning.

Gas Turbines Coupled with Mechanical Vapor Compression System under Ambient Conditions of Riyadh, Saudi Arabia

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Abstract

The current work evaluates the performance of a gas turbine coupled with a mechanical vapor compression system under the arid ambient conditions of Riyadh, the capital of Saudi Arabia. Energy and exergy analyses of typical gas turbine and mechanical vapor compression systems are performed using the average hourly temperature and relative humidity. Three systems of mechanical vapor compression are evaluated. Those systems are simple mechanical vapor compression system, multistage mechanical vapor compression system with flash intercooling coupled with the dry air condenser (without cooling tower), and multistage mechanical vapor compression system with flash intercooling coupled with the wet air condenser (with cooling tower). Results indicate that the maximum exergy destructions of simple mechanical vapor compression system, multistage mechanical vapor compression system without cooling tower, and multistage mechanical vapor compression system with cooling tower are 3.7, 2.9, and 1.04 MW, respectively. The functional exergy efficiency of a gas turbine coupled with the cooling is approximately constant and higher than that without a cooling unit.

Keywords: Gas turbine performance; TIAC technologies; Arid ambient conditions; Exergy analysis.

A Large-Scale Energetic, Economic and Environmental (3E) Comparisons of Solar Adsorption Cooling System (Silica-Gel/Water) and Conventional Vapor Compression Cycle

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Abstract

In hot and dry regions such as the Gulf Cooperation Council (GCC) countries, the cooling demand is often responsible for more than 70% of electricity consumption which puts a large strain on the electricity grid and leads to significant emissions. Solar thermal assisted Silica-Gel/Water Adsorption chillers for space cooling have the potential to reduce the reliance on grid electricity for cooling but require careful design to make them both economically and environmentally beneficial. Here we evaluate the solar thermal adsorption chiller performance based on large-scale cooling demand through a TRNSYS simulation for one year of operation. The proposed system contains two main parts. The 1st part is the solar part which includes evacuated tube solar collectors, air cooler, storage tank, cooling tower and circulation pumps. The 2nd part is the adsorption cooling system which includes thermal generator unit (Silica-Gel/Water adsorption beds), condenser, and evaporator unit. Energetic, economic, and environmental aspects are investigated for an installation in the capital city of KSA. We compare the solar adsorption cycle to the conventional vapor compression cycle. In addition, we present a parametric study over the main design parameters. Results reveal that the system solar fraction can reach 96% for a solar collection area of 5500m^2 with a storage tank volume of 400m^3 for an annual cooling demand of 4616MWth. Furthermore, the annual energy cost is reduced by 74% for the solar adsorption system compared to the conventional vapor compression cycle. Meanwhile, the CO_2 saving percentage for the solar adsorption cycle was about 72% compared to the conventional vapor compression cycle. Carefully designed solar thermal cooling systems can reduce the greenhouse emissions while covering a large scale of cooling demands. This can reduce the strain on the electricity grid as well as greenhouse gas emissions.

Keywords:
Evacuated Tube Solar Collector; Storage Tank; Adsorption Cycle; Air Conditioning; Silica-Gel/Water; TRNSYS; Renewable Energy; Solar driven cooling.

Thermodynamic Performance and Economic Analysis of a Gas Turbine Power Plant Coupled with Evaporative Cooling System

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Abstract
This study aims at evaluating the thermodynamic performance and economic analysis of a Solar Taurus 60 gas turbine coulpled with an evaporative cooling system. The first and second law analyses were carried out to determine both thermal and exergetic efficiencies, and exergy destruction of the plant. The economic analysis was carried out using operating performance indices. The thermodynamic performance assessment on the plant was carried out by a computational model developed utilizing MATLAB R2018a software. Results of the study shows that the gas turbine has a thermal efficiency ranging from 27.6% to 33% with evaporative cooling system for a range of ambient temperature (280K - 310K) and an overall exegetic efficiency of 20.02%. The highest exergy consumer is combustion chamber (91.37%). The thermal efficiency of the power plant with a regenerator increased by about 10% under the same range of the ambient temperature. This Justifies the possibility of further improvement by incorporating a regenerator. The economic analysis indicates that for all the performance indices, the power plant falls short from the international standards; the capacity utilized was below 50%. This calls for effective management to ensure that the plant operates at an optimal level and this will in turn ensure reliable and cost-effective operation of the power plant.

