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Feng-shui as a Clue: Identifying the Landform Patterns of Heavy Impact Areas and Surviving Sites from the 2013 Historic Floods in Boulder County and Nearby Areas, Colorado, USA

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--Abstract: Boulder, Colorado is one of the most attractive and desirable small towns in the U.S. because of its beautiful mountain landscape and healthy living conditions. From September 9th-15th of 2013, a historic flood struck the peace of Boulder and its surrounding communities. The violent power of flood destroyed houses, roads and bridges, wiped out small towns, re-routed creeks and streams, and took lives. This flood in the foothills of the Rockies was caused by a week of heavy rain over the complex mountain terrain with steep landforms. One year later, this epic natural disaster has provided a unique opportunity to investigate and research the landform patterns of the high impact areas, since the sites destroyed by the flood still can be identified, even after reparation. Damaged sites are accessible by the public, although some areas are still restricted. Now is the crucial time to conduct research recommendations on site selections for building structures in the mountain areas, since many houses and bridges are in the re-construction phase. Rebuilding houses in the same pre-flood locations would lead to those houses being destroyed again during future floods.

As a professor and *feng-shui* consultant who researches on landscape settings and has lived in the Boulder mountain region for over 20 years, the author will present her research on the landform patterns of the flood's heavy impact areas in order to establish guidelines to avoid building at those places. The author will also identify the patterns of the mountain locations where homes survived well during the flooding in order to recommend safe areas in the mountain neighborhoods for rebuilding or for the future development. This research includes three aspects: 1) Field investigations of landforms of mountains and rivers, and roads in the flood's heavy impact canyons of the Boulder County and nearby areas; 2) Comparative study of the geomorphologic principles on mountain floods with the Chinese *feng-shui* criteria of site selections emphasizing landforms of mountain and water, *feng-shui* (Chinese geomancy) is an ancient Chinese practice used to harmonize people with their environment, particularly the form school of *feng-shui* provided analyses of landforms and their impacts on the mountain residents; and 3) Identifying the landform patterns of the heavy impact areas and the patterns of surviving sites from mountain floods. This research uses interdisciplinary approach to site selections in the mountain area, taking into account adaptation to climate challenges and geographic conditions. Wise site selections would contribute to a sustainable strategy of environmental planning for better survival during future floods in the Boulder mountain area and beyond.

Polygeneration and Sustainable Energy System Development

Challenges and opportunities from optimization viewpoints

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Abstract

A sustainable energy system is an integrated approach to supplying local energy demands from renewable energy or/and high-efficiency polygeneration energy sources. The approach can be seen as a development of the distributed generation concept. The main characteristics of a sustainable energy system are (cost) efficiency, reliability and environmental-friendliness.

Energy efficiency accounts for the largest share for all options for reducing CO_2 emissions. Polygeneration is an important energy efficient technology for providing electric power and heat as well as other energy products in a single integrated process.

In this paper, we mainly discuss the role of the polygeneration in a distributed energy system and contributions of polygeneration in the sustainable energy system development. We first describe the characteristics of polygeneration plants to highlight the complexity of polygeneration technologies. Then we review typical methods for dealing with interdependence between different energy products for polygeneration. Next we discuss practices in operating polygeneration plants and point out some practice some practices in the industry may prevent the potential of polygeneration into full play.

Keywords— *polygeneration; energy efficiency; distributed energy system; sustainable energy system*.

OPTIMIZATION OF LIPID EXTRACTION AND CHARACTERIZATION OF FATTY ACID, UNSAPONIFIABLE FRACTION AND TOTAL PHENOLIC CONTENT OF *Chlorella vulgaris* Beijerinck

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ABSTRACT

Thirty one bags of *Chlorella vulgaris* cultures produced 46.43 grams of oven-dried biomass. The optimized lipid extraction procedure for *C. vulgaris* was found to be sonication with 2:1 (v:v) chloroform:methanol at 1:20 (g:ml) algae:solvent ratio. Yield using this procedure was 51% based on oven-dried algae.

The *C. vulgaris* lipid extract was analyzed for its lipid profile, fatty acid composition and unsaponifiable fraction composition. The *C. vulgaris* oil extracts obtained using the optimized procedure showed that triglycerides, sterols and 1, 3-diglycerides were present. GC-FID of the fatty acid components as fatty acid methyl esters showed the following compostion: lauric acid, myristic acid, palmitic acid, palmitoleic acid, stearic acid, oleic acid, linolelaidic acid, and linolenic acid. Traces of unknown fatty acids were also present. The extract contains 12% unsaponifiable fraction composed of sterols, δ-tocopherol, α- tocopherol, β-carotene and carotenes. Estimation of phenolic content of *C. vulgaris* using Folin-Ciocalteau procedure showed that water extracts contain the most phenolics expressed as 5.14 gallic acid equivalent/ g algae as compared to hexane and ethyl acetate extracts with phenolic content of 0.41 and 1.77 gallic acid equivalent /g algae, respectively.

Analysis of the other lipid extracts showed that extraction procedure affects both yield and lipid profile. Yield increases with polarity of solvent system. Yield of sterols also increases with solvent polarity. Triglycerides, on the other hand, decreases with the polarity of solvent systems used. A more varied fatty acid class was obtained using more polar solvents compared with the usage of less polar ones. Careful assessment of extraction methods is thus, important in obtaining valuable compounds from microalgae. The choice of solvent and extraction procedure depends not only on lipid yield but also on the target compound as based on the researcher's objective whether for aquaculture, high-value compounds and biodiesel production.

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Improvement of ethanol productivity from sweet sorghum juice by *Saccharomyces cerevisiae*

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Abstract

The aim of this research was to increase ethanol productivity from sweet sorghum juice by *Saccharomyces cerevisiae*. Firstly, *S. cerevisiae* NP01 and SSJ-KKU01 were selected to determine their growth in yeast extract malt extract (YM) broth containing 100 g l^{-1} of glucose and in sweet sorghum juice (SSJ) containing 100 g l^{-1} of total sugar. The results showed that SSJ-KKU01 gave higher specific growth rate and higher cell concentration than NP01 in both inoculum preparation media. The highest yeast cell concentrations in YM and SSJ of SSJ-KKU01 were 6.18×10^8 (at 15 h) and 3.53×10^8 (at 18 h) cells ml^{-1}, respectively. The effects of urea supplementation (0.77, 1.54 and 2.30 g l^{-1}, corresponding to the nitrogen content of 3, 6 and 9 g $l^{-1}$of yeast extract, respectively) and temperature (28, 30, 32 and 34 °C) on the growth of SSJ-KKU01 were then carried out in the inoculum preparation step. It was found that the urea addition did not promote yeast growth and the optimum temperature for yeast growth was 32 °C. Optimization of initial sugar (170, 210 and 250 g l^{-1}) and urea concentration (0.77, 1.92 and 3.07 g $l^{-1}$of urea, corresponding to the nitrogen content of 3, 7.5 and 12 g l^{-1} of yeast extract, respectively) for high levels of ethanol productivity (Q_p) by SSJ-KKU01 was further investigated using response surface methodology (RSM), based on a central composite design (CCD). The ethanol fermentation was carried out under batch mode at 32°C in 500-mL air-locked Erlenmeyer flasks with agitation rate of 200 rpm, and the initial cell concentration was ~5×10^7 cells ml^{-1}. The response variable considered was the Q_p value. The results showed that the optimum conditions for the maximum predicted Q_p value (2.82 g l^{-1} h^{-1}) were the initial sugar and urea concentrations of 175.59 g l^{-1} and 2.68 g l^{-1}, respectively. When the verification experiment under the optimum conditions was carried out, the Q_p value was 2.91 g l^{-1} h^{-1} with the ethanol concentration (P) of 78.55 g l^{-1} (~10%, v/v), and the fermentation time of 27 h. Under control condition (no urea supplement), the maximum P value was 75.92 g l^{-1}, but the Q_p value was only 1.05 g l^{-1} h^{-1} at 72 h.

