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The Effect of the Various Arrangements of the Lithium-ion Battery Pack on the Cooling Performance

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There is a growing interest in high-efficiency, long lasting and safe energy storage systems used in a variety of applications such as transportation, aviation and grid energy storage. Batteries, which are electrochemical energy storage devices, play a vital role in meeting this interest. The operation temperature directly affects the efficiency, lifetime and safety of the battery pack. Thus, heat removal from the battery surfaces is of great importance to eliminate the negative effects of over temperature and to keep the battery pack in the desired temperature range during the operation. The cooling problem of a lithium ion battery pack numerically investigated by using the air as the coolant in a rectangular duct. Two different staggered arrangement and the in-line arrangement of the battery pack were applied separately. Heat removal from the cell surfaces was compared for the prescribed arrangements under the same hydrodynamic condition. The finite control volume based numerical solution was used to solve the forced convection heat transfer for the cross-flow through the battery pack in a three-dimensional domain. The solution of the governing and the auxiliary equations were carried out by using the ANSYS/Fluent software. In ANSYS/Fluent, a constant heat generation of 52000 is assigned for each cell in the pack. The results show that the battery packs using two different staggered arrangements has further improvement in heat transfer up to 12.07% compared to the in-line arrangement.

Keywords: Lithium-ion battery, heat transfer enhancement, thermal management, cooling, CFD

An Experimental Study on Overall Heat Transfer Coefficient of Some Wall Brick Models

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It is known well that the majority of the heat losses of buildings occur at outer walls which are made of a few layers such as plaster, wall bricks, insulation material etc. It is expected that the wall bricks having low overall heat transfer coefficient to reduce heat losses through buildings in order to increase building heating performance. In order to achieve this expectation, the wall bricks are produced with materials which have low thermal conductivity and cavity (hole) which weakens thermal transport mechanism. In this study, it is aimed to decrease the overall heat transfer coefficient of wall brick models with various cavities which affect the natural convection mechanism. For this purpose, some changes are made on the cavity geometry of a single cell of the hollow wall brick model and the heat transfer experiments of the proposed geometries were repeated under three different (7, 9, 12 W) thermal powers. The building is simulated as an insulated chamber made of styrofoam with dimensions of 300 mm x 300 mm x 300 mm. The wall brick models are produced from PVC (decota) material in dimensions of 160 mm x 160 mm x 50 mm and mounted to a wall of the insulated chamber. The experiments are carried out on the brick models having the cavity geometries of regular symmetrical *I* profile and asymmetrical Z profile. The temperatures are measured at 3 points on the both sides of the brick models. It has been measured that the overall heat transfer coefficient of the Z model is lower than that of regular *I* profile as 7.1% depending on the heat transfer direction.

Keywords: Hollow wall brick, Inclined cavity, Thermal insulation, Heat transfer direction, Energy saving.

A Review of the Effects of Micro Fin Geometry and Alignment on Flow Boiling Characteristics in Microchannel Heat Sinks

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In parallel with the reduction in the size of electronic devices, the amount of heat released per unit surface area of the device components increases. In order to ensure system security and sustainable performance, the high heat fluxes must be removed from the related surfaces. In this context, one of the most effective thermal management methods that can be used is flow boiling in heat sinks with micro fins. The role of phase change in heat transfer, the nearly constant surface temperatures during the relevant process and the increase of surface area per unit volume due to the micro fins make this method effective. In flow boiling, the bubble dynamic and the heat transfer have a close and a complex relation. Especially, in micro-scale flow passages, the interaction between the bubble dynamics and liquid-vapor phases leads to a much more complex physical mechanism. Therefore, by means of the advancing manufacturing technologies, the novel heat sinks consisting of micro fins with different geometric configurations are developed instead of conventional parallel microchannel ones. In the present paper, the studies investigating flow boiling characteristics in heat sinks having different geometric configurations and alignments are reviewed, and the detailed information with regards to the effects of geometry on heat and flow behavior is presented. This study considering the fin configuration will contribute to the development of novel heat sink designs for the enhancement of heat transfer performance.

Keywords: Micro fin, Microchannel, Flow boiling, Heat transfer, Bubble dynamic

Artificial Neural Networks for Drying Characteristics Determination: An Application in Fluidized Bed Drying

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Drying have a several usage of purpose which are extend the shelf life of food products, to reduce packaging costs and shipping weights, to protect original flavors and nutritional values. In recent years, with increased interest in organic products, dried vegetables and fruits are in great demand. In this study, the drying characteristics of button mushrooms have been investigated in fluidized bed dryer. Button mushrooms (Agaricus Bisporus) are rich protein source and covers 37,7% of the world's fungal production. Experimental study was carried out in fluidize bed dryer at air temperatures of 45-50-55-60 °C at constant air velocity of 6,5 m/s and at constant 50 °C drying air temperature of 5.5-6.5-7.5 m/s. Mushrooms cut like a slab with thickness of 5 mm and experimental drying times have been examined. Experimental data were used as inputs of artificial neural network and a network was trained. With the help of the trained network, the best experimental conditions were selected by calculating the error rates between the inputs and outputs. Thus, test costs, equipment usage rates and energy consumption were reduced.

Keywords: Mushroom, Drying, Fluidized bed dryer, Drying characteristic, Artificial neural networks.

A Comparative Analysis on Heat Pipe Heat Exchangers and Rotary Regenerative Heat Exchangers

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In this study, a mathematical modeling study of a heat pipe heat exchanger (THEX) was performed. Then, the rotary type regenerative heat exchanger (RHEX), which is widely used in heat recovery applications, is also analytically modeled. Using these models, which are confirmed by experimental data from the literature, a regenerative heat exchanger design with the same volume as the heat pipe heat exchanger has been designed. Using the proposed designs, heat pipe heat exchanger and rotary type regenerative heat exchanger with the same mass flow and air inlet temperatures were compared in terms of air outlet temperatures, total effectiveness value, total fan power requirements, mass and material cost. In this context, the effects of heat pipe heat exchanger fin spacing and hot air inlet velocity were investigated. Under the same operating conditions, the total effectiveness value of THEX is found to be 34.60% higher than RHEX, the total fan power requirement at RHEX is approximately 151 times higher than THEX, the total mass of RHEX is approximately 16 times higher than THEX, RHEX total material cost is approximately 4 times higher than THEX. In general, the heat pipe heat exchanger stands out in terms of effectiveness, total fan power requirement and cost.

Keywords: Heat pipe heat exchanger, Rotary type regenerative heat exchanger, Heat recovery, Mathematical modeling

Investigation of Boiling Instability in Rectangular Spiral Mini Channel

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Boiling behavior in two-phase flow studies is extremely important in terms of the operational performance of nuclear reactors, heat exchangers and electronic systems. Boiling instabilities indicate dynamic changes that occur on the system against sudden changes of flow on the systems. Boiling instabilities have a significant effect on boiling instabilities with the elongation of the channel and mixing of the flow. In this study, density, pressure and temperature oscillations were investigated experimentally in a spiral mini channel with a rectangular cross-section. The spiral mini channel has a rectangular cross-section of 3 mm x 2 mm, a spiral width of 16 mm and a diameter of 60 mm. System working pressure was examined at 0.3 MPa and 0.4 MPa values. The refrigerant of R-134a is used as a working fluid in the experimental setup. Experiments were carried out at 100 kg/m2s and 300 kg/m2s mass flow rates. The vapor quality is between 0-0.99. Stainless steel foil is used to provide homogeneous heat flux from the bottom surface of the duct. To measure the temperature oscillations (TO) in the spiral mini channel, T-type thermocouples are placed at the channel inlet and outlet. Coriolis flowmeter was used for the measurement of density wave oscillations (DWO). Pressure difference oscillations (PDO) were also obtained using absolute pressure gauges at the inlet and outlet of the duct. According to the experimental results, the S-N characteristic curve was obtained for the spiral mini channel. Besides, due to the increasing heat flux, it has been concluded that pressure difference oscillation and density wave oscillations have significant effects on amplitude and frequency.

Keywords: Two-phase flow, Boiling, Pressure oscillation, R-134a

Experimental Investigation of the Effects of Foam Heat Sinks on Heat Transfer in Cross Flow

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In this study, it is aimed to improve the heat transfer increase the channel with cross flow and different parameters. In the experimental study, different Reynolds values were used and local Nusselt number and friction coefficient variations were examined in the channel. Air was used as the working fluid. Inside the test section is placed 50 mm from the aluminum foam channel inlet with different PPI values. The reason for this situation, when the heat transfer increase is examined, it was found to be the most efficient model. Depending on the different heat flux values, the temperature distributions on the surface were obtained by thermal imaging technique. As a result of the experiments, it was seen that aluminum foam and cross flow used according to empty channel had a positive effect on heat transfer increase.

Keywords: Heat transfer, Cross flow, Aluminium foam

Mixed Convection in a Vertical Parallel-Plate Microchannel with Viscous Dissipation Effect

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In the present study, fully developed mixed convection flow in an open-ended vertical parallel plate microchannel is theoretically analyzed by using a perturbation series method. The viscous dissipation in the fluid as well as the velocity slip and the temperature jump at the wall are included in the analysis. The microchannel is considered as asymmetrically or symmetrically heated with uniform wall temperatures. The effects of mixed convection parameter, Knudsen number, Brinkman number and ratio of wall temperature difference on the Nusselt number as well as the velocity and temperature profiles are examined.

Keywords: Microchannel, Vertical parallel plate, Mixed convection, Rarefaction, Viscous dissipation

Experimental Investigation Jet Flow with Different Aluminium Foam Receivers

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In this study, it is investigated experimentally to improve the heat transfer in the duct with different parameters with jet flow. This study different Reynolds values and channel height-jet hydraulic diameter (H / Dh) ratios were used. In addition, the aluminum foam with 3 different PPI values is placed 50 mm inside the channel inlet in the 100 mm x 20 mm channel. When the studies in the literature are examined, it is seen that the foam position is the most efficient area in terms of heat transfer in jet flow studies. In this study, temperature distributions on the surface were obtained by using thermal imaging technique. According to the results, it was found that aluminum foam and jet flow used according to the empty channel significantly contributed to the increase of heat transfer.

Keywords: Heat transfer, Jet flow, Thermal camera

Adaptation of the Touhami et al Correlation for Pool Boiling Outside a Horizontal Tube at Subatmospheric Pressures

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Boiling at pressures below atmospheric pressure finds its application in the evaporators of absorption refrigeration machines, the design and sizing of these pieces of equipment requires the determination of the heat transfer coefficient with correlations taken from the literature under these operating conditions; a review of the correlations giving the heat transfer coefficient during pool boiling was made, likewise a review of the experiments of boiling outside a horizontal tube carried out at subatmospheric pressures for three kinds of substances namely, water, hydrocarbons and refrigerants was studied; a comparison of the data collected from the experiment and those calculated with five chosen correlations showed a deviation with relatively high margins; the modification and adaptation of the correlation of Touhami *et al* to the case of low pressure boiling has given convincing results.

Keywords: Boiling, Horizontal tube, Heat transfer coefficient, Pressure, Subatmospheric.

An Energy Efficient Mixed Flow Submersible Pump Design and Computational Fluid Dynamic Processes in a Case Study: 7” 110 m^3/h

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With the increasing consumption of water, demand for freshwater, therefore; the usage of groundwater is gaining importance all around the world. According to some research, all water is involved by oceans at the rate of 96.5% and part of it is contained as freshwater. The freshwater value of around 68.6% is found in glaciers, the remaining part of it is found as groundwater. The groundwater supply process is only possible via submersible pump systems. The energy efficiency value is given as EU 547/2012 “Eco-design Requirements for Water Pumps” with a common criteria “Minimum Efficiency Index (MEI)”. This value is calculated with some equation system including motor rotation speed, head, and flow rate. When the efficiency values calculated for the partial load (75% · Q), full load (Q) and overload (115% · Q) value of the volumetric flow rate are calculated depending on the MEI and hydraulic test values are equal to or greater than the MEI values, it can be said that the product can be formed according to the regulation.The study focuses on product design in accordance with the EU 547/2012 coded “Eco-design Requirements for Water Pumps”. In the scope of the study, rotors and stators designs and Computational Fluid Dynamics analyses were performed. First of all, the designs of the rotor were made via CFturbo® with the specifications determined when evaluated according to the customer needs and pump characteristics. After final rotor design was decided, stator design process was started with CFX® analysis in parallel to define the stage performance criteria; head (mCW), power (kW) and efficiency (%).
After conducting the single-stage Computational Fluid Dynamics (CFD) studies of THE final design, the three-stage analyses are run and the specifications of the second stage were found; efficiency value of 86.33%, head 11.52 mCW and 3.98 kW per stage.

Keywords: Mixed – flow pump, Pump design, Computational fluid dynamics, Energy efficiency, Minimum efficiency index, Eco-design.

Numerical Investigation of Flow and Heat Transfer in an Open Cavity

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In this study, buoyancy-driven cavity flow for mixed convection regime is investigated. A parametric study is carried out to investigate the effect of the heated wall, Richardson number, Reynolds number, heat flux value, and cavity geometric parameters numerically for turbulent flow. The working fluid is assumed as air with Pr=0.71 The problem is modeled as 2D incompressible flow with solving Navier-Stokes equations using Fluent software with Boussinesq approximation. Length to depth ratio and height to depth ratio of the cavity is varied between $0.25<L/H<5$, $0.25<D/H<3$, respectively. Reynolds number is changed between $24000<Re<96000$ Firstly, numerical parameters effect like turbulence model, dimension effect, mesh effect are carried out to obtain results that are independent of the numerical errors. After developing a numerical methodology, a parametric study is carried out. Results indicate that the D/H and L/D ratio has a direct effect on the thermal performance of the enclosure. It is observed that when $Ri<1$ buoyancy effects are negligible, and when $Ri>1$ buoyancy effects are dominant; thus increasing the Richardson number rises the Nusselt number. This parametric study also depicts that the turbulent diffusion mechanism has a critical role in heat transfer. It is demonstrated that, for an aspect ratio lower than 1, a single elongated eddy is formed in the cavity region.

Keywords: Cavity, Mixed convection, Heat transfer, Richardson number

Investigation of Flow Field Characteristics of Synthetic Jet Driven by Half Sinusoidal Signal

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In this study, the flow field characteristics of a synthetic jet driven by a half sinusoidal signal wave was carried out experimentally and compared to a complete sinusoidal signal. In addition, the synthetic jet driven by the half sinusoidal signal was studied with different amplitudes and duty cycles. To elucidate the effectiveness of the actuator, the half sinusoidal signal wave was arranged with different offsets. Synthetic jet driving frequency and voltage were f=4 Hz and E=5 Vpp respectively. To obtain synthetic jet flow, also known as zero net mass flux, a woofer type actuator and cylindrical nozzle having D=12.7 mm outlet diameter were used. Instantaneous and time averaged jet velocities were acquired by using a hot-wire anemometer in the range of Reynolds number from 4,000 to 20,000 based on the mean jet velocity occurred during the blowing period. Synthetic jet velocity flow fields were measured in different dimensionless axial distance (y/D) and dimensionless radial distance (r/D). Increasing amplitude of half sinusoidal signals generate tandem jets with different velocities where jet with higher velocity can reach the foregoing jet. By the measuring of instantaneous velocity time history along with jet axial centre line, the tandem jet's motions were examined whether or not to be a conjoint single jet structure.

