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Review Article

A Review of Cobalt-Based Metal Hydroxide Electrode for Applications in Supercapacitors

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Supercapacitors are the cutting-edge, high performing, and emerging energy storage devices in the future of energy storage technology. It delivers high energy and produces higher specific capacitances. This research study provides insights into supercapacitor materials and their potential applications by examining different battery technologies compared with supercapacitors' advantages and disadvantages. Transition metal hydroxides (cobalt hydroxides) have been studied to develop electrodes for supercapacitors and their use in various fields of energy and conversion devices. Cobalt-based metal oxides and hydroxides provide high-capacitance electrodes for supercapacitors. Metal hydroxides combine high electrical conductivity and excellent stability over time. The metal oxides used to prepare the electrodes for supercapacitors are cobalt-based metal oxides and hydroxides. It is stronger than most of the other oxides and has tremendous electrical conductivity. Cobalt hydroxides are also used in supercapacitors instead of other metal hydroxides, such as aluminum hydroxide, copper hydroxide, and nickel hydroxide. This study gives a complete overview of the preparation, synthesis, analysis, and characterization of cobalt hydroxide thin film electrodes by using the electrochemical deposition technique, parameters measurements, important characteristics, material properties, various applications, and future enhancement in supercapacitors.

1. Introduction

Supercapacitors, as sustainable energy storage devices, can contribute to the natural ecological environment and society. Cobalt hydroxide is a kind of metal oxide material with cobalt and oxygen as the main elements. Cobalt hydroxide is a material that has been explored as a potential electrode material for use in supercapacitors. It has several properties that make it attractive for this application, including a high specific capacitance, good electrical conductivity, and good stability over a wide range of pH conditions. Cobalt hydroxide has been shown to have a high energy density, making it an interesting choice for use in supercapacitors. In addition, it has good cycling stability, meaning it can maintain its performance over a large number of charge/discharge cycles. One of the main challenges in using cobalt hydroxide as an electrode material for supercapacitors is its relatively high cost compared to other materials. Further,

sustainability

MDPI

Article

Ecological Footprint Assessment of Concrete: Partial Replacement of Cement by Water Treatment Sludge and Stone Dust

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Abstract: Currently, most concrete industries use conventional cement (Ordinary Portland Cement) as a binding material which involves natural resource depletion, colossal CO_2 emissions, and a huge energy supply. The present study addresses this critical issue by using stone dust (sun-dried and calcinated) and water treatment sludge (sun-dried and calcinated) to replace cement partly in M20-grade concrete production. The environmental impact of ready-mixed concrete (RMC) production with conventional cement and partially replaced cement by other cementitious material, i.e., stone dust and water treatment sludge in concrete, is assessed through ecological footprint (EF) indicator. Moreover, a novel sustainability index is proposed for ready-mixed concrete plants to scale the environmental impact of different types of concrete (or grades) on the sustainability scale (environmental, social, and economic sustainability). The results showed that the sun-dried water treatment sludge and sun-dried stone dust could effectively replace cement (15% by weight) in the concrete, with a comparable compressive strength over the M20 ready-mixed concrete. The EF of conventional M20 RMC is estimated to be 0.02295 gha/m^3. The EF of concrete (with sun-dried water treatment sludge) is reduced by 13.14% of the conventional ready-mixed concrete. The Ecological Sustainability Index (ESI) of the ready-mixed concrete plant is estimated to be 718.42 $/gha. Using water treatment sludge and stone dust in concrete production can be an innovative solution because it simultaneously solves the problem of waste disposal, large carbon emissions, cost, and high environmental impact.

Keywords: ready-mixed concrete; ecological footprint; stone dust; water treatment sludge

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1. Introduction

Concrete has been one of the most prolific and widely used materials for building structures in modern industrialized society due to its robustness, strength, and low cost [1]. Moreover, it is also considered a versatile and durable material for climate-resilient construction [2]. Worldwide, around 32 billion tonnes of concrete are produced annually. Cement contributes around 10% of the concrete mass and at present it is produced at a rate of 4 billion tonnes per year globally [3]. The consumption of concrete has nearly tripled in the last 40 years, accounting for almost four tonnes per capita annually, and this demand is expected to rise further [3]. Although the benefits of concrete are plenty, it is considered

Energy-water nexus for thermal power generation in India: challenges and opportunities

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Abstract
Thermal power generation is economical in the current scenario, but it is a water-intensive process, resulting in a high-water footprint. In this research, life cycle water use (LCWU) was assessed for three coal-based thermal power plant in India. The LCWU was found to be in the range of 2.5 to 3.5 L-kWh^{-1}. The results of the LCWU of coal-based thermal power plants in India are higher than the global average of 1.75 L-kWh^{-1}. In order to reduce the dependency on water, air-cooled condenser (ACC) with a novel approach of reducing temperature of air before entering into condenser is purposed using vapour absorption chillers. A 300 MW thermal power plant located in the South India region is chosen to illustrate the application of the proposed system. Initially, waste heat from flue gas is used to run a vapour absorption chiller, and finally a solar-assisted vapour compression chiller is used. Also, in order to utilize large coastal lines in India, an alternate approach of sea water cooling-based thermal power generation is investigated. A 2 MW steam turbine plant utilizing deep sea water is designed and analysed. In seawater cooling system the condenser temperature is reduced, increasing efficiency by 1.9% and power output by 133 kW. It resulted in power generation with multiple benefits, including cooling, desalinated water, and increased plant efficiency. The outcomes of this study provide information on water use in Indian thermal power plants along with its comparative assessment. A study of ACCs and seawater-cooled condensers is also an opportunity to reduce the life-cycle water use in thermal power plants in India.

Keywords Energy · Water footprint · Thermal power plant · Air-cooled condenser · Sea water cooling

1 Introduction

Increase in population, economic development and changing consumption pattern leads to increase in water demand globally. Coal has fueled the growth of electricity generation and industry. It continues to be a major single fuel in the electricity sector (IEA, 2021). UN

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Concurrency and Computation
Practice and Experience

RESEARCH ARTICLE

Secure Internet of Things based hybrid optimization techniques for optimal centroid routing protocol in wireless sensor network

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Summary

The recent survey depicts internet growth has been reached to billion of people and Internet of Things (IoT) as another milestone. IoT is wired or wireless communication technologies to establish a communication channel between devices and services available over the Internet. The wireless sensor networks (WSNs) is one of the most essential technologies assisted in IoT for real-time applications. The energy efficiency is a major issue in IoT and it becomes more complex due to large scalability and the WSNs cannot be applied directly to the IoT. Moreover, routing is a very challenging aspect that takes place in such platform because of it is intrinsic properties. In this article, we

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A spectrally efficient modified asymmetrically and symmetrically clipped optical (mASCO)-OFDM for IM/DD systems

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Abstract

A novel spectrally efficient modified asymmetrically and symmetrically clipped optical (mASCO)-OFDM for intensity modulated direct detection (IM/DD) systems is presented. The conventional ASCO-OFDM systems use two frames to transmit the conventional asymmetrically clipped optical (ACO)-OFDM and symmetrically clipped optical (SCO)-OFDM system. The proposed mASCO-OFDM system replaces the two frame SCO-OFDM by a single frame modified SCO (mSCO)-OFDM. The mSCO-OFDM clips the data on only one side of the symmetry and performs an absolute function on the other side of the symmetry. This allows mASCO-OFDM to be 1.333 times more spectrally efficient than the conventional ASCO-OFDM. The mASCO-OFDM reduces its receiver's complexity by estimating and eliminating the clipping noise distortion in time domain. Overall, this system has 43% lower complexity in comparison to ASCO-OFDM system. The mASCO-OFDM shows a better BER performance and a lower Peak Average Power Ratio (PAPR) than ASCO-OFDM. The proposed system also shows better BER performance than ACO-OFDM for the same spectral efficiency.

Keywords ACO-OFDM · SCO-OFDM · ASCO-OFDM · mSCO-OFDM

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Prediction of CI Engine Emissions Fueled with Multiwalled Carbon Nanotube-Doped Waste Cooking Oil Biodiesel using Multilayer Neural Network

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Nanocatalysts play a significant role to improve the thermal and physical properties of biodiesel. In the present work, the multiwalled carbon nanotubes (MWCNTs) as an additive with the fraction of 30, 40, and 50 ppm are dispersed with the different biodiesel–diesel blends of 10%, 30%, and 50% of waste cooking oil (WCO)-based biodiesel (B10, B30, B50) for the prediction of four-stroke compression ignition (CI) engine emissions using multilayer neural network (MLNN) model. An MLNN model uses a backpropagation algorithm to map input and output parameters. The input parameters to MLNN are load, blends, and MWCNTs in ppm. On the other hand, the output parameters are HC, CO, and NO_x. The results for the optimum topological structure of 3-10-3 denoted mean square error (MSE) equal to 0.095 that are capable of predicting the emissions for different operating conditions. Thereafter, the developed MLNN model is tested on an experimental setup consisting of a single-cylinder four-stroke CI engine and emission analyzer. The emission characteristics predicted by MLNN are called to be nearly experimental measurements with reasonable accuracy as it depicts the good "*R*" values as 0.95, 0.96, and 0.976 for HC, CO, and NO_x, respectively, and also gives the reasonable average relative error values as 0.83%, 1.01%, and 1.05%, for HC, CO, and NO_x, respectively. Further, the developed model is suitable for predicting emissions of CI engines, thus minimizing the cost, time, and labor effort.