Improvement of batch butanol production from sugarcane molasses by *Clostridium beijerinckii* TISTR 1461 using gas stripping system

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Abstract

Butanol is an excellent biofuel, compared to the currently popular fuel additive, ethanol. It can be produced by fermentation process called acetone–butanol–ethanol (ABE) fermentation of *Clostridium* spp. One of the main problems associated with the ABE production are the low product concentration and productivity caused by butanol toxicity. The toxicity of butanol causes cell membrane damage, resulting in the inhibition of cell growth. Gas stripping is a simple technique with low energy requirement that can be used to separate butanol from fermentation broth during the ABE fermentation. The aim of this study was to investigate the butanol fermentation by *C. beijerinckii* TISTR 1461 in batch process with gas stripping system. The butanol production medium was sugarcane molasses containing 40 g L^{-1} of total sugar and 0.81 g L^{-1} of urea. The fermentation was carried out at the initial pH of 6.5 at 37 ^{o}C under anaerobic condition. The gas stripping system was connected to a 2-L fermenter and the gas stripping was started at 12, 18, 24, 30 and 36 h of the fermentation. The flow rates of gas and coolant (ethanol) of the gas stripping system were 1 L min^{-1}. The temperature of the coolant in condenser was maintained at -10 ^{o}C. The results showed that the butanol, ABE concentrations, butanol productivity and sugar utilization under all conditions with the gas stripping system were higher than those without the gas stripping system. The highest butanol production efficiency was achieved at the gas stripping time of 18 h. Under this condition, butanol, ABE concentrations and butanol productivity were 16.85, 22.40 g L^{-1} and 0.35 g L^{-1} h^{-1}, respectively; whereas these values under no gas stripping were 12.56, 17.95 g L^{-1} and 0.26 g L^{-1} h^{-1}, respectively. The results showed that under the fermentation with the gas stripping system, the butanol concentration and butanol productivity improved ~34 to 35% compared to those of the batch fermentation without gas stripping system. In addition, the sugar utilization increased from 76% to 93%.

Optimization of aeration rate and aeration timing for high levels of ethanol production from sweet sorghum juice under VHG fermentation

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Abstract

Bioethanol is an alternative energy source, which is both renewable and environmentally friendly. It can be produced via fermentation by yeast from biomass and plentiful renewable resources. A small amount of oxygen supply during ethanol fermentation not only promotes yeast cell growth, but also promotes sterol and unsaturated fatty acid synthesis in plasma membrane, resulting in an increase in ethanol tolerance. Therefore, the aim of this research was to optimize aeration rate and aeration timing for ethanol production under very high gravity (VHG) fermentation by *Saccharomyces cerevisiae* NP01 using response surface methodology (RSM) based on factorial design. The ethanol production medium was the juice from sweet sorghum stalk containing 280 g l^{-1} of total sugar and 3.45 g l^{-1} of urea. The aeration rates were 0.05, 0.20 and 0.35 vvm, and the aeration timing varied at 12, 18 and 24 h. The fermentation was carried out at 30 ^{o}C in a 2-L fermenter, and the initial cell concentration was ~ 3×10^7 cells ml^{-1}. The response variable considered was ethanol concentration. The results showed that the optimum conditions for the ethanol fermentation were aeration rate, 0.31 vvm and aeration timing, 12.01 h, with the predicted ethanol concentration of 126.07 g l^{-1}. When the ethanol fermentation under the optimum conditions was verified, the ethanol concentration (P), productivity (Q_p) and yield ($Y_{p/s}$) were 127.80 g l^{-1}, 2.66 g l^{-1} h^{-1} and 0.50, respectively. Under no aeration with (positive control) and without (negative control) urea supplementation, the P values were 119.64 and 79.74 g l^{-1}, respectively. To investigate intracellular composition in plasma membrane of yeast cells during the ethanol fermentation, ergosterol content was determined. It was found that the ergosterol synthesis in the plasma membrane related to aeration supply during the fermentation. The ergosterol content under the optimum condition was 13.21 mg g DCW^{-1}, whereas they were 3.94 and 2.30 mg g DCW^{-1} in the positive and negative control conditions, respectively. The results clearly indicated that the aeration supply during ethanol fermentation significantly promoted the ergosterol synthesis.

Kinetic models of batch ethanol production from sweet sorghum juice under normal gravity fermentation using logistic function and modified Gompertz models

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Sweet sorghum, *Sorghum bicolor* (L) Moench, is an alternative feedstock for the future supplies of ethanol production because its stalks contain high fermentable sugar mainly sucrose, fructose and glucose. The aim of this research was to investigate the kinetics of batch ethanol fermentation from sweet sorghum juice containing 160 g l^{-1} of total sugar with and without nutrient supplementation by *Saccharomyces cerevisiae* NP01 using logistic function and modified Gompertz models. The logistic function model is used to describe the yeast growth, whereas the modified Gompertz model is used to explain the ethanol production. The results showed that the calculated values of these parameters from both models using SigmaPlot® 11.0 corresponded well to the experimental data with high coefficient of determination ($R^2 > 0.9$). According to the fitted growth model under without nutrient supplementation, the calculated values for initial biomass concentration (X_0 = 1.85 ± 0.18 g l^{-1}), specific growth rate (μ_m = 0.20 ± 0.04 h^{-1}) and maximum biomass concentration (X_m = 4.90 ± 0.18 g l^{-1}) were quite satisfactory with the experimental values (X_0 = 2.07 ± 0.14 g l^{-1}, μ_m = 0.18 ± 0.04 h^{-1} and X_m = 5.02 ± 0.07 g l^{-1}). However, the calculated value of the maximum ethanol concentration (P_m = 53.39 ± 3.50 g l^{-1}) from the modified Gompertz equation was distinct with the experimental data (P_m = 45.23 ± 2.78 g l^{-1}). Under yeast extract supplementation (9 g l^{-1}), the calculated μ_m (0.37 ± 0.04 h^{-1}) and X_m (12.87 ± 0.35 g l^{-1}) were consistent with the experimental data (μ_m = 0.32 ± 0.11 h^{-1} and X_m = 12.82 ± 0.07 g l^{-1}), whereas the calculated X_0 (0.84 ± 0.25 g l^{-1}) differed from the experimental data (1.85 ± 0.02 g l^{-1}). However, the calculated P_m (77.45 ± 1.40 g l^{-1}) was close to the experimental data (74.37 ± 4.51 g l^{-1}). Due to the price of yeast extract, it is not appropriate to be used as a nitrogen source for industrial ethanol production. Therefore, urea (2.3 g l^{-1}) (the same total nitrogen content in 9 g l^{-1} of yeast extract) as a low-cost nitrogen, was used instead of yeast extract. The results showed that the predicted parameters for growth yeast and ethanol concentration using both models under urea addition well agreed with the experimental data (R^2 = 0.9770 for cell growth and 0.9965 for ethanol production). The results clearly indicate that these models can be employed for the development of ethanol production process from sweet sorghum juice.

Continuous ethanol fermentation from sweet sorghum juice with product recovery by gas stripping technique

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Abstract

Bio-ethanol is an attractive alternative fuel because it is a renewable bio-based resource and can be produced from several different biomass feedstocks. Sweet sorghum has the greatest potential for biological transformation into ethanol to be used as bio-fuel because it is a non-food feedstock with a growing period of 120-150 days. Its stalks contain high levels of fermentable sugars (mainly sucrose, fructose and glucose) and many trace elements essential for microbial growth and ethanol production. Ethanol can be produced from various fermentation processes *i.e*. batch, fed batch and continuous fermentations. The continuous process has more advantages over the other fermentation systems in terms of ethanol concentration and productivity. During the continuous fermentation, an appropriate aeration supply is required for yeast growth. However, high ethanol concentration in fermentation broth may retard ethanol production efficiency. The aim of this study was to study the performance of the continuous ethanol fermentation with product recovery by gas stripping technique using *Saccharomyces cerevisise* NP01 as the ethanol producer. Ethanol production medium was the sweet sorghum juice containing 230 g/L of total sugar supplemented with 6 g/L of yeast extract. The conditions of continuous fermentation in a 1-L fermenter were dilution rate, 0.02 /h; aeration rate, 0.2 vvm and temperature, 30 ^{o}C. The gas flow rate of the gas stripping system was 1 L/min. The results showed that when the gas stripping was applied into the continuous system, the fermentation efficiency was enhanced approximately 15%. The ethanol concentration and productivity under the process with gas stripping were 92.49 ± 0.92 g/L and 1.85 ± 0.02 g/L.h, respectively; while these values under same condition without gas stripping system were only 80.32 ± 1.76 g/L and 1.61 ± 0.06 g/L.h, respectively. The use of gas stripping in the continuous ethanol fermentation also improved the sugar utilization. The sugar consumption under using gas stripping was almost complete (96.68 ± 0.14%), whereas it was only 85.34 ± 1.31% under no gas stripping system.

