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Local disturbances and wind field distribution modeling in Georgia

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Abstract—The wind is one of most important meteorological element used both in science and energetic industry. However its origin and nature isn't well understood yet. The Sun, together with the Earth's motion along its orbit, govern changes in the solar–terrestrial environment on time scales ranging from minutes to glacial cycles. The quasi-steady flow of the solar wind is also modified by coronal mass ejections (CME) and cause geomagnetic storms with subsequent impacts on Earth. The energetic particle precipitation (EPP) leads to the modification of the ionosphere and neutral atmosphere. Observations have suggested that energetic particle forcing may affect wave propagation, zonal mean temperatures, and zonal winds in the Northern Hemisphere. Wind direction and value in atmosphere surface layer is depending on local geographic conditions and thus it is manifold. The meteorological observation data, Earth Observing System Satellite data are used to conduct statistical analysis in order to identify wind parameters. For this reason wind flow mathematical model for local area also was developed.

Estimating the Mass Mean Diameter of Droplets in a Combustible Mixture

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Abstract—The issue with hydrocarbon fuels is that combustion at low flow rates (~ ml/min) is difficult. Injectors or vaporizers, such as those used in automotive engines, typically work at high pressures and relatively high flow rates. The use of a flow blurring injector shows promise. A flow blurring injector which vaporizes liquid hydrocarbons at low flow rates has been developed. It purports to produce gasoline droplets on the order of tens of microns. The issue considered in this paper is how to estimate this droplet size without the expensive equipment that is usually used in these situations. A model was built, based on experimentally measuring the air and fuel flow rates, which gave droplet diameters within an order of magnitude of the expected diameter.

Keywords—Flow Blurring Injector, Gasoline Vaporization, Mass Mean Diameter

Implementation of renewable energy systems on sailboats for auxiliary energy systems

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Abstract—This paper presents the study and implementation of various sources of renewable energy in cruises. For this purpose, different sources of renewable generation (photovoltaic, wind and hydrodynamic) easily installed in the sailboats were selected.

In order to check the technical feasibility of these types of devices in a cruise, a simulation has been carried out under real conditions of wind, temperature and radiation.

In order to carry out the measures, different devices have been installed in a sailboat with the aim to register real data. The devices were: a radiation detector located in the possible location of photovoltaic panels, and a meteorological station that allows to measure the speed of the wind and the temperature. In addition, a GPS device was used to measure the cruise speed in the case of going out to the sea. The models of these renewable systems have been realized and implemented under the simulation environment of Matlab / Simulink®.

The photovoltaic energy was determined from data of irradiation and temperature. For this, a highly contrasted model available in the literature has been used. The main advantage of this model is that it can be configured from data commonly provided by the manufacturer. As far as obtaining the wind power, this is obtained from the curves provided by the manufacturer of wind speed and power generated.

In addition to photovoltaic and wind energy, other type of energy is generated due to the movement of the sailboat when it is traveling, with a hydrogenerator located at the stern of the boat. Similar to wind power, the hydro-power is obtained from the manufacturer's own curve.

Finally, these models have been used for the simulation from the recorded data of the radiation, temperature, wind speed and boat speed, in order to select and size the devices, and also calculate their energy production for a given period.

Numerical analysis and design optimization of multi-coil units for latent heat cold storage

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Abstract—The use of latent heat cold storage systems in commercial food storage industry has experienced a notable growth over the past few decades due to their advantages in terms of high energy storage efficiency, relatively low production and maintenance costs. This technology is a proven way to match efficiently energy supply with fluctuating demand. It has certainly a great potential impact on energy savings at world level. Among the various cold storage techniques, approaches involving the coil tubular heat exchanger (CTHE) modules appear to be particularly well suitable for compact and cost-effective applications.

In this paper, we report a simple cold storage module developed by our team for low-cost cold storage applications. It consists of a multi-coil tubular heat exchanger integrated in a tank filled with a phase change material (PCM). The operation principle is that during charging, at night-time hours, the heat transfer fluid at the inlet of the CTHE has a temperature lower than the PCM solidification point. This fluid is pumped through the CTHE and progressively freezes the PCM in the tank. Then, during discharging, at the period of on-peak load with more expensive electricity costs, the energy (cold) accumulated in the PCM tank at night-time, can be extracted to use in an external cooling system (food storage, acclimatization, etc.). The charging/discharging cycle duration depends upon the job criteria and cold storage strategy selected by the user.