1. Introduction

The research on alternative fuels has received attention due to growing demand and limited availability of petroleum; the cost is rising. Because of that, there is a requirement to search for alternate fuels for compression ignition (CI) engines [1]. In this connection, biodiesel from nonedible oils as feedstock becomes of greater interest. However, the cost associated with the production is high as compared with diesel. Due to the aforesaid reason, biodiesel is not appropriate for commercialization. In this context, there is a need for biodiesel whose production cost should be less compared with diesel. Further, waste cooking oil (WCO) is considered an economical biodiesel feedstock as its price is considerably lower than oil from other sources [2–5]. In the previous works, investigation of CI-engine parameters has been carried out via experiments [5–8]. Further, in recent advances, nanotechnology proved that nanomaterial-dispersed fuel can be used for better performance of engines due to its good mechanical and thermophysical properties than traditional materials [9–13]. The research work related to the experimentation of CeO_2 [14] and ZnO_2 [15] influence on CI engine operated with biodiesel is observed. Experimental discussion on the influence of carbon nanotubes over the diesel engine is reported by Tewari et al. [16] and by Basha and Anand [17], the result of Al_2O_3 and CeO_2 added in

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Ecological footprint and economic assessment of conventional and geopolymer concrete for sustainable construction

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ABSTRACT

Cement is the binding material in conventional concrete which involves excess lime quarry and large volume of CO_2 emission during its production. On the other hand, the geopolymer concrete is a cement-less concrete where materials such as fly ash, blast furnace slag, bottom ash, construction, and demolition waste etc. are utilized as binder (precursor) when activated with alkaline solution. In the present study, ecological footprint along with the mechanical properties and the incurred cost of the production of M30 conventional cement concrete prepared according to IS, ACI and DOE code of practices were assessed and compared with that of geopolymer concrete. Cement concrete prepared according to IS, ACI and DOE code of practice had the compressive strength of 41 MPa, 43 MPa and 32 MPa respectively at 28 days. The compressive strength of geopolymer concrete was found to be 48 MPa at 28 days which was higher than that of all the conventional concrete. But the ecological footprint and the cost of geopolymer concrete production was found to be lower than that of conventional concrete. The geopolymer concrete had the lowest ecological footprint or the bio-productive land requirement of 0.0224 gha/m^3 when compared to that of conventional cement concrete. The conventional cement concrete prepared as per the IS code had the highest ecological footprint of 0.0546 gha/m^3. Heat curing contributed to 44% and the material contributed to 46% in the total ecological footprint of geopolymer concrete. However, burden of energy incurred on heat curing can be further reduced by the use of non-conventional source of energy. The production of geopolymer concrete also provides a sustainable disposal option for industrial waste produced as a by-product. Therefore, geopolymer concrete could be seen as eco-friendly and economical alternate to conventional concrete in the era of sustainable development.

1. Introduction

Construction industry plays a key role in the country's development and accounts for more than 6% of the world's GDP (Gross Domestic Product) (Market Prospects, 2021). Urbanization and infrastructure development led to the demand for huge concrete production. Cement is the main ingredient required for the production of concrete and acts as a binder for aggregates and filler materials. Cement production is adversely affecting the environment as it involves the exploitation of natural lime deposits and emission of large volume of a greenhouse gas, CO_2 into the atmosphere. Globally cement producing industries are among major CO_2 emitters and contributes to 8% of the global CO_2 emission (Farooq et al., 2021). Amran et al. (2020) reported that cement production continues to grow at 9% annually. Fig. 1 shows the cement produced by different countries of the world in 2020 (USGS, 2021). It is evident form Fig. 1 that around 4.1 billion ton cement was produced globally in 2020, and China had the largest share followed by India (USGS, 2021). Fig. 2 shows the CO_2 emission due to cement manufacturing in 2005 and 2020 by selected countries (Statista, 2020). The direct CO_2 emission per ton of cement produced has increased by 1.8% per year during 2015–2020. A 3% annual reduction to 2030 is required to achieve Net Zero Emissions by 2050 (IEA, 2021). Special focus on improving fuel efficiency, reducing clinker to cement ratio, using supplementary cementitious materials, and developing alternate

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ORIGINAL PAPER

Fractional Integral and Derivative Formulae for Multi-index Wright Generalized Bessel Function

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Abstract
This article deals with the study of the multi-index Wright generalized Bessel function (or Bessel–Maitland function) $\mathbb{J}^{(\alpha_j)_m,\ \varsigma,\ c}_{(\beta_j)_m,\ k,\ b}(.)$ where $(j = 1, 2, \ldots, m)$ with the relation of pathway fractional integral operator and with extended Caputo fractional derivative operator which plays a remarkable contribution in the physical sciences, and various engineering disciplines, can be represented as the generalized Wright hypergeometric function ${}_r\Psi_s[z]$. We also discuss some special cases of our main result by choosing some particular values of the parameters in $\mathbb{J}^{(\alpha_j)_m,\ \varsigma,\ c}_{(\beta_j)_m,\ k,\ b}(z)$.

Keywords Bessel–Maitland function · Pathway fractional integral operator · Extended Caputo fractional derivative operator

Mathematics Subject Classification 2010 · 33C20 · 33B15

Introduction and Preliminaries

The Bessel function has grown noteworthiness due to its involvement in the solution of the problem in a conduction of heat, propagation of electromagnetic waves along wires, small vibration of gas, and variable flow of heat in a sphere, the stability of vertical wire, torsional vibration of a vertical cylinder, etc. (see [1]). Many authors of various fields have investigated

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Modified Hottel-Whillier-Bliss Equation for an Active Solar Distillation System for Higher Yield and Thermal Efficiency

Based on energy-balance equations for a photo-voltaic thermal (PVT) active solar distillation system, a modified Hottel-Whillier-Bliss (HWB) analytical characteristic equation as a function of design and climatic parameters has been derived in the present article. It has been found that there is a significant difference between characteristic equations for PVT-based active solar distillation and the conventional flat plate collector (FPC). It is due to (i) opposite nature of loss factor from inside surface to ambient through glass cover and (ii) temperature dependence of the evaporative heat transfer coefficient between water surface and condensing cover in the solar distillation system. Numerical computations have been obtained for the characteristic curve of the proposed active solar distillation system and flat plate collector under the condition of a typical day in New Delhi, India. Further, the effect of performance parameters such as packing factor, electrical efficiency of individual PVT collectors, and water mass have also been studied for the proposed active PVT solar distillation system. Moreover, daily yield of portable water has been found to be 7.34 kg/m^2 at $n=5$ and $\beta_c=0.25$ which is 100.5% higher than the daily yield of 3.66 kg/m^2 obtained at $n=1$, $\beta_c=0.89$.
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Keywords: Hottel-Whillier-Bliss equation, PVT collectors, active solar still, solar energy, boiling, energy systems, heat and mass transfer, heat exchangers, thermal systems

1 Introduction

The world is facing challenge to produce freshwater for the survival of human beings and without its availability in adequate quantity, the existence of all us will be in peril [1]. Due to the tremendous growth in the population and industrial development, the scarcity of fresh water is growing [2]. There are various large-scale fresh water production techniques such as reverse osmosis, electrodialysis, multi-effect distillation, and membrane distillation, which are energy-intensive technologies [3–5]. Energy and water crises are often a phenomenon in most countries of the world. The concept of harnessing renewable energy for sustainable development [6] particularly solar energy to power desalination systems has gained recent research interest.

The solar distillation unit is one of the most successful sustainable purifying brackish/hard water system used to produce potable water in rural area to meet the requirement of human being. Renewable sources are most suitable for distillation [7], cooling [8], and pasteurization [9]. The solar distillation system is classified as passive and active. The active solar still is a hybrid case of the passive solar still. In the year 1982, Malik et al. [10] have comprehensively reviewed the research work on both passive and active solar stills carried out by many scientists all over the world. Their review includes the importance, historical background, various designs of passive and active solar still, internal heat and mass relation etc. Further, Lawrence and Tiwari [11] have developed a theoretical model for an active solar distillation unit under the mode of natural circulation. Tripathi and Tiwari [12] have investigated the effect of solar fractionation on the performance parameters of a passive solar still and validated by experimentation. They found a significant role of solar fractionation in thermal modeling of the solar distillation system. Later on, many attempts have been made on many aspects of the solar distillation system to enhance the productivity (yield) and thermal efficiency [13,14]. Some of them are self-sustained photo-voltaic thermal collector based active solar stills [15–17]. Further, the effect of nanoparticle [18], phase change material [19,20], water depth [21], shape of condensing cover [16], etc., on the performance of active solar distillation has also been carried out.

Singh and Tiwari [22] have conducted a comparative performance analysis between the photo-voltaic thermal-compound parabolic concentrator (PVT-CPC) coupled active solar stills having single and double slopes. They have found that the single slope model has better performance than the double slope. The research work till recently carried out by many researchers on the solar distillation system has again been reviewed by Tiwari and Sahota [23]. However, Tiwari [24] made an attempt to develop a characteristic equation for the single slope solar distillation unit. In continuation of this, Dev et al. [25] have developed a characteristic equation for the double slope solar distillation system. After that Gupta et al. [26] have developed a characteristic equation for PVT-CPC base active solar distillation without any explanation of its behavior.

From the literature, it has been observed that the analyses have not been compared with the characteristic equation developed by Hottel-Whiller-Bliss (HWB) for the flat plate collector (FPC) [27]. Also, a detailed explanation of the non-linearity behavior of the characteristic curve is missing in the open literature. The works carried so far in the open literature have only considered the average solar cell temperature of the whole system to calculate electrical output. Therefore, in view of this research gap, an analytical modified HWB characteristic equation for PVT active solar distillation as a function of design and climatic parameters with basic assumptions has been developed in the present work. A developed modified characteristic equation has also been compared with analytical results developed by Hottel-Whiller-Bliss for the conventional flat plate collector. Moreover, a comparison of the

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Time domain diversity combining with delay-and-advanced operation in two layered asymmetrically clipped optical OFDM system

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Abstract

This paper demonstrates the advantage of application of time domain diversity combining (TDDC) at the transmitter over the time domain diversity combining receiver (TDDR) for a single layer of ACO-OFDM in terms of reduced complexity. The paper further demonstrates the implementation of time domain delay-and-advanced operation with TDDC at the transmitter for a two-layered LACO-OFDM system, where all the subcarriers are utilized and an improved BER performance is achieved. The new improved 2-LACO-OFDM system achieves 2.7 dB, 3.3 dB and 3.7dB better optical signal to noise ratio (OSNR) than the ACO-TDDC, 2-LACO-TDDC, 3-LACO-TDDC respectively.