Enhancement of butanol production efficiency from sugarcane molasses by low-cost nutrient supplementation

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Abstract

Butanol is an important chemical with many applications including biofuel. It can be produced by fermentation process called acetone–butanol–ethanol (ABE) fermentation of *Clostridia*. Sugarcane molasses, a byproduct of sugar production process, is readily available at relatively low cost in Thailand. It contains high fermentable sugars (sucrose, glucose and fructose), including some trace elements essential for bacterial growth. Dried spent yeast (DSY), a byproduct from brewery industry, has high nitrogen content. Therefore, it was used as a low-cost nitrogen source for butanol production from sugarcane molasses. The aim of this study was to enhance butanol production efficiency from sugarcane molasses by *Clostridium beijerinckii* TISTR 1461 using the low-cost nitrogen source, DSY. The fermentation was carried out in 1-L screw-capped bottles with working volume of 750 ml at the initial pH 6.5, 37 ^{o}C and agitation rate of 100 rpm under anaerobic condition. Initial sugar (25, 45 and 65 g l^{-1}), DSY (0, 3 and 6 g l^{-1}) and calcium carbonate (4, 8 and 12 g l^{-1}) affecting butanol fermentation were optimized for high butanol production using response surface methodology based on Box-Behnken design. The results showed that the initial sugar and DSY had a linear effect on butanol concentration with R^2 of 0.9180, whereas calcium carbonate had no significant linear effect. The optimum conditions for the butanol production were the initial sugar, 60.57 g l^{-1}; DSY, 5.32 g l^{-1} and calcium carbonate, 8 g l^{-1}. The verification experiment under the optimum conditions found that the highest butanol concentration was 11.77 g l^{-1}. This value was very close to the predicted value (11.89 g l^{-1}) indicating that the model was acceptable. Under the optimum conditions, the butanol productivity and yield were 0.33 g l^{-1} h^{-1} and 0.37, respectively, and the ABE concentration was 15.84 g l^{-1}. In the control treatment (no supplement), the concentration and productivity of butanol were 8.62 g l^{-1} and 0.14 g l^{-1} h^{-1}, respectively. High butanol production efficiency under the optimum condition implies that sugarcane molasses has high potential to be used as a raw material for butanol production and DSY can be used as the low-cost nitrogen source for improvement of butanol production efficiency.

Improvement of ethanol productivity from sweet sorghum juice by *Saccharomyces cerevisiae*

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Abstract

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Coal ash utilization of extracting aluminum by an acid method

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Coal contains both energy and mineral resources. For graded use of coal resource, coal ash was studied for aluminum extraction. An acid leaching process was conducted to obtain suitable leaching conditions with high aluminum leaching rate from coal ash, after the coal was fired in circulating fluidized bed boiler (CFB) from northeast China. The coal ash samples were crushed and dried before analysis and leaching. Results showed that Al_2O_3 accounted for 35.67wt%, which exceeded the average Al_2O_3 content (27.8wt%) in China. Sulfuric acid leaching tests were carried out to study the variation of aluminum leaching rate with different factors, such as acid concentration, reaction temperature, leaching time and the ratio of liquid to solid (S/L). Leaching tests indicated that the aluminum leaching rate firstly increased with the increase of acid concentration, and then decreased. The maximum aluminum leaching rate was 97.34%, obtained at the sulfuric acid concentration of 10 mol/L. However, the aluminum leaching rates with 5 mol/L sulfuric acid at 110°C were 93.13%. It demonstrated that the decrease of aluminum leaching rate was only 4.21% when the acid consumption was reduced by half. Thus, suitable sulfuric acid concentration for leaching process was 5 mol/L. The corresponding leaching temperature was 110°C. Moreover, leaching results showed that the higher temperature and S/L had weak impacts on aluminum leaching rate. Thus, the suitable leaching conditions were: 5 mol/L sulfuric acid, 110°C、2h and a S/L of 1:3. Under this conditions, the aluminum leaching rate was 91.5%. X-ray diffraction (XRD) and scanning electron microscopy (SEM) analysis showed that the raw coal ash contained both crystalline and amorphous materials. But no reflections of aluminum-bearing crystals was presented. Therefore, amorphous materials were estimated to be aluminum-bearing materials because the raw coal ash contains 35.67wt% Al_2O_3. The high leaching rate was attributed to the amorphous aluminum-bearing materials which has high chemical reactivity. Thus, it demonstrated that the CFB coal ash, generated at about 900°C, was suitable for aluminum extraction by the acid method due to the dominated amorphous aluminum-bearing materials.

Evaluation of solar resource and environmental conditions in the coastal line of Atacama Desert (Chile) for the implementation of photovoltaic plants

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Abstract

In this work, the aim is to design photovoltaic systems for grid connection and self-consumption at the coastal zone of the Atacama Desert, northern Chile, where the city of Antofagasta is located. This region is characterized by high radiation levels, strong dependence on fossil fuels and an increasing concern about the environment. In order to achieve the goal, several steps are required: First, the measurement, collection and data processing of the global horizontal solar irradiance, temperature, humidity and wind velocity in three different locations within the city (north, center and south). Both the solar resource and environmental conditions can affect the performance of photovoltaic technologies; Second, the analysis of the electricity consumption from three sub stations in the city; Third, the determination of the needed photovoltaic power capacity to match with the costumer´s electricity demand. Once this steps are achieved, it is possible to develop the simulation of the designed photovoltaic system and perform the economic evaluation considering local laws and regulations. The solar irradiation reached values of 8.2 kWh/m^2 in summer and kept above 4 kWh/m^2 in winter. The wind speed blew in southwest direction, mean values of the relative humidity kept between 75% to 78% and the ambient temperature maintained between 10 ^{o}C and 30^{o}C throughout the year. The electricity consumption in the city depends on the socioeconomic group. In a next step, all this data will be used to design photovoltaic plants matching the energy demand.

Keywords: photovoltaic systems, design, solar radiation, atmospheric variables, electricity demand.

ISOLATION AND SCREENING OF THERMOTOLERANT YEASTS FOR ETHANOL PRODUCTION FROM EDIBLE LOCAL FRUITS IN THAILAND

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Abstract

Thermotolerant yeasts are capable of growth and fermentation at high temperatures, which have several advantages such as reduce cost for cooling system, reduce risk of contamination of mesophilic microorganisms and increase the speed of catalytic reactions related to fermentation. In this work, isolation and screening of thermotolerant yeasts capable of producing ethanol from edible local fruits in Thailand were investigated. Various sources of samples such as Carambola, Calabura, Jujube, Governor's plum, Mamao, Passion fruit, Spring Bitter Cucumber, White mulberry, Myrabolan wood, Elephant banana, Manila tamarind, Jackal Jujube, and Noni were collected from the Northeastern Thailand including Maha Sarakham, Kalasin, Khon Kaen, Udon Thani, and subjected to the isolation and screening of thermotolerant yeasts by using enrichment culture technique. As the results, thirty five isolates of yeast were obtained and they were maintained on YM agar. Among these isolates, only ten isolates were able to grow at temperature up to 50^{o}C indicating that these isolated yeasts are thermotolerant yeasts. According to the invention, a preliminary investigation for ethanol producing strains was conducted. The results showed that all ten isolates can produce ethanol at 40°C, however the highest ethanol concentration (about 10 g/l) was obtained from strain RMU Y-12. In order to improve the ethanol production capacity by the isolated yeasts, further study on fermentation optimization is needed and this is now under investigation.

Purification and characterization of a thermostable xylanase from thermophilic-anaerobic *Caldicoprobacter algeriensis* sp. nov. strain TH7C1^T isolated from an Algerian Hot Spring

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Abstract

An extracellular thermostable xylanase (called XYN35) from a thermophilic-anaerobic *Caldicoprobacter algeriensis* sp. nov. strain TH7C1^T isolated from the hydrothermal hot spring of Guelma in the northeast of Algeria was purified and biochemically characterized. Matrix assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF/MS) analysis revealed that the purified enzyme is a monomer with a molecular mass of 35,075.10-Da. The sequence of its 21 N-terminal residues showed high homology with those of bacterial xylanases. The optimum pH and temperature values for xylanase activity were pH 11 and 80 °C, respectively. The XYN35 thermoactivity and thermostability were upgraded in the presence of 5 mM Ca^{2+}. Its half-lives at 70 and 80 °C were 9 and 6 h, respectively. The xylanase showed higher specific activity on soluble oat-spelt xylan followed by beechwood xylan. This enzyme obeyed the Michaelis-Menten kinetics, with the K_m and k_{cat} values being 1.33 mg soluble oat-spelt xylan/ml and 400 min^{-1}, respectively. While the xylanase from strain TH7C1^T was activated by Ca^{2+}, Mn^{2+}, and Mg^{2+} it was, strongly inhibited by Hg^{2+}, Cd^{2+}, and SDS. These properties make this xylanase a potential candidate for future use in biotechnological applications particularly in the pulp and paper industry.