The practical implementation of a high-efficient CTHE module requires an appropriate approach for design optimization related to a complex multivariate problem. Accordingly, we need a computational tool that makes it possible to simulate the temperature field variation, as well as the melting and solidification front evolution in computational domains having a complex 3D geometry. In this work, we use the well proven COMSOL Multiphysics® software package. We estimate the effect of different design parameters (such as the temperature and flow rate of the heat transfer fluid, coil tube radius, axial pitch, number of turns, etc.). In our study, the objective function is the energy storage efficiency. It is worth noting that most commercial cold storage applications operate at a relatively narrow temperature range, close to the PCM melting point, where the viscosity is relatively large. Therefore, our numerical models involve a simplified approximation, in which the heat transfer in the PCM is dominated by conduction. Finally, the initial guess values for the coil-to-coil tube distances were generated by solving the classical one-dimensional Stefan problem.

Keywords—latent heat cold storages, multi-coil heat exchanger, cold storage tank.

Novel facilitated transport membranes containing silver carrier for separation of propylene/propane mixture in petrochemical industry for reducing global warming

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Abstract—About 130 million tons of ethylene and 55million tons of propylene have been produced every year in the world and thus, olefin production process is very important in the chemical process. About 20% of the production energy of petrochemical industry is consumed in the olefin/paraffin separation, which accounts for 0.3% of global energy use [*Nature* **532,** 435–437 (28 April 2016) doi:10.1038/532435a].

Cryogenic distillation process has been used commercially for a long time. But due to the similar size and condensability (or volatility) of olefin/paraffin, the distillation process has been carried out under harsh energy-consuming conditions (for example, -160°C for ethylene/ethane). To reduce energy consumption and greatly reduce global warming, alternative separation technologies such as absorption, adsorption and membrane have been investigated for many researchers.

Facilitated transport membranes (FTMs) could be a promising alternative for this olefin/paraffin separation with high selectivity and permeability for olefin, where they adopt the reversible π-complex formation between transition metal ions (i.e., Ag^+ or Cu^+ etc.) and double bond of olefin. Olefin is complexed with facilitating agent at high pressure of feed side and the complexed olefin transports across the membrane to low-pressure side by diffusion of complex or by re-complexation with adjacent metal ion due to concentration difference. FT membranes, in general, are classified into three categories – 1) supported liquid membrane - porous support, 2) water-swollen polymer membrane - ion exchange membrane and crosslinked hydrophilic polymer, and 3) solid-state polymer membrane - polymer electrolyte or conduction polymers.

In this study, two water-swollen FTMs were prepared by coating of PVP (polyvinyl pyrrolidone)/$AgBF_4$ /TCNQ (7,7,8,8-tetracyano quino dimethane) solutions onto polyetherimide (PI) membranes and by coating of sulfonated sulfone/chitosan/$AgNO_3$ solutions onto polysulfone(PSf) membranes, respectively. $AgBF_4$ and $AgNO_3$ were chosen as facilitation agents, respectively, for two membrane preparations because Ag^+ is known to be non-toxic among various transition metal ions. Pure gas permeation test for propylene (C_3H_6) and propane (C_3H_8) were performed as a function of operation pressure for two FTMs. A simulation program was developed in terms of feed and permeate pressure and membrane selecitivity based on the pure gas permeation data. The separation properties of these two membranes were estimated for propylene and propane from the simulation program. Excellent propylene/propane selectivity of 240-44 and propylene flux of 10-28GPU were obtained with the FTMs. A simulation program was developed in terms of operation pressure and membrane selectivity, which predicted that one-stage FTM process could provide 99.5% of propylene at high recovery of 90-98% at permeate side from binary feed gas mixture of 95 propylene % /5 % propane, which indicates the FTMs have the great potential to reduce energy consumption in olefin/paraffin separation and therefor, can reduce global warming.