Keywords ACO-OFDM · LACO-OFDM · ACO-TDDC · LACO-TDDC

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Research Article

Life Cycle Ecological Footprint Reduction for a Tropical Building

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Rapid urbanization significantly impacts natural resource demands and waste management in the construction sector. In this study, a novel methodology has been developed that could assess the overall environmental impact of a building during its lifespan by considering resources such as building materials, energy use, emissions, water, manpower, and wastes. The proposed method can estimate the life cycle ecological footprint (EF_T) of a building. The result indicates that 957.07 global hectares (gha) of bioproductive land are required during the lifespan of the case building. The CO_2 absorption land is the most significant bioproductive land in the EF_T of the building. The low environmental impact of building materials may reduce the ecological footprint (EF) of buildings, and using renewable energy can also reduce the operational EF of a building. The proposed building materials and solar PV systems have the potential to reduce the building's life cycle environmental impact by up to two-thirds. The EF assessment of all existing and proposed buildings may be examined in order to execute strategies for a sustainable construction sector.

1. Introduction

Rapid urbanization influences natural resource demand and energy use as well as greenhouse gas (GHG) emissions [1, 2]. The construction industry is accountable for 40% of the global materials demand [3], 32% of the global energy consumption, and 19% of the global energy-related GHG emissions [4]. The Indian construction industry is expected to grow annually at 5.6% during 2016–20, and it may grow annually up to 7.1% by 2025 [5]. However, one-quarter of the total consumed primary energy and one-third of the total generated electricity are consumed in Indian buildings [6, 7].

In the entire lifespan of a building, energy, construction materials, manpower, construction and demolition (C&D) waste, water, transportation, and GHG emission are considered to be the major factors that have an ecological impact [8–11]. Many studies on life cycle energy [12, 13], emissions [14], C&D waste [15], transportation [16], and water consumption [17] in buildings have been reported. The estimated material use in India is projected to be nearly 15 billion tonnes by 2030, and it will further increase up to 25 billion tonnes by 2050 [18], while total C&D waste generated in the country in 2015 was about 716 million tonnes [19]. Bardhan analyzed that the building material production and building construction phase required water up to 27 kilolitres/m^2 of the floor area [17]. Waste is generated in every phase of the building, while the maximum C&D waste is generated when the building is demolished [15]. The energy consumption and CO_2 emissions by the transportation of building materials and C&D waste are significantly low as compared to the total life cycle energy consumption and emissions of the building [16]. Ding examined the energy consumption pattern during the different life stages of case study buildings; the study suggested that the operational phase and the construction phase of the building are responsible for 62% and 38% of the total life cycle energy

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Overview of the effect of aggregates from recycled materials on thermal and physical properties of concrete

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ARTICLE INFO

Keywords:
Crushed rubber
Plastics
Concrete
Thermal conductivity
Strength
Recycled materials

ABSTRACT

The effect of adding different aggregates on thermal and mechanical properties of concrete is investigated. The materials used as aggregates are crushed rubber results from wasted tiers, recycled plastics, organic, and inorganic wastes. The mechanical and thermal properties of concert investigated are density, compressive strength, and thermal conductivity. Moreover, data of the drying rate of concrete with compressive strength are shown. The study shows a comparison between modified concrete and traditional one is shown. Results shown that rubberized concrete showed a drop in the compressive strength, thermal conductivity, and density. For example adding 10% of rubber aggregates the compressive strength dropped by 8 MPa for 7 days of drying and 10 MPa for 28 days of drying. The average reduction of thermal conductivity between the three mixes was $0.11 W/m.K$. The average decline in the concrete density between the three mixes was 122 kg/m^3.

Introduction

In Kuwait there is a massive tire landfill in Sulaibiya, the tires accumulate to 480 thousand tons of tires (daily mail news, 2013). Tires has a ring torus shape and it tend to hold water providing a perfect habitat for mosquitos to breed (Learning English, 2016). Moreover the risk of fire is high, for instance on the 17th of April 2012 in Al Jahrah governorate a blaze awakened by the fuel of the landfill tires that consumed the effort of numerous firefighters all over the country from every department to tame the fire (Nasa, 2012). Even more, the residue released after burning the tires pollutes the soil and disturb the agriculture. When burning tires styrene, benzene compounds, and butadiene is released. Not only the black smoke which consist of CO_2, SO_2, NO_2, and HCL reduces the visibility, but the butadiene is a substance that causes cancer in living tissue. There are about 1.5 billion tires are manufactured all over the world annually. One billion tires are estimated to be disposed each year, if the increasing rate of disposal stays constant by 2030 there will be 1.2 billion tires disposed (Global recycling, 2019). The European association published in 2009 that 3.2 million tons of used tires were tossed away. The recovery ratio was 96%. 18% were reused and retreated, 38% were recovered, and 40% were used for producing energy (Barbuta et al., 2015). To extend the life of the plant and expand the knowledge and tools of engineering, the motivation is to refunction the rubber and infuse it with other materials to enhance the properties of the concrete. The chosen material to infuse with concrete is rubber. Since Kuwait has a hot atmosphere, processing rubber into concrete is a feasible solution to decrease thermal conductivity of the concrete; so, the HVAC systems in residential parts of Kuwait will not work as much cutting the use of energy. Furthermore, the rubber has a lower density than the aggregates used in the concrete. Meaning that the concrete will decrease in weight easing the transport of concrete (Sukontasukkul, Sangpet et al. 2020). Additionally, performance enhancement of rubberized concrete and the potential uses of waste tire rubber in cement concrete have been studied (Li et al., 2019a,b). The utilisation and reuse of waste tire rubber in concrete can reduce the consumption of raw materials, which leads to economic efficiency and sustainable development of the construction industry. In this review, we conclude the major

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Energy analysis of lithium bromide-water and lithium chloride-water based single effect vapour absorption refrigeration system: A comparison study

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ARTICLE INFO

Keywords:
COP
LiBr–H_2O
LiCl–H_2O
Optimization
Solution concentration
Generator temperature

ABSTRACT

The present research article discussed; a detailed energy analysis for single effect vapour absorption refrigeration system using two working pairs Lithium bromide-water (LiBr–H_2O) and Lithium chloride-water (LiCl–H_2O) under different operating climate conditions. The performance parameters of the both the systems like coefficient of performance (COP), solution concentration, heat load at different components and optimum operating generator temperature have been investigated for both the systems. The capacity of the systems is fixed as 300 kW. The present work has been simulated for the evaporator temperatures of 5, 10 and 15 °C while the condenser temperatures of 25, 30 and 35 °C. Result shows, the maximum COP of LiBr–H_2O system comes out to be in the range of 0.741–0.902, whereas in case of LiCl–H_2O system it is to be in the range of 0.809–0.926. The minimum load at the generator for LiBr–H_2O system is 382.573 kW, while for LiCl–H_2O as 370.787 kW. Comparison shows that the LiCl–H_2O system has better COP and minimum generator load as compared to LiBr–H_2O system, especially at lower evaporator temperatures. The optimum operating generator temperature has been observed 54.56 °C for LiBr–H_2O system and 56.25 °C for LiCl–H_2O system.

1. Introduction

Demand of high-grade energy is increasing rapidly to meet the needs of domestic and industrial users in the world (Gürel et al., 2021). Especially refrigeration and heat pump consume around 17% of the world electricity (Sateesh et al., 2021). In order to save high-grade energy (i.e., electricity) vapour absorption refrigeration system are becoming the best alternative (Meraj et al., 2021). The vapour absorption refrigeration system (VARS) not only save the energy but also save environment using natural working fluids for its operation (Kumar and Rakshit, 2021). The vapour absorption system satisfies both Montreal Protocol, 1988 and Kyoto Protocol, 1997, due to this these systems are also used for air conditioning applications (Talpada and Ramana, 2019). The vapour absorption system generally operates through low grade energy in the form of solar energy, waste heat and geothermal energy etc. (Modi et al., 2022). Absorption cooling was first invented by the French scientist Ferdinand Carré in 1858 (Shirazi et al., 2018). The system has demanded especially from last decade due to use of low grade energy and natural working pair (Assilzadeh et al., 2005). The system has major contribution in climate also (Keppler, 2018).

Many authors have performed simulation (Mohammadi et al., 2019) and experimental (Zhou et al., 2021) work on vapour absorption system. The challenge with this system is its poor performance compare to the conventional vapour compression system. In view of this, many works have been carried out to improve the performance of system. A plethora of research have been carried out for different working pairs. The working fluids have an important role in the performance of vapour absorption refrigeration system. Karamangil et al. (2010) performed a detailed review over working pairs. Also, they have discussed the effects of operating temperatures, effectiveness of preheater and precooler along with multiple working fluids. Recently, Liu et al. (2021) revealed the latest working pairs for vapour absorption refrigeration system and concluded that some pairs are environment friendly with significant enhancement of the COP. Siddiqui (1994) performed economic analysis

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Physical, Mechanical and Morphological Characterization of A356/Si_3N_4 Nanoparticles Stir Casting Composites

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ABSTRACT

A356 alloy based composites are extensively used in different component industries like components of automobile parts owing to pronounced strength to weight ratio. In the current paper, A356/Si_3N_4 nanocomposites are fabricated by means of stir casting by varying Si_3N_4 reinforcement nanoparticles. Silicon Nitride (Si_3N_4) nanoparticle is intermixed to Al powder mechanically to develop their wettability among the particles of A356/Si_3N_4 nanocomposites. The Si_3N_4 nanoparticle is integrated by altering weight percentage. The electomechanical stirring process to produce the vortex is taken up to spread Si_3N_4 nanoparticles in the liquefied matrix dispensed into a permanent mould. Morphological investigation of the composite specimen is accomplished by TEM. Based on the study, it can be acquired that the strengthening by Si_3N_4 nanoparticles promotes the strength and hardness of the fabricated nanocomposites. The maximum tensile strength is depicted to be 319 MPa for A356/5%Si_3N_4 nanocomposites whereas hardness is increased from 43 HBN to 86 HBN. The physical

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ORIGINAL PAPER

Life cycle ecological footprint of building: a case study of low-rise tropical residential building

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Abstract

Rapid growth in the construction sector significantly influences the natural resource demands, waste assimilation, as well as its also responsible for environmental pollution. The combination of life cycle assessment (LCA) approach with Ecological Footprint (EF) analysis gives an opportunity to measure an environmental imprint of a building on the planet. The life cycle ecological footprint (EF_T) methodology has been developed for a low-rise residential building located in the Indian tropical climatic zone. The EF_T of the low-rise residential buildings is 74.02 gha (i.e. 0.49 gha/m^2 per floor area of the building). The Ecological Footprint of building construction is about 15.41% of the total EF_T of the low-rise building. The Ecological Footprint of the operational phase of the low-rise building is the highest (83.67%) among all the life cycle phases. The EF_T of the building can be reduced in the range of 1.51–4.33% by replacing the fired clay brick (FCB) with proposed low environment impact bricks/blocks in the brickwork of the building. For achieving Sustainable Development Goals, the EF assessment of all proposed and existing buildings should be examined and policymakers try to promote low EF materials for construction.