Keywords : *Caldicoprobacter algeriensis,* XYN 35, Purification, Characteristics , MALDI-TOF MS.

Some Physiochemical and Heavy Metal Concentration in Surface Water Streams of Tutuka in the Kenyasi Mining Catchment Area.

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ABSTRACT

This research was conducted in the Akantansu stream of Tutuka in Kenyasi in the Brong Ahafo Region of Ghana in the months of October and November 2010 and January 2011. The major objectives of the study were to measure levels of pH, BOD (biochemical oxygen demand), lead, chromium, and arsenic in the Akantansu stream of Tutuka and to find ways that the community could ensure safe water use. To achieve the objectives of the study, sampling was done over a period of three months and data was collected and analyzed into graphs and ANOVA tables. The research revealed that the levels of arsenic and BOD were high as compared to the standards of WHO and EPA. If the people of Tutuka continue to use the stream, they may experience negative health effects (e.g., nausea, vomiting, diarrhea, etc.). The level of pH, chromium and lead was acceptable as compared to the standard of WHO and EPA.

GREEN TERMINAL TECHNOLOGY

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Ports are relatively large places, where different modes of transportation interract. According to different studies, because of that, they are also places of high saturation of air pollutants and water pollutants (Bailey & Solomon, 2004 and Bailey et al, 2004).

Almost in every port the following are the main reason for pollution and emissions: trains, marine vessels, trucks & terminal cargo handling equipment. The first three belong to the outer companies and can't be manipulated by the port or the terminal authorities. The only large part, that can be considered as a variable in control of the port or a terminal, which leases or owns a part of the port territory is the on-site equipment.

The traditional technologies vary in different types of terminals, that is the main reason why the research has been limited to certain types of cargo handling terminals. General cargo terminals usually have the following equipment: cranes (quayside, rear, rail etc.), terminal tractors, forklifts and depending on the type of cargo other equipment (for example, reach stackers or RTG's for containers).

Purpose - The research paper aims to analyze different available eco-technologies that can replace the existing traditional technologies that are used for trans-loading operation on general cargo terminals, in particular - container terminals. The paper will assess these technologies and provide recommendations for the implementation of certain technologies.

Design/methodology/approach - different modern eco-technologies have been analyzed and compared to the traditional technologies used in general cargo terminals. Economic effectiveness has been calculated in order to understand if the existing eco-technologies are more economically effective.

Findings - the results show us the fact that only terminal tractors and forklifts can be changed to new eco-friendly alternatives, taking into account the price of the existing eco-technologies and the economical effect that they bring besides the decrease of emissions.

Originality/value - this study presents the evaluation of existing ecological alternatives that can be introduced in modern general cargo terminals.

Keywords: terminals, air pollution, eco-technologies, comparison, economic effectiveness

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Hazardous Hydrometeorological Events in Georgia under Global Climate Change Conditions

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Increasing of intensity and frequency of natural disasters is observed worldwide and is also discussed on the national level. One possible reason – apart from the ongoing debates on climate change may be related to unplanned anthropogenic mismanagement. Global trends show an increasing damage from natural hazards and thus increasing losses from occurred disasters

Due to complex orographic conditions and influence of the black Sea Georgia is one of most problematic country by natural disasters. Here exist most of Earths climatic types, from marine wet subtropical climate of west Georgia and steppe continental climate of east Georgia up to eternal snow and glaciers of high mountain zone of Great Caucasus, and also approximately 40% of observed landscapes. Current geodynamics and orographic properties of Georgia play an important role in occurrence of geological (earthquake), geomorphologic (landslide, mudflow, snow avalanche), hydro (flash flood) and meteorological (drought, hurricane, lightning, hail, fog, frost, ice) hazards.

Thus those climatic zones condition formation of different dangerous hydrometeorological phenomena, namely: hailstone, heavy showers, flooding, thunderstorm, draughts, and sea storms. The damages and losses in economy, infrastructure and also casualties are impressive. For protection of population, environment and economy urgent preventive measures have to be necessary. Especially injuries on environment are unreverseable. Based on hydrometeorological observation data for Georgian territory dangerous events have been analyzed to identify risk areas and detailed protective measures

A Study on the analysis of FAME derived from microalgae using gas chromatography

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Abstract

As the third generation biofuel, biodiesel derived from micro-algae is considered to be a promising fuel. The yield of micro-algae per unit area is about hundred times higher than palms which have highest productivity in the biomass. In addition, micro-algae as a feedstock for biofuels don't need complicated pre-treatment process such as lingo-cellulosic biomass. Despite the advantages of the micro-algae, there are positively necessary not only manufacturing technology but also quality improvement (especially the oxidation stability) in order to accelerate the commercialization of biodiesel. The FAME (fatty acid methyl ester) composition of biodiesel determines fuel quality and indicates the characteristics of raw materials. In this study, the FAME (in the biodiesel derived *tetraselmis suesica*) analysis is carried out to research the biodiesel quality using GC-FID (gas chromatography-flame ionization detector). EN14103:2011 presents the method for determination of FAME content in biodiesel. However, when we analyzed the sample according to this method the internal standard (C19:0, methyl nonadecanoate) was overlapped with other peaks of the sample. Therefore, the method is optimized to improve accuracy of analysis by changing GC column, oven program, etc. As the result, figure 1 is shown that there is no overlap peak between original peaks of biodiesel and C19:0.

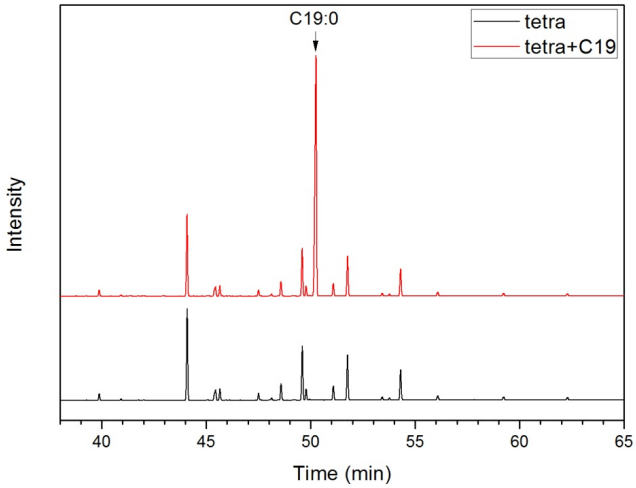

Fig 1. Chromatograms of biodiesel derived from microalgae w/o and w/ C19:0

A Study on the characteristics of biodiesel derived from micro-algae under accelerated oxidation conditions.

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Abstract

Biodiesel has advantages to reduce GHG(Greenhouse Gas) compare with the fossil fuel by using oil comes from plant/animal soures and even waste such as used cook oil. The diversity of energy feeds brings the positive effects to secure the national energy mix. In this circumstance, Micro-algae are one of the prospective sources, though some technical barriers exist such as cost-down to commercialization and improving the product quality. In this study, we analyze the biodiesel which is derived from *Dunaliella Tertiolecta.* through the BD100 quality specifications designated by law. From that result, it is revealed the oxidation stability is one of the properties to need to improve. To find the reason, we test the oxidation tendency of each FAME components through some methods under the accelerated condition. It is revealed that the higher double bond portion, the more oxidative in FAME components($C_{18:1}<C_{18:2}\ll C_{18:3}$). After accelerated oxidation for 48h, it is proved by changing the sample compositions and low molecular weight hydrocarbon and FAME was founded as a result of thermal degradation. Some alcohol and aldehyde are also made by FAME oxidation.

Comparison of the emission characteristics for a vehicle fueled with enriched biogas and natural gases

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ABSTRACT

The characteristics of exhaust emissions and the fuel economy of a compressed natural gas (CNG) vehicle fueled with biogas and natural gases were investigated. A large CNG vehicle currently used as a city bus in Korea was tested on a chassis dynamometer under the European Transient Cycle (ETC) and the National Institute of Environmental Research (NIER) 06 cycles. One CH_4-enriched biogas (97.6% CH_4) and five natural gases with different CH_4 contents (81.6−94.0% CH_4) were used as test fuels. Total hydrocarbons (THC), CO, NO_x and CO_2 emissions in the NIER 06 cycle were higher than those in the ETC cycle for all tested fuels, while the fuel economy in the NIER 06 cycle was 43.7−51.5% lower than that in the ETC cycle. Total VOC emissions increased with increasing CH_4 content in the fuel, with toluene being the highest proportion of the BTEX emissions in both the ETC cycle (72−80%) and the NIER 06 cycle (73−78%). Emissions of elemental/organic carbon exhibited a similar trend to that of nanoparticle emissions. Total organic carbon was mainly comprised of organic compounds at 97−99% (ETC cycle) and 95−99% (NIER 06 cycle). Polycyclic aromatic hydrocarbon emissions in the NIER 06 cycle were 133.3−577.8% higher than in the ETC cycle because of incomplete combustion and an increase in unburned fuel in the NIER 06 cycle, which is a low- speed driving mode. Nanoparticle number concentrations were lowest for M91 among the 6 tested fuels; the total number of particles in the NIER 06 cycle was 33.2−123.8% higher than in the ETC cycle.