Selection of the optimal solution for effective voltage regulation in complex grid connected photo-voltaic system

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Abstract—The integration of distributed generators with the conventional grid increases the voltage of network which may cause serious problems in the system. Reactive power injection is one of the most reliable methods to mitigate voltage rise in the network but it can increase power losses in the network. This paper demonstrates the application of 'genetic algorithm multi-objective optimization' in a realistic grid connected photo-voltaic system of Italy to minimize two objectives i.e. voltage and power losses simultaneously. Since the realistic system under consideration is a complex 1310 bus system so the use of genetic algorithm to get the optimized solution yields a large number of solutions. This creates confusion for the decision maker to select an optimal solution from a wide variety of available solutions. To overcome this problem, this paper outlines a technique based on cluster analysis to group the solutions in optimal number of clusters. The data points within a cluster share the same traits while the ones in different clusters have profound incongruity with each other. This facilitates the decision maker to consider the properties of whole clusters instead of every individual solution. Each cluster has a centroid which is the middle point of the cluster representing mean of all solutions with in that cluster. The centroid may appear to be an appealing optimal solution for the decision maker but this is not always true. In order to select the optimal solution from each cluster, we have proposed a technique based on calculation of distance between centroid and all possible solutions in a cluster. The solution with minimum distance from centroid is selected as the optimal solution from each cluster. The results obtained on a realistic case study are presented and discussed in order to assess the benefits deriving by the application of the proposed approach.

Novel semi-alicyclic polyimide membranes for recovery of CH_4, CO_2 and H_2 of by-product gases in steel industry for reducing global warming

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Abstract—Huge amount of by-product gas mixtures (H_2, CH_4, CO, CO_2, N_2 etc.) has been produced from steel industry in Korea and worldwide. Among these by-product gases, CH_4 and H_2 are included in Coke Oven Gas (COG), while CO_2 and CO are included in Blast Furnace Gas (BFG) and Linz Donawitz Gas (LDG) in steel industry. If they can be efficiently separated at high purity and recovery, they can be used for carbon capture and utilization (CCU) which producing valuable chemical products such as methanol, ethanol, ethylene, acetic acid, etc., and therefore, contributing to reduction of global warming. There are typical separation technologies: cryogenic, adsorption, absorption and membrane. Membrane technology can be a promising new separation technology owing to cheap plant construction, easy operation, environmental friendliness etc. The economy and energy efficiency of membrane process depends mainly upon gas selectivity and gas permeability of membrane materials.

This study shows the preliminary result for the gas sepration properties of soluble polyimides as membrane materials - CO_2/N_2 (or CO_2/CO) and H_2/CH_4 (or CO_2/CH_4) selectivities and CO_2 and H_2 permeabilitis. We have developed an alicyclic dianhydride -5-(2,5-dioxotetrahydrofuryl)-3-methyl-3-cyclohexene-1,2-dicarboxylic anhydride (DOCDA) based homo- and co-polyimides with various dianhydrides and diamines using *m*-cresol as a solvent, respectively. Thin dense membranes were prepared from the copolyimides and measured their gas permeation properties with a typical time-lag apparatus. All homo- and co-polyimides showed good solubility for organic solvents and excellent thermal stability.The synthesized polyimides showed excellent CO_2/N_2 (or CO_2/CO) and H_2/CH_4 (or CO_2/CH_4) selectivities, and relativley high CO_2 and H_2 permeabilities. These results confirmed these polyimides could be used as membrane materials for the sepation of CO_2, CH_4, H_2 and from by-product gases in steel industry.