Keywords Ecological Footprint · Life Cycle Assessment · Environmental Assessment · Residential Building · Low-Rise Building

Abbreviations

E_c	Amount of electricity/fossil fuel used during building construction
E_d	Amount of electricity/fossil fuel used during building demolition
E_o	Amount of electricity/fossil fuel used during building operation
T_k	Average travelling distance of labour
T_{mi}	Transportation distance of the material
T_{wi}	C&D transportation distance of the material
W_i	C&D waste generation
X_{mi}	Consumption of materials
Z_k	Number of labours
α_c	Emission factors of energy (electricity/fossil fuel) consumed during construction
α_d	Emission factors of energy (electricity/fossil fuel) consumed during demolition
α_o	Emission factors of energy (electricity/fossil fuel) consumed during operation
AAC	Autoclaved aerated concrete
C&D	Construction & demolition
CPWD	Central public work department
CSEB	Compressed stabilised earth block
EF	Ecological footprint
EF_e	EF of energy consumption
EF_f	Annual Ecological Footprint of food consumption
EF_l	EF of manpower
EF_{land}	EF of built-up land use α_o
EF_m	EF of material consumption
EF_t	EF of transportation

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Research paper

Energy and exergy analyses of active solar still integrated with evacuated flat plate collector for New Delhi

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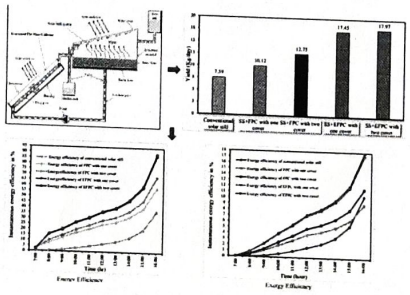
HIGHLIGHTS

- EFPC has around 175% higher productivity with conventional solar still system.
- SS-EFPC-2C has energy efficiency 46.64%, while exergy efficiency around 8.21%.
- SS-EFPC-2C has higher water basin temperature as 103.12 °C compared to another configuration.
- SS-EFPC-2C is the best system as compared to the other configurations.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Solar still
Evacuated flat plate collector
Energy efficiency
Exergy efficiency
Climate condition

ABSTRACT

In the present communication, modelling and performance of solar still integrated with Evacuated Flat Plate Collector with one cover glass (SS-EFPC-1C) and two cover glass (SS-EFPC-2C) have been carried out for the climate condition of India at New Delhi. Furthermore, energy and exergy analyses of both the system as SS-EFPC-1C and SS-EFPC-2C have been evaluated and presented. Moreover, comparison between different configuration of the solar still, namely, conventional solar still (SS), solar still augmented with flat plate collector having one glass cover (SS-FPC-1C) and having two glass cover (SS-FPC-2C) have also been presented. The mass of water has been taken as 20.8 kg, wind speed 2.5 m/s, and mass flow rate 0.019 kg/s. Results show that daily productivity of the proposed system i.e., EFPC has around 175% higher productivity with conventional solar still at 14:00 p.m. Also, daily energy efficiency obtained for Solar Still, SS-FPC-1C, SS-FPC-2C, SS-EFPC-1C and SS-EFPC-2C are around 39.74%, 30.95%, 36.10%, 45.85%, and 46.64% while the daily exergy efficiency is 2.69%, 3.99%, 5.19%, 7.95%, and 8.21%, respectively.

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ORIGINAL PAPER

Introduction of Metal Layer in Junctionless Accumulation Mode FET:-Proposal and Analysis

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Abstract
In this paper, we have proposed single gate junctionless accumulation mode FET (JAM) and underlapped junctionless accumulation mode FET (UL-JAM) with metal layer implant in gate oxide at channel-drain interface (MI-JAM and UL-MI-JAM). This architectural addition of low work function metal layer in JAMFET reduces gate induced drain leakage (GIDL) considerably. It reduces the electric field assisting tunneling at channel-drain interface. Therefore, it improves overall ON-state to OFF-state current ratio by 2 orders for channel length 40 nm. I_{ON}/I_{OFF} is further improved by two orders in UL-JAM compared to MI-JAM. We also showed effect of metal layer misalignment at drain-channel interface and effect of inserted metal layer work function on various performance metrics such as early voltage, transconductance to current ratio etc. We have found considerable improvement in these metrics for UL-MI-JAM (2x) as compared to conventional JAM. Furthermore, we investigated the reliability of metal layer inserted devices with respect to temperature and trapped interface charges. Finally, to see the circuit performance of the devices we simulated a CMOS inverter using both conventional and proposed devices and compared different circuit performance matrices.

Keywords Gate induced drain leakage (GIDL) · Gateral band-to-band tunneling (L-BTBT) · Metal layer implant (MI) · Junctionless accumulation mode (JAM) · (UL) Underlap

1 Introduction

From the past 40 years there is a continuous quest in semiconductor industry to design faster, smaller and low power devices. To achieve this feat there has been continuous scaling down in the size of transistor (MOSFETs) which is the most fundamental block of the computing devices. But, this incessant scaling further to nanometer regime puts a limit to transistor performance brought by the scaling process. This is mainly due to the requirement of ultrasteep doping profile in Source/Drain-Channel interface with complementary dopant in channel region and high doping in Source/Drain regions. Ultrasteep doping profile in nanometer regime is extremely difficult to realize whereas high source/drain doping requires high temperature annealing process.

This leads to thermally assisted lateral diffusion of dopant atoms from Source/Drain regions into channel region [1]. Therefore, to overcome these stringent requirements in MOSFETs junctionless field effect transistors (JLFETs) were proposed in [2]. The device architecture of JLFET is such that it is devoid of any metallurgical junctions and therefore, it removes ultrasteep doping profile at source/drain to channel region and associated complex thermal budget requirements [3]. Moreover, this architecture reduces short channel effects considerably. But, JLFETs have their own set of challenges such as high source-drain series resistance, realization of efficient volume depletion, band to band tunneling in the OFF-state and random dopant fluctuations [4]. There are device architectures which mitigates these challenges in JLFETs. One of the alternatives is Junctionless Accumulation-Mode Field Effect Transistor 'JAMFET' [5–8]. The salient feature of JAMFET is low source/drain series resistance owing to high doping in source-drain region. The channel doping is also reduced to improve the mobility of carriers. Low source/drain series resistance and superior carrier mobility

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Study of the Microstructure, Mechanical Properties, Residual Stresses, and Distortion in Type 316LN Stainless Steel Medium Thickness Plate Weld Joints

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Abstract

A nuclear reactor that utilizes fast neutrons to produce more fissile nuclear fuels than they consume while generating power is called Fast Breeder Reactor (FBR). The FBR components are currently welded by multi-pass Tungsten Inert Gas (TIG) welding process. There are limitations associated with multi-pass TIG welding of 316LN SS plates. This research work on 316LN stainless plates will be valuable in extending the utilization of the advanced welding process for fabricating structural parts in FBRs. In the present study, weld joints of 5.6 mm thick 316LN stainless steel plates have been made using multi-pass TIG welding process and by autogenous Activated-TIG (ATIG) welding process. An in-depth comparative study on the effect of the above welding processes on the weld attributes of the weld joints such as bead geometry, microstructures, ferrite content, hardness, tensile, impact toughness properties, residual stress and distortion has been carried out. ATIG joint manifested narrow weld bead when compared with that of the TIG weld joint. Though ferrite content was low, there was no hot cracking in the weld due to lower restraint and hence reduced shrinkage strains. TIG weld exhibited higher hardness and strength properties than the base metal and ATIG weld joint due to the existence of higher δ ferrite. However, at high temperature, both weld joints have exhibited similar values of ultimate tensile strength and percentage total elongation. Moreover, ATIG joint has higher impact toughness than TIG joint due to the very low δ ferrite

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Thermal Performance Comparison and Augmentation of Two Identical Box-Type Solar Cookers Operating in Tropical Climatic Conditions

In the present study, experimental studies have been performed to compare the thermal performance of two geometrically identical box type solar (B-T-S) cookers. To carry out this aim, the thermal performance of BTS cooker in terms of figure of merits, namely, first figure of merit (F_1) and second figure of merit (F_2) are calculated for both cookers as specified by the Bureau of Indian Standards (BIS). At no-load condition (i.e., stagnation test), it is found that first figure of merit for both cookers that is cooker 1 and cooker 2 is around 0.12. This implies that both the cookers are identical in thermal performance. In addition to this, the effect of lugs height, reflector, number of pots, and load on B-T-S cooker performance have also been investigated. From the results and discussion, it is concluded that the use of lugs reduced the heat transfer rate between cooking pot and absorber plate. Further, it is found that the pot content temperature is enhanced by 25.5% and 23.4% by using mirror and aluminum reflector with cooker, respectively. However, it is observed that the performance parameters of B-T-S cooker in terms of F_2 increases linearly with the increase of number of cooking pot (with correlation $F_2 = 0.0316n + 0.2238$, where n is the number of pots) and load (correlation as $F_2 = 0.0451\ m + 0.1844$, where m is the mass of water in cooking pot) on the pot. [DOI: 10.1115/1.4050323]

Keywords: box type solar cooker, absorber plate, thermal performance, reflector, lugs

1 Introduction

Energy is a vital importance for sustaining life on Earth [1]. The demand of energy is increasing continuously due to its rapid use in the areas of transportation, industrial and domestic purpose, agriculture, etc. Fossil fuels have till now fulfilled most of our energy demand but these are depleting at a very fast pace and creates very serious environmental pollution [2]. On the other hand, the prices of fossil fuel are increasing day by day and it is expected in the future that it shall go up more because of the limited availability of the fossil fuel. Therefore, the other sources of energy must be explored in order to fulfil our energy demands to sustain life on the earth. So, the renewable sources of energy meet our energy demands [3–6]. Renewable energy is extracted from the sources which can be replenished such as sunlight, geothermal, wind, tides, etc. It not only prevents the formation of smoke but also helps to protect ozone depletion from greenhouse effect. It is free for us, cheap source of energy but not present to all the time that is intermittent in nature. However, it can be made useful to all time by applying the knowledge of thermal storage techniques [7–10]. Further, there are various technologies used to enhance the performance of the system run on renewable energy by improving heat transfer rate using nanofluids and hybrid configuration, etc. [11–13]. It is necessary to a have a certain amount of energy in order to perform cooking.