Keywords: Synthetic jet, Tandem jets, Signal modulation

Bubble Pump Design and Performance Analysıs

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The design of any refrigeration system is a critical aspect because it has to be efficient and energy saving more than the previous similar designs. In this paper, an integrated cooling system in terms of lifting tube distribution, water reservoir, temperature sensors, controllers, water level sensor locations, and automatic control systems has been designed.The design conditions were assumed that a hot surface released different amounts of heat 550W, and 1500W is to be cooled and maintain the temperature under the desirable limit, the experiments have been conducted under the atmospheric pressure used many configurations such as a different number of 8mm diameter lifting tubes from 1 to 4 tubes, and different submergence ratios 0.3, 0.4, and 0.5.The design process of this system consists of a literature review of all available systems and the required components for this system. The Selecting criteria were based on efficiency, costing, and energy consumption. Then The sizing has been made to find the quantity and capacity of each component. After that, an optimal arrangement of parts and components was designed, and an automatic control system has been developed to control the electrical equipment. Then the data have been recorded and tabulated, the efficiency has been calculated, the theoretical model based on the fundamentals of fluid mechanics has been compared with the experimental data, and at the last step, the conclusion has been extracted, through that, the slug flow pattern could be noticed in the experiments as the desired flow type where the heating power is 1500W. And by comparing the results of experiments with the theoretical model, it was obvious that the performance was directly proportional to the submergence ratio and the number of lifting tubes.

Keywords: Bubble pump, Submergence ratio, Lifting tubes, Slug flow, Refrigeration cycle

Numerical and Experimental Investigation of Air Injection Process with Venturi Pipe Part

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Air injector processes with venturi pipe part (VPP), simple in design and easy to operate, have been used in a wide variety of industrial, agricultural and water/waste water treatment applications in environmental engineering. The air injector process occurs when a minimal amount of differential pressure exists between the inlet and outlet regions of a venturi device. This paper introduces a numerical and experimental study of air injector process within a venturi device and its relationship with the Reynolds number for minimal flow conditions. An investigation of the air-water injector has been carried out to study the influence of operating conditions on the hydrodynamics and mass transfer characteristics of the injector by using two-fluid computational multiphase fluid dynamics (CMFD) modeling. The numerical work was performed by means of the program ANSYS CFX 11.0 software. The CMFD results are validated with experimental data. Flow field analysis and prediction of injector performance are also conducted.

Keywords: Air injection, Computational fluid dynamics, Venturi pipe part

Analysis and Design of an Air to Air Heat Exchanger Used in Energy Recovery Systems

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With the continuous worldwide energy use increase, energy efficiency is gaining high importance. Consequently, many methods have been investigated for potential energy savings. One of these methods is the use of heat recovery systems. These systems basically re-use waste heat and reduce energy consumption. Also, they are increasingly used to reduce heating and cooling demands of buildings. Their main feature is to provide fresh air to the place which is heated by the exhaust air with the help of a heat exchanger working between two different temperature sources. There are various heat exchangers that can be used for different engineering applications with many different sizes, weights, shapes and flow patterns. The most commonly used types of heat exchangers in ventilation systems are cross-flow heat exchangers. They have a thermal efficiency in the range of 50-75%. Many studies have been carried out to increase the efficiency of this type of heat exchangers which are preferred because of their small structure and low cost. In this study, cross-flow flat plate and dimpled plate heat exchangers were compared using Engineering Equation Solver (EES) program and ANSYS Fluent software in order to determine how the surface geometry affects heat transfer. Different dimple geometries were analyzed by using ANSYS Fluent software to find f friction factor and Colburn j factor in laminar and turbulent flows in order to develop an optimum design. As a result of the simulations, optimum geometry required to increase efficiency was determined.

Keywords: Heat recovery, Cross flow heat exchanger, Dimpled plate, Heat transfer, Efficiency

Termodynamic Investigation of Flat Plate Collector

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A flat plate collector is a heat exchanger that converts solar energy into heat energy. The solar collector transmits a part of the incoming solar radiation to the fluid. Collector efficiency is the ratio of the heat obtained from the fluid to the radiation coming on to the collector. In this study, flat plate collector modeling is done and the parameters affecting the efficiency are investigated. Thermodynamic analysis of the plat plate collector was made by taking into consideration the parameters of fluid flow, solar radiation intensity, absorber surface and transparent cover.

Keywords: Flat plate collector, Collector efficiency, Energy

Development and Thermodynamic Analysis of a Hybrid Evaporative Evaporator Air Cooling System

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In this study performance analysis of a hybrid cooling system which developed by integration of an evaporativ cooler and a cooling machine's evaporator is conducted. A performance increase on cooling machine is aimed by evaporative cooler integration. Researches are conducted on different scenarios to indicate the highest increase of performance. Evaporative cooler, cooling machine evaporator and the fan, which are the main units of hybrid cooling system, are integrated due to 6 different scenario and tested and analysed for 3 different air velocity.
The variation of cooling capacity, temperature drop , energy consumption and etc. are studied for each system component and whole system in each scenario and these variances are linked with system performance.

Keywords: Evaporative cooling, Cooling machines, Air conditioning systems, Humidification, Evaporation

Performance Prediction of a Two-Bed Adsorption Chiller Using the Silica Gel Water Working Pair Considering the Effect of Hot and Cold Water Temperatures

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Adsorption technology used in adsorption chillers is a new and environmentally benign technology. Adsorption chillers use low-quality waste heat and renewable energy resources. Silica gel –water working pair is the most common adsorbent/adsorbate pair used in adsorption chillers. This work evaluates the effect of hot and chilled water temperature on the performance of a two-bed adsorption chiller, which uses the silica gel-water adsorbent/adsorbate pair. A mathematical model that previously developed for the theoretical analysis of adsorption chillers has adapted to this current system. Simulation work carried out to determine the influence of hot and cold water temperatures on the COP and cooling capacity. A parametrical analysis has done to interpret the results.

Keywords: Adsorption, Chiller, Silica gel, COP, Cooling capacity

Performance Analysis of Solar and Geothermal Energy Powered Kalina Cycle

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In this study, the solar energy and geothermal energy powered Kalina cycle (SGEP-KC) was investigated according to the thermodynamical and economical analysis. The heat obtained from the parabolic solar collector integrated geothermal energy powered Kalina cycle with thermal energy storage. The geothermal energy used in Kalina cycle as a primary energy source. The energy efficiency, exergy efficiency and Net Present Value (NPV) of Kalina cycle were investigated according to solar radiation, geothermal fluid return temperature, turbine inlet pressure and condanser pressure. Solar radiation values of Kutahya Province were used in thermodynamical and economical analysis. As a result, the most effective geothermal fluid return temperature, turbine inlet pressure and condanser pressure values were determined respectively as 373.15 K, 4308 kPa and 700 kPa for all annual solar radiation values. The energy efficiency and exergy efficiency values for the specified operating parameters were respectively calculated as 11.1124 % and 47.0740 %. The NPV values of these system configuration were determined as 126.857 Million US$ and 84.186 Million US$ for the highest radiation value of 6.48 kWh/m^2 and the lowest monthly solar radiation value of 1.51 kWh/m^2, respectively. As a result, the system was found to be worth investment as a result of thermodynamical and economical analysis.

Keywords: Kalina cycle, Energy, Exergy, Geothermal energy, Net present value

ORC Sistemlerinde Kullanılan n-Pentane Akışkanının Pompada Sıkıştırma Oranının Termodinamik Verimlere ve Ekserji Yıkımına Etkisi

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Günümüzde atık ısıdan enerji üretimine yönelik sistem tasarımları hızla geliştirilmektedir. Burada hedeflenen amaç, tasarlanan sistemlerde düşük ısı kaynaklarında da güç üretimini sağlamaktır. Düşük sıcaklık değerleri için güç üretiminde yaygın olarak Organik Rankin Çevrimerli (ORC) kullanılmaktadır. Bu çevrimlerde yaygın olarak kullanılan akışkan n-Pentane akışkanıdır. ORC ile güç üretim sistemlerinde çevrimde kullanlan akışkanın pompada sıkıştırması güç üretimi için istenen bir durumdur. Ancak pompada akışkanı sıkıştırma, pompanın çekeceği gücü artıracaktır. Bu sıkıştırma işinden kaynaklanan entrpi artışı sebebiyle, hem pompada hem de türbinde ekserji yıkımının artmasına sebeb olacaktır. Sıkıştırma oranı 10 olarak seçildiğinde pompanın çektiği güç 14,1 kW olurken, türbinde üretilen iş 716 kW olmaktadır. Bu sıkıştırma oranına bağlı olarak enerji ve ekserji verimleri sırasıyla % 12.58 % 30,3 olarak hesaplanmıştır. Sıkıştırma oranın artırılması sonucunda, türbine giren akışkanın basıncıda arttılacak ve dolayısıyla güç üretimin de 660 kW'dan 812 kW'a yani %23' lük artış meydana gelmektedir. Türbindeki ekserji yıkımı da 189 kW'dan 233 kW'a kadar çıkmaktadır. Sıkıştırma oranın güç üretiminde ve ekserji yıkımında büyük rol oynamasından dolayı optimum bir sıkıştırma aralığına bağlı sistem dizaynı yapılması sistemin daha verimli çalışmasına ve türbinin termodinamik performansına katkı sağlayacaktır.

Anahtar Kelimeler: Enerji, Ekserji, R600, ORC

Comparative Techno-Economic-Environmental Assessment of Biomass Fuelled Integrated Energy Systems

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In this research, an integrated energy system providing electric power, heating power and fresh water is proposed and investigated. Different biomass sources with different heat values are considered as an input for the studied system. With the purpose of leading designers and engineers in choosing the biomass type for utilizing in integrated energy systems, the considered configuration has been technically, economically and environmentally analyzed and their performances have been compared to each other in the case of different biomass types. The selected parameters for this comprehensive comparison are energy and exergy efficiencies, Net Present Value (NPV) and CO2 and NOx emissions.

Keywords: Thermodynamic analysis, Environmental assessment, NPV, CO2, NOx

Thermodynamic Analysis of Automobile Brake System

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In this study, an automobile's disc brake systems are experimentally simulate. Experiment system; consist of the brake disc, caliper, pads, electric motor that used to incitement of the brake disc and a hydraulic pump to provide the oil pressure required to the brake unit. To simulation of the braking process, the brake disk is rotated at a constant speed and the applied force to the disk for different brake pressures of various temperature changes in the disk braking are measured. Braking system had been evaluated thermodynamically by using the measurement results obtained.

Keywords: Breaking system, Energy, Exergy

The Performing of Thermodynamic Analysis of R134a Refrigerant and Alternative Refrigerants on Their Application Areas

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Fluorocarbon and chlorofluorocarbon refrigerants are widely used in vapor-compression refrigeration systems. Due to the high ozone depletion potential (ODP) and global warming potential (GWP) of these refrigerants which are used, alternative fluid exploration studies are ongoing. In this study, alternative refrigerants for R134a refrigerant which are especially and commonly used in vehicle and household refrigerants which have zero ozone depletion potential but high global warming potential were investigated. R32, R152a and R1234yf coolants which has lower Global warming potential as alternative were used. A detailed energy and exergy analysis of these refrigerants is presented according to the theoretical vapor compression refrigeration cycle. Besides, the Performance Coefficients (COP) of the cooling cycle were theoretically compared. In addition to these, the behavior of these alternatives in different application fields and in different cooling conditions in the literature was examined.

Keywords: Energy, Exergy, RT134a-R32-R152a-R1234yf

Numerical Analysis of Aerodynamic and Aeroacoustic Characteristics of Subsonic Rectangular Cavity with Different Aspect Ratios

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In the aerospace industry, interior storage carriages, that carry items such as weapons and bombs form cavities. When the free stream flow reaches the cavity leading edge, a shear layer forms above the cavity zone. This shear layer formation changes the mean surface pressure distribution and induces pressure fluctuations in the cavity zone. Self-sustained pressure oscillations cause unsteady and complex flow field inside the cavity. This complex flow field can damage the structure of air vehicles and causes high sound pressure levels (SPL). Based on the dynamic loads and SPL levels, structural fatigue of the cavity and its characteristics can be observed. Adverse and steep pressure gradients, which prevent the safe release of stores, can formn this study, the flow topology of the subsonic cavity is investigated numerically. A verification study is performed comparing the numerical results obtained with experimental results from the literature. After reaching satisfactory results, the flow fields are investigated, and aeroacoustic characteristics of the cavity are examined for Mach number 0.19 and Reynolds number 1.2×106. The cavity aspect ratio (L/D) is varied between 2 and 10. The shear layer formation, Rossiter modes, acoustic modes and SPL levels are obtained and compared for different L/D ratios. Also based on the Sound Pressure Level (SPL) analysis of the pressure fluctuation, the dominant frequencies are calculated and compared with the Rossiter's formula.

Keywords: Cavity, Subsonic flow, Acoustic level, Rossiter mode, SPL

A Numerical Study on Phase Change Material Integrated Borehole Heat Exchanger

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Borehole heat exchangers are commonly used as ground source heat exchangers in ground source heat pump (GSHP) applications. Designing borehole heat exchangers is essential for GSHPs as the thermal performance of borehole heat exchangers affects COP of GSHP systems. In this study, the thermal performance of the phase change material (PCM) integrated borehole heat exchanger was modeled under transient working conditions with a numerical code that is developed in MATLAB. Moreover, the borehole exchanger is integrated with a flat plate solar collector to examine the effects of real weather conditions on the heat transfer characteristics of the storage unit. A simplified lumped thermal resistance model was used for modeling the solar collector. The numerical model of PCM integrated borehole, on the other hand, was developed using the finite volume method (FVM) to discretize the governing equation. Strongly implicit solver (SIS) was used to solve coefficient matrix. The lumped model for the flat plate collector and numerical models of the borehole and the PCM annulus were validated with available numerical and experimental studies from the literature. Short-term heat storage performance of the borehole heat exchanger with different backfill materials, i.e., PCM or soil, was then investigated for selected days of each season of the year.

Keywords: Borehole, Thermal energy storage, Solar energy, Numerical heat transfer

Numerical Investigation and Optimization of the Effect of Heat Transfer and Pressure Drop on the Circuit in Finned Tube Heat Exchangers

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Optimization of heat exchangers, which are frequently used in many industries such as air conditioning, automotive, aviation industry, is very important today. Optimization is needed to optimize production and operation costs. The purpose of this study is to design an optimal circuit for improving heat transfer in finned tube heat exchangers. Performance in finned tube heat exchangers where water is used as work fluid is directly related to the homogeneous distribution of the temperature difference between the water temperature and the air temperature throughout the heat exchanger. If there is no homogeneous distribution, air velocities on the surface will cause differences between the circuits due to air flow and temperature temperature distribution. Such as this situation will reduce the performance of the heat exchanger. For this reason, the design of the circuit for the heat exchanger is very important to achieve a homogeneous temperature distribution. Literature studies have shown that with the number of rows and the number of circuits increases the importance of the circuitry optimization in finned tube heat exchangers increase as well. Most of the circuitry optimization studies have been done with refrigerants and the studies with water as a work fluid are limited. In this study, numerical studies were carried out to determine the circuitry for ensuring the maximum average temperature difference between fluids (water-air) and a circuit optimization was performed according to these studies.