Vehicle Routing Problem for Electric Bus Energy Consumption Estimation

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Abstract:

Electric vehicle driving distance depends greatly on battery capacity. In this paper, the vehicle routing problem was studied for electric bus with different energy consumption rates. The energy consumption estimations of electric buses on the shortest circular path were calculated and compared. For the giving points, the best bus travelling route is proposed with the circular distance of 71.16 km and energy consumption per loop of 92.51-128.09 kWh. In addition, the best point for building electric vehicle charging station is also suggested using number of revisit trips.

Keywords:

PEV, Vehicle Routing Problem, Energy Consumption Estimation, Electric Vehicle.

Experimental investigation of mechanical and thermal properties of a new biosourced insulation material

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Abstract

This paper focuses on the mechanical and thermal properties of a new ecological material designed to be used for building insulation. The investigated sustainable building material is a palm fiber-lime composite. The main target of this study is to demonstrate the possibility of using renewable resources available in the north-Africa and Middle-Est as insulating building materials.

The abundance of date palms in some regions of the world presents an opportunity to develop a low cost construction material, with a reduced environmental impact and offers occasion for recycling the material at the end of its life. The confectioned material is a light concrete, which can ensure both thermal and acoustic insulation. For preparing this material, we were inspired by the techniques used for the production of hemp-concrete. The latter is widely used especially in Europe for the thermal insulation of buildings.

The analysis carried out shows that this bio-composite: has a good thermal insulation properties and acceptable mechanical resistance. The behavior of this material during the compression test looks like wood. The thermal conductivity and specific heat capacity are sensitive to the variation of the composition ratio (fibers / lime) and the compaction of the material during its manufacturing.

Mots clés: palm fiber, thermal insulation, mechanical properties, thermal properties, biosourced composite.

Energy and Exergy Analysis of a Solar Air Collector Having a Roughened Absorber with Circular Protrusions

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İsmail Solmuş, Atatürk University, Department of Mechanical Enginnering, Turkey

In this study, energy and exergy efficiencies of a solar air collector having a roughened absorber with circular protrusions have been investigated and compared with the flat plate solar air collectors. The system has been theoretically investigated for different geometrical roughness parameters by help of energy balance between the elements of collector. Geometrical roughness parameters such as ratio of the relative print diameter (RPD), relative longway length (RLL) and relative shortway length (RSL) are examined for different air mass flow rates.

A Novel Control Scheme for Pitch Regulated Vertical Axis Wind Turbines

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Abstract

The main objectives of individual pitch control of Vertical Axis Wind Turbines (VAWT) are to provide high starting torque at cut in wind speed, maximize generated power at low wind speeds and regulate power at its rated value at high wind speeds. Additional objective is to limit dynamic loads acting on the VAWT. Several challenges are encountered with the implementation of individual pitch control of straight bladed VAWT. The necessity to correlate the azimuthal position of each blade to wind speed direction and the required speed of response of individual blade pitch actuation systems are the main challenges that add to both complexity and cost of the VAWT.

This paper presents a novel design for pitch control and actuation system for a 5 KW power straight bladed VAWT. A combined feedback feed forward controller for pitch control at high wind speeds was synthesized. In this design the blade is split into two identical segments. Upper and lower sets of blades are equipped with a single actuation system. In this work we consider the case in which the upper set is actuated with a negative pitch angle while the lower set is actuated with a pitch angle of same magnitude and opposite sense. This novel design allows the pitch control system to rely on wind speed measurement only and to perform independently from the blades azimuthal position.

This combined controller was synthesized for regulating the angular speed of the VAWT at high wind speeds. The synthesis was based on simple linear dynamic models of the VAWT. These models were derived in the neighborhood of nominal operating conditions. A Double Multiple Stream Tube (DMST) aerodynamic model with variable induction factors was developed to determine the nominal operating VAWT torque characteristics.

Nominal torque at variable wind speeds and constant pitch angle as well as nominal torque at variable pitch angle and constant wind speed were determined. These nominal torque- angular speed characteristics allowed the derivation of multi linear models evaluated at the rated angular speed of the VAWT for different wind speeds. These multi linear models resulted in several first order transfer functions that express VAWT's angular speed with respect to both pitch angle and wind speed. Gains and time constants of these transfer functions were expressed in terms of VAWT's rotor moment of inertia, aerodynamic characteristics and generator torque characteristics. A PI controller was synthesized for set point tracking condition. The proportional gains as well as the integral time constants were determined in terms of the gain, time constant of the derived transfer function as well as time constant of the pitch angle actuation mechanism.

To improve the disturbances rejection performance of this PI controller, a feed forward controller was added to compensate for wind speed fluctuations. Only static compensation was required to enhance disturbance rejection characteristics of the control scheme. Simulation of the above synthesized combined controller on the newly designed 5KW VAWT was conducted, see Fig.-1. Adequate closed loop performance was demonstrated with very good set point tracking as well as wind speed disturbances rejection.

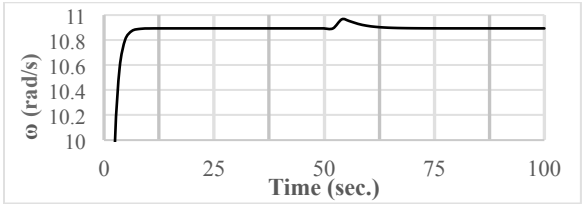

Fig.-1 Set point tracking and disturbance rejection closed loop response.

Electric Bus Transit Shortest Path and Least Energy Consumption Path Based on Traffic Conditions

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Abstract:

Long vehicle driving distance increases pollution emissions for both internal combustion engine (ICE) and electric vehicles (EVs). ICE vehicle burns fossil fuels while driving but EV uses electricity based on marginal electric power sources with high green house gas (GHG) emissions. Shortest path driving distance is very importance to minimize battery energy depletion and find the most economical route for EV. In this paper, the shortest path for multiple destinations was determined for normal traffic condition. Additionally, the path with least energy consumption was determined for electric bus-transit when some subtrips have different traffic conditions. As the results, order of visited points on least energy consumption for electric bus-transit route alters to shortest path. Amount of energy difference was presented for both shortest path and least energy consumption.

Keywords:

Electric vehicle, electric bus, shortest path, least energy consumption, traffic, estimation.

Saudi Arabia's Domestic Energy Situation and Policy: Focusing on Demand Side Management on Residential and Commercial Buildings

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Saudi Arabia's domestic energy consumption is skyrocketing. The energy consumption currently relies exclusively on oil and natural gas with oil contribution of 130 million tons oil equivalent (mtoe) and natural gas of 93 mote in 2012. In addition, oil consumption is growing by 3.9% per year putting Saudi Arabia in the world's sixth-largest oil consumer with a quarter of its own production of crude oil and natural gas liquids. Studies showed that on a 'business as usual' trajectory, Saudi Araba would become a net oil importer in 2038. This would have a severe effect on government spending, over 80% of which dependent on oil revenues. As electricity sector represents around 42% of total energy consumption with a demand growth exceeding the gross domestic product (GDP) growth, the position and role of this sector in energy are becoming increasingly important. According to the BP Statistical Review of World Energy 2014, Saudi Arabia generated 292.2 billion kilowatthours (kWh) of electricity in 2013, 7% more than in 2012 and more than double the electricity generated in 2000. As usual business case anticipated that the CO_2 emission from power and water sector would reach in year 2030 to around 800 tons per year.

The objective of the paper is to Analyze the economic and environmental consequences of adopting energy policy as fuel policy in the current fossil fuel-based energy system in Saudi Arabia and set a more proactive institutional and policy response, in the demand side, to transition to a sustainable energy system and help safeguard the stability of Saudi Arabia's role as a global energy supplier. A detailed energy demand analysis is conducted to define the high consumption dilemma in Saudi Arabia. An econometric electricity forecasting model is developed, validated against the business as usual forecasting and used to investigate the potential of applying demand side management to realize economic and environmental benefits. The results of the analysis showed that the overall electricity demand reduces by more than 16% as a result of implementing efficiency standards for cooling systems at residential and commercial buildings. As a result, 2035 electricity demand in buildings is anticipated to decline by more than by 118 TWh during that year from the BAU case. The peak load is also anticipated to decline by almost 13% or more than 18GW in year 2035. This would result in avoidance of high investment of $7 billion and reduction of 64 tons of CO_2.