Courtyard Building a thermal and daylight regulator in hot and arid regions. A case study

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Abstract—This paper investigates in indoor thermal and luminous environments of the existing courtyard buildings in an arid area, in order to identify daylighting strategies and thermal comfort conditions in this type of building. As Biskra town is situated in the hot and dry region of Algeria and facing a hot and intense radiation, drives us to seek a balance between thermal and luminous environments. During summer and winter seasons, monitoring campaigns have been conducted to collect air temperature and illuminance levels data using a digital monitoring instrument; these on-site measurements intend to assess courtyard impact on it adjacent spaces under clear sky conditions. A Special attention based on courtyard building's architecture of different morphologies and periods such as: traditional, colonial, post-colonial and contemporary samples. The selection of relevant samples morphologies can reveal many strategies on climate adaptation under local conditions. The important findings are related to the high potential for natural lighting and thermal control that courtyard building offer, and later, discovered the relationship between the morphological indicators and the qualities of thermal and luminous environments of adjacent spaces, in addition, courtyard remains more effective in controlling, regulating and homogenizing the daylight. The trilogies (Indoor spaces/outdoor/courtyard) are interacting in systemic ways for enhanced building's thermal and luminous performances and solve the dilemma between daylighting and protecting the building from hot sunlight in arid regions.

Keywords—Courtyard building; Daylighting; Thermal environment; On-site measurement; Arid climate.

Daylight Efficiency Prediction of Courtyard vs. Conventional Building Models Using Simulation Tool under Specific Climate Conditions

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Abstract—The major goal of the present research is to investigate in daylighting efficiency of different building typologies under specific climate conditions of hot and arid regions. It has been demonstrated in previous research that courtyards in buildings offer the ability to regulate various environments of the indoor spaces. However, in hot and arid regions lighting and protecting the building is always problematic. To estimate the degree of correlation between morphological characteristics and illuminance levels, the monitoring under clear sky during different seasons to test building models daylight efficiency using a simulation tool (DesignBuilder). The results are then used to establish the optimal design solutions. The simulation testing with geometric modifications has proved essential in carrying out a comparative analysis between the courtyard type and other Architectural morphologies such as mono block type. The courtyard type performs well in terms of daylighting. The comparative analysis determined the optimal architectural configuration, and parameters such as: courtyard opening ratio, depth, and orientation, can provide the most appropriate building typology for daylight in hot and dry areas.

Keywords—Building Typology; Daylight; Indoor Space; Simulation; Arid Zone

Thermal Performance of Solar Facade Concepts Applying Selective and Transparent Insulation Functions: Preliminary Experimental Study

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Abstract—Recent scientific progress in the field of building science and building engineering deals with current challenges and future directions in buildings, sustainability and creation of healthy built environment. One of the major factors contributing to this issue is application of new advanced materials, concepts and technologies. Such approach can contribute to the development of new building materials and innovative building envelope concepts. Solar façade principles are adequate for relevant utilizing of solar energy technologies when designing sustainable energy sources in buildings. This study focuses on an experimental analysis of a proposed non-ventilated solar facade concept to integrate the need for this sustainable energy design approach for buildings. A new solar façade prototype based on transparent insulation material and a selective absorber is tested experimentally and contrasted with conventional insulation and a non-selective type of absorber, respectively. The presented study focuses on an experimental non-ventilated solar type of façade exposed to solar radiation both in the laboratory and in outdoor tests. Based on solar wall principles, the key intention is to monitor temperature response within proposed components at small scale level. Due to the high solar absorbance level of the façade, high- and low-emissivity contributions were primarily studied. All the implemented materials were contrasted from the thermal aspects point of view. Temperature response is monitored by means of a solar simulator whilst outdoor testing employs real solar radiation exposure. The main objective of this analysis resides on i. Monitoring of temperature response within proposed components; ii. Analyzing the thermal benefits of optical properties involved in components; iii. Measurements of a comparative nature with solar radiation incidence; iv. Experimental confrontation between laboratory and outdoor testing. The resultant temperature growth within proposed concepts was specifically analyzed. The maximum level of the measured temperatures in proposed concepts is more than 100°C, thus the solar radiation received and transferred into the thermal energy has appreciable extent. The results of the solar-based experiments show with small-scale experimental prototypes that high potential of solar energy may be involved when designing sustainable energy sources in buildings.