Keywords: Thermodynamics, exergy analysis, energy systems, evaporative cooling system, exergy destruction

Green Refrigerant R600 for Diffusion Absorption Refrigeration DAR machine: Modeling and Performance analysis

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Abstract

The increase of refrigeration and air conditioning demand implies a significant increase of glabal electricity consumption and greenhouse gas emissions. Solar Absorption refrigeration is one of the most important method on utilizing thermal energy instead of electricity and natural's refrigerants replacing most environmentally unfriendly refrigerants as chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs).
In this study, a detailed performance analysis of the diffusion absorption refrigeration DAR machine operated with green refrigerant R600 is studied.
A parametric study is carried out allowing the investigation and discussion of influences of absorber effectiveness Effabs, driving heat temperature Tmax, cooling medium temperature Tc, and solution mixture concentration on the minimum evaporation temperature, on the circulation ratio, and on coefficient of performance COP.
The performance characteristics of this system is then analyzed parametrically by computer simulation with three cooling mediums 27°C, 30°C and 35°C (air) and three absorber effectiveness 50%, 80% and 100%. In the case of air-cooled machine with absorber effectiveness of 80%, the optimum driving temperature is around 170°C, and the corresponding COP reaching 0.13. While in the case of water-cooling, the coefficient of performance is higher and up to 0.23 with a lower optimum driving temperature around 135°C easy to reach with solar thermal collectors.

Keywords: Green refrigerant, Hydrocarbon, Absorption, Solar Refrigeration, Simulation, Performance

Feasibility study of a heating project for agricultural greenhouses using industrial thermal waste.

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Abstract : This work consists of studying the possibility of using industrial thermal waste at a low thermal level, in particular for heating agricultural greenhouses. It presents the energy study and the characterization of the various thermal discharges of a sulfuric acid production unit of the Tunisian Chemical Group in Gabès. The night-time heating requirement of an agricultural greenhouse was calculated for the two types of tomato and cucumber crops.

Thermophysics analysis of recuperative heat exchanger based miniature J-T cooler applicable to IR devices

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Abstract
A miniature Joule-Thomson (J-T) cooler with a recuperative type of heat exchanger (H-E) operated in steady-state condition finds extensive application in several civilian and defense applications. The present work discusses the numerical analysis of iteratively designed H-E operating under steady-state conditions along with comparing experimental results against numerical predictions. A customized code has been developed in MATLAB using Runge-Kutta method for solution. The results have been validated using commercial software COMSOL multi-physics and observed to be in good agreement. The need for smaller computational resources making it significantly less time-intensive is a clear benefit of the developed code. It also provides physically correct results enabling predicting thermal performance of recuperative H-E. Efficacy of the developed model is also proved as the experimental validation of the code was carried out against the observed thermal characteristics.

Keywords: JT cooler, steady-state, numerical analysis

Exergoeconomic Analysis of an Ammonia Fuel Cell-Based Integrated System with Two Organic Rankine Cycles

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Abstract
An exergoeconomic analysis of an integrated system that produces electric power using a molten alkaline ammonia fuel cell and two organic Rankine cycles for additional power generation as means of waste heat recovery. This integrated system also produces freshwater and space heating. This integrated system is modeled using exergoeconomic analyses through applying the cost balance equation to every component in the system. The results of this modeling show that this integrated system has an exergoeconomic factor and an exergy destruction cost rate values of 15.3%, and 0.0464 $/s, respectively. Also, a parametric study is conducted to show the trade-off between increasing the overall exergy efficiency of the integrated system, which is desirable, while the unit cost of products also increases, which is undesirable. This trade-off necessitates the use of multi-objective optimization tools to find optimum operation points of this system.

Keywords: Ammonia, integrated system, energy, exergy, efficiency, exergoeconomic analysis, fuel cell.