Cooking is an important activity performed on a daily basis in order to fulfil our eating requirements. Cooking is classified into four categories that are based on the temperature requirements, they are as follows: (i) baking (around 90 °C), (ii) boiling (100–130 °C), (iii) frying (200–250 °C), and (iv) roasting (more than 350 °C). In urban areas, cooking is done by utilizing fossil fuels such as liquefied petroleum gas and in some cases by using electric stove. But in rural areas, cooking is still done by utilizing traditional fossil fuels resources such as coal, kerosene, firewood, agricultural wastes, and cow-dung cakes [14]. In India, 70% of the population dwells in the rural areas, which shows that most of the Indian populations rely on these fuel resources for cooking purposes [15]. Nevertheless, the prolonged exposure to the cooking fire may lead to respiratory infections, eye damage, and lung cancer [16,17]. World Health Organization (WHO) reported that the total number of deaths per year is 1.5 million due to air pollution in kitchen [18]. Thus, it is found that the use of an alternative source of energy such as renewable energy in the form of solar energy would be more advantageous for cooking purpose, particularly in the region where solar radiation is found in abundance [19–21]. India receives a large amount of solar energy in form of sun radiations. It is

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ORIGINAL

Experimental and numerical study of Pool boiling and critical heat flux enhancement using water based silica Nanofluids

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Abstract
Experimental and Numerical Studies on saturated pool boiling have been carried out over a nichrome wire submerged in both distilled water and silica–water based nanofluids. The concentrations of the silica nanoparticles are varied from 0.01 vol.% to 0.05 vol.% in step size of 0.01. Numerical simulation has been carried out by using Mixture Multiphase Approach. Moreover, heat flux values by applying traditional Rohsenow correlation and the surface-liquid constant (C_{sf}) for wire and nanofluids is proposed that fits the experimental as well as numerical data. From the present work, it is inferred that the numerical solutions are in good agreement with the experimental data. Furthermore, thin nanoparticle coatings on heating surface were observed after each experiment. Critical Heat Flux enhancement in nanofluids may be due to the deposition of nanoparticles over the heater surface. Also, the Critical Heat Flux of nanofluids was found to be 38.5% higher (at 0.03 vol.% of silica nanoparticles concentration) as compared to distilled water.

1 Introduction

Boiling may be categorized by the flow regime in two types; pool boiling and flow boiling. In pool boiling the liquid is quiescent and its motion near the surface is primarily due to natural convection and the mixing induced by bubble growth and detachment. In flow boiling, fluid flows over a heated surface. With the need for better heat transfer medium used in different fields such as chemical industries, electronics engineering, nuclear power plants, etc., people have investigated a better medium for heat transfer namely nanofluids which is made of nanoparticles of different sizes dissolved in base fluids. Nanofluids significantly increase the thermal conductivity of the base fluid in weak concentrations [1, 2]. Nanoparticles can be of metal powder such as Cu, Al, Ag, Au and non-metal powder such as ZnO, Al_2O_3, SiC, Si, etc. There are mainly three types of base fluids used Ethylene Glycol, distilled water and engine Oil [3].

In the presence of nanoparticles, Particle-particle and particle-molecule interactions play a major role in increasing the thermal conductivity of nanofluids, which enhances the heat transfer [4]. For decades, extensive investigations have been carried out to study the pool boiling of various fluids like water, refrigerant, etc. [5, 6]. Pool boiling studies have drawn the attention of scientists and engineers owing to the growing demand for high energy dissipation in electronic equipment and computing machines. Boling Heat Transfer is mainly influenced by two parameters that are heat transfer coefficient (HTC) and critical heat flux (CHF) [7].

In the pool boiling applications, a drastic reduction in the heat dissipation just after reaching the CHF value may lead to devastating results. Therefore, a fundamental understanding of the mechanism responsible for the initiation of this condition is of great importance. Kutateladze [8] postulated that the meaning of bubble generation and departure get lost near the CHF condition, and it was essentially a hydrodynamic phenomenon with the destruction of stability of two-phase flow boiling existing close to the heating surface. The critical condition is reached when the velocity in the vapor phase reaches a critical value. Zuber [9] further formulated the concept by considering the formation of vapour jets above nucleating

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Measurement of thermal diffusivity for food products under natural convection cooling

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Abstract. In the present communication, experimental analysis has been done for evaluation of relationship between the thermal diffusivity with temperature of Potato and Brinjal (a spherical shaped food products) subjected to a natural convection. Free convection is a type of flow of motion of fluid which is not generated by an external source but by some parts of the fluid being heavier than other parts. The analysis simulates the one-dimensional Fourier equation experimentally, applicable to the regular shapes of the product (cylindrical and spherical shaped products). The experimental setup consists of a deep freezer maintained at 263 K and 1.013 bar pressure. Variation of product temperature inside the product has been measured along the radial direction of the shape.

Keywords: Natural convection; Pre-cooling; Thermal diffusivity; Skin temperature; Spherical food products.

1. Introduction

Being healthy is not an overnight phenomenon. Natural products are healthier than man made products [1]. A diet high in fresh fruits and vegetables in the form of salad can help to protect us from many diseases [2]. Natural products are biodegradable in nature so improper food storage can lead to several problems like growth of bacteria and moulds [3]. Fruits and vegetables are highly sensitive in nature and their spoilage costs wastage of billions of dollars annually worldwide [4]. Due to negative impact on the environment include air pollution, climate changes, soil and water pollution. The cost in transport sector growth dramatically which is neither by the consumer nor by the transport services but due to environment. A study say that road transport contributes up to 92% of all the cost when compared to other transport modes. Post-harvest losses of fruits and vegetables are more serious in developing countries than those in developed countries.

Food preservation is a technique used to prevent food from spoiling. It also increases shelf life of food products. It includes method such as drying [5], irradiation [6], pasteurization [7] and the addition of chemical additives [8]. The very first stage of food spoilage can be detected through its appearance, foul. Smell, colour etc. Major factor of food spoilage is due to change in pH values and changes in climatic conditions like temperature, air etc. [9]. Zhang et al. [10] have found the thermal properties of

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ORIGINAL PAPER

Investigation of Gate Material Engineering in Junctionless Transistor for Digital and Analog Applications

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Abstract

In this paper, we propose dual material gate with dual-*k* dielectric gate oxide double gate junctionless transistor 'DMG-DK-JLT' for significant enhancement of performance. We showed, using 2D simulation that the proposed DMG-DK-JLT exhibit: 1) suppressed gate induced drain leakage due to band to band tunneling in OFF state (V_{DS} = 1 V, V_{GS} = 0 V) by 5 orders. 2) Impressively high I_{ON}/I_{OFF} ratio of ~10^8. 3) For V_{GS}=V_{DS} = 1 V, DMG-DK-JLT performs better over conventional double gate JLT on various digital and analog performance metrics such as transconductance (G_m, 64% improvement), early voltage (V_{EA}, 107% improvement), intrinsic gain (G_mR_O, 294% improvement), unity gain cutoff frequency (f_T, 48% improvement), output resistance (R_o, 139% improvement), and transconductance-to-drain current ratio (G_m/I_D, 218% improvement at V_{GS} = 0.2 V, V_{DS} = 1 V). We also compared its performance on above metrics with other gate material engineered Junctionless transistors. Moreover, we also show these values are further improved several orders by adding high-*k* gate sidewall spacer to our proposed DMG-DK-JLT.

Keywords Dual-material gate (DMG) · Band-to-band tunneling (BTBT) · Junctionless transistor (JLT) · Double-gate junctionless transistor (DGJLT)

1 Introduction

THE unremitting scaling of the conventional MOSFETs has made it extremely difficult to realize ultrasteep doping profile in source-channel and channel-drain interface. Also, continuous scaling inherently contributes to high leakage current and therefore high power dissipation. Furthermore, ion implantation doping process in source and drain intrinsically leads to a stochastic distribution of dopant atoms as the dopants are bombarded onto the semiconductor film at high temperature [1]. In addition, this high temperature puts a complex restriction on thermal budget as lateral diffusion in source/drain is unavoidable while annealing.