Keywords—Solar wall; Solar façade; Selective absorber; Transparent insulation material; Thermal performance; Solar simulator; Outdoor test

Utilization of microbial mats for the production of various biofuels

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Abstract—Microbial mats are considered one of the smallest ecosystems in the world, with physiologically different microorganisms coexisting in harmonic synergy. This cohabitation brought about favorable qualities that has been exploited in the field of applied biotechnology. The abundance of microbial mats and dominance of oxygenic phototrophs, mainly cyanobacteria and algae, in such mats deems this biomass a potentially economical feedstock for biofuel production. The ability of these oxygenic phototrophs to adapt to environmental stresses by accumulating compounds, like carbohydrates or lipids, is a useful component when considering production of different biofuels, like bioethanol or biodiesel. The diversity found in these microbial mats also deem the presence of minute amounts of methanogens in the anoxic layers, which has not been investigated for their potential biomethane emissions via anaerobic digestion. In this study, 11 different microbial mats were screened for their carbohydrates, lipids and methane emission and potential candidates were used for production of bioethanol, biodiesel and biomethane. From the screening stage, a mat with 43% carbohydrate content was selected for a bioethanol production process which involves cellulase production, saccharification using the produced cellulase and commercial cellulase, then fermentation of the resulting sugars. The activity of cellulase produced from indigenous *Bacillus licheniformis* ASGS5 in this process was 41% of the commercial cellulase from *Aspergillus niger*. A maximum bioethanol yield of 0.76 ± 0.1 g/l was obtained from the mat hydrolyzed with commercial cellulase, where the one hydrolyzed with produced cellulase resulted in about 80% of this yield. A lipid content of 18.6% was measured from one mat, which was optimized under stress conditions, being elevated salinity and nitrogen deprivation, to 22.7% and 27.3% respectively. The fatty acid profile of the lipids extracted under these conditions was analyzed using gas chromatography. The mats were also screened for biomethane emission after 14 days of anaerobic digestion. Out of 3 mats with detectable biomethane emission, the one with the highest value was selected for 49 days of anaerobic digestion. The biomethane produced by this microbial mat reached 95.3 ± 9.5 ml CH_4/g VS, which was about half that of a manure sample (208 ± 35 ml CH_4/g VS) digested at the same conditions. Results of this study displayed the possibility of using microbial mats to produce bioethanol, biodiesel and biomethane, yet optimization of each process is still required to improve the yields of each. Taking the results of this study in consideration, microbial mats have the potential to become an economical and renewable feedstock for production of different biofuels.

Potential of fecal waste for the production of bioethanol

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Abstract—Fecal waste is considered an environmental burden that requires proper disposal, which ultimately becomes also an economical burden. Since fecal waste is a nutrient-rich source, it has been utilized to produce biomethane via anaerobic digestion. Apart from the methanogenic community, Fecal waste have been shown to contain around 30-50% carbohydrates of their dry weight, of which between 50 to 84% could be converted to simple sugars, depending on the process and conditions. Apart from using commercially available cellulytic enzymes for the cellulose-to-ethanol conversion, there has been no reports that utilized fecal waste for enzyme generation and saccharification in a single process. In this study, the fecal waste from cows, chickens, goats and humans have been compared for cellulase production, saccharification and fermentation to produce bioethanol. This approach for converting fecal waste to bioethanol has several advantages. First, the cost of commercial cellulase could be saved by producing the enzyme within the same process. Second, fecal waste was used in the entire process, making the process more economical. Third, utilizing fecal waste for bioenergy production will significantly reduce their negative impact on the environment. This approach also utilizes indigenous organisms, *B. licheniformis* ASGS5 and *C. Aciditolerans*, for cellulase production and fermentation of simple sugars to bioethanol. Activities of cellulase produced from *B. licheniformis* (77.5-390.4 U/g) were comparable with previous studies. The amounts of simple sugars from different fecal waste exhibited a positive correlation with the obtained biological cellulase activities. Production of bioethanol was achieved from all samples, with chicken fecal waste yielding as high as 1.6 ± 0.25 g/l. Therefore, bioethanol production can be more economical using chicken fecal waste for cellulytic enzyme production, saccharification and fermentation. Utilization of fecal waste for the production of biofuels is environmentally and economically beneficial, thus further investigation of the potential of this nutrient rich waste is highly advised.