TiO_2 / ZnO Photocatalytic Activity for Hydrogen Production

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Abstract— The present work investigates Zn doped TiO_2 (1.0, 5.0, 8.0, 10.0, 12.0 and 30.0 wt.% Zn) photocatlaysts were prepared by low cost sol-gel auto-ignition method and systematically investigate their structural, optical and surface morphological properties with x-ray diffractometer, UV-Vis spectrophotometer, Fourier Transform Infrared spectrometer (FTIR) and scanning electron microscopy (SEM) with energy dispersive x-ray spectroscopy (EDX). The photocatalytic H_2 evolution of the TiO_2-ZnO suspensions was evaluated in an aqueous ethanol medium (50 vol. %) under UV illumination. The Zn^{+2} concentrations utilized to prepare TiO_2-ZnO nanocomposites were found to have significant effect on the specific surface area, pore volume, and photocatalytic activity. The H_2 evolution results obtained with TiO_2-ZnO nanocomposites were compared with H_2 generation using commercial TiO_2 P25 and individual TiO_2 nanoparticles. The photocatalytic activity of TiO_2-ZnO composite enhanced significantly as compared to bare TiO_2 nanoparticles and commercial TiO_2 P25. With respect to an increment in Zn^{+2} doped, the photocatalytic activity of the composite increased and reaching an optimal H_2 production of 1048 $\mu mol.h^{-1}$ of catalyst for the TiO_2-ZnO composite containing 10 wt.% Zn. These solids were proved in the photocatalytic water splitting and resulted seven times more active (1048 $\mu mol.h^{-1}$) than the reference TiO_2 (150 μmol.h-1) and two times more active than TiO_2 P25 (595 μmol.h-1) semiconductors.

Keywords— Hydrogen production, Photocatalysts TiO2–ZnO, Photoconductors TiO2–ZnO, Water splitting.

Uncertainty Characterization of Coherent Doppler Lidar for Wind Forecast Improvement

by

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Abstract:

The High Resolution Doppler Lidar (HRDL) built at National Oceanic and Atmospheric Administration (NOAA) has been part of several on-shore and off-shore deployments. This has produced a comprehensive dataset which can be used to study processes important for wind energy. An important aspect of providing this wide range of meteorological data is to properly characterize the uncertainty associated with these measurements.

With the above intent in mind, the Lidar Uncertainty Measurement Experiment (LUMEX) was conducted at Erie, Colorado during the period June 23rd to July 13th, 2014. The major goals of this experiment were the following:

1. Characterize sampling error for vertical velocity statistics
2. Analyze sensitivities of different Doppler lidar systems
3. Compare various single and dual Doppler retrieval techniques
4. Characterize error of spatial representativeness for separation distances up to 3 km
5. Validate turbulence analysis techniques and retrievals from Doppler lidars

This experiment brought together 5 Doppler lidars, both commercial and research grade, for a period of three weeks for a comprehensive inter-comparison study. The Doppler lidars were deployed at the Boulder Atmospheric Observatory site in Erie (Colorado, USA), site of a 300 m meteorological tower. This tower was instrumented with six sonic anemometers at levels from 50 m to 300 m with 50 m vertical spacing.

A brief overview of the experiment outline and deployment will be presented. Results from the sampling error analysis and its implications on scanning strategy will be discussed. Results from inter-comparison of retrieval techniques and error of spatial representativeness analysis will be presented to illustrate the choice of scanning strategy and retrieval algorithm based on the application, such as boundary layer studies or wind energy.

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Field Measurements of Temperature Dependence for Different PV-Module Technologies in Libya

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Abstract–

The most important part of any photovoltaic system is its PV generator that is its modules. The operating temperature of photovoltaic modules is one of the key factors affecting the electrical efficiency of the PV module, and thus the efficiency of the whole system. This paper will present the field measurements which were conducted in University of Tripoli on three different technologies to model their temperature dependent in the four seasons of the year. The results showed a lower temperature dependent for thin film PV modules, the measurements were used to model the temperature dependent for single, multi crystalline, and Tandem PV modules to help estimate PV performance in a harsh places like Libya.

Keywords — temperature dependent, modules, performance

Techno-economic and GHG assessments of methane production via biogas upgrading and power to gas technology

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To decrease the use of fossil fuels and face the energetic demand, the integration of renewable energy is a necessary step. Part of this renewable energy can be supplied by the production of electricity from photovoltaic panels and windfarms. The massive use of these intermittent energies will probably lead to periods with a production exceeding the demand, and there is consequently a need to convert this surplus into a storable form of energy. Power-to-gas technology consists in using this surplus of electricity to convert water into hydrogen by electrolysis, and then to synthetize methane from carbon dioxide and hydrogen. The combination of this technology with the production of biogas by anaerobic digestion can highly increase the energy production from biowastes.

Techno-economic and greenhouse gases (GHG) assessments of methane production via the combination of anaerobic digestion and power-to-gas technology have been applied to sewage sludge valorization, with the injection of the produced biomethane into the gas distribution network. Process studies and equipment design have been addressed considering already available technologies. The corresponding economic assessment has been done by calculating the production costs of 1 MJ of biomethane. As both waste treatment and energy production are supplied, two functional units have been chosen for the Life Cycle GHG Assessment of this system: the treatment of 1 kg of sewage sludge and the production of 1 MJ of energy.

Sensitivity analyses have been done on biogas upgrading technologies, electricity prices, internal rate of return, electricity consumption of the electrolysis step and annual operation time of the methanation process. Economic results underlined the sensitivity to electricity prices, and also to the functioning duration of the methanation process. The more the electricity is expensive, the longer the operation time of the methanation process must be to be competitive with simple injection of methane from biogas. The reduction of the internal rate of return and the electricity consumption of the electrolysis step can significantly affect the production costs. The current context does not feature adapted conditions to ensure an economically viable chain. Nevertheless, the evolution of the energetic context in the next few years as well as the expected technological improvements will contribute to overall cost reduction.. A sensitivity study with cost breakdown analysis is presented; it particularly shows that electrolysis is the bottleneck and some insights are given towards cost reduction possibilities. From an environmental point of view, the power-to-gas technology generates slightly more greenhouse gases by MJ than direct injection. However the higher amount of produced biomethane allows a much better energy recovery from the sewage sludge. It appears that the composition of the electricity mix and the methane losses management affect GHG emissions. Future development of low electricity consumption of the electrolysis process, and integration of renewable credits from CO_2 valorization can increase the competitiveness of this technology.

Luminous and thermal effect of slit angle solar protection in hot climates. The case of South orientation.

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Abstract:

Solar protection should be considered as an integral part of the facade design to meet the daylighting requirements with the need to reduce solar gain. However, its application in the building may cause some conflicts such as the contradiction between the winter and summer comfort or those of thermal and visual comfort, especially for hot climates. Therefore the designer must be aware when choosing a solar protection design parameters.

In this paper, we study, through numerical simulation, the thermal and luminous effect of slats angle in hot dry climates. Two simulation softwares were used: Radiance and TRNSYS. The simulations were performed for a south facing window and three angles were considered: horizontal, 30 ° down and 30 ° upwards.

We have taken as a case study the city of Ghardaia (latitude: 32.23 ° N, longitude 3.49 ° E) located in southern Algeria and characterized by a hot climate.

Keywords: Solar protection, Radiance, TRNSYS, Thermal comfort, Daylighting.

Application of risk analysis to improve environmental sustainability of forest yards in wood-energy chain

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Thermal plants using wood biomass have been strongly supported in recent years by the European Union. The design solution deemed more sustainable for the environment involves the construction of small plants, whose needs can be guaranteed by timber coming from the surrounding territory. Often this solution can not be deemed as the most compatible with the requirement of safety. For small size wood-energy chain the implementation of the best available technology regarding occupational and environmental safety implies an higher economic charge compared to large systems based on major capital investments.

Purpose of this study is the application of a methodology designed for the analysis of risk in order to identify and to assess the impacts on the environment. This analysis will be applied to forest yards, corresponding to the first phase of the forest - wood – energy chain, i.e the raw material procurement. Based on the feedback received, adjustments to the methodology will be identified to permit an easier application both to occupational risk analysis and to environmental impact assessment. It will therefore be possible to optimize the identification of the procedures to implement. A future goal is the application of the method to the entire supply chain, from timber's procurement to the plant's realization and implementation.