Therefore, requirement of steep doping profile and ultrafast annealing needs to be addressed. One Solution to these problems is junctionless transistor (JLT) which is devoid of any metallurgical junctions. It utilizes gate to control resistance of semiconductor film beneath it and thus eases the need of ultrasteep doping Profile and annealing process. JLT works on the principle of modulation of carriers inside the heavily doped semiconductor film by the application of an electric field through gate electrode and hence, controlling the resistivity of the semiconductor film in the channel region [2]. Consequently, JLT can be viewed as a MOS capacitor as the channel with appended source and drain region on both sides. The application of gate voltage drives the transistor from volume depletion to partial depletion and thereafter flatband condition and accumulation condition are achieved [3, 4]. The gate work function of JLTs are chosen such that in OFF state we achieve volume depletion. However, to realize efficient volume depletion throughout the thickness of JLT we requires two things 1) Good electrostatic control of gate over channel region, This is only possible using very high work function (~5.1 eV) and extremely low work function (~3.9 eV) gate electrodes for n-JLTs and P-JLTs respectively. 2) Thickness of device needs to be narrow so that electric field penetrates through entire thickness of channel region in OFF-state. Now, such efficient and superior gate control leads to high source-to-channel barrier height which minimizes short channel effects. But, it leads to significant overlap between valence band of channel region and

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Comparative performance analysis of photovoltaic modules of different materials for four different climatic zone of India

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Semi-transparent
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ABSTRACT

The expected effectiveness of different types of photovoltaic modules (PV) reveals remarkable loss due to difference in meteorological parameters like solar radiation and ambient temperature. There is a need to foresight exact performance of modules in different field. In the present manuscript, monocrystalline, polycrystalline and thin films PV modules performance are evaluated and compared for four climatic zone of India (New Delhi, Srinagar, Bangalore and Jodhpur). An analytical expression for different PV technologies is obtained by using basic energy balance equations. Various parameters like ambient temperature, radiation intensity and design factors are the functions of simple algebraic expression. Electrical efficiency, module surface temperature and electrical energy per annum produced are evaluated and presented for present module effectiveness. Comparison of the result show that the electrical efficiency of the PV module does not mainly depends on the solar radiation intensity of climatic zones but are greatly affected by peak temperatures PV modules. Bangalore having moderate climatic conditions, has higher electrical energy per annum yield as compared to Jodhpur despite of having hot climatic conditions, for all the PV modules. The amorphous silicon being the best among other PV Modules in terms of electrical energy output. The efficiency is observed to be low at high module temperature because of the higher resistance. Further, this paper also aims to study the effect of opaque (tedlar) and semitransparent (glass) back cover plate on the performance of the PV module. Semi-transparent back cover plate has low module temperature than opaque back cover plate because solar radiation is transmitted away through its non-covering area. Hence, opaque is less efficient than the semitransparent one.

1. Introduction

Energy plays a dominant role for the improvement of the economy. Industrialization and fast population growth have depleted our natural resources, which are exhaustible and hence, energy requirement is leading to increase day by day. According to Ministry of

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Research Article

An Efficient CNN for Hand X-Ray Classification of Rheumatoid Arthritis

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Hand Radiography (RA) is one of the prime tests for checking the progress of rheumatoid joint inflammation in human bone joints. Recognizing the specific phase of RA is a difficult assignment, as human abilities regularly curb the techniques for it. Convolutional neural network (CNN) is the center for hand recognition for recognizing complex examples. The human cerebrum capacities work in a high-level way, so CNN has been planned depending on organic neural-related organizations in humans for imitating its unpredictable capacities. This article accordingly presents the convolutional neural network (CNN) which has the ability to naturally gain proficiency with the qualities and anticipate the class of hand radiographs from an expansive informational collection. The reproduction of the CNN halfway layers, which depict the elements of the organization, is likewise appeared. For arrangement of the model, a dataset of 290 radiography images is utilized. The result indicates that hand X-rays are rated with an accuracy of 94.46% by the proposed methodology. Our experiments show that the network sensitivity is observed to be 0.95 and the specificity is observed to be 0.82.

1. Introduction

Joint inflammation is a state of spasms and pain in a human where two or more bones join together. Arthritis results in excruciating pain, joint swellings, joint stiffness, and poor function in joints. Healthy joints move naturally with the help tissue called the articular cartilage which is slippery and smooth. The tissues absorb pressure and shock which is caused by motion and pressure due to extreme stress on the joints where bones meet. This extreme pressure causes destruction of the tissues in the cartilage further resulting in arthritis. The only and primary cause of arthritis is the degradation of cartilage in the joints. The arthritis is generally classified in two types: (1) osteoarthritis and (2) rheumatoid arthritis.

In osteoarthritis, cartilage and underlying bone degenerate which causes pain and stiffness. Generally osteoarthritis is more common in middle age people. On the other hand, rheumatoid joint pain is an incendiary infection that influences joints.

Rheumatoid joint pain (RA) is an immune system condition and is quite possibly the most limit types of provocative joint pain. Beforehand, bone misfortune from rheumatoid joint pain (RA) was considered irreversible. Be that as it may, the presence of biologic specialists stayed away from the movement of bone misfortune related to RA [1]. The major imagery discoveries identified with RA advancement incorporate bone weakening, narrowing of joints, and periarticular osteoporosis, showing the annihilation of construction of the bones. Specifically, the event of bone disintegration proposes functioning RA; therefore the assessment of bone disintegration is exceptionally significant for the underlying analysis and later assessment of RA patients.

The procedures mentioned above are extremely tedious, in every case, since they require the assessment of all

ORIGINAL ARTICLE

Effect of Nitromethane and Jatropha Biodiesel on the Combustion, Performance and Emission Characteristics of Diesel Engine

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ABSTRACT – The experimental work reported has been carried out in two parts; Jatropha biodiesel production and engine test. The engine test has been carried out on a direct injection, single-cylinder, water-cooled stationary diesel engine. Several diesel fuel blends which contain 10% and 20% by volume of JBD and 1% and 3% nitromethane were prepared. The effects of these blends on the combustion, performance, and emission characteristics of diesel engine were studied. The tests were performed under constant speed and varying load conditions without altering injection timing. A maximum increase of 11.73%, 3.2 % and 7.68 % in the brake thermal efficiency, the brake specific fuel consumption and exhaust gas temperature were achieved respectively for 20% Jatropha biodiesel and 3% nitromethane at full engine load. Compared to the pure diesel operation, the peak in-cylinder pressure of blended fuels was lower at the full load conditions. Also, the maximum net heat release rate of blended fuels was lower than that of diesel at all loading conditions. In regards to the engine emissions, the results showed that the blended fuels reduced carbon monoxide at 18.6–28.9% and unburned hydrocarbon of 7.5-24.2%, while increased the emission of nitrogen oxides at 6.9–14.3% and carbon dioxide at 4.3-10.5%.

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Diesel engine;
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NOMENCLATURE

°CA	crank angle degree	JBD	Jatropha biodiesel
BSFC	brake specific fuel consumption	BTE	brake thermal efficiency
CO	carbon monoxide	CO_2	carbon dioxide
CN	cetane number	DME	dimethyl ether
DI	direct injection	EGT	exhaust gas temperature
KOH	potassium methoxide	MXEE	methoxide ethyl ether
NaOH	sodium hydroxide	NO_X	nitrogen oxides
PM	particulate matter	ROHR	rate of heat release
RTDs	resistance temperature detectors	CI	compression ignition
ID	ignition delay	NE	nitro ethane
NDIR	non-dispersive infrared	γ	specific heat ratio
BDE	biodiesel dimethyl ether		
B10	10% Jatropha biodiesel + 90% diesel		
B20	20% Jatropha biodiesel + 80% diesel		
B10NM1	10% Jatropha biodiesel + 1% nitromethane + 89% diesel		
B10NM3	10% Jatropha biodiesel + 3% nitromethane + 87% diesel		
B20NM1	20% Jatropha biodiesel + 1% nitromethane + 79% diesel		
B20NM3	20% Jatropha biodiesel + 3% nitromethane + 77% diesel		

INTRODUCTION

Internal combustion engines have been used extensively to fulfil society's needs for power and transportation [1]. However, the number of vehicles and further fuel demands are increasing every day. Therefore, many countries trying to develop alternative fuel technology for their vehicles. These days, diesel engines are using in the automotive area, passenger cars as well as heavy-duty, owing to the better fuel economy. However, there are two major challenges possess the use of diesel engines; fossil fuel sustainability and the environmental concern on engine emissions. However, diminishing and unreliable petroleum reserves and deteriorating environment have made scientists seek alternative fuels for diesel.

Since the last decades, researchers around the world have been trying to find new alternative fuels that are available and environmentally acceptable [2]. One of the promising alternative fuels considered for diesel engines is biodiesel [3]. Biodiesel is renewable as well as environmentally friendly fuel. It has similar properties to diesel fuel. Addition of fuel additive is one of the possible approaches for reducing the high viscosity problem of biodiesels. The oxygen concentration

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ARTICLE

Effect of Soiling on the Performance of Solar PV Modules: A Case Study of Aligarh

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ABSTRACT

The world's future is with renewable energy resources and solar energy which is a clean and sustainable energy resource. Solar PV module is exposed to external environments where dust deposits are a major derogatory factor. The soil and its effect on the performance of the solar module is usually a matter of high concern for the areas of high density and high frequency of low frequency and low-intensity rainfall. Due to the PV module, the effects of dust are examined in relation to various types of dust concentration and spectral transmission. For examination and analysis, experimental investigation is reported in the paper. The investigation shows that dust effects are accumulated, i.e., the performance of the PV module decreases over time with increasing statements, or until it is cleaned manually or through rain. It is also observed that the inclination of the PV installation plays a major role in the quantity of dust deposited on the angle equipment, where the concentration of dust is reduced as a result of higher tilt angles. Aligarh, with its irregular environmental conditions, suffers from high air pollution and minimum rainfall during dry winter. In this study, the impact of dust on the PV module is examined in relation to the dust density of the dust and the meteorological variables for Aligarh, with the purpose to calculate the drop equation describing efficiency loss.