Maximization power coefficient of horizontal axis wind turbine blades (HAWT) using blade element momentum theory BEM

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Abstract—The horizontal axis wind turbine (HAWT) blade geometry with the diameter of 10.054 m using the S809 airfoil profile have been investigated numerically. The optimum blade shape, obtained using improved blade element momentum (BEM) theory. The main objectives are to predict the aerodynamic performances such as forces and torque imposed on the rotor blades, which are essential to its structure or design. This approach requires much less computing time and memory than three-dimensional simulation flow around the wind turbine rotor with simple CFD method. The flow is assumed unsteady, incompressible and fully turbulent.

Keywords—BEM method; CFD; aerodynamic performances; horizontal axis wind turbine.

Energy recovery from algal waste

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Abstract—Marine macroalgae are an abundant resource in coastal areas. In most cases, this algal matter is removed from the beaches and treated as waste. The collected algae constitute a source of biomass with a high potential to produce energy. Three possible options for energy recovery from residual algal matter have been analyzed: to obtain biodiesel, bioethanol and pellet manufacturing. The energy recovery from macroalgae confers a saving on current disposal costs as a residue and an environmental benefit because it is Kyoto Protocol compilant. Six different marine algae have been used as raw materials: Fucus Spiralis, Pelvetia Canaliculata, Saccorhiza Polyschides, Enteromorpha (Ulva), Polysiphonia Lanosa and Calliblepharis Ciliata.

Macroalgae have a high content of carbohydrates and low lignin content, which make them to be a suitable substrate in the fermentation process for bioethanol production. To obtain this biofuel, chemical processes –such acid hydrolysis– and biological processes –enzymatic hydrolysis and alcoholic fermentation– have been tested. Concentrations of sulfuric acid of 0.05, 0.2 and 0.5M have been used in the acid hydrolysis processes. The results obtained show that higher production of bioethanol was achieved with the highest concentration of acid autoclave conducted hydrolysis. A greater amount of ethanol was managed by Fucus Spiralis algae when an acid hydrolysis process was followed by a fermentation in an orbital incubator. In the case of fermentation with intermediate enzymatic hydrolysis, the Calliblepharis Ciliata algae produces the highest bioethanol amount. On the other hand, very low conversion percentages of oil to biodiesel were determined for all studied algal species.

Finally, with the objective of making pellets and evaluating its burning quality, intrinsic characteristics of each species (calorific value, ash content, volatile content and fixed carbon content) were tested. Fucus Spiralis, Pelvetia Canaliculata and Calliblepharis Ciliata were found as the most suitable species for making pellet. The quality of pellet obtained was similar to that obtained by other raw materials.

Keywords—bioethanol; biodiesel; pellets; macroalgae;

EXHAUST EMISSION CHARACTERISTICS of WASTE FRYING OIL – DIESEL FUEL BLENDS in a CRDI DIESEL ENGINE

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Abstract—In this study, waste frying oil (WFO) (without converting biodiesel) was blended with mineral diesel fuel (MDF) in the ratios of 2%, 7%, 15% and 25% (v/v) on condition that the viscosities of all WFO-MDF blends were lower than 5.00 mm^2/s (viscosity upper limit given in European Biodiesel Standard, EN 14214). It was aimed to determine the influences of the direct use of WFO-MDF blends with low viscosity on the exhaust emission characteristics of a modern diesel engine equipped with electronically controlled high pressure fuel injection system which is very susceptible to fuel quality. Test fuels were used in a common rail direct injection (CRDI) diesel engine. Engine tests were performed at constant engine speed of 2000 rpm and five different engine loads (50 Nm, 75 Nm, 100 Nm, 125 Nm, and 150 Nm). Effects of WFO-MDF blends on the exhaust emission characteristics were determined and compared to that of MDF as the reference fuel. WFO usage increased all the emissions types measured. This difference between the emissions of neat MDF and MDF-WFO blends became more pronounced with increasing engine load and WFO percentage in the blend.