After identifying the criteria to determine the most suitable operating procedures (according to the characteristics of the examined wooded lot), the individual work phases have been divided into sub-phases and elementary processes. For each elementary processing the main sources of risk have been identified. They were divided into employed equipment, materials (raw and complementary materials, waste and products), work environment and organization. Keeping this division for each source of risk the related hazard's factors, the possible impacts on the surrounding environment deriving from them and the procedures to minimize them have been identified and verified on real cases.

The performance evaluation of a new model which based on bright sunshine hours and satellite imagery, for the estimation of daily global solar radiation for two locations in Turkey

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Abstract

Measurements of the accurate global solar radiation at the Earth surface are needed to use in the researches for solar energy applications and for climate change and variability studies. Surface global solar radiation measurements are accurate enough but expensive to install the necessary instruments and such data are rare. Therefore, satellite images are used commonly in order to derive spatially continuous accurate solar radiation maps on the surface of the Earth. These images are very important for a good evaluation; but they are insufficient alone to use for the accurate estimates. In fact, they can indirectly support the accurate estimations of solar radiation at the Earth surface. In this study, we present the performance analysis and evaluation of a new developed model for estimation of the global solar radiation, based on the surface measured data (bright sunshine hours) and on the information acquired from the satellite images. The performance of the new model for the two different climatic zones of Turkey is analyzed; namely for two locations (Ankara and Erzurum). The analysis is carried out for typical continental climate characteristics of Ankara and cold and snowy climatic characteristics of Erzurum. Using the data for 12 months of a year, a preliminary study has been carried out for selected stations which produced important information for an extended work. Results can be used either to increase the performance of the models or to analyze long-term climate change studies with more accurate estimates.

Experimental Validation of the Dynamic Simulation of the Performance of A Flat Plate Solar Collector in A Thermosyhon Water Heating System Using TRNSYS.

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Abstract–

The performance of a thermosyphon solar water heating system which was designed, constructed and operated under the weather data of Zaria Nigeria (latitude 11.2 ^{o}N and longitude 7.8 ^{o}N) was experimentally determined. The results of the experiment were used to validate the predicted annual performance of the system through simulation using TRNSYS. Firstly, a two day experiment was conducted and during the experiment, the ambient temperature, solar radiation and the inlet temperatures and outlet temperature of the solar collector and storage tank were recorded at an interval of one hour daily from 8.00 am to 6.00 pm local time. The results obtained from the experiment were compared with the simulated results, in order to compare the trend and the level of agreement between of the experimental results and the simulated ones. Secondly, the Nash-Sutcliffe coefficient (NSE) statistical tool was employed to analyse the difference between the experimental results and the simulated results in order to determine the predictive power of the simulation software. The comparison of the experimental results with the simulated result show good agreement and trend. The computed NSE values of 0.956 and 0.885 between the modeled tank inlet temperature and the observed tank inlet temperature for the two days test confirms that the model formulation using TRNSYS software proposed here for the performance simulation of the system is valid and realistic owning to the good quality of fit between experimental results and the simulated results.

Keywords– Simulation, TRNSYS Software, Tank inlet temperature, Validation

Towards a multiscale microclimatic characterization of urban forms in desert cities. Comparative study of thermal issues in canyon street models. Case of Beni Isguen (Algeria).

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Abstract

This paper aims to study the influence of urban morphology on microclimatic parameters in order to approach a multiscale characterization of urban forms in hot dry regions.

The case study is one of five mineral compact cities composing the “M’zab Valley” located in Algerian full desert. Basic urban morphological indicators are suggested and evaluated. They correspond to two interdependent scales of urban form: the street and the urban fabric. Particular attention is paid to the spatial concept of "urban box ", because the open urban space is continuous and limited horizontally and vertically (soil, built forms and openness to sky).

The study of these questions used in first part, results of field measurements carried out during summer and winter conditions. The analysis of results allows proposing theoretical models of urban open spaces. The study of microclimatic behavior of these models is carried out in ENVI - met simulation software in the second part of this paper.

Research methodology consists of the superposition of morphological and microclimatic analyses. We firstly present the morphological characteristics and indicators and then evaluate their influence.

Part of results shows that the thermal behaviour of a given morphological area is the reverse of the behaviour of its wind flow. Thermal conditions within streets are concerned both with solar exposure and wind flow effect (diurnal and nocturnal periods).

Keywords: Urban morphology, hot dry climates, street canyon, microclimatic characterization.

Wind Farm Optimization Based on CFD Simulation of Non-Flat Terrain

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Wind farm optimization defines the engineering problem of designing a wind farm with the objective of maximizing the energy production with respect to the operating costs. In the present work, a wind farm optimization model suitable for non flat terrains is presented. The proposed model combines an existing analytic model with a Computational Fluid Dynamics analysis. Wind turbines produce energy according to the local wind speed and at the same time generate a wake that propagates downwind and interfere with the other turbines in the wind farm. For this reason, the optimal wind farm design is driven by the interaction between wind turbine wakes. A systematic approach for the wind farm design optimization can be first found in the work of Mosetti et Al [2] and it's been followed and improved by several authors in the recent years. Wind farm optimization models are based on a wake model to estimate the effect of the wind speed reduction behind each wind turbine. The wake model is required to be computationally efficient since the computation of the wind speed is performed many times during the optimization process. Several wake models have been developed over the years and one the most widely used is the Jensen model [3]. One of the limitations of the Jensen model is that it is based on the assumption that the undisturbed wind flow is homogeneous over the wind farm site and is therefore not suitable for the analysis of wind farms located over non-flat terrains. The present work represents an attempt to extend the Jensen model and make it suitable to deal with moderately hilly terrains. A CFD field is calculated beforehand [4] and is integrated into the Jensen model considering a one way coupling of the wind speed field. A similar coupling technique applied to wind turbine wake models can be found in [1]. Finally, a testcase based on an analytically derived terrain topology is set up to prove the concept.

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Biomass energy conversion in Combined Cycle Systems: a techno-economic analysis

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Abstract

This paper aims to analyze the performances and the economic feasibility of different arrangements of combined cycle (CCGT) power plants able to utilize biomass.

In particular, the first CCGT arrangement includes a recovery boiler that is conveniently converted to a biomass post-combustion system. A second way is based on the co-firing of the syngas produced in a biomass gasifier. A third, hybrid configuration, includes a two output gasifier: a first gas stream is co-fired with the main fuel, while the second stream, characterized by low quality syngas, feeds a post combustor at the gas turbine outlet. Different hybrid configurations have been taken into account, depending on the high quality syngas proportion: 10%, 20% and 50%.

Finally, a techno-economic analysis has been carried out and the three plant arrangements analyzed have been compared with two reference plants: a standard CCGT and a typical direct biomass power plant. The plants have been modeled by using the commercial software Thermoflex®.

The analysis has been conducted with the objective of determining the conversion rate of energy added by the biomass and the investment required for plant modifications. To this purpose, a new efficiency parameter has been introduced, defined as the ratio between additional electrical power output and heat power from biomass input. Then the kWh generation cost has been calculated taking into account both incremental capital and maintenance costs.

Results show a reduction in energy production cost with the biomass conversion efficiency, except for the hybrid configuration, when it has a gasifier output less than 20% in high quality syngas.

Although the thermodynamic result and the economic profitability are strongly related, as is evident in the co-fired system, an economic advantage can also be achieved in hybrid systems, despite their lower efficiency, as they can manage also a poor quality, less expensive biomass.

Production, properties and characterization of biodiesel from selected indigenous microalgae strains of Northern Greece

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The demand for alternative fuels has increased in the past several years. Biofuels are gaining importance as significant substitutes for the depleting fossil fuels. The fact that biofuels are renewable fuels with very low emissions of CO2 in the lifecycle offers them a competitive advantage. However, the first produced biodiesel derived from edible oil seed crops (first generation feedstocks), lurking a serious risk of disturbing the overall worldwide balance of food reserves and safety. The second generation feedstocks for biodiesel production obtained from non-edible oil seed crops, waste cooking oil, animal fats, etc., but these feedstocks are not sufficient to cover the present energy needs. Recent focus is on microalgae as the third generation feedstock. Microalgae do not compete for land, but they can grow in salty (sea), brackish (lagoons) and fresh (lakes) water. Moreover, microalgae have high photosynthetic efficiency using solar energy, water and carbon dioxide to produce higher quantities of biomass than other feedstocks. In the present research work, two indigenous fresh water and two marine Chlorophyte strains have been cultivated successfully under laboratory conditions using commercial fertilizer (Nutrileaf 30-10-10, initial concentration=70 g/m^3) as nutrient source. The produced biodiesel from the microalgae biomass achieved a range of 2.2-10.6% total lipid content and an unsaturated FAME content between 48 mol% and 59 mol%. The properties of the ultimate biodiesels were determined, based on the compositions of the various substrates, and compared with the specifications of petroleum diesel and EN 14214.