Keywords: Finned tube heat exchangers, Performance, Circuit design

CFD Analysis of Fluid Passing Through Venturimeter

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Flow analysis is an important issue for many industrial applications. Computational Fluid Dynamics (CFD) is a branch of fluid mechanics in which the problems in which fluid behavior is effective are solved by numerical methods and algorithms. Measurement, evaluation, especially measurement of gas and liquid is very important for fluids. In this study, computational fluid dynamics analysis of the fluid passing through the venturimeter is performed. The venturimeter is a very suitable pipe for narrowing and re-expanding the pipe cross-sectional area to observe pressure and velocity changes. In this study, two different fluids are used as liquid fluid passing through venturimeter and air as gas fluid. ANSYS-CFX program was used to analyze the velocity and pressure changes of these fluids passing through the venturimeter using different turbulence models. The values used in the numerical analysis are the same as those in the laboratory environment. Venturi tube dimensions are entered exactly the same as the venturi tube dimensions used in the experiment. SST, k-Epsilon and k-Omega turbulence models were used for different fluid types. Experimental results were observed in the laboratuary and numerical results were obtained with the help of these results. Speed and flow graphs of air and water in different situations are presented.

Keywords: Venturimeter, Turbulence models, SST, k- Epsilon, k- Omega, Velocity.

Design and Prototyping of Air-to-Ground Smart Fire Extinguisher Ammunition

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Fires are disasters that are caused by various reasons and have serious consequences including loss of life and property. In our country, fires especially threaten forests, strategic areas such as chemical production and storage facilities, oil and natural gas pipelines, ammunition storage areas. In our country, as in all over the world, we try to combat fires effectively by using land-based and aerial firefighting methods.
The aim of this study is to design and prototype a smart fire extinguishing ammunition, which is a product that can be used in aerial firefighting methods to fires and is much more effective than the existing tools. The ammunition is thrown from the aircraft to the point where the fire is located, forcing the fire to extinguish by stopping the contact of the flames with the air. The ammunition contains a powder-extinguishing agent, the main substance of which is boron. The extinguishing ammunition is designed based on the dimensions of a general-purpose ammunition from air-to-ground used by many NATO countries today. Thus, this extinguishing ammunition can be easily loaded onto the aircraft without any modification to the aircraft. This feature will facilitate the export of the product to all countries that use NATO standards in aircraft. A software is developed to enable the fire extinguishing ammunition to function autonomously. Prototype of this fire extinguishing ammunition is produced. It is predicted that smart fire extinguishing ammunition will bring a new product that has never been done before to the fire extinguishing industry, which has a size of 90 billion dollars all over the world, and will provide a significant amount of currency input to our country with its export.

Keywords: Fire extinguisher ammunition, Smart ammunition, Aerial firefighting.

A New Vortex Preventing Element Design for Francis Turbines and Comparison of Different Geometric Shapes

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In recent years, countries have turned to renewable energy resources since fossil fuels effect the environment badly and they have limited resources. Hydraulic energy is one of the most effective renewable energy resource because of its high potential and ease on convertibility. Francis turbines which convert potential and kinetic energy of water into mechanical energy have high efficiencies which reach almost 90%. Yet, with some modifications such as preventing some phenomenas like cavitation, vortex rope etc., these efficiencies could still be increased. In this study, a new element is designed named Vortex Preventing Element (VPE). The aim is to prevent the low pressure and stagnant regions in the entry of draft tube, by locating this element between runner and draft tube. The principle of this element is to resist the outgoing water from runner by spiral forms and regulate the flow before it enters to draft tube. VPE with one spiral form is analyzed with CFD in ANSYS CFX and it is seen that flow is more stabilized with respect to the case of Francis Turbine without VPE. Then, the number of spiral form is thought to be effective on preventing this phenomena so that these two case are investigated in the concept of this study. As a result, it is seen that VPE is regulating the complex outgoing flow from runner and prevents low pressure regions. Also by obtaining torque values from analyses, it is seen that the new element increases the turbine efficiency about 2-3%.

Keywords: Francis turbine, CFD, Efficiency, Renewable energy

Effects of Injection and Suction Through a Perforated Circular Cylinder on Some Thermo-Fluid Parameters

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The effects of uniform injection and suction through the surface of a perforated circular cylinder with various aspect ratios on the vortex shedding, heat transfer and some aerodynamic parameters have been investigated numerically. The finite-volume method has been used for solving the ensemble averaged Narvier-Stokes equations for incompressible, turbulent near-wake flow with the *RANS* turbulence model equations. To find the optimum conditions, the effects of injection and suction through the surface of the cylinder with various injection/suction coefficients *G* and different perforation rates are studied. The results show that parameters such as drag and lift coefficients, pressure coefficient and Nusselt number influenced drastically in some cases as well as flow field parameters.

Keywords: Injection and suction, Perforated circular cylinder, Heat transfer, Turbulent flow

Effect of Magnetic Field on Flow and Heat Transfer in Hydrodynamically and Thermally Developing Couette-Poiseuille Flow Between Paralel Plates

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In this study, a 2D numerical analysis is conducted in order to investigate the hydrodynamically and thermally developing flow of an electrically conducting, viscous, incompressible and Newtonian fluid between the parallel plates under uniform magnetic field. The problem geometry consist of two electrically insulated parallel plates in which the one is stationary and the other one is moved at constant velocity. The fluid is heated by applied constant heat flux at the walls and external uniform magnetic field is applied perpendicular to the flow. Two different cases have been investigated under thermal boundary conditions: constant heat flux at the moved wall and adiabatic stationary wall (Case A) and uniform heat flux at the stationary wall and adiabatic moved wall (Case B). Heat generation from viscous dissipation and Joule heating are also included in the analysis. The continuity, momentum and energy equations are solved numerically in ANSYS 16.0 by using finite volume method. In the flow region, magnetohydrodynamic (MHD) fluid flow and heat transfer, which are caused by the interaction of fluid movement and electromagnetic field, are examined. For different wall velocities and heating conditions, the influence of Brinkman and Hartmann numbers on the velocity and temperature profiles as well as Nusselt numbers are presented.

Keywords: MHD, Paralel plates, Viscous dissipation, Joule heating, Couette, Poiseuille

Validation Study of a Naturally Ventilated Solar Facade

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Solar facades are used extensively on building envelopes due to electricity production, thermal energy storage, passive heating, ventilation and air conditioning of living spaces and its aesthetic structure. This article presents a comprehensive numerical validation study of a naturally ventilated solar facade with different inlet and outlet positions. Preliminary prototyping studies are carried out for a solar facade located in Tarsus, Mersin. The studies are carried out with ANSYS Fluent commercial software, and the results are compared with the data in the literature. For the validation studies, two and three dimensional simulations are performed, and the effects of different turbulence models on temperature and velocity regions are evaluated. The findings are presented as changes of temperature, velocity and turbulence kinetic energy contours.

Keywords: Solar facade, Double skin facade, Solar chimney, Natural ventilation

Numerical Investigation of Naturally Ventilated Facade with PCM Located in Mediterranean Region

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In recent years, with the rapid depletion of natural resources and the increasing population, there has been a need to minimize the energy consumption of buildings for ventilation and air conditioning. For this reason, solar facades have been widely used in recent years, and the use of phase change materials in building facades has become one of the main R&D studies. This paper presents a two-dimensional numerical investigation of a naturally ventilated solar facade with PCM in the Mediterranean climate. The ventilated facade consists of two regions: (i) the air duct between the outer shell and the absorber, (ii) the absorber containing PCM. The scope of this work is to emphasize effects of thickness of the PCM layer on absorber temperature, velocity and temperature of air inside the channel, phase change characteristics and latent heat storage.

Keywords: Solar facade, Double skin facade, Thermal energy storage, Natural ventilation

Numerical Investigation of the Effect of Air Velocity on Heat Transfer to Heat Sink in Thermoelectric Modules

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Today, the demand for energy increases day by day. Energy costs also increase rapidly. In the world and also in our country, a lot of incentives are made in areas such as renewable energy in order to meet our own energy needs and to diversify our energy production. In this context, thermoelectric energy is an important source in the conversion of heat to electrical energy. The amount of electricity generated from heat depends on the temperature difference of a thermoelectric module. The greater the difference, the more electricity is generated. This study aims to analyze the heat sink design of an thermoelectric module by using Ansys Fluent program. According to the results of this analysis, in future studies, the appropriate heat sink is planned to use in the construction of a larger thermoelectric generator.

Keywords: Thermoelectric module, Heat sink, Numerical modelling

Modelling and Performance of a Thermoelectric Refrigerator

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Thermoelectric refrigerators are widely used in electronics, medical, and food industry application areas. A refrigeration effect can also be achieved without using any moving parts by merely passing a small current through a closed circuit made up of two dissimilar materials. This effect is called the Peltier effect, and a refrigerator that works on this principle is called a thermoelectric refrigerator. They consist of several thermoelectric legs sandwiched between two thermally conductive plates, one cold and one hot. Thermoelectric refrigerators presently cannot compete with the vapor-compression refrigeration system because of their low coefficient of performance (COP). However, they have preferred in some applications because of their small size, simplicity, quietness, and reliability. In this study, a thermoelectric cooler having a maximum cooling power of 50 W, having a dimension of 40mmx40mmx3.6 mm, is modeled in a multi-physics software. Also, the performance of a thermoelectric refrigerator is investigated. It is computed the temperature difference between ceramics plates versus electric current and COP for a temperature difference between ceramics plates. The simulation results are compared with experimental values.

Keywords: Thermoelectric, COP, Refrigerator, CFD, Modeling

Numerical Investigation of the Effect of Obstacles Configuration in the Flow Channel on Heat Transfer

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In this study, the effect of placing rectangular obstacles in a square section channel on heat transfer was investigated numerically. Channel length was determined as 200 mm. The rectangular obstacles are arranged as shapes of triangular, concave and flat with respect to the channel side surface. The obstacles were selected as 3 mm thickness and placed on the heating surface 3, 6 and 9 rows and analyzed for the maximum high values of the resistors 20, 40 and 60 mm. During the numerical analyses, the boundary condition of constant heat flux was enforced to the inferior surface of the test section and the other surfaces were assumed as adiabatic. Air was used as working fluid (Pr=0.7). Numerical analyses were performed for the range 10 000–30 000 of the Reynolds numbers in ANSYS–FLUENT 14.5 commercial program by using the k–ω SST turbulence model. It was seen that the flat obstacles provide maximum heat transfer. However, maximum pressure loss was also obtained in the same obstacle applications. The results were showed that obstacles geometry and rows play an important role in heat transfer. Although It was seen that the flat obstacles provide maximum heat transfer, maximum pressure loss was also obtained in the same obstacle applications.

Keywords: Numerical analysis, Turbulent flow, Concave resistance

Investigation of Air Flow Inside an Airplane Passenger Cabin

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Airplane use are increasing worldwide and airplanes are the only means for long distance travels. However, the passenger cabins of airplanes could contain contaminants due to passengers and the carbon dioxide level should be controlled during the travel. In the present study, a part of the passenger cabin of a commercial airplane was modelled considering symmetrical conditions and the air flow inside the cabin was analysed numerically using Ansys-Fluent software. As a conclusion the streamlines of air released from air ducts was obtained and the flow path of air inside the passenger cabin was determined. The flow path of air also gives information about the contaminant spread inside the cabin.

Keywords: Airplane cabin; Air flow path; ANSYS-Fluent analysis; Numerical analysis; Contaminant spread

Using of Natural Ventilation System for Irrespirable Gases in Production Lines and Improving Indoor Air Quality

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The use of ventilation systems from our homes to industrial areas is increasing day by day with the growth of the population and the industry.Systems which is used to meet the need for ventilation ,create a large energy consumption.Natural ventilation systems are used in industrial areas in order to reduce energy consumption and to provide more environmentally friendly ventilation.Ventilation systems that provide ventilation using a difference in temperature and pressure and do not have any energy consuming components are called natural ventilation. In this study, natural ventilation system working process in a ceramic production line is examined.

Keywords: Natural ventilation, Industry

Effect of Vertical Skirt on Airflow and Particle Distributions in an Operating Room: A Numerical Study

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Bacteria-carrying particles (BCPs) released from surgical staff are the main factor causing surgical site infection (SSI). Operating room (OR) ventilation plays an important role in reducing the risks of such infections. The aim of this study is to investigate the effect of the vertical skirt on airflow and particle distribution in an OR with laminar ventilation system (LAF) via computational fluid dynamics (CFD). Two different ventilation strategies are comparatively examined: (i) with skirt, (ii) without skirt. Two different particle diameters (10 and 20μm) are considered for a constant value of the air change rate (30 ACH). The simulation results show that the vertical skirt contribute to the enhancement the unidirectional airflow provided by LAF. It is also found out that an OR with a skirt has a great potential to reduce the particle deposition in the surgical site.

Keywords: Operating room, Surgical site infection, Ventilation, Vertical skirt

Air Conditioning System Design of a Archives Storage Facility in the Warm Climate Region

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It is known that miscellanies, manuscripts and books with historical and cultural value get damaged, stained or decayed by time in where they stored or displayed. Dry thermometer temperature, relative humidity values and amount of light play an important role in the occurrence of these damages. In this study, for a library located in the city of Mumbai which has rare books collections and archive spaces, heating and cooling loads were calculated with Hourly Analisys Program (HAP) by taking into account the climatic and structural factors and created a BIM model through Autodesk Revit. To provide ideal ambient conditions to prevent the rare books from wear down and damaged by the ambient conditions and for the air conditioning of other areas in the facility, variable refrigerant (VRF) system and packaged rooftop units were investigated.

Keywords: Rare books, Archive, Library, HVAC systems, System design

Investigation of Bım (Building Information Modeling) System in terms of Pressure Energy Losses in Ventilation Systems

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In terms of mechanical installations, the design process of the buildings is generally based on drawing independent projects for each installation. This method is not sufficient in terms of how the installation systems, which are similar in terms of the space they occupy, should be positioned relative to each other and to the manufacturing of other specialties. Thus, there are many clashes in the conventional construction method. This creates high energy consumption due to the pressure loss for the installations.
In order to minimize energy costs in air conditioning systems, pressure losses should be reduced. In order to calculate the pressure losses correctly, it is necessary to know clearly the pressure loss parts such as fittings of the ventilation system. In the conventional method, the pressure losses of ventilation ducts are calculated by neglecting fittings in the 3rd dimension. However, during the installation phase, fittings of the 3rd dimension are also added to the fittings in the project. This causes the ventilation system to have more pressure loss than the values calculated in the project and to generate more energy consuming systems. A ventilation system model created with BIM (Building Information Modeling) expresses more clearly the type and number of all parts of this system. With the 3D models prepared with BIM, it can be observed how an installation will be formed before the construction phase. Thus, the dimensions of the cavity required to create a ventilation system design that would result in less pressure loss can be more clearly defined.