Analysis and Feasibility of Employing a New and Novel Hybrid Solar Chimney PowerPlant (HSCPP) – KSA Case Study

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Abstract

This work presents a novel design of a Hybrid Solar Chimney Power Plant (HSCPP) that combines a traditional Solar Chimney Power Plant (SCPP) structure with a Cooling Tower (CT) structure. The common components between the SCPP and CT are the chimney and a bidirectional turbine. The HSCPP works as a traditional SCPP during the daytime, and as a CT at night, producing electricity and distilled water 24/7. The Kingdom of Saudi Arabia (KSA) has been selected to assess the performance of the HSCPP due to its vast geographical area, and weather variations. Sixteen cities in KSA were selected to cover the entire geographical area. The results showed that there are quite variations in the weather conditions based on if the city is inland or near the water. The results also show that the performance of the HSCPP varies from city to city following the trends of the weather conditions. The results show that the highest annual electrical energy production (676.20 kWh) was observed at the city of Shahrurah (in the south), and the highest annual water production (143,898 tons) was observed at the Riyadh city. This confirms that the geographical location and weather conditions are critical to getting the optimal performance out of the HSCPP

Keywords: Water Distillation, Solar Chimney, Solar Chimney Power Plant, SCPP

Solar Chimney Power Plant Integrated with Water Desalination Plant – Qatar Case Study

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Abstract

This work presents a novel approach of integrating a standard solar chimney with a water desalination power plant through directly coupling the excess heat from the desalination plant to the solar chimney. The integration allowed for enhanced performance of the solar chimney in terms of electricity and distilled water production. The results show that, when coupling 150°C air from the water desalination plant to the chimney, the integration provided a 31-fold increase in electricity production (37878.34 kW), and an 8.6-fold increase in distilled water production (6207.09 ton). The results also show that when coupling air at 200°C, the electricity production increased by 48-fold (60105.15 kW), and the water production is increased by 11.7-fold (6207.09 tons). The comparison and assessment of the performance are based on a 24-hour profile.

Keywords: Water Distillation, Solar Chimney, Solar Chimney Power Plant

A Comparative Analysis of Dual Fuel and Conventional Marine Diesel Engines

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Abstract
This research comparatively investigates Diesel and dual-fuel engines. Commercial engine catalogs were used to compile data for the study. The study aims to gain an understanding of the merit of engine types to a broader extend. In these comparison processes, product performance, fuel consumption based on operating performance, NOx emission, air mass and temperature from the exhaust, Energy Efficiency Design Index EEDI, market prices of the engines, and the costs of the fuels they use are all evaluated. The EEDI is calculated using current BIMCO data. To ensure compliance with the 2021 and subsequent regulations, the calculation is carried out on a 161-meter, 1200 TEU container ship. According to the study, the diesel engine appears to be more affordable, taking up less space in the engine room and requiring less auxiliary machinery and equipment. However, when fuel consumption and current prices are compared, the dual-fuel engine can save around $175 per ton of fuel compared to the Diesel engine. Furthermore, when their environmental impact is compared, it has been determined that the diesel engine causes up to around five times more NOx than the dual-fuel engine.

Keywords: Diesel engine, dual-fuel engine, emission, energy, efficiency, marine engineering

The potential of recycling food waste, with an automatic composter and its use for sustainable agriculture

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Abstract
According to expert estimates, 40-60% of municipal solid waste is food waste. Many effective methods of composting food waste have been developed. However, one of the limiting factors of their use is the time factor, also the dependence of the process on temperature factors, humidity, pH and the need for special places for composting piles. Automatic composters come in a variety of capacities, have a specific composition of thermophilic microorganisms, and have fixed compost processing times. However, there is still little information on the quality composition of the compost produced this way, its phytotoxicity, and its potential for use as a fertilizer. The purpose of this article is to produce compost from food waste using THE SCHNELL KOMPOSTER (Model S-50), to study the composition and certain properties of the compost immediately after composting and after one year of storage and evaluate its potential use as a crop fertiliser. In 6 months, 200 kg of compost was produced from it using composter. The total nitrogen content of the resulting compost was 1.7%. The gross phosphorus content was 0.542% and potassium -1.68%. pH was 4.5. The humus content was 15.60%. The storing of compost at room temperature for one year did not change pH, but the total content of nitrogen increased by 0.32%, the total content of phosphorus decreased by 0.05% and the total content of potassium by 0.36%. The results of phytotesting showed that the use of 5% compost in the soil pods had the best stimulating effect on the growth of oat sprouts (20.8 cm) and radish (5.6 cm); with increasing the content of compost (15%), inhibition of growth of oat (14.2 cm) and radish (3.1 cm) was found in the test-crops. Recycling food waste by composting will contribute its part to sustainable development and climate change.