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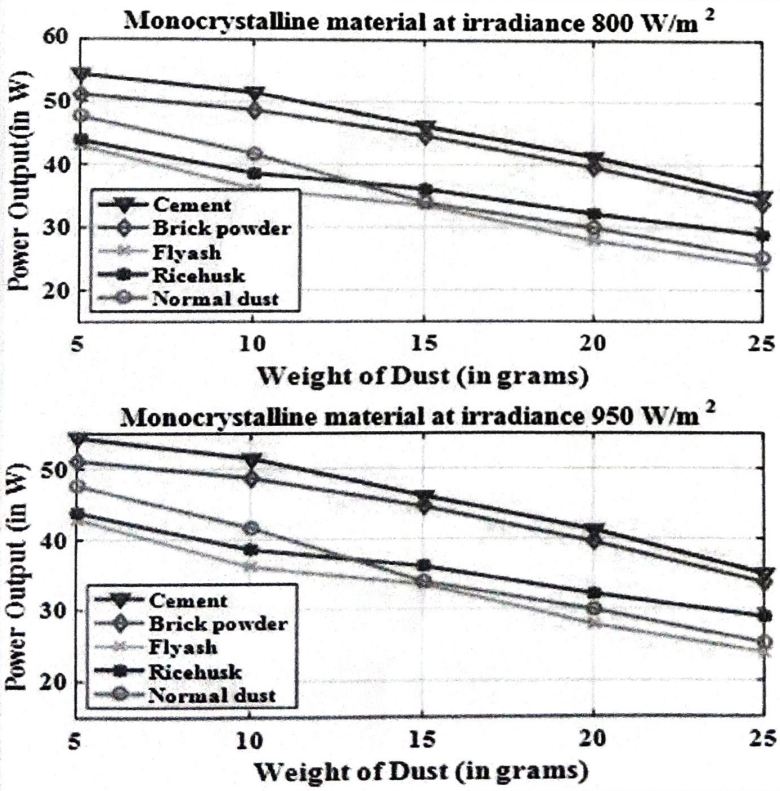
Solar PV; dust accumulation; power versus dust weight; efficiency versus soil weight; soiling



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AbbreviationsGHGs: Greenhouse gases; CO_2: Carbon Dioxide; CdS: Cadmium Sulfide; CdTe: Cadmium Telluride; CIS: Copper Indium Selenide

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Thermal modelling of PVT-CPC integrated vapour absorption refrigeration system

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ABSTRACT

In this paper, the single effect vapour absorption refrigeration (VAR) system is integrated with fully covered semi-transparent photovoltaic thermal-compound parabolic concentrator (PVT-CPC) collector. The thermal model of this integrated system has been obtained under constant mass flow rate mode of the collector. The thermal model is based on the basic energy balance of each component of the integrated system in terms of design and climatic parameters. Also, solar coefficient of performance (SCOP), refrigeration coefficient of performance (RCOP) and exergy coefficient of performance (ECOP) have been evaluated for the proposed integrated system. The numerical simulation have been performed for the climatic conditions of capital city of INDIA (i.e. New Delhi) with the help of MATLAB R2015a. From the results and discussion, it is found that PVT-CPC integrated with VAR system is most suitable for the self-sustained operation up to five hours for a typical day of summer month of New Delhi.

Selection and Peer-review under responsibility of the scientific committee of the 2nd International Conference on Future Learning Aspects of Mechanical Engineering.

1. Introduction

Recently, the absorption systems accomplish the energy saving challenges by application of low grade energy in the form of heat. Also, the absorption system protect environment from ozone depletion and global warming by the utilization of natural working pairs in their cycles. However, the performance of the systems are poor as compared to the compression refrigeration system [1]. But, the researches focuses to enhance their performance by the incorporation of different methodology/technique [2,3]. Moreover, the absorption system will be more economical if it operates through solar energy [4]. The photovoltaic thermal system is however most suitable for the operation of vapour absorption systems [5].

Photovoltaic thermal (PVT) system refers to integration of photovoltaic module and a conventional solar thermal flat plate collector. This technology is used to enhance the overall utilization of solar energy. From this system, electrical energy and thermal energy both can be obtained simultaneously. First liquid type PVT collectors was designed by Wolf [6]. After that, this technology was improved by Kern and Russell [7]. Later on, a lot of research has been done in PVT technology to improve its performance. Hegazy [8], Shyam and Tiwari [9] have performed their studies on the performance of PVT air collectors. Chow et al. [10], Dubey and Tiwari [11], Mishra and Tiwari [12] have investigated the sensitive analysis on the performance parameter of PVT water collectors. Further, some authors have performed their research on the PVT integrated greenhouse dryers, roof and PVT facades etc. Shyam et al. [13] have performed an experimental validation of various performance parameter of partially covered series connected N-PVT collector operated at given mass flow rate. Recently, Tripathi and Tiwari [14] have conducted a comparative parametric analysis of low concentrated PVT collector by considering water and air as a working fluid.

A lot of research has been done in the field of solar air-conditioning systems since the last few decades [15–17]. They have performed their investigation on solar absorption refrigeration system using either ammonia-water (NH_3-H_2O) or lithium bromide-water (LiBr-H_2O) solution as a working fluid. They have

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Exergy Analysis of Single-Effect Vapor Absorption System Using Design Parameters

In the present communication, internal irreversibility at each component of a single-effect vapor absorption refrigeration system has been evaluated and presented. The irreversibility is induced owing to the pressure drop in the shell and tube and energy exchange between the working fluids. Each component of the system is considered to be a shell and tube-type energy exchanger with slight modifications depending upon the applications. Each energy exchanger is divided into three control volumes, namely, tube wall, shell, and tube for which both energy and exergy balances are applied to evaluate the exergy destruction rate (EDR). Moreover, the overall EDR in the energy exchanger is then estimated in the form of pumping work and energy exchange duty. This objective function is further simplified in the form of design parameters such as tube diameter, friction coefficient, number of tubes, number of baffles, and overall heat transfer coefficient for the energy exchanger. In addition to this, optimum generator temperature and minimum EDR of each component of the absorption system have been tabulated and presented. Results show that for a single tube, UA value in the system component ranges from 2.99 W/K to 48.9 W/K depending on the operating conditions and design parameters of the system. Also, the number of tube in the system components ranges from 1108 tubes to 24803 tubes and the number of baffles in the respective components ranges from 2 to 7. [DOI: 10.1115/1.4048594]

Keywords: design parameters, vapor absorption system, exergy analysis, solar energy, energy conversion/systems, energy systems analysis, renewable energy

1 Introduction

In the recent era, the vapor absorption systems have been providing a sustainable route to produce refrigeration/air-conditioning/heat pump [1] by using low-grade energy [2] and natural working fluids [3]. Over the last decade, the absorption system is perceived as the most promising substitutes of cooling system to mitigate the challenges of energy and environment.

Different types of low-grade energy can be utilized to operate the absorption systems [4]. Among them, solar energy is the best option [5]. Moreover, vapor absorption systems use natural working fluids [6], which protects the environment from ozone depletion, CO_2 emission, and greenhouse effect, etc. [7]. Working fluids are a combination of absorbent and refrigerant. Various combinations were explored, among them two are very common as lithium bromide–water ($LiBr–H_2O$) and ammonia–water ($NH_3–H_2O$) [8].

One of the major concern with the absorption system was its poor performance as compared with the conventional vapor compression system. Researchers have put significant effort to improve its performance using different techniques/methods/approaches, etc. [9,10]. Some authors have claimed that the coefficient of performance (COP) of the vapor absorption refrigeration systems (VARS) increases significantly from single to triple effect cycles. They have reported the triple effect cycle has 132% more COP as compared to the basic (or single effect) cycle [11]. However, multi-effect cycle requires higher operating temperature [12]. Most of the studies reported in the literature on this system are based on numerical modeling with different system configurations, while most of them focused on the exergy-based modeling [13–15]. Exergy evaluation of the thermal system can be considered as one of the most powerful tools which is capable to gauge the usefulness (quality) of the energy flowing in the system. Additionally, the quantities like the exergy destruction rate and exergy loss identify (quantify) the location (magnitude) of the sites where the exergy is destroyed in the system and hence provide the true information/path of how to improve the efficiency of the existing system [16]. Second law analysis has been carried out by Samanta and Basu [17] for single-effect absorption system (SEAS). They optimized the generator temperature (T_g) of the cycle by considering COP and entropy generation as the objective function. They have found that minimum entropy generation rate and maximum COP do not correspond to the same T_g. Modi et al. [18] carried out thermodynamic analysis of SEAS using two working pairs as ammonia/sodium thiocyanate and ammonia/lithium nitrate. They have investigated the minimum source temperature to operate the system and provided a comparative analysis. Advance exergy analysis of SEAS operated with solar energy has also been carried out by Rosiek [19]. Ramos et al. [20] performed modeling and simulation of SEAS driven through solar energy using ASPEN HYSYS and MATLAB tools to analyze the system performance. They concluded that there is a proportional relationship between heat load of each component and heat flow coming through the solar captive system to the generator.

However, all such works are based on energy and exergy balances, evaluated using enthalpy and entropy at state points of all component of the VARS selected as a control volume. Some of the researchers have attempted to design the absorption refrigeration system using "UA" model. Florides et al. [21] proposed the design and dimensioning of SEAS which consider heat transfer coefficient of the fluids in the energy exchanger, employing UA model to obtain the energy exchanger area and its cost. They have compared both theoretical and experimental results derived for a small unit with a nominal capacity of 1 kW. Kalogirou et al. [22] also carried a similar study and found the U value of various components of the SEAS, but with limited analysis. Bakhtiari et al. [23] performed modeling and simulation of a single-effect cycle using the UA model and compared it with the experimental results. Siddiqui

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Effect of N-Photovoltaic thermal integrated parabolic concentrator on milk temperature for pasteurization: A simulation study

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ABSTRACT

In this study, an effort has been done to develop the thermal modeling of solar milk pasteurization system operated through N number of fully covered semitransparent photovoltaic thermal integrated parabolic concentrator (N/PVT/IPC). The thermal mathematical model of the present proposed system has been exhaustively demonstrated for the assessment of performance parameters namely, solar cells electrical efficiency, electrical power output, useful thermal energy gain and temperature of milk (which is to be pasteurized) in terms of both design and climatic conditions. Moreover, effect of operating parameters such as mass flow rate of withdrawn milk, number of collector, packing factor, and mass flow rate of collector fluid on milk pasteurization temperature have been comprehensively discussed. The present numerical simulations have been carried out for New Delhi, India climatic condition. Based on mathematical computation, it has been found that milk temperature for pasteurization increases significantly with increase in number of PVT/IPC collectors at lower packing factor. Further, it is also concluded that the proposed pasteurization system under optimal design and operating parameters can produce 216 kg of pasteurized milk and 5.7 kW h of electrical energy. Correspondingly, after simulation it is inferred that the proposed system is self-sustained under 6 h of operation.