Keywords: Mechanical installations, Ventilation, BIM.

Bidirectional Flyback Based Differential Power Proccessing Converter For Photovoltaic Applications

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Conventional photovoltaic (PV) energy conversion architectures are often forced to trade off efficiency and cost for increased power production. In many applications, cells or modules are connected in series as high voltage is required. When PV cells are connected in series, they experience internal and external mismatch that reduces output power. The differential power processing (DPP) approach overcomes this drawback by enabling each PV element to operate at its maximum power point (MPP) while only processing a small fraction of the total power produced. DPP converters are used to control PV elements, sub-panel strings, or individual PV cells. DPP converters process only the difference in power between PV elements. This paper includes a bidirectional flyback converter (BFC) based PV to Bus DPP architecture at the submodule level. When a mismatch occurs, bidirectional DPP converters can inject or subtract current to the string. If there is no mismatch between serial cells, the DPPs are shut down and process any energy. The PV to Bus architecture and MPPT control method have been validated by simulations results using bidirectional flyback based DPP converters on a standart 72 cell PV module under severe, moderate, light and no mismatch conditions.

Keywords: Bidirectional flyback, Differential power proccessing, Photovoltaic, MPPT

Important Parameters in Solar Power Plant Installation and Analytical Hierarchy Process

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The limited reserves of fossil fuels and the damage they cause to the environment make renewable energy sources more and more important. The share of imported fossil fuels in electricity generation in Turkey is very large. Therefore, it is important to turn to alternative sources in electricity generation. One of these alternatives is solar energy, which is a renewable energy source. Investments in solar power plants in the world and in our country are increasing rapidly from year to year. Our country has an important solar potential with a total annual sunshine duration of 2741 hours and annual total solar energy value of 1527 kWh/m2.year.
In this study, the energy situation of Turkey, renewable energy sources and solar energy situation were evaluated and the parameters which are important in the installation of solar power plant are mentioned under three main headings as plant efficiency, legal regulations and environmental effects. In addition, the location selection of solar power plant with the help of algorithms using various criteria has been examined and the studies have been emphasized.

Keywords: Solar energy, Renewable energy, Solar power plant site selection

Sensorless Flow Rate and Total Head Measurement of Centrifugal Pumps Operating with Variable Frequency Drive

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Centrifugal pumps are widely used in industrial and HVAC applications. In many applications, centrifugal pumps are worked with variable frequency drive control to reduce energy consumption and regulate operational state. Some control systems need to use pump measurements to monitoring system variables and stability of control. Therefore, additional components needed such as sensors, circuity and cables which can increase system cost and complexity. In this study, a method of sensorless flow rate and total head measurement to regulate centrifugal pumps outlet are presented. Estimation of pump output values at different operating points and speeds has been realized using known pump characteristic curves and the affinity transformations. The results were compared with the actual measurements and high accuracy was obtained.

Keywords: Centrifugal pump, Variable speed drive, Sensorless flow rate, Sensorless head

Exergy Analysis of a Solar Power Plant and Comparison of Production Values with Software

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In this study, one-year production values of a 910 kW solar power plant in Eskişehir were compared with the simulation in computer software, and energy and exergy analysis was performed for a photovoltaic panel with 250 W power used throughout the year. The values obtained in the simulation made with the System Advisor Model software were found to be 2% different from the actual production values. Annual energy and exergy analysis were performed by using the production values and technical characteristics of the panel and meteorological data. After the energy and exergy analysis, the average annual energy efficiency was calculated as 13.5% and the annual average exergy efficiency was calculated as 12.6%. According to the values obtained, it was observed that energy and exergy efficiencies decreased as the ambient temperature increased.

Keywords: Solar energy, Simulation, Exergy analysis

Following the Balloon Temperature of a Solar Water Heater Installed in Oran, Algeria

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The energy consumed for domestic hot water needs is constantly increasing, the use of solar energy can contribute to a share in the energy mix; a study was made on the installation of an individual solar water heater with forced circulation for the needs of an average family installed in the climate of Oran, the energy approach is based on the balance sheet of inputs and outputs and the accumulation inside the balloon. The temperature inside the balloon has been followed, indicating that it can reach peaks of more than 50 °C; performance results show that solar coverage can drop from 18% in January to 66% in July.

Keywords: Flat panel, Balloon, Temperature, Hot water, Solar energy.

Review of the Recent Development of Chalcopyrite Thin-Film Solar Cells Based on Polycrystalline Compound Semiconductors Cu(InGa)Se2

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Various types of chalcopyrite semiconductors are used in highest efficiency thin film solar cells, specifically in flexible solar cells. There are many challenges towards development of photovoltaic (PV) performance of thin film and ultra-thin film solar cells. Thickness and surface of thin film layer which has high effects on the performance of cells, electron recombination, interface contact between thin film layers, grain size and grain boundaries can be mentioned as existing problem in thin film solar cells. Alkali post-deposition treatment is reported in recent researches to reduce thickness of absorber as well as reducing electron recombination to improve PV performance of chalcopyrite thin film solar cells. This paper aimed for analysing recent developments and challenges in improved PV performance of chalcopyrite thin-film solar cells based on polycrystalline compound semiconductors Cu(InGa)Se2.

Keywords: Chalcopyrite thin film solar cells, Compound semiconductors, Flexible solar cells, Alkali treatment, Cu(InGa)Se2

Artificial Neural Network Modeling of Parabolic Trough Type Solar Thermal Power Plant

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In this study, thermo-economic analysis of the Parabolic Trough Type Solar Thermal Power Plant was performed. The economic analysis of this system was made using the NPV method. Then, it was compared the analysis result and NPV result obtained by ANN . A total of 900 designs were realized according to different operating parameters determined for R-134a refrigerant. ANN model was realized by using the MATLAB program. The back-propagation learning algorithm with three different variants, namely LevenbergeMarguardt, Pola- Ribiere Conjugate Gradient, and Scaled Conjugate Gradient were used in the network to find the best approach. The best results were obtained in the LM-10 algorithm during the training and testing steps. When the obtained results are examined, the analysis results of the most suitable system are as follows; the energy efficiency, exergy efficiency and generated power of the system are 18.4 %, 23.6 % and 281.9 , respectively. In addition, the profitability value of the system has been determined as 1.317 million USdolar. When the analysis results and ANN results were compared, the error percentage was found to be 0.013 %. This value is an acceptable error rate.

Keywords: Solar power plant, Parabolic trough type solar collectors, Artificial neural network

Design of a Cooling Channel for a Photovoltaic Panel

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Photovoltaic panels are attracting more attention in Turkey as the solar potential is very high in many regions. It is a well-known fact that even though the electricity generation is higher when the solar radiation is high on the panel, the efficiency of the panel drops as its temperature increases. In this study, it is intended to achieve cooling effect using an air duct placed under a photovoltaic (PV) panel, thereby increasing the efficiency of the panel's electricity generation. The PV was chosen as Panasonic monocrystalline panel of 1.67 square meters with a capacity of 330W. An aluminum channel was placed under the panel and the cooling fluid was used as air. Hourly electricity generation, PV efficiency and cell temperature values over a year were calculated using measured ambient temperature, global and diffuse radiation data by using MATLAB program. Furthermore, same calculations were made using PV SOL software for the chosen PV and compared with obtained values in MATLAB. A very good agreement was accomplished between the results obtained from MATLAB program and the results provided by PV SOL software. Maximum cell temperature was determined as 57.91 oC on July 21st at 13:00 as a result of hourly calculations. The incident solar radiation was found as 976 W/m2 when the panel reached maximum temperature. The PV and cooling channel were modeled in ANSYS Fluent software and cooling effect was investigated for different air velocities for the hour when maximum cell temperature was reached. Additionally, the effects of some protrusions attached on the cooling channel on heat transfer and pressure drop were also investigated.

Keywords: Photovoltaic panel, Efficiency, Cooling channel, ANSYS fluent analyses.

Analysis of 100 kw Solar Photovoltaic Power Plant Which can be Installed in Trabzon

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In this study, 100 kW solar photovoltaic solar power plant is modeled and simulated by using System Advisor Model (SAM) software using meteorological data of Trabzon province. As a result of these studies, annual electricity generation amounts, initial investment cost, net present value and repayment period of the power plant were calculated. According to the results, the annual photovoltaic solar power plant has an annual electricity production of 106,844 kWh, an initial investment cost of $ 85,700 and a payback period of 9.2 years. Monthly production values of the plant are as follows; 6,269.5 kWh for January, 7,466.9 kWh for February, 9,670.3 kWh for March, 10,242.5 kWh for April, 11,346 kWh for May, 11,642.8 kWh for May, 10,539 for July, 1 kWh, 10,626.1 kWh for August, 9,269 kWh for September, 7,979.5 kWh for October, 6,165.2 kWh for November and 5,626.4 kWh for December. The net present value of the modeled power plant is calculated as $ 25,750.

Keywords: Solar energy, Photovoltaics, Net present value, Renewable energy

A Study of the Effect of Baffles Inside Solar Collector

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Nowadays, solar collectors are used in many areas such as space heating, hot water production, drying of agricultural products. In order to improve the technology of solar collectors, it is important to analyze the flat plate solar collector performance and optimum condition. In this study, air solar collectors using air as carrier fluid are discussed. The finite element method was used for the analysis of the baffle geometries of the standard size air solar collector placed in the air flow path and the cases where flat absorbent plate and barrier absorbent plate were used. The effect of baffle geometries on the efficiency of the collector is discussed. 3D model of absorbent plates, glass cover and baffles were modeled by ANSYS Workbench. It was found that the outlet temperature is lower in the case for flat plate air collector than baffled solar air collector. With the installation of the internal baffles, the outlet temperature of the collector has been increased and its efficiency has been improved approximately 5% on an hourly basis.

Keywords: Solar collector, Efficiency, Ansys

Dynamic Simulation of a Flat Plate Solar Collector System under Various Climatic Conditions

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Flat plate solar collector (FPSC) is an feasible appliance available for solar energy usage. The aim of using a FPSC is to employ the absorbed sun's radiation to increase the temperature of working fluid and then transfer this heat to a new one which can be utilized for different low and medium applications.
In this study, a numerical simulation is conducted to investigate the transient performance of a flat plate solar collector (FPSC) under a hot and humid climate conditions. In this regard, a real time stand-alone FPSC system is modelled by using TRNSYS program. This research study is addressed taking into account the real climatic conditions of Trabzon and Izmir, the tropical cities placed in Turkey. The amount of energy consumed during the year is calculated. In addition, the performances of FPSC for both weather data are compared, including the temperature changes and the amount of solar energy for both weather conditions.

Keywords: Flat plat solar collector, Thermal performance, TRNSYS.

Theoretical Modeling and Investigation of System Parameters of Organic Rankine Cycle with Nanofluid Used Solar Parabolic Trough Collector

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The increasing demand for energy worldwide and the depletion of fossil-based fuels as well as the damage to the environment have led to an increase in the need for renewable energy sources. Improving the performance of the systems required for energy generation from renewable energy sources enable us to benefit from these resources in the maximum amount. Particularly, in systems used to generate energy from the sun, which is one of the renewable energy sources, many scientific studies about the effects on the performance and efficiency of the system of adding nanoparticles to different working fluids and using these systems integrated with other systems are conducted. In this study, theoretical modeling of organic rankine cycle with solar parabolic trough collector is done. The validity of the theoretical model is proved by comparing it with the results of the study done in the literature. The effects on system efficiency and performance of adding nanoparticles (Al2O3, CuO, Cu, SiO2, TiO2) of different types and concentrations to the working fluid (Therminol VP-1, Syltherm 800) used in solar parabolic trough collector and the use of different refrigerants (toluene, MDM, cyclohexane, n-pentane, n-Hexane, R11, R123, R113, R141b) in organic rankine cycle are examined, and optimum system parameters are determined.

Keywords: Solar energy, Solar parabolic trough collector, Organic rankine cycle, Nanofluid.

A Machine Learning Approach for Solar Power Plant Electrical Power Estimation

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Environmental pollution is caused by fossil fuels, so the importance and use of renewable sources of energy have grown in recent years. Instead of fossil fuels, harvesting energy from renewable sources such as wind, solar, and water will minimize emissions accumulated in the atmosphere and thereby provide a sustainable environment.
In this study, electrical power obtained from a solar power plant in İkitelli, Istanbul, was estimated by machine learning methods. Multiple Linear Regression algorithm delivered more accurate findings than Random Forest and Support Vector Regression approaches as a result of the calculations. The simulation results showed that the electrical power generated by the solar power plant can be successfully estimated from the real data set. With the widespread use of data collection systems, it has been determined that methods such as machine learning and deep learning can be functional in predicting electrical power by using actual data instead of different solar energy simulation programs.

Keywords: Machine learning, Electrical power, Solar energy, Solar power

Experimental Investigation of Thermal Gaın in Pv Panels

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Photovoltaic (PV) technology which can convert solar radiation into electric energy by photovoltaic effect is the most popular one between solar harvest. While it absorbs the sunlight coming on the photovoltaic panels, a small amount of this energy taken by the pv panels is converted into electrical energy while a large amount is converted into heat energy. This results in a significant temperature increase in PV panels. This temperature increase causes panels' electrical efficiency to decrease, this decrease is 1-2 % at temperatures above 30 ˚C. For efficiency increase and thermal energy gain in PV panels; photovoltaic thermal (PV/T) panels are developed. Easily applicable, efficient thermal energy gain application studies for this purpose are continuing.
This study is for this purpose as well. A thermal gain application designed as a serpentine type was applied to a 20 W polycrystalline PV panel to obtain a PV-T type panel. PV/T panel's temperature and electrical efficiency have been investigated compared to a PV panel of the same features at Karabuk city climatic conditions on different days on September. According to the experimental results; the highest panel surface temperatures have been obtained at 789 W/m2 radiation value; at this radiation value, PV panel's surface temperature is 59,93 ˚C, its electrical power is 11,8 W, its electrical efficiency is 13%, those of PV/T, on the other hand, are 43,90 ˚C, 14,44 W, 16% respectively. Thermal power and thermal efficiency obtained from PV-T panel at the same irradiance value was found to be 29.34 W, 32.60%.

Keywords: Photovoltaic/Thermal, Solar energy, Energy analysis.

Design and Analysis of Evacuated Tube Solar Collector Integrated Supercritical Brayton Cycle for Low Temperature Applications

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The objective of the current research is to investigate the performance of the evacuated tube solar collector assisted sCO2 Brayton cycle for low temperature applications. sCO2 Brayton cycle is powered by solar energy by means of 15 sets of collectors each having 13 evacuated tubes. The whole system is analyzed with the help of the first and second law of thermodynamics in order to determine the performance parameters such as energy and exergy efficiencies with exergy destruction rates. The analysis is made using the average solar radiation values for each months of the year. The EES program is used for the system design and performance assessment. According to the results, the energy and exergy efficiencies of the system are calculated as 16% and 73%, respectively for August. Among the system components, the highest exergy destruction rate occurs in the evacuated tube solar collector with a value of 8.70 kW.