Keywords: food waste, compost, composter, humus content, phytotesting

A Brief Study on Cobalt-Chlorine Thermochemical Hydrogen Production Cycle

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Abstract
In this study, analyses are performed via the Aspen Plus software to examine the Cobalt-Chlorine (Co-Cl) thermochemical cycle in detail. There are four reactions in the Co-Cl thermochemical cycle. These are listed as the hydrolysis reaction in which hydrogen is obtained, the thermolysis reaction in which oxygen is obtained, the reduction reaction and finally the hydrochlorination reaction. The hydrolysis reaction exhibits high conversion at temperatures above 700 ^{o}C and vacuum pressure of 1e-4 bar. The thermolysis reaction takes place above 650 ^{o}C. Similarly, the thermolysis reaction works under vacuum pressure. The reduction reaction can be completed under low temperature and atmospheric pressure. The final reaction, hydrochlorination, can also form a product under atmospheric pressure at temperatures below 150 ^{o}C.

Keywords: Cobalt Chloride, Hydrogen production, Thermochemical cycle, Water splitting

Mathematical Modeling and Characterization of the PEM Fuel Cell

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Abstract
In this work, we present mathematical modeling of a Proton Exchange Membrane Fuel Cell (PEMFC) system using an Amphlett model, which able to simulate the behavior of fuel cells from electrical and dynamic properties. Moreover, using the MATLAB environment to simulate the values of a Heliocentris-FC50 fuel cell found in the Laboratory of Electrical Engineering (LAGE). The simulation results reveals very good understanding for FC performance, in addition the impact of temperature and the pressure on the performance of the FC, the influence of these factors should be taken into consideration to choose the best conditions for this FC to operate at the best efficiency.

Keywords: Mathematical model, PEM fuel cell, Simulation.

Blending Renewable Hydrogen with Black Sea Natural Gas: A Case Study

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Abstract
In this study, an integrated system is designed to produce renewable hydrogen and blend it with natural gas available in the Black Sea in the City of Zonguldak for countrywide utilization, and a case study is, in this regard, considered for Turkey. To use the natural gas reserves in a more efficient and environmentally friendly manner, blending it with the addition of 20% hydrogen by volume is the prime focus of this study. For this purpose, hydrogen production capacities from renewable energy sources such as solar, wind, and wave are calculated and found out as 174,210 kg, 1432 kg, and 1257 kg, respectively. The effects of hydrogen addition on blend gas consumption and the lifetime of existing reserves are investigated. With the addition of 20% hydrogen by volume, annual blend gas consumption increased from 46.55 billion m^3 to 54.11 billion m^3, while natural gas consumption decreased from 46.55 billion m^3 to 43.29 billion m^3. Thus, the reserve life has increased from 11.6 years to 12.5 years.

Keywords: Natural gas, hydrogen, solar energy, wind energy, wave energy

Assessment of Hydrogen and Natural Gas Blending for Use in Different Locations

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Abstract
In this study, a techno-economic assessment of the renewable hydrogen production and blending with natural gas in the existing pipelines are performed for various locations. In this regard, solar and wind energy-based power systems integrated with reverse osmosis units are designed and compared in energy, environment, and cost. Solar PV panels and wind turbines are considered for electricity and hydrogen production for residential applications in an environmentally benign way. Here, the heat required for a community consisting of 100 houses is provided by a boiler by hydrogen and natural gas blend as fuel. The costs of capital, fuel, operation, and maintenance are calculated and evaluated. The total net present costs are calculated between $3.02 million and $4.15 million for the various locations. An environmental impact assessment is performed by comparing carbon dioxide, carbon monoxide, unburned hydrocarbons, particulate matter, and nitrogen oxides.