Keywords—biodiesel; direct use; viscosity; waste frying oil; exhaust emission

Situational Analysis of Wind Energy in Azerbaijan

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Abstract—Located at the Caspian Sea between the two mountain ranges- the Bigger and Smaller Caucasus, Azerbaijan is well known with its fossil resources such as oil and gas. The depletion of natural resources in the medium and long run, the challenges imposed by the ongoing climate change, rising energy demand requires to transition towards sustainable energy technologies. The location and the climate of the country enable it to have enormous wind energy with the highest number of windy days mainly in the coastal sides, at the Caspian Sea and in the central parts of the country.

The aim of this paper is to analyze current state and development perspectives of wind energy in Azerbaijan. For this purpose SWOT analysis of wind energy in Azerbaijan has been described. In the research the strengths, weaknesses, opportunities and threats are evaluated and internal as well as external factors are identified. The conducted SWOT analysis reveals that the further development of wind energy sector in Azerbaijan strongly depends on the following: legislative system on renewable energy, tariff incentives and other support systems for the investors, financial institutions, public awareness, extra subsidies for the traditional energy, and administrative regulations.

Keywords—wind energy, SWOT analysis, wind power deployment in Azerbaijan, renewable energy

Diffusion of Mitigation Technologies in Kazakhstan

Analysis of Barriers for Small Hydro Promotion

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Abstract—Kazakhstan is expected to be the biggest renewable energy player in Central Asia with ambitious target increase from 3persent by 2020 to 50 percent in energy balance by 2050. EXPO-2017 in Astana will bring the best international practices and resource-saving technologies to demonstrate international tendency of renewables development, as well as the success of introducing the Green Economy Concept in Kazakhstan.

Despite good legislative base in place and conditions created by state the real diffusion of mitigation technologies including small hydropower develops at a slow pace. The conducted analysis of barriers preventing small hydropower technology diffusion and investigated policy mechanisms allows selecting effective measures that promote the development of small hydropower, increase the competitiveness of technology, and accelerate development with lower climate change impacts in Kazakhstan.

Keywords—small hydropower, mitigation, technology diffusion, climate change

Investigation on village greenery's windproof effect in severe cold regions of China

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Abstract—For centuries, the wind environment of villages and towns in severe cold regions has long been a significant factor influencing the villagers' outdoor comfort in winter, which could be improved by appropriate greenery design. By means of questionnaire survey and field measurement, this paper carried out some basic investigations on the existing circumstances of wind environment and greenery of villages and towns in severe cold regions. Based on which, with the application of ENVI-met, this paper went on to simulate and analyse the windproof effects of four common forms of village greenerys (windbreaks, border trees, square landscape and courtyard greenery) under various parameter settings (porosity, size, form, interval and wind direction), thus providing references for applying greenery to improving wind environment in practice.

Keywords—Severe cold regions, villages and towns, wind environment, greenery, numerical simulation;

Macroalgae for bio-crude production

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Abstract—Obtaining biofuel from algae has acquired a great importance in recent years, mainly due to the rising prices of conventional fuels and the high potential of biofuels to replace them. The algal biomass has good qualities which make it an attractive raw material for manufacturing biofuels. In coastal areas, the death of a multitude of clams and bivalves is caused by the large accumulation of macroalgae on the seafloor or on sandbacks. These algae, which are mostly untapped, can be collected and used to produce liquid, solid or gaseous biofuels. Different hydrothermal processes such as hydrothermal carbonization (HTC), hydrothermal liquefaction (HTL) or hydrothermal gasification (HTG) can be used to obtain fuels from macroalgae. At present, none of these processes has been studied in depth.

In this research, hydrothermal liquefaction (HTL) to obtain a liquid fuel was carried out using macroalgae as raw material. Three different species of marine macroalgae collected in Spain, were used: Fucus Spiralis, Pelvetia Canaliculata and Enteromorpha Prolifera (Ulva). All tests were carried out with 1:10 ratio algae:distiller water, which is 9% by weight of solids. The liquefaction experiments were conducted at temperatures of 250 °C and 300 °C, with residence times of 15-180 min. Na_2CO_3 was used as catalyst. Once mixed (algae, distilled water and catalyst), the mixture was introduced into the discontinuous reactor, it was closed at 15 Nm and then it was introduced into a muffle. The heating temperature, from room temperature to the working temperature, was experimentally calculated resulting in 16.42 °C/min. After the HTL process completion, the resulting product was mixed with dichloromethane and then decatated and separated. The dichloromethane was then evaporated to obtain the bio-crude which was analysed. The best results were achieved for Enteromorpha Prolifera macroalga when it was subjected to 2 hours of HTL at 250 °C of temperature.