Keywords: Energy, Exergy, CO2, sCO2 brayton cycle, Evacuated tube.

Potential for the Use of Solar Energy in the Food Industry

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The food industry has strategic importance for the country's economies because of the evaluation of agricultural products, supplying raw materials to industry, feeding the society, contributing to employment and foreign trade. A large amount of energy is used for the production, transport, processing and storage of food products. It is very important to discuss the sustainability of food production as food needs are expected to be double in the next 50 years. The energy used during the safe delivery of food products to end consumer is provided by fossil fuels. Nowadays, the studies on increasing the applicability of renewable energy sources in food production have increasing trend since the current consumption of the existing fossil fuel resources are impressive.
The novel methods such as solar power generation by photovoltaic and solar thermal, solar refrigeration, solar cooking, solar cooling/heating and solar drying, etc. are applicable in the food industry. The most common use of solar energy is sun drying. In the traditional drying processes carried out under natural conditions, the climatic conditions are sufficient on control of the process, the hygienic problems due to pollutions by dust, birds, insects, and living organisms, etc. could be possible, and thus the assurance of the food quality is questionable. The use of solar energy by its storage or its assistance in the form of heat energy is often preferred due to the high energy costs during the artificial drying process.

In this study, the use of solar energy, one of the primary renewable energy sources, as an alternative in the food processing applications requiring high fuel consumption is discussed. In this regard, the potential for different aims of using solar energy is examined and their applicability in food industry is discussed. This study is financially supported by projects; Ege University BAP-FDK2019-20627 and TUBİTAK 119O132.

Keywords: Drying, Energy, Food, Renewable, Solar

Design and Aerodynamic Performance Analysis of Micro Wind Turbine Blade

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In the near future, due to the depleting fossil fuels and increasing the energy demand, countries tend to use more renewable energy sources. Wind energy is one of the most important renewable energy sources and wind turbines are used to utilize this energy. Blade that is a part of wind turbine, is the first ring of the energy production chain and transmits the kinetic energy taken from air to mechanical parts as mechanical energy. Aerodynamic and mechanical parameters are taken into consideration during the design phase of the blade. The power taken from the air is directly affected by the aerodynamic design of the blade. In this study aerodynamic design methodology of horizontal axis wind turbine blades being widely used nowadays, have been considered and basic blade aerodynamic design parameters namely, power (N), tip speed ratio (λ), blade number (B), aerofoil selection, aerofoil drag coefficient.

Keywords: Wind energy, Wind turbines, Wind turbine blade design and performance

Design of the Deformable Wind Turbine Blade to Keep Efficiency at High

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Wind turbines are the most widely used systems for converting the wind energy into electrical energy. In wind turbines, wind energy is converted to mechanical energy by turning the turbine blades and then to electrical energy with the help of a generator. The maximum efficiency of the horizontal axis turbine is obtained the conditions at which the ratio of the lift to drag force is maximum. However, when the wind speed changes, the system goes away from the design condition and the efficiency decreases accordingly. Therefore, the turbine blade design is very important. The aim of this study is; by using deformable blades to keep the value of the Cl/Cd ratio at about the design condition by changing the wing geometry appropriately when the wind speed changes. Optimization studies were performed on the blade according to the active stall and various attack angles required for the deformable wind turbine blade calculations. In the optimization, Ansys Fluent Adjoint Solver with the k-ε is used. The simulation model created is validated with data on Cornel University Confluence. Optimization is based on 4 degree angle of attack, 25m/s wind speed and Cl/Cd 13,205625. When angle of attack is10º and wind speed is5m/sΔCl/Cd increased by 3,417799. When angle of attack is4º and wind speed is50 m/sΔ Cl/Cd decreased by -0,317247. By changing the geometry of the blade, the value of the Cl/Cd is kept approximately constant at various local wind speed.

Keywords: Deformable wind turbine blades, Airfoils, k-epsilon turbulance model, Cl/Cd optimization, Ansys fluent adjoint solver

The General State of Wind Energy and Policies in Turkey

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Nowadays, energy has become one of the vital components for the survival of humanity and countries tend to use renewable energy sources in order to provide their growing energy demands. Also countries aim to reduce the use of non-renewable energy sources that are predicted to be depleted in the near future and are known for their environmental damage. The usage of wind energy which is one of the most important renewable energy sources has increased in Turkey and the world. In this study, the general state of wind energy in Turkey has been evaluated. For this purpose, the wind energy potential and developments for Turkey were examined then, wind energy activities in Turkey form past to the present time have been evaluated and current status of them have been determined. It has been tried to shed light on the renewable energy policies of our country by evaluating the committed and planned activities with this work.

Keywords: Wind energy, Wind turbines, Wind energy policies

Investigation of Vertical Axis Wind Turbines and Their Components Design

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Wind energy and developments of wind turbine design are getting important today all around the world. To increase the efficiency of the wind turbine the scientists make a lot of researches. One of these topics to increase the efficiency is vertical axis wind turbines, their blades and motors design. Also, the generated energy and connection to the grid is come together with some problems and have to study on.
In this study, vertical axis wind turbines blades and developments to increase the efficiency are investigated firstly. Design steps and finite element analysis of an axial flux, permanent magnet, coreless stator, double rotor machine designed for a low power wind turbine application are investigated. A real-size model of the machine has been prepared by using Ansoft Maxwell software, and electromagnetic analysis has been conducted. Induced stator voltages depending on the magnetic flux distribution and angular position of the rotors have been obtained for different operation speed and load conditions. How to electricity is connected to the grid is investigated and given a proposal and simulated.

Keywords: Axial flux generator, Wind turbine, Permanent magnet machine, Finite element analysis method (FEA), Electromagnetic analysis, Vertical axis wind turbine.

Wind Energy Potential Assessment of Susurluk Region in Balıkesir

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The energy demand has been rapidly increasing due to increasing industrialization and increasing population. In order to meet this increasing demand, countries implement new policies of renewable energy resources instead of building fossil based conventional power plant. Among many renewable energy resources, wind energy is the one of the top one. That's why wind power plant investments are augmented in last decade in Turkey. In this study, wind potential of Yalova region is investigated with the aid of Windsim, a commercial CFD software. Windsim solves the governing equations by using hourly wind speed data gathered from Turkish Meteorological Service and roughness of the Yalova region. The analysis result showed that Yalova has a huge wind potential and establishing a new power plant in Yalova region will help environment a lot.

Keywords: Wind potential, Yalova, Windsim

Manufacturability of Solid Oxide Fuel Cell Metallic Interconnects by Powder Metallurgy Approach

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This study aimed for investigating manufacturability of solid oxide fuel cell (SOFC) metallic interconnects through powder metallurgy (P/M) method. To this goal, interconnect samples were manufactured through P/M methods using Nickel, stainless steel 316L, Inconel 600, SUS 445J1, 1C44Mo20 and Crofer®22 APU powders. Different manufacturing parameters were employed (compaction pressure, compaction temperature and sintering temperature) to obtain sound samples. Porosity, microhardness and coefficient of thermal expansion (CTE) measurements were performed. Porosities of samples were measured through optical microscope images. Image J software was used to binarize the photos taken on samples. Five different measurement points were selected on the surface of the samples (randomly) in the microhardness process and Vickers microhardness values were determined applying 50 g.f load. CTE values of samples were measured using dilatometer equipment at 800 °C inairatmosphere.Results showed that porosity and coefficient of thermal expansion values of samples decreased with the increasing compaction pressure and temperature as well as sintering temperature while microhardness values increased. Porosity values were measured between 2-36% considering for all samples depending on used powder size and manufacturing parameters. Microhardness values were in the range of 99-261 HV. Coefficient of thermal expansion values were measured between 13.4-34.6x10-6 K-1 for Nickel, stainless steel 316L, Inconel 600, SUS 445J1 and 1C44Mo20 samples while 11.4-13.1x10-6 K-1 for Crofer®22 APU sample. As an overall conclusion, it was shown that only the Crofer®22 APU powder can be used as interconnect material when manufactured by P/M approach as its coefficient of thermal expansion is in the suggested range (9-12x10-6 K-1) for SOFC system requirements.

Keywords: SOFC, Metallic interconnect, Powder metallurgy, CTE, Porosity, Microhardness.

Development of a Dynamic System-Level Thermodynamic Model of Solid Oxide Fuel Cell (Sofc) Integrated Gas Turbine (gt) Power Plant

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The increasing demand to obtain green energy due to growing awareness on global warming and decreasing fossil fuel sources has made fuel cell (FC) technology more popular in the last years. Especially, solid oxide fuel cell (SOFC) is a promising technology to be used in the stationary application (e.g. combined heat and power generation, cogeneration and trigeneration) due to fact that it has higher conversion efficiency and no environmental impact compared to conventional power systems.However, high cost of SOFC materials has been considered as an important issue for the SOFC system commercialization. In addition, system integration of SOFC based on interaction between the balance of plant (BOP) components is another significant problem. Typical main components of the SOFC system are SOFC stack included internal reformer, gas turbine (GT), compressor, valves, and heat exchangers. In the present work, the transient zero-dimensional (0-D) SOFC model is developed in the MATLAB/Simulink environment. This model is then employed the dynamic thermodynamic model which includes mass and energy balances for the system components of hybrid SOFC/GT power plant. Through this model, a hybrid SOFC/GT system performance (e.g. system efficiency and net electrical power output) is investigated under the effect of operating conditions of the SOFC/GT system.

Keywords: SOFC, System-level, Balance of plant, Dynamic model

Portable PEM Fuel Cell Design

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Due to the rapid depletion of fossil fuels and increasing energy requirements, fuel cells are among the most studied alternative energy sources in recent years. Among many different types of fuel cells, polymer electrolyte membrane fuel cells (PEMYH) attract a lot of attention from academic and industrial environments due to their many advantages such as low operating temperature, high efficiency energy generation and lack of noise problems. Due to this deep interest, fuel cells are becoming more widespread because their energy efficiency is high and they are harmless energy systems.
In this project, our goal is to expand the fuel cell. For this purpose, in order to reduce costs, ease of production in anode bipolar plate, cathode air plate and materials that may be more common and lower costs in the market were examined and used. In addition, one of the main problems of the commercially available fuel cell derivatives is the expiry of the assembled cell stack, which has become obsolete and the whole stack has to be dismantled and undamaged parts can be damaged during this process. The solution to this problem is to design an ergonomic fuel cell. In this ergonomic design, the fuel cell replacement can be done easily in minutes.

Keywords: Fuel cell, Ergonomic design, Production cost, Becoming more widespread.

Exergy and Thermoeconomic Analysis of Solar Hydrogen Production and Liquefaction Process

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In this work, exergy and thermoeconomic analysis of solar hydrogen production and liquefaction process have been realized. Hydrogen produced from conventional sources, that is produced from steam reforming of natural gas and other fossil fuels, which release greenhouse gases and other climate -changing emissions (about 97% of total production) and hydrogen produced from renewable energy sources (using electrolysis): from solar energy using photovoltaics for direct conversion, from solar thermal energy, wind power, hydro power and biomass. The idea of using solar energy is to protect environment from the unwanted greenhouse gas emissions. Hydrogen could only become a clean energy carrier if it is produced from the use of renewable energy sources. Since hydrogen had to be produced, the process in which electricity was produced was followed by electrolysis of water. In the present work, the exergy analyses will be realized in two stages. In the first phase, exergy analysis of the solar hydrogen production system (including electrolysis) has been performed so that the exergy efficiencies for these processes can be determined. Because hydrogen is transported in a liquid form, the liquefaction process is also taken into account. The hydrogen liquefaction process is very energy intensive and thus it requires a lot of exergy. It has a great impact on the final exergy efficiency of all processes. In the second phase the exergy efficiency for the liquefaction process is found. In this work, the exergy efficiencies of the system are presented before and after the liquefaction process. The exergy analysis has revealed exergy efficiencies in solar-receiver system, organic rankine cycle and electrolysis unit and liquefaction process. The exergy efficiency of the system is calculated by multiplying the individual efficiencies. Thermoeconomic analysis of the system is also carried out.

Keywords: Hydrogen, Exergy, Solar energy, Second law efficiency, Liquifaction

Design of a Future Hydrogen Supply Chain: A Multi Period Model for Turkey

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Energy resources such as petroleum will not be sufficient in the near future to fulfill increased demand. For this reason, energy will become one of the priority issues in the strategic plan of the countries. Hydrogen is one of the most promising alternative energy source because of its advantages. However, as the hydrogen technologies are not used actively, the required infrastructure is not enough. For this reason, it should be designed carefully. Systems that enable the transmission of hydrogen energy from production to end users are called hydrogen supply chains (HSC). Design of the HSC is the first step of supply chain management and its aim is to define the modes of production, facility, and transportation. HSC consists of four important stages: primary energy sources, production, storage and transportation. While the required raw material to produce hydrogen is provided from the primary energy sources, the demands of end users and warehouses are fulfilled by transferring the produced energy with different transportation modes. In this study, we analyze the HSC of Turkey with the aim of meeting the hydrogen demand for the transportation sector for the period between 2021 and 2050. Our goal is to minimize the total cost of HSC while meeting demand. Thus, we solve the mixed integer programming model for HSC. Our results are consistent with previous similar studies. While meeting the demand from local production facilities was 12% in the first period, it is seen that this ratio increased to 48% at the end of the planning horizon. The analysis also reveals that almost all networks do not simultaneously produce and import hydrogen, that is, they either produce or import hydrogen. The results are robust as there are small differences in terms of installed facilities compared to solutions of different optimality gaps.

Keywords: Hydrogen supply chain, Multi-period model, Mixed integer programming

Calibration of a Low-Cost Globe Thermometer with Linear Regression Method

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Mean Radiant Temperature (MRT) shows direct and reflected wave radiation fluxes on a human body. On the other hand, measurement of the MRT is vital to determine thermal comfort of occupants. Traditionally, MRT can be obtained by calculation or measurement methods. Calculation methods are very complex due to the nature of radiation flux components. Besides, measurement methods are not cost-effective since the methods require high number of pricey sensors. Globe thermometer is one of the ways to obtain MRT, however, calibration of these devices are significant on their accuracy. In this study, a low-cost globe thermometer is developed and calibrated with a well-known commercial globe thermometer. First, a 135 mm matt-black painted copper globe thermometer is produced to measure MRT in a cost-effective way. A measurement campaign is conducted in a university office which is located at Ankara, Turkey. These data are then compared with the data of the commercial globe thermometer. As a final step, the low-cost globe thermometer is calibrated with Linear Comparative Calibration Method (LLCM), which is commonly used calibration technique. Results showed that MRT could be easily measured by using low-cost globe thermometer with low error rates and high accuracy.

Keywords: Globe thermometer, Mean radiant temperature, Radiation, Calibration.

Thermoelectric Thin Film Modules

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Energy is undoubtedly one of our most important needs, whose consumption is constantly increasing and will continue to increase in the future. Developing technology and increasing the number of people cause an increase in energy needs. Many methods are used to handle the energy need. One of the most important factors in handling the required energy is to provide high efficiency at a low cost. In this study, to overcome these energy problems, the development of thermoelectric thin-film modules will be studied.