Keywords: Cost, Efficiency, Emissions, Energy, Hydrogen, Natural Gas, Renewable Energy

Investigation of the Effect of Diesel Fuel / N-Amyl Alcohol Blends on theEmissions of a Turbocharged Common Rail Engine

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Abstract

The technical characteristics of the fuels used in internal combustion engines are developed considering the environmental impacts as well as meeting the demands of engine manufacturers and users. Emissions released as a result of burning the fuel in the cylinder have negative effects on the environment and human health, together with the increasing population. For this reason, studies are carried out to reduce emission values in vehicles used for passenger and cargo transportation. In this study, NA-5, NA-10 and NA-15 fuels were obtained by blending N-amyl alcohol with diesel fuel at 5%, 10% and 15% by volume. The emission values of the obtained fuels were tested under full load conditions using a BT190-FR hydraulic dynamometer in a commercially used 1.9 Multijet engine. As a result of the study, it was observed that fuels containing N-Amyl alcohol decreased CO, CO2, HC and NO emissions, and increased O2 emissions.

Keywords – *N-Amyl Alcohol,Pentanol, Diesel Engine, Exhaust Emissions, Alternative* Fuel

Performance Analysis of A New Solar Based Integrated Mobile System For Caravan Applications

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Abstract

In the current study, development and assesment of a new integrated mobile solar energy system for fifth wheeler caravans are performed. During the daytime, the system utilizes photovoltaic/thermal (PV/T) solar panels to supply electricity and hot water and a novel photoelectrochemical (PEC) reactor to provide solar- based green hydrogen and wastewater treatment. The system also comprises a proton exchange membrane (PEM) fuel cell to generate electricity from hydrogen during the nighttime. The excess heat occurring from the operation of the PEM fuel cell is utilized for space-heating in the caravan. The performance of the PEC reactor and PEM fuel cell packs are evaluated through electrochemical analyses. Further, a thermodynamic study is conducted on the integrated system using four thermodynamic balance equations, and the overall energy and exergy efficiencies of the integrated system are evaluated. With the solar irradiance of 600 W/m2, the system's overall energy and exergy efficiencies are evaluated as 22.27% and 20.88%, respectively. With a similar solar irradiance and quantum efficiency of 30%, The PEC reactor operates with an energy efficiency of 9.2% and exergy efficiency of 9.42%. The electrical efficiency of the PEM fuel cell is evaluated as 53.63%, whereas the efficiency of the PEM fuel cell reaches up to 78.5% in case of utilizing the excess heat for space-heating in the caravan.

Keywords: Solar energy, hydrogen, photoelectrochemical process, energy, exergy, efficiency.

Design and evaluation of a new solar-biomass based energy system for a small community

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Abstract
In this paper, an integrated system is proposed and analyzed accordingly, which generates power, heating and freshwater while being supplied with two distinct renewable energies; biomass and solar thermal. The system integrates a multi-staged steam Rankine cycle with the steam generator energized via heat transfer from hot biomass combustion gases and hot solar thermal oil. It also integrates a multi-effect desalination unit energized with thermal energy recovered from hot flue gases. The biomass combustion rate is controlled so that steam is generated steadily and at constant parameters regardless of the fluctuation and intermittence of solar radiation. Considering the solar radiation for a typical day in KSA, the biomass consumption decreases three times during the noontime with respect to the nighttime. Nevertheless, when the biomass combustion rate is higher, the integrated system generates more heating by-product and more freshwater. The study shows that the need for typical solar thermal storage can be eliminated, and so the economic competitiveness of the solar thermal energy resource substantially increased.

Keywords: Solar energy, Biomass, Rankine cycle, Integrated system, Energy, Exergy, Efficiency.

A comparative economic study of hydrogen production methods using Hydrogen Economy Evaluation Program (HEEP)

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Abstract

This paper presents a comparative economic study of hydrogen production using several nuclear reactors integrated with selected hydrogen production methods. The Hydrogen Economy Evaluation Programme (HEEP) tool is used for this study. This tool was developed by International Atomic Energy Agency (IAEA). HEEP offers different nuclear power plants, hydrogen production plants, storage, and transportation methods within its database along with various options of storing and transportation. In addition, HEEP provides the thermal energy and power cost information, estimations for capital and fuel costs, decommissioning, O&M, and consumables. These data are validated and reviewed by IAEA.

Furthermore, this tool offers cost estimates that incorporate numerous hydrogen storage and transportation options. The storage option considers three approaches compressed gas, liquefaction, and metal hydride. At the same time, transportation options include vehicles and pipelines. The outcomes of this study will compare the costs of various possible nuclear hydrogen production options using low and high temperature electrolysis technologies.

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