Keywords—bio-crude, fuel, algae, waste, hydrothermal liquefaction

Bioethanol Production from Waste Office Paper

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Abstract—In this research, bioethanol was produced from office waste by acid hydrolysis and subsequent fermentation using Saccharomyces cerevisiae. Conditions for the acid hydrolysis of waste paper were optimized by varying acid volume from 100 to 300 mL, reaction time 30-180 min, with a sulfuric acid concentration of 5.0 at 121 ºC in an autoclave. The best results were obtained for acid hydrolysis of waste paper with the following conditions: an acid volume of 200 mL during 120 min of reaction time. After the fermentation process with Saccharomyces cerevisiae during 24 hours at 30 ºC and 150 rpm, 0.1035 mL ethanol /g dried paper were obtained. Finally, some physical properties of obtained bioethanol were determined and compared with the standards.

Keywords—bioethanol, waste office paper, acid hydrolysys, fermentation

Developing the permanently internationally competitive sector in new industry – lessons from the case of photovoltaic panels production in Germany

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Abstract—This paper is a case study of determinants of the development of photovoltaic (PV) panels production in Germany in the years 2000-2016 in the context of creating a permanent international competitive advantage of the sector. The purpose is to identify the causes of initial success and subsequent failure of German producers and to draw conclusions on how to build a sustainable competitive advantage in manufacturing sector in new industry. The conclusions will be useful in the developing many new renewable technologies that are currently at the experimental stage of development and after appropriate refining the technology and with the appropriate management may be not only a source of clean energy, but also become an export industry of the economy of the country, which will develop them. Conclusions will be applied to both companies and government.

German PV panels production sector recorded a very rapid growth in the first decade of the twenty-first century. However, since 2010 demand for its products has been steadily and rapidly declined. This situation arose from a decrease in the demand on the German market, caused by reduction of subsidies and with the emergence of Chinese manufacturers who began mass production of the PV panels at a much lower cost. As a result, German companies, which largely were responsible for the improvement of the refinement of PV technology in the world, have fallen and / or have been taken over, also by Asian manufacturers. Among the most important reasons for the failure of the German manufacturers there should be indicated that they decided to produce in Germany, what combined with a high share of human labour, despite high production automation, resulted in high cost of their products. In addition, basic technology of PV panels was easy to copy, so the Germans did not have exclusivity on it. In addition, German manufacturers were too much focused on their domestic market and its specificity, losing it along with a reduction in subsidies and not being able to compete effectively abroad. The situation was also worsened by actions of the German government, which directly and indirectly supported the Chinese manufacturers in expanding their production.

The Germans should produce in countries with low-cost labour force and there, through automation, gain a cost advantage over local producers. Products in various types should be produced in places with the greatest demand. Thanks to more advanced technology, the Germans could also gain a technological advantage in Asia. German government whereas should more carefully pay attention on whom to support and if those entities will not be potential competitors of German companies.

Keywords: photovoltaic panels, Germany, international competitiveness of the sector, China

Modification of TiO_2/Perovskite Interface in Solar Cells with Al^{3+} Ions to Decrease Charge Losses

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Abstract—Herein we describe the design and fabrication of an improved planar perovskite solar cell by adding a small amount of Al^{3+} to the interface of $TiO_2/CH_3NH_3PbI_3$. The best efficiency of the cell has been increased from 16.32% to 18.72%. We measured the current–voltage characteristics at various temperatures to determine the dominant recombination process in refer.-PSCs and Al-PSCs. We concluded that the formation of Al_2TiO_5 decreased the surface defects at the TiO_2-perovskite interface and primarily explains the efficiency improvement of the solar cell. We have also shown that it is possible to fabricate planar PSCs devoid of an independent insulating layer, i.e. our process of applying Al^{3+} opens a new way to fabricate low-cost, high-efficiency PSCs.