The thermoelectric effect is determined by measuring the electrical properties resulting from the temperature difference between the two different types of materials. When a current is passed through a circuit composed of two different metals connected, depending on the direction of the current, heat is absorbed from one of the metals and released from another.
In engines, industrial processes, various boilers, and many other energy-consuming devices, the waste heat released into the environment can be recycled and reused as clean energy. If waste heat recovery and management are done correctly, more efficient and cheaper operation of systems in companies can be used to reduce operating costs and greenhouse gas emissions.

For this purpose, thin films were grown on glass, Kapton tape and Si (100) substrates by using two different BiSeTe / BiSbTe alloy materials which are placed in industrial Peltier as a n and p-type semiconductor. The thermal evaporation method has been used to develop thermoelectric modules nanoscale form. The thermoelectric properties of n, p, and n-p cells obtained during this study were investigated by forming certain temperature gradients on them by making serial connections. To find the temperature gradient, data, and images, a thermal camera is used.

Keywords: Termoelectric effect, BiTe, Seebeck

Development of a Novel Temperature and Relative Humidity Data Logger

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Data loggers measure indoor air parameters such as temperature and relative humidity by using several sensors in buildings. These parameters are the most important factor in calibrating energy simulation programs. However, data loggers are very expensive and require hard-to-understand hardware in order to store data. In addition, these devices use standard Lithium batteries to supply the energy of sensors, however, some of the data can be missed due to the low battery life of the data loggers. Furthermore, tracking of the measured data is very difficult since they require additional software's which are very confusing for engineers and architects.
The purpose of this study is to develop a novel low-cost data logger and record the measured data as an excel file into the microSD card. For hardware purposes; a temperature and humidity sensor, an Arduino microcontroller, a microSD card module, a solar panel and a battery unit are used while software codes are written in order to generate permanent data. The prototype of the novel low-cost temperature and relative humidity data logger is manufactured and tested in a case building at Atilim University in Ankara/Turkey. Then, the novel data logger is compared with well-known commercial data logger during four days. The results show that the cost of the data logger can be decreased by approximately 82% while the accuracy of the data is 98% and 97% for temperature and relative humidity, respectively, compared to the commercial data logger.

Keywords: Thermal comfort, Data logger, Renewable energy, Measurement

Electrochemical Characterization of Temperature Dependence in Lithium-Ion Battery

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Lithium batteries are the one of the most preferred energy storage devices for today's world due to their high capacity and high power density. Cylindrical ones such as 18650 commercial lithium batteries are commonly used in automotive, IT and space industry since their stability, sustainability and applicability. Thus, in order to investigate the performance of the battery and develop its technology, analyzing the electrochemical reactions occurred in the battery is crucial. Electrochemical Impedance Spectroscopy (EIS) and pulse tests are frequently used methods to understand the electrochemical performance of the batteries. The EIS measurements of fully charged battery are conducted in the frequency range of 200 kHz and 10 mHz for the deep understand of polarization processes. In this study, we interpreted the electrochemical stability of Nickel Manganese Cobalt oxide cathode and graphite anode material cylindrical SONY Murata 18650-lithium battery in different temperatures. In addition, equivalent circuit modeling of the commercial lithium battery has obtained in order to understand the physical meaning of the electrochemical kinetics.

Keywords: Energy systems, Battery, Impedance, Electrochemistry

Smart Thermos Design and Protype Manufacturing

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Thermoses are the devices that keep the temperature of the food and beverages placed in it stable for a long time. In this study, modification of a standard thermos cup, smart thermos design and protype manufacturing which keep the liquid temperature constant at desired value were realized for small cooling volume. A temperature control system that can keep its temperature constant for both cold and hot beverages was presented. The system contains thermocouple, fan, peltier, different type of sensors and electronic components and a control unit which is coded suitable for the Arduino. The protype was run actively in laboratory conditions and temperature changes of the water in the smart thermos were observed while experiments were carried out. The proposed smart thermos can be used in everyday life of people and it can be commercialized because it is simple and economical.

Keywords: Smart, Arduino, Peltier, Thermoelectric, Thermos

Influences of Vanisperse in Negative Active Material on the Performance of Lead-Acid Battery

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The organic additive vanisperse (modified lignin derivative) has been produced for lead acid batteries. Increasing the number of cycle life, improving the cold cranking performance and increasing the capacity can be regarded as main advantages of this additive. It also counteractes the formation and also increasing of a new non-permeable layer of big sulfate crystals on the negative active material surface. It has been proved that lead acid batteries which includes vaniseperse inside run bestly.
In this study, it is aimed to increase the electrical performance of standard lead acid batteries by developing chemical properties of negative electrode. For that purpose, different types (VN-X, VN-Y) and rates of vanisperse were used as additives in negative paste. This study consists of three steps. In the first step, different type vanisperse additives were characterized. In the second step, negative active materials were prepared. The last step, lead acid batteries and electrical performance tests were done (12V 66Ah 610EN).
Electrical performance tests were applied according to Turkish Standards Institute 50342-1 standards. The electrical test results of the experiments were compared with the test results of a standard battery without a new additive. As a result, the porosity of the electrode increased due to the vanisperse additive used in the negative active material, thereby the electrical test results positively affected. Owing to the 0,3% Vanisperse X used in lead acid battery, capacity, cold cranking ampere, internal resistance test, charge acceptance test and life performance have increased significantly.

Keywords: Lead acid battery, Vanisperse, Negative active material

Energy Efficiency Analysis of Turbocharges with Wastegate

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Recently, thanks to the new improvements in engine size and the turbocharger used for engine type, the vehicles have been made more economical and environmentally friendly.
In this study, it is analyzed the efficiency analysis of the turbocharger for a 5,0-liter diesel engine volume and wastegate pressure ratio of 2,4 by using the Concept NREC program in the range of 1000-3200 rpm. As a result of the analyzes, it is found the turbocharger efficiency between 42-58%. For turbocharger, compressor, turbine and engine input and output values were analyzed at optimum shaft speed. According to the results of these analyzes, the effects of turbine inlet and outlet temperatures on turbocharger efficiency were obtained and shown on the graphs. The most important part of the turbocharger is to operate of the turbocharger in the heart region beyond the surge limit on the compressor performance map. As a result of this study, compressor efficiency value was obtained in 81% of heart region. Analyzes were performed for the turbocharger speed 100 475 rpm reference shaft speed and comparisons were made for different wastegate pressure rates.

Keywords: Turbocharger, Diesel vehicles, Wastegate, Turbocharger, Performance map, Compressor and turbine

Indigenous Oil Yielding Plants as Energy Sources in Pakistan

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Pakistan is a country which lies in between tropic of Capricorn and tropic of Cancer with diverse climatic conditions. Pakistan has rich biodiversity of oil yielding plants; some cultivated by local farmers while majority are wildly distributed in various zones of Pakistan. Among these oil yielding plants there is rich diversity of biodiesel yielding wild resources e.g. pongame, castor beans, mustard etc. Current energy crises throughout the world generally and Pakistan particularly need the energy from renewable sources like biodiesel. Biodiesel is an emerging solution for the present day concerns about rising oil prices and depletion of fossil fuel resources throughout the world. In current scenario due to shortage of energy resources, biodiesel is very good option for energy security in Pakistan. There are large arable lands with good climatic conditions for large biomass production of biodiesel yielding species. In this project we have identified rich diversity of oil yielding plants with biodiesel potential are identified based on biodiversity assessment, biodiesel production through transesterfication and fuel properties comparison with ASTM standards. This study will provide pictorials of oil yielding plants, biodiesel samples, byproducts and their botanical aspects for wider interest which might be adopted by other countries to utilize these natural resources for biomass energy.

Keywords: Oil yielding plants, Pakistan, Biodiesel, Biomass energy.

Turkey's Pumped Hydro Storage Status: Current Scheme and Potential

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Today, with the rapid increase in energy demand, the search for new and clean energy sources has gained great importance. Renewable energy resources arising from this search have become of great importance for countries by spreading rapidly around the world. In addition, the increase in the number of renewable energy plants such as wind-solar and the high stopping costs of base load power plants have created the need for storing electrical energy. Among the storing technologies, pumped hydro energy storage (PHES) is widely used around the world as it is very costly to store large amounts of energy as electricity. With the growing interest in PHES around the world, global PHES capacity is projected to grow by 78 GW by 2030, significantly more than other energy storage technologies. The objective of this study is to investigate the current situation PHES potential of Turkey. For this aim, the working principle, types and advantages of PHES are examined at first. After, the PHES utilization potential of the world is investigated followed by the potential of Turkey. It is estimated that the PHES systems can provide a significant benefit for our country's energy reliability, continuity and reducing its dependence on foreign energy sources.

Keywords: Pumped hydro, Energy, Efficiency, Energy storage

RF Sputtered Tio2 Thin Films with Various Deposition Conditions for Triboelectric Friction Layer

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During the last decade, with the incredible presence of electronic devices in our daily lives, alternative solutions to unravel the energy requirement have begun to be assembled. Triboelectric nanogenerators (TENGs) emerge to transform energy from the existing conditions into the electricity as an exceptional energy harvesting technology. TENGs maintains several advantages such as cost-smart, energy-saving and adaptability with material choices, originated in the coupling of working mechanisms between triboelectrification and electrostatic induction.
Instead of using unpractical polymers for long-term usage in tough conditions as a friction layer in TENGs, using durable TiO2 thin films are one of the suitable choices through semiconductor materials. With good chemical and mechanical stability, TiO2 films are the most widely used oxide for electronic applications owing to low cost and high activity. Especially, the low-temperature phase - anatase exhibits different surface charge density properties with varying surface modifications to affect TENGs performance.
TiO2 films deposited on Si(100) substrate by using the RF magnetron sputtering method with various working powers and partial O2 pressures. To manage the triboelectric performance, structural and electrical characterizations accomplished with X-ray diffraction, scanning electron microscopy, semi-logarithmic current-voltage and frequency-dependent capacitance measurements. The variations on working power and partial O2 pressures affect the crystal and surface structure under the influence of sputtering conditions caused by development in the particle distributions. The surface charge density characteristics were received by the influence of the variation in the working power and partial O2 pressures concerned from the frequency-dependent capacitance measurements. The maximum capacitance value at very low frequencies regarded as a further contribution for the triboelectric, which is quite close to the natural oscillation frequency due to the coupling of triboelectrification and electrostatic induction.

Keywords: Triboelectric effect, TiO2, Triboelectric nanogenerator, Friction layer

The Thermal Decomposition of the Liquid Hot Water & Alkali Pretreated Cotton Fiber

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Besides green energy production, exploiting renewable sources in materials production has recently gained interest in being eco-friendly and sustainable. Due to the abundance of agricultural wastes, easy accessibility, eco-friendly and lightweight, the interest in using agricultural wastes for the production of plant fiber has increased. Plant fibers can be used as a reinforcement material for biocomposite. The thermal degradation of natural fibers has a high significance on the extrusion temperature for thermoplastic composites and the curing temperature of thermosets. Pretreatments of plant fiber improve the thermal degradation of fiber. This research aims are to investigate the thermal analysis of liquid hot water (LHW) and alkali pretreated cotton fibers. Experiments of liquid hot water are carried out by varying temperature (140, 160, and 180 °C), reaction time (30 and 60 min). Cotton fibers are pretreated with NaOH solution (5% in weight) for one h, two h, three h, and four h at room temperature. According to the result of thermogravimetric analysis of LHW and alkali pretreatments, alkali pretreatment (5% w/v, three h) was applied to LHW (180 °C, 60 min) pretreated fibers. The results of liquid hot water and alkali pretreatments, and co-pretreatment were compared with the thermal behavior.

Keywords: Plant fiber, Liquid hot water pretreatment, Alkali pretreatment, Thermogravimetric analysis

Experimental Investigation of the Pulsating Heat Pipes Having Larger Flow Sections in the Evaporator Region

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With the development of manufacturing technology, the size of electronic devices increasingly shrinks; which causing the release of high amounts of heat, and thus overheating problems. Therefore, the number of studies investigating alternative thermal management methods for cooling of electronic devices increases. Pulsating heat pipes (PHPs) are passive cooling devices operating depending on the thermally induced oscillations. Differently from the active cooling technologies, the heat pipes do not require any mechanical device (a pump and/or a fan) for operation. For this reason, pulsating heat pipes are one of the most suitable thermal control tools for cooling of the electronic components.

In this study, influence of the inclination angle on thermal performance and flow characteristics of a flat plate closed loop pulsating heat pipe investigated experimentally. The heat pipe has a novel geometry including larger flow sections in the evaporator region; which also provides variation of the channel widths in the relevant region. Ethanol is used as the working fluid. Experiments are carried out for different inclination angles (-90°, 0°, 30°, 60° and 90°) and thermal powers (5W – 60W) at a constant filling ratio of 50 %. A high-speed camera is used to obtain the images of pulsating flow in the heat pipe.

At the positions including positive inclination angles (30º, 60º and 90º), it is observed that thermal resistance significantly reduces with the increasing thermal power. The possible reasons can be explained by improvement in the circulation rate of the working fluid and the increment in oscillation amplitudes. On the other hand, at the top heating mode (-90°) and the horizontal orientation (0°), the thermal resistance showed a horizontal trend with increasing thermal power; which indicates that the heat pipe is not working. The relevant results also supported by flow visualizations

Keywords: Pulsating heat pipe, Thermal performance, Flow visualization

Elastocaloric properties of the optimized Ni-Ti alloy

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Cooling /heating technologies have great importance for sustaining and maintaining the comfort of life in modern societies such as long-term food storage, home and office air conditioning [1]. The problems of global warming caused by damages to nature of materials used in existing cooling technologies operating in traditional vapor compression cycle increase the concerns about environmental issues in society. For this reason, worldwide vapor compression technologies are being abandoned gradually according to developing technology. Systems based on solid state-caloric effects which are an alternative to existing cooling technology have been attracting attention with the studies carried out in recent years [2]. In solid-state cooling technologies of magnetocaloric and electrocaloric requires a high driving external field to achieve very uniform thermal entropy changes. Among these, elastocaloric can be defined as different from others because having a stress-induced phase transitions. This mechanical stress field can be easily produced with the current technological possibilities and the relatively cheaper than related to the initial investment, maintenance and repair costs [3].
In this study, direct temperature changes under stress based on the elastocaloric effect near room temperature of systems obtained in NiTi alloy were investigated. NiTi alloy was obtained through an arc melting furnace under vacuum with Ni and Ti elements and then heat-treated. Surface and composition measurements were performed by electron microscopy and the crystal structures were determined before and after heat treatment by X-ray powder diffraction technique. Alloy transforms from B2 (*Pm3m*) ordered cubic structure to a monoclinic B19 P2 (*P2/m*) martensitic phase. The phase transition temperatures of the materials were measured by the temperature-dependent resistivity measurement system. A home-made system that sensed the temperature change of the material under mechanical stress fields from 300 to 400 K was used to examine the elastocaloric temperature changes of the materials in different stress values.