1. Introduction

The growing global economic and material standard drive huger energy demand which will increase by another 30%–50% until 2040. Currently, the industrial sector (including the non-combusted use of fuels) consumes around half of all global energy and feedstock fuels, with residential and commercial buildings (29%) and transport (21%) accounting for the remainder. Moreover, during industrial revolution in the mid of eighteen century, consumption of fossil fuel increased exponentially which results in shortage of fossil fuel reservoir and global warming [1,2]. Hence, owing to limited resources of fossil fuel and to provide eco-friendly energy, a plethora of research have been done over the renewable energy based systems in the recent decades [3,4]. Solar energy is one of the most suitable and freely available renewable energy for the sustainable development [5] in both developing and underdeveloping countries. Solar energy can be utilized by two technologies, namely, solar thermal technology and photovoltaic. Solar thermal technologies consist of flat plate collector (FPC), parabolic trough collector (PTC), evacuated tube collector (ETC) and solar concentrator etc., which are well-known as solar thermal collectors [6,7]. These collectors convert solar energy into thermal energy and further used for various purposes such as house heating and cooling [8], water heating [9], industrial heating [10], refrigeration [11], power generation [12] etc.. However, the photovoltaic technology includes photovoltaic (PV) module made up of either crystalline silicon solar cell or thin film solar cell. This type of technology is employed for direct conversion of solar energy into electrical energy because of photovoltaic effect of solar cells of PV module [13].

In addition to this, during mid-1970s, the concept of photovoltaic thermal (PVT) collector has introduced which convert solar energy into both thermal and electrical energy simultaneously [14,15]. Later, exhaustive work have been carried out to develop their design and enhancement of system performance [16–18]. Afterward, the concept of PVT was introduced in the building

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Performance Analyses of Photovoltaic Thermal Integrated Concentrator Collector Combined With Single Effect Absorption Cooling Cycle: Constant Flow Rate Mode

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In the present communication, performance analyses of interconnected N number of fully covered semitransparent photovoltaic thermal integrated concentrator collectors combined with single effect vapor absorption refrigeration system have been carried out. The proposed system was analyzed under the constant mass flowrate of collectors' fluid. Mathematical expressions have also been derived for generator temperature of the absorption unit as a function of both design and operating parameters. Further, simulations have been performed for a typical day of May month of New Delhi climatic conditions. Performance parameters have been evaluated such as collector exit temperature, generator inlet temperature, electrical power output, electrical efficiency, overall thermal energy gain, instantaneous thermal efficiency, overall exergy gain and coefficient of performance of the absorption system. The simulation code has been written in MATLAB. From the present analyses, the following salient conclusions have been drawn: Operating generator temperature of the absorption system is suitable for five number of photovoltaic thermal-integrated parabolic concentrator collector connected in series. The proposed system will continue operating for 5 h during May month in New Delhi climate conditions. The maximum solar coefficient of performance, refrigeration coefficient of performance, and exergy coefficient of performance are reported as 0.1551, 0.8344, and 0.2697, respectively, for the proposed novel system under given design and operating conditions. Additionally, the effects of other design parameters of this novel system have also been investigated.
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Keywords: N/PVT/IPC, VARS, constant mass flow rate, self-sustained, COP, alternative energy sources, energy conversion/systems, power (co-) generation, renewable energy

1 Introduction

Energy plays the key role in the sustainable development of the society [1,2]. During the industrial revolution of eighteen century, the use of fossil fuels (e.g., coal, petroleum oil, and natural gas) increases exponentially. In the present era, energy consumption demand rapidly increases due to population growth and global warming, which also causes climate change that have drawn renewed interest to develop eco-friendly systems. Moreover, huge amount of energy is consumed worldwide in cooling and air-conditioning purposes. In this regard, the vapor absorption refrigeration systems (VARS) are widely researched in the recent decades as they are economical in comparison with the vapor compression refrigeration system, because absorption system operates with low-grade energy in the form of heat such as solar energy, geothermal energy, and waste heat from industrial processes [3]. Besides this, the vapor absorption systems use natural substances as the working fluid, which protect the environment from global warming and ozone depletion [4]. The various pairs of absorbent–refrigerant mixture are possible and discussed/studied/tested by Yokozeki [5]. Among all the pairs, lithium bromide–water ($LiBr\text{-}H_2O$) pair is most suitable for the air-conditioning application whereas ammonia–water ($NH_3\text{-}H_2O$) pair is suitable for the refrigeration purpose.

In the last few decades, a lot of researches have been performed in the area of solar air conditioning systems [6–11]. Their studies conclude that the refrigeration and air-conditioning with solar energy would be economical and environment friendly. Srinivas and Reddy [12] proposed a combined cooling and power system by integrating a Kalina cycle with vapor absorption refrigeration system, and the system is driven through solar energy. Henning [13] have presented a detail review on solar-assisted air-conditioning buildings, which deals with the closed solar thermal energy–driven cooling system (e.g., adsorption and absorption systems) and the open solar thermal-driven system (e.g., desiccant cooling systems). The economic analysis of the solar thermal cooling system has been carried out by Tsoutsos et al. [14] and concluded that the vapor absorption chiller would be cheaper than the other systems.

Further, several authors have published their work on the absorption system operating with the integration of solar thermal collector such as conventional flat plate collector (FPC), evacuated tube collector, parabolic trough collector, and integrated parabolic concentrator (IPC). Furthermore, different working pairs have also been taken to operate the absorption refrigeration system. Ammonia–water or lithium bromide–water solution is generally considered

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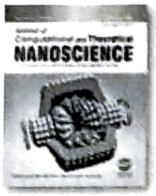

Energy Efficient and Quality of Service Compromise Techniques for Wireless Body Area Networks

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Abstract | References | Citations | Supplementary Data | Suggestions

In the present era the use of e-health plays a major role in the field of medical science. Today a significant attraction interest is towards Wireless Body area network (WBAN). The major challenges of Wireless Body area network (WBAN) technique are to maintain the quality service and to track the network stability for a longer time, e.g., probability of delivery, and latency. The main important issue is to maintain the energy efficiency within the formed network. Here we propose a protocol for WBANs based on MAC using the multi-dimension (MD) graph optimization to compromise the energy consumption and QoS in data transmission. In WBANs, low battery performing on-body or inculcate biomedical sensor nodes are applicable to observe and gathers the physiological signals like body temperature, blood pressure, ECG and EEG. The MAC protocol design utilizes an optimization algorithm to optimize the scheduled traffic and channel of WBAN. The proposed protocol simulation results will be better than TDMA, CA-MAC and IEEE 802.15.6 MAC in terms of energy efficiency and QoS for large network conditions.

Keywords: MAC; QoS; WBAN
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An Energy Efficient Routing Protocol for WSN Assisting IoT

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***Abstract*: In present modernized era Wireless Sensor Network (WSN) is used for many applications like Smart homes, Weather monitoring systems, Smart cities etc. and it is integrated into the (IoT). In this the nodes are resource strained in different ways, like energy resource, Storage resource, computing resource etc. To maintain a long network a powerful routing protocols are required. Here we proposed a technique for WSN using a routing protocol for energy efficient assisting IoT based on Hybrid optimization techniques to enhance the energy efficiency and network lifetime. A new series of hybrid algorithm is adapted for clusters and based on the center position cluster head(CH) which is rotated for distributing the energy between the sensor nodes. An advance technique is proposed for enhancing the network lifetime and energy utilization. A remaining energy is viewed in the proposed routing protocol in certain nodes to evaluate the center position. The proposed simulation result will show and compare with LEACH, LEACH-C, GEEC and the present existing EECRP. The proposed routing protocol will perform better than the existing system.**

Keywords: Wireless Sensor Network Clustering, Energy Efficiency, Internet of Things.

INTRODUCTION

In the 21st century, wireless and mobile communication success is too high. The different WSN merge with various wireless network to impart universal approach change ad achieve a dynamic scheduling algorithm which solves the throughput issues. For real time performance it is easier to alter the checking point cost depending on the energy level available in sensor system. It has long running computation scarce and low power Internet of Things (IoT) devices intermittent energy source [1]. A good device from independent energy supplies are IoT operations including medical transplant and sensors applicable in military which are prominent and hugely in demand [2], telemetry [3], intelligent building [4], and remote sensing usages [5]. Check pointing ranking is to determine maximum and minimum energy calculating the residual energy resource allocation.

IoT is also known as Internet of Everything it is the amalgamation of various techniques which contains web-based segments that collects, transmission and compute the data what they obtained from their ecosystem using embed sensors, processors and communication hardware. The next big revolution in the world of communication is predicted to be IoT [6]. The main purpose of IoT is to build a perfect network of every wireless devices which can communicated over the Internet. A IoT ecosystem has lot of units with enormous diversification scales from small sensors to large, dynamic data center nodes, the powerful execution setting, unambiguous nature of the data created by smart phenomenon, all these made IoT ecosystem as an atypical ecosystem [7]. Collecting physical data and converting it into valuable data and work include many operations, such operation requires a support from the IoT ecosystem. For detail, some applications are latency sensitive and some need complicated transforming like data and time series analysis [8]. IoT devices such as sensors have limited transforming and energy support, and they are not efficient of storing the huge data and to transmit out the complicated task. Thus there is need of powerful components to carry out transformation process required by IoT applications. these devices may be smart-phones, gateways and data centers [9].

Resource management incorporates performance monitoring, arrangement of network framework and firmware upgrades etc. [10]. The connectivity of resource management is generally placed at the IoT network end and produce all the applicable information at user end, where the vast number of devices and the data is handled by device manager. IoT is progression in computer technology and communication that aims to connect smart objects composed via Internet. Smart objects mean everything that environments can communicate or not [11]. The flow of events and data produced the interconnection of these objects is used to facilitate their coordination, tracking, management, control. The combination of various technologies and concerns are some of main defies achieving in order to take returns of this new archetype [12]. WSN can play a main role by gathering surrounding information and environment data. However, installing WSN design for accessing the novel challenges raised on internet, which requires to block before taking benefits of such considerations [13]. The major challenge of IoT is the restrictions of resources like, supply of energy, power processing, memory space, wireless communication bandwidth and range, which influence the routing in multiple ways [14]. The direction of the short range shows that the routing should be done in a multi-hop mode, i.e. in

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