Keywords: Elastocaloric, Ni-Ti, Phase transition

Heat Transfer and Thermal Management of Lithium-Ion Battery Pack System with Forced Air Convection

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Due to the temperature limitations of lithium-ion batteries, one of the main components of electric vehicles, studies on battery cooling systems gain momentum every year. A two-dimensional analysis of a battery pack has been carried out. A hydrodynamic and thermal analysis has been conducted for air-cooled 6x6 battery pack (36 batteries in total) system. The system is analyzed using the ANSYS / FLUENT software for aligned and staggered battery arrangements for steady-state conditions. The temperature distribution and pressure drop in the system are examined for mean air velocities of 0.5 m/s, 0.75 m/s and 1 m/s. The battery pack is composed of Lithium-ion 26650, LiFePO4 batteries. Numerical analyses are conducted for the discharge conditions of the batteries. Uniform and constant heat generation are assumed for the batteries during the discharge process. Heat generation is taken as 1.43 W and 2.75 W per battery corresponding to 2C and 3C discharge rates, respectively. The effect of battery arrangement and the air mean velocity on the temperature distribution and the total pressure drop in the system are investigated.

Keywords: Battery cooling, Lithium ion battery, Air forced convection, Battery thermal management

Magnetic Refrigeration Technology and Applications

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Up to this time, conventional vapor compression refrigeration systems have been widely used for cooling applications. Chlorofluorocarbon and hydrochlorofluorocarbon containing refrigerants used in these systems damage the ozone layer. Vapor compression refrigeration systems have direct and indirect effect on global warming in two ways. Leakage of refrigerant from the system components or its spread to the outside during service can considered as a direct effect. The indirect effect is the use of a carbon emitting power plant fort the generation of electrical energy used by the refrigeration system. And also the indirect effect is directly related to the cooling performance coefficient of the system. Nowadays, when system efficiency and environmental impacts are taken into consideration, alternative methods are being searched for refrigeration applications instead of vapor compression refrigeration systems. Research on magnetocaloric materials and the development of magnetic refrigeration technologies provide an alternative to the conventional vapor compression refrigeration cycle. Magnetic refrigeration is based on the principle that a ferromagnetic or paramagnetic material exhibits a magnetocaloric effect and this effect allows heat exchange from the environment using a heat transfer fluid in the heat exchanger. These systems have no negative effects on the environment in terms of global warming and ozone layer. On the other hand, since there are no compression and throttling process in magnetic refrigeration systems, they are theoretically more efficient than vapor compression system. In addition moving parts are reduced in the system and noise generated during compressor operation is eliminated in magnetic refrigeration. In this study, magnetic refrigeration technology has been compared in terms of working principle with conventional vapor compression systems energy efficiency, cooling performance and environmental effect and its application fields have been investigated.

Keywords: Energy efficiency, Magnetic refrigeration, Magnetocaloric effect

Thermal Comfort Analysis of Historical Mosques. Case Study: The Ulu Mosque, Manisa, Turkey

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Mosques are sanctuary places for Muslims where they can communicate with each other and perform their religious activities. On the other hand, historical mosques contain lots of artworks which have cultural heritage values. These mosques have originally not any Heating, Ventilating and Air-Conditioning (HVAC) systems. For this reason, obtaining thermal comfort becomes a significant issue. In this study, a systematic approach on monitoring and evaluating microclimate and thermal comfort of historical mosques were developed. As a case study, The Ulu Mosque, Manisa/Turkey was monitored between 2015 and 2018 and thermal comfort evaluation of the mosque was conducted during worship periods based on the method provided by ISO 7730 Standard. A dynamic Building Energy Performance Software, DesignBuilder, was used to model the mosque, and the model was calibrated by using hourly indoor temperature data. The calibrated model was then used to develop retrofitting scenarios. Thirteen different scenarios were proposed to improve thermal comfort of prayers during worship periods. The results were evaluated according to EN 16883 Standard for conservation of cultural heritage. Electrical radiator heating with intermittent operating schedules was obtained as the best scenario to protect cultural heritage, while decreasing Predicted Percentage of Dissatisfied (PPD) from 45% to 10% in winter months. Additionally, intermittent operation saved 46.9% of energy compared to continuous operating schedule.

Keywords: Thermal comfort, Historic mosques, Retrofitting, Energy analysis

Superelastic Properties of NiTi for new generation cooling technologies

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Refrigeration technologies used in modern societies are used to meet various needs from the operation of technological devices to the storage of fresh foods and ventilation systems. The working principle of today's traditional refrigeration technologies is based on traditional gas compression systems. The gases contained in the cooling technologies can cause environmentally harmful liquids and greenhouse gas production. To minimize these environmental problems, more cost-effective, environmentally friendly energy-free cooling system is being investigated as an alternative to traditional methods. Moreover, one of the main problems of conventional cooling systems is their low efficiency. Instead of these energy-intensive systems, high-efficiency alternative cooling technologies should be developed. For this purpose, solid-state cooling systems that exhibit magnetocaloric, electrocaloric and superelastic effects are being investigated extensively worldwide. The development of superelastic cooling applications is directly proportional to the development of high-performance superelastic materials. Among the properties of a good superelastic material, the mechanical strength under stress must have a high entropy change. The best-known alloys with these properties are composed of alloys having shape memory properties. Due to the martensitic properties of these Ni-based and Cu-based alloys, major changes in structural phase transition and entropy are observed. This entropy change causes a temperature change in the material. Superelastic cooler designs can be made by using these materials in suitable mechanisms by removing this temperature change from the environment with the help of coolant.
This study covers the examination of superelastic cooling systems that promise efficient and environmentally friendly energy that will not increase carbon emissions and will not produce harmful gases and greenhouse effects. To achieve this result, NiTi alloys are produced by using arc melter and investigate the structural properties by using the X-ray diffraction device, scanning electron microscope and temperature changes in the material due to stress within the mechanical measurement device.

Keywords: Superelastic, NiTi, Cooling Technologies

Theoretical Investigation of Engine Performance and Exhaust Emissions in Ethanol-Fueled Dual-Plug SI Engine

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Spark ignition (SI) engines have been widely used in on-road vehicles with two and four wheels. The effects of equivalence ratios, spark timings and spark plug locations on engine performance and exhaust emission characteristics were theoretically investigated in ethanol-fueled dual-plug SI engine in this study. Findings showed that dual-spark plug configuration (SpL@d) in SI engine is convenient solution to continue improved engine performance and exhaust emission characteristics if there are some design constraints while the centrally located single plug (SpL@c) configuration gives the best engine performance and fuel economy.

Keywords: SI engine, Dual-plug, Ethanol, Engine performance, Exhaust emission

Engine Performance and Exhaust Emissions of a Spark Ignition Engine Operating on 2.5 % N-Butanol/Gasoline Blend and 2.5 % N-Butanol/Gasoline Blend with 9 % Water Injection to Intake Air

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The aim of this paper was to investigate the effects of 2.5 n-butanol/gasoline blend (nBGB2.5) and 2.5 n-butanol/gasoline blend with 9 % water introduction to intake air (nBGB2.5-WI9) on the engine performance, fuel cost and exhaust emissions in an automobile spark ignition engine (SIE). nBGB2.5 contains 2.5 % n-butanol and 97.5 % gasoline in volume basis. Firstly, experiments for neat gasoline (NG) and 2.5 % n-butanol/gasoline blend (nBGB2.5) for five different loads have been performed at 3000 and 5000 rpms. Then, an adapted carburettor was amounted on intake manifold on this engine and tests for 2.5 n-butanol/gasoline blend with 9 % water introduction to intake air (nBGB2.5-WI9) have been conducted at the same loads and engine speeds.

The test results showed that nBGB2.5 generally decreases brake specific fuel consumption (bsfc), carbon monoxide (CO) and total hydrocarbon (THC) emissions at all of the selected loads at 3000 and 5000 rpms. However, nitrogen oxides (NOx) increase at 3000 rpm and they decrease at 5000 rpm for applying nBGB2.5. As NOx could not reduce to the desired extent for only nBGB2.5, nBGB2.5 was applied by injecting 9 % water into the intake air (NBGB2.5-WI9). At 3000 rpm, NOx decrease with nBGB2.5-WI9 compared to nBGB2.5. However; in both applications, NOx are higher than that of NG. At 5000 rpm, NOx decrease with nBGB2.5-WI9 compared to nBGB2.5 and NOx lower than that of NG for two applications. nBGB2.5-WI9 and nBGB2.5 decrease NOx approximately 49 % and 9 % respectively for 90 Nm load at 5000 rpm. The use of nBGB2.5-WI9 has reduced CO more than the use of nBGB2.5 at two engine speeds. However, the applying of nBGB2.5-WI9 has increased THC and bsfc more than the applying of nBGB2.5. Total fuel cost for selected nBGB2.5 and nBGB2.5-WI9 become higher than NG.

Keywords: Spark ignition engine, N-butanol, Water introduction to intake air

Sesame Harvesting Waste: Thermal Characterization and Conversion for Biofuel and Biochar Production

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Plant residues and agricultural wastes are considered as green energy source since their sustainable use could minimize substantially the environmental impacts of fossil fuels. Thermochemical conversion processes such as pyrolysis are a suitable method for advanced biofuels. This study examines the potential use of sesame harvesting waste for biochar production through the pyrolysis technique. To determine the optimum operating parameters, the impact of temperatures (from 300 to 600 °C) and residence time (from 15 to 45 min) were investigated on biochar production yields through the slow pyrolysis of sesame harvesting waste. The physicochemical and combustion characteristics of the sesame waste biochars were investigated. In particular, the raw biomass and biochars properties are analysed using numerous analytical techniques such as thermogravimetric analyses (TGA/DTG), the ash fusion temperatures (AFTs) and calorific value (MJ/kg) analyses. It indicates that the thermal behavior of biochars is suitable for combustion as solid fuel. The results revealed that sesame harvesting waste can be used as a good precursor for the production of high energy density biofuels. The biochar produced at low temperatures was a good feedstock for solid fuel production in the improvement of the combustion and emission quality.

Keywords: Sesame harvesting waste, Slow pyrolysis, Biochar, Biofuel

Optimization of Insulation Thickness for Pipes in a Low-Temperature District Heating Network

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In the study, a thermo-economic analysis is conducted with a method called Equivalent Annual Worth (EAW) Analysis to determine the optimum insulation thickness of pipes such as supply and return water pipes; hot water and circulation pipes existed in a low-temperature district heating network. In the analysis, energy savings over a lifetime and payback periods of the pipe insulation material are calculated depending on the different nominal pipe sizes (20-150 mm). The results show that the optimum insulation thicknesses are found between 30 mm and 40 mm. The investment cost of the pipe insulation material changes over the range 0.53-11.78 $/m; while total energy savings of the insulation material waves to 102.17 $/m from 19.24 $/m according to the variable pipe insulation thickness like 25-100 mm. The payback periods of the different insulation thicknesses are calculated between 0.06 and 2.53 years.

Keywords: District heating; Low-temperature district heating network,;Pipes; Optimum insulation thickness;Energy savings

Second Law Analysis of Novel Fractal Structured Heat Exchanger

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In this study, thermodynamic analysis of a fractal-like ducted heat exchanger has been performed experimentally. The hydraulic diameters of the milled ducts on the heat exchanger used in the study are in the range of 3.00 mm to 6.00 mm. The heat exchanger is formed by milling the 156 channels with three different hydraulic diameters, lengths and symmetrical shapes on circular aluminum plates and assembling the plates together. The heat exchanger was analyzed for two cases where the average fluid temperature circulating in the cooling circuit of the system was above and below ambient temperature. Exergy loss and second law efficiency were calculated for the heat exchanger developed by this experimental study and the methods for increasing the efficiency of the designed heat exchanger were investigated. Exergy loss and second law efficiency were calculated for the heat exchanger developed by this experimental study and the methods for increasing the efficiency of the designed heat exchanger were investigated.

Keywords: Fractal heat exchanger, Energy analysis, Exergy analysis

An Ore Enrichment Plant, The Effect of Operation Optimization of Operators on Production and Energy Efficiency

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Republic of Turkey has developed various strategies to enhance the efficiency of using energy sources on public/private industries and civilian usage for the purpose of reducing the foreign-source dependency, in the scope of National Energy and Mining Policy. This study, based on National strategies, aims to enhance the efficiency of the industries on using of energy sources and using the mine resources more efficiently by presenting an enriching ore facility that uses the flotation method. The process includes crushing, screening, grinding, flotation and dehydration.
In this study, the electric energy use per tone of crushing and screening unit, which is the base of flotation method mineral liberations first process, is aimed to decrease. It represents the first step that affects the other unit's efficiency and production quality. The operations processed in crushing/screening unit, and the machines used are operated by operators. The failures are identified which is based on operator mistakes both directly and implicitly, the effects of failure typical errors and analyzes on energy efficiency are examined by Process Failure Mode and Effect Analysis which is a risk analysis method. In this method, the interaction of operators of machines and processes is taken into consideration, and the risk priority factors of the failures that effect efficiency are calculated and sorted.
By the identification of failures that have high risk priority factor, the optimization work is done, and the increase rate of production and energy efficiency are indicated as charts and graphics that comprise of controls are presented. The effect of an increase in energy efficiency in the energy consumption per tone is identified.

Keywords: Optimization, Efficiency, FMEA

Parametric Analysis of a Plate, Finned and Cross Flow Heat Exchanger for Heat Recovery in Buildings

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A plate, finned and cross-flow heat exchanger, HEX, is designed to recover the heat lost during the ventilation of the buildings in the winter. Aim of the study is to investigate the effects of the parameters like channel width, channel height, outside air temperature, mass flow rate of the air on the dimensions of the heat exchanger. The mean temperature difference method (LMTD) was used in the design. The air requirement for a house with 4 people living and 100 m^2 floor area to be ventilated in the winter months was calculated (485 m^3/h). Based on this air requirement, a parametric analysis is conducted. By fixing the hot and cold side inlet and outlet temperatures, the effect of channel width, height and mass flow rate or the air on HEX length is investigated under pressure drop constraint (200 Pa). In addition, for a fixed geometry creating a reasonable pressure drop value, the effect of outside air temperature on HEX effectiveness is sought. HEX length of the present study is compared with the heat recovery devices with different fin geometry available in the literature for the same operating conditions and the main dimensions.

Keywords: Heat recovery device, Heat recovery in buildings, Air to air heat exchanger, Plate finned heat exchanger, Cross flow heat exchanger

Lead Acid Batteries for Micro Hybrid Electrical Vehicles – Influence of Different Type Expanders on the Performance of the Negative Plates

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Battery performance of the start-stop vehicles whose production rate increasingly go on, affects directly the CO2 emission and fuel consumption. Batteries are used in start stop and hybrid automotive applications to provide CO2 savings and economic benefits to our society. However, start-stop function is commonly compromised by low DCA and the formation of lead sulfate morphologies that inhibit proper dissolution and regeneration of the active material during recharge. The object of this study is to increase the profits of fuel consumption and CO2 emission by maintaining the effectiveness of the battery performance in lifetime. Produced innovative product by worked on design with more frequent and period of start-stop property of the battery will come into use in developing technology and add value to our country by supplying to international automotive industry. To ensure this performance with additives which are added to paste that is used in production of plates are passed over special processes to change the morphological structure.
In this study, it is aimed to increase the electrical performance of enhanced flooded battery (EFB) by developing chemical properties of negative electrode. For that purpose, different types (EFB-1-2-3-4-5) of expanders were used as additives in negative paste. This study consists of three steps. In the first step, different type EFB expander additives were characterized. In the second step, negative active materials were prepared. The last step, enhanced flooded batteries (12V 60Ah 520EN) were manufactured and electrical performance tests were done. According to Turkish Standards Institute 50342-1 and 50342-6 standards. The electrical test results of the experiments were compared with the test results of a standard Ako company enhanced flooded batteries without a new additive. As a result, owing to the EFB-1 used in lead acid battery, capacity, cold cranking ampere, internal resistance, charge acceptance and life performance have increased significantly.

Keywords: Enhanced flooded battery, Expander, Negative active material

Ship Energy Efficiency Analysing Approaches: A Case Study

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Ship Energy efficiency has become an important concern for ship owners and all stakeholders in the maritime sector. With rising environmental awareness, the problem of reducing ship-borne pollution is becoming more and more important. For this purpose, it is crucial to maintain appropriate methods to sustain energy efficiency and reducing the emissions on marine vessels. These approaches include the construction of a low-resistance vessel, the use of effective propeller and shaft systems, the selection of an appropriate and efficient main engine and generator, and the use of alternative energy sources during the design process. During the operation of the vessel, methods such as routine maintenance work, the operation of the vessel through compliance with energy efficiency and emission regulations are essential.
In this study, the methods used to increase the energy efficiency of ships within the framework of the Energy Efficiency Design Index (EEDI), the Energy Efficiency Operational Indicator (EEOI) and the Ship Energy Efficiency Management Plan (SEEMP) employed to assess the energy efficiency of the ships were reviewed and evaluated. Applications to improve energy efficiency for different types of ships have been studied with the aid of these approaches. A case study showed that the methods which were examined contribute between 20% and 30% to improving the vessel's energy efficiency.

Keywords: Ship, Energy efficiency, EEDI, SEEMP, EEOI

Effect of Collection Tank Level on Energy Consumption of Lifting Pumps in Drinking Water Distribution Systems

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Submersible pumps and lifting pumps are among the indispensable elements of drinking water supply systems. The operational costs as well as the investment costs of these mechanical equipment are of great importance for the operating institutions. Most of the energy consumption costs, which have an important place in the expenditure budgets of the water and sewerage administrations, arise from the pumps in the system. Therefore, the efficiency of elements of this system has a very important role in terms of energy costs for the water and sewage administrations responsible for supplying drinking water to the public in our country. Today, dependence on energy and increasing energy consumption necessitate measures to reduce costs on energy. Lifting pumps are pumps that pump water from a mid-level collection tank, where water is drawn from the wells by submersible pumps, to an upper feed tank. The aim of this study was to investigate the effect of collection tank level on energy consumption of lifting pumps in drinking water distribution systems. For this purpose, an experimental setup consisting of a borehole, a collection tank, a lifting pump and a distribution tank was established in an independent laboratory in Kayseri. A SCADA system was integrated into the experimental system to monitor and evaluate the energy consumption. The results showed that the pump efficiency increased with the tank level, thus reducing the energy consumption.

Keywords: Drinking water supply, Lifting pump, Specific energy, Specific cost

Comparative Thermodynamic Analysis of Organic Rankine Cycle with Different Working Fluids

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In this study, the electricity generation ability of low-temperature heat sources throughout Organic Rankine Cycle. In this aim, three different cycle types -namely essential, Reheat and Regenerative – were performed by energy and exergy analysis. Besides, the most common used working fluids were investigated in these cycle types. According to the analysis, the effects of major parameters on overall efficiency such as, turbine inlet pressure, condenser pressure, evaporator pressure, pump and turbine efficiency and the type of working fluids I were discussed. This study presents a thermodynamic study carried out on the use of low-temperature heat sources for power generation through an Organic Rankine cycle, Cycle with different types of working fluids. Different working fluids have been screened, but the most commonly used working fluids have been examined in this project. Thermodynamic properties, environmental impacts and safety are important parameters when selecting working fluids.

Keywords: Organic rankine cycle, Organic working fluid, Regenerative cycle, Reheat cycle

Auxiliary Power Generaiıon Design for Power Plants with Using Thermoelectric Generators

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Today, power plants are one of the main sources of energy production. Since fossil fuels such as natural gas are used in energy production, it is important to increase efficiency in terms of environmental concerns. Power generation efficiency of a power plant is generally varies between 25% and 40%. The waste heat recovery systems exist in a way that heating of buildings and industrial steam generation. The following proceeding will introduce waste heat recovery system with using thermoelectric generators (TEG), the operation of which is based on, Seebeck Effect. Sample data is provided by BilEnerji Power Plant for the analysis part. Mathematical modelling of thermoelectric generators are presented. A vertical rectangle type heat exchanger is designed, optimized and analyzed in terms of pressure drop and heat transfer coefficients . In this proceeding, this case is analyzed with the software MATLAB. During analysis, heat transfer coefficients, Peltier effect, Reynolds number, and Nusselt number for different correlations are used and the efficiency of TEG's were tried to maximize with changing the parameters given. Finally, the proceeding propose to use more efficient TEGs to run the system and using fin in heat exchanger will increase total electrical power output of TEGs.

Keywords: Thermoelectric generators (TEG), Waste heat recovery (WHR), Power plant, Exhaust heat recovery (EHR)

Occupational Health and Safety in Wind Power Plants

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Energy, which is the main source of economic development and social development, is becoming an increasingly important issue. The continuous increase in energy needs, as well as the limited and depletable resources available, has led us to find and develop alternative energy sources. As one of the clean and renewable energy sources, wind energy has been used since ancient times. Today, with modern wind turbines, wind energy is transformed into electrical energy. The wind energy sector, which determines the development levels of the countries, continues to grow by gaining momentum in recent years in our country. The wind energy sector is one of the fastest growing environment-friendly energy sources among renewable energy sources in our country and in the world. Therefore, among renewable energy sources, wind energy is an alternative type of energy preferred by many countries in the world. There are a number of risks specific to the wind energy sector in workplaces away from central settlements in severe weather conditions, which are not often seen in many production sectors. Therefore, occupational health and safety risks in this sector generally differ substantially from risk factors in other production sectors. Identifying the types of accidents experienced and to be experienced can only be analyzed through the data obtained and an excellent result can be reached. In this study, wind power plants in injury accidents at work occurring in Turkey and their causes are evaluated.

Keywords: Occupatıonal health and safety power plants

Geopolymer Cement Production in the Struggle to Global Warming

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Concrete made from ordinary portland cement (OPC) is one of the most popular and widely used bulding material. Manufacturing of OPC generates the chemical reactions that releases a very large amount of CO2 into the atmosphere. Today, the world cement industry is responsible for approximately 1.35 billion tons of the total greenhouse gas emissions. Therefore, the efforts have been made to develop building materials alternative to OPC has increased greatly in recent years. To produce environmentally friendly concrete, geopolymers, as new type of cement, attract many researchers. In the production of geopolymer, there is no need for a process at high temperature as in Portland cement. In this way, CO2 emissions and energy consumed are reduced, thus reducing production costs. Compared to OPC, geopolymers have also many technical advantages such as high compressive strength, high acid resistance, low shrinkage and low alkali silica reaction. Source materials for the synthesis of geopolymers have an important role in final properties of the geopolymers. Natural pozzolans, one of the starting material for geopolymers, is readily available worldwide, yet its use is limited. The technology of making geopolymer cement using local pozzolanic materials from Bayburt tuff (Gümüşhane) and Pileki Stone (Rize) and the results of laboratory tests conducted is carried out in this study. In conclusion, Bayburt tuff and Pileki stone-based geopolymer cements showed the considerable mechanical development in terms of construction industry and also it is able to reduce the effects of global warming. In addition, it is found that Bayburt tuff is more reactive than Pileki stone.

Keywords: Geopolymer, Global warming, Environmental pollution, Bayburt tuff, Pileki stone

Sustainable Phytoremediation with Energy Crops in Turkey

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Contamination of soil by toxic elements and compounds is a global issue. This problem is increasing day by day with anthropogenic effects. Conventional methods of soil decontamination possess disadvantages in forms of environmental and financial burdens. Alternative solutions are being sought for cleaning contaminated areas. One of these is phytoremediation. Phytoremediation has considerable economic and environmental advantages. Our article focuses on the phytoremediation potential of energy crops which are cultivate for biomass production in Turkey. Energy crops are resistant to stress conditions and can provide high biomass yield in a short time. In addition, they help to restore the properties of contaminated soils due to their incorporation of toxic substances. For phytoremediation to be carried out with energy plants in a sustainable manner, the obtained biomass must be evaluated in the energy production plants. In this context, Turkey was divided into regions both the energy crops cultivation and biomass energy production plants were examined. This approach ensures local and safe energy production by reducing dependence on external energy sources through economic and environmentally friendly improvement.

Keywords: Energy crops, Phytoremediation, Biomass energy, Soil contamination

A Comparative Life Cycle Analysis of 1 MW and 2 MW Onshore Wind Turbines

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Wind power is one of the cleanest sources of electricity today; unlike fossil fuels, wind turbines do not release greenhouse gasses or pollutants when generating electricity. However, some environmental impacts associated with the construction of wind turbines need to be considered. The goal of the study is to compare the life cycle environmental impacts of electricity generation from two different sizes of onshore wind turbines, 1 MW and 2 MW turbines. The assessment of environmental sustainability has been carried out using life cycle assessment (LCA). The scope of the study is from cradle to grave, comprising electricity generation as well as plant construction and decommissioning of the wind turbines. Both fixed (tower and basement) and moving parts (rotor, nacelle, mechanics, cabling and electronics) are considered for the construction of the turbines, taking into account manufacturing of construction materials, transportation and energy requirements for installation. The LCA study has been carried out following the guidelines in the ISO 14040/44 standards. LCA software GaBi v.9.2 has been used to model the two different sizes of wind turbines considered. The LCA impacts have been calculated according to the CML methodology. The results indicate that the environmental impacts from 2 MW turbines are lower than for 1 MW turbines, ranging from up to 70%. Recycling of materials after decommissioning reduces the impacts.

Keywords: Wind power, LCA, Sustainability, Environmental impacts

Thermal Power Plant Emissions and Emissions Prevention Studies in Turkey: Kıte Energy

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CO2 emissions are steadily increasing rapidly in Turkey. Developing strategies to reduce CO2 emissions in our country, which is a party to the Kyoto Protocol (KP) in 2009, has become extremely important. CO2 emissions caused by the energy sector in Turkey is of the order of 90% and electricity demand is increasing by 7-8% every year. This study was selected thermal power plants in Turkey and emissions were investigated. The emissions of the plants separated as natural gas and coal were compared in terms of CO2, NOX, SO2 ratios. As a result of these investigations, CO2 emissions must be reduced, especially in the electricity generation sector. Many environmental technologies have been developed to reduce emissions. One of these is the Air Source Wind System.
In this Air Source Wind System, electrical energy is generated using aerodynamic forces transferred from the aircraft to the ground by rope or pump kite. The energy conversion is achieved by a two-phase cycle consisting of a production phase in which electrical energy is produced and a recovery phase in which less energy is consumed. According to current estimates, installed power worldwide is estimated at 80 GW as of this year.

Keywords: Global warming, Emissions, Thermal power plant, Wind power

Türkiye Şartlarında Fitoremediasyon Tekniğinde Kullanılan veya Kullanılma Potansiyeli Olan Bazı Bitkiler

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Endüstriyel gelişme, artan dünya nüfusu ve kentsel yaşamın beraberinde getirdiği çevre kirliliği insan sağlığı başta olmak üzere doğal yaşamı tehdit etmekte ve ciddi çevresel problemlere sebep olmaktadır. Çevresel kirlilikten kaynaklanan olumsuzlukları azaltmak için bu kirleticilerin doğal ortamdan uzaklaştırılmalarına yönelik teknikler de gelişmektedir. Kirlenmiş alanların iyileştirilmesinde (remediasyon) kullanılan geleneksel mühendislik yöntemleri pahalı olduğu için bunun yerine düşük maliyetli ve çevre dostu olan fitoremediasyon tekniği üzerinde yoğunlaşılmıştır. Fitoremediasyon, bitkiler kullanılarak insan aktiviteleri sonucunda kirletilmiş toprak, su ve havanın temizlenmesi olarak tanımlanmakta olup, bu yöntem bitki ile iyileştirmeye odaklanan, doğanın dengesini bozmayan, yapılabilirliği yüksek, su, sediment ve topraklarda kirleticileri parçalamak, sabitleme uzaklaştırmak suretiyle temizlemeyi hedeflemektedir. Fitoremediasyon yöntemi ile arıtılabilen kirletici grupları arasında ağır metaller, radyoaktif maddeler, klorlu çözücüler, petrollü hidrokarbonlar, poliklorlu bifeniller, polisiklik aromatik hidrokarbonlar, klorlu pestisitler, organofosforlu pestisitler, patlayıcılar, nutrientler ve yüzey aktif maddeler sayılabilir.
Fitoremediasyon tekniğinde çevresel kirleticileri absorbe eden, dokularında yüksek seviyelerde biriktiren (hiperakümülatör) ve fiziksel, kimyasal ve biyolojik süreçler aracılığıyla detoksifiye eden bitkilerin kullanımı tercih edilmektedir. Fitoremediasyon yöntemi ile klorlu pestisitler, organofosforlu pestisitler ve poliklorlu bifeniller topraktan temizlenebilmektedir. Fitoremediasyon yönteminin başarılı olması için, kirliliğin yoğunluğu, kirliliğe toleranslı ve biriktirici bitki seçimi, bitkinin gelişimi için uygun ortamın hazırlanması ve takibi iyileşmenin oluşacağı sürenin planlanması dikkat edilecek hususlardandır.
Bu çalışma ile çevre kirliliği ile bundan kaynaklı olumsuzlukları azaltmak için güncel ve en avantajlı tekniklerden biri olan fitoremediasyon tekniği ile ilgili konular vurgulanarak bu teknikte kullanılan veya kullanılabilme potansiyeli olan bazı bitkilerin tanıtılması hedeflenerek ilgili literatüre katkılar sağlanması amaçlanmıştır.

Anahtar Kelimeler: Fitoremediasyon, Hiperakümülatör, Bitki, Çevre kirliliği

Mixed Convection in a Square Cavity Filled with Hybrid Nanofluid

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Mixed convection in a square cavity heated from left wall and cooled from right wall is investigated numerically. The horizontal walls of the cavity are insulated. The heated wall of the cavity is moved upwards. The cavity is filled with a water based hybrid nanofluid containing Ag-MgO nanoparticles. Three different nanoparticle volume fraction (0,1 and 2 %) and two different Richardson number (10-1 and 1) are investigated numerically for different Reynolds numbers. Differential equations are discretized over the SIMPLE algorithm and solved iteratively using the finite control volume method. Streamlines, isotherms and average Nusselt numbers for heated wall are presented. It is determined that the heat transfer increase with increasing nanoparticle volume fraction.

Keywords: Mixed convection, Square cavity, Hybrid nanofluid