This research has been co-financed by the European Union (European Social Fund – ESF) and Greek National Funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) – Research Funding Program: ARCHIMEDES III.

Keywords: *Microalgae, chlorophytes, biodiesel properties*

The Influences of the Physical Parameters on the Performance of a Methanol Steam Reformer

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Hydrogen energy is emission-free, portable and possesses high energy density. It is therefore considered one of the potential energy resources. In fuel cell applications, the electrical efficiency and the combined heat and power (CHP) efficiency derived from hydrogen can achieve 60% and 90%, respectively. Although hydrogen is abundantly reserved on earth, it should be extracted from a variety of hydrides. These include fossil fuels like natural gas and alcoholic fuels, as well as biomass and water with power input from renewable energy resources. In the near future, hydrogen produced from fossil energy, accompanying carbon-dioxide capture technologies, can still play a significant role in the progress of the emerging hydrogen economy.

Methanol is regarded as an important feedstock for hydrogen production due to its high energy density and superior transportability. In this work, an experimental platform was constructed to evaluate the performance of a small-scale methanol steam reformer. The objective was aimed at the influences of various physical parameters on the methanol steam reforming (MSR) process. The hydrogen, carbon monoxide and carbon dioxide production rate, as well as methanol conversion, were experimentally analyzed with respect to different levels of the space velocity of the feedstock, the porosity and temperature of the catalyst bed, and the steam-to-carbon (S/C) ratio. It revealed the methanol conversion was sensitive to the temperature of the catalyst bed and the catalyst loading. The maximum methanol conversion does not necessarily correspond to maximum hydrogen production rate since a portion of the generated hydrogen was extracted during the water-gas shift process. The hydrogen production rate can reach about 2.7 times of the methanol feed rate. In addition, the by-product concentration of CO was significantly influenced by temperature and S/C ratio. On the other hand, a packed-bed dispersion model of methanol conversion is established to analyze the influences of the aforementioned physical parameters. Accordingly, dimensionless parameter groups can be discussed as well. It is anticipated to provide clues to systematic design of a MSR reactor.

Keywords: methanol steam reforming (MSR), conversion, hydrogen production, dispersion model, packed-bed reactor

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Fig. 1 The experimental platform of a methanol steam reformer employed in this work.

Design of Experiments for determining the parameters affecting the behavior of the modified wheat straw adsorbent

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Abstract–

The use of wheat straw, a lignocellulosic material, as an adsorbent of hydrocarbons in water has been investigated. Previous studies showed that this material can be utilized as an efficient adsorbent when its lignin content reaches 20% on a dry basis. This can be partly explained by the fact that lignin on the surface contains charged functional groups which may attract charged oil droplets. A 3-level Box-Behnken design, with factors the maleic acid ($C_4H_4O_4$) concentration (M) and the temperature and time of wheat straw treatment, was performed to determine the effect of the parameters affecting the behavior of the treated wheat straw as an adsorbent. Several analytical methods such as Mercury Porosimetry, Thermogravinetric Analysis (TGA), Total Organic Carbon (TOC) and Scanning Electron Microscope (SEM) were utilized to characterize the material and its adsorbancy potential.

Applications Used to Decreasing the Energy Used in Home Building

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Abstract

Energy saving through incorporation of automation techniques in buildings is usually too complicated and costly and it is necessary to protect environment. There is no single, direct or standard method to estimate and validate the energy consumption in buildings. The energy is consuemed in building for heating or cooling purposes to save a comfortable conditions. Buildings account for about 40% of the global energy consumption and contribute over 30% of the CO2 emissions. Higher indoor temperatures in summer time conditions would lead to less prevalence of cooling systems as well as less cooling requirements. The raising of the average summer temperature introduces a good potential for energy saving, the matter that should be adopted in both the buildings under design and the constructed buildings. Further research and development work conducive to a better understanding of thermal comfort and energy conservation in buildings have been identified and discussed. This paper reviews the thermal comfort research work, discusses the implications for building energy efficiency ,the thermal energy storage systems (TES), the using of phase change material (PCM) in buildings. All of these techniques are widely investigated , discussed and analyzed. Also; the current study introduces both a revision for the developed applied energy saving latent heat storage phase change materials (PCMs) and an environmental friendly humidity-controlled materials. Finally, the current revision make a highlight on the promising technologies for energy saving and PCM application in buildings with focus on room applications.

WIND POWER DEVELOPMENT IN VIETNAM: SOLUTIONS TO REDUCE GENERATION COST

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Abstract:

Developing renewable energy in general and wind energy in particularly is now becoming the ultimate trend for many countries in the world to efficiently ultilise the huge clean energy supply, especially when global hydrocarbon resources are being depleted gradually. Vietnam has been seen to have great natural and geographical advantages to develop wind energy projects (potential 513.360 MW at 65 metre height according to World Bank (WB) documents estimated). However, wind power projects developed in Vietnam are still limited and far from the country's potential. One of the main reasons is that wind generation cost is not as competitive as other conventional generation technologies. This paper look into the cases from other countries with developed wind industry such as Germany, United States, China… Besides, the authors review the experiences from all wind projects implemented in Vietnam to propose practical solutions. Three major solutions has been presented, particularly in (i) technical, (ii) economic-financial-management and (iii) regulatory perspectives. Simulation results regarding these solutions has been calculated for Hoa Thang wind power project (developed by PetroVietnam in Binh Thuan province, center of Vietnam) as a case study.

Keywords: Wind energy, generation cost, regulatory perspective, wind projects in Vietnam, case study.

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Cost and Performance Comparative Model for Dust Mitigation Technologies for Solar PV in Saudi Arabia

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Abstract:

Solar photovoltaics are rapidly emerging as promising technologies to develop more sustainable energy systems, creating a promising opportunity to tackle the world's intermittent energy challenge. Certain geographic locations provide exceptionally vast capacities of incident solar irradiation (insolation), making them attractive spots for harnessing the world's available sunshine – yet many of them face particular atmospheric challenges; namely dust. The dust problem instigated a whole field of research, with studies indicating a total reduction of 30-60% in PV efficiencies due to dust.

While some research has investigated potential technologies for dust mitigation, not much has studied the impact of implementing them commercially, or took into account the effects of climate. This paper presents a model consisting of a performance module and a financial module, to compare three main dust-mitigation technologies (electrodynamic screens (EDS), air-blowing mechanisms, and superhydrophobic nano-coatings) against each other, and against a reference based on manual cleaning. The model calculates the Levelized Cost Of Energy (LCOE) as an objective metric for comparison. Saudi Arabia is used as a case study to validate the results, given its unique combination of enormously high annual insolation and high levels of dust storm frequency.

Dust mitigation technologies show major dependence on climate and topography, and increase total power capacity dependence on seasonality. Different technologies increase power capacity disproportionally depending on the location despite the relative proximity of the test points. In some locations, the annual power production increases by a total of 13.25%. Overall, while nano-coatings yield higher power capacities for most locations, EDS returns the lowest LCOE for all locations, due to its low capital investment costs. The model is globally applicable; has the potential of studying additional technologies, and incorporating effects of other aerosols, making it relevant for any large-scale PV application.

SNOWPACK IN NORTHERN KAZAKHSTAN IN CONDITIONS OF REGIONAL CLIMATE CHANGE

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Recently the interest in research of snowpack has grown due to the regional climate changes that have been occurring in the last few years. The snowpack is one of the most important climate forcing factors. The territory of Northern Kazakhstan is located in such a latitude zone for which a long duration of a steady occurrence of a snowpack is distinctive for up to 4-5 months without a break in time and the snow in this area plays a big role on the climate there.

The global warming that was observed in the 20th and at the beginning of the 21st century also shows its occurrence in other regions of Kazakhstan too. Thus, in Northern Kazakhstan the highest increase in air temperature for the period of time 1941-2012 is typical for autumn (0.3 °C/10 years), winter (0.28–0.34 °C/10 years) and, especially, spring (0.35–0.37 °C/10 years), but as for the summer, then, the tempo of increase is a bit lower (0.20–0.25 °C/10 years). All tendencies of increase in air temperature are statistically significant.

A steady snowpack forms in Northern Kazakhstan in November-December and, in what, its formation occurs from north to south of the reviewed territory. In North-Kazakhstan and Akmola regions it is being formed from the 5th till the 12th of November, in Kostanay region there is a delay for up to 8-10 days (i.e. 14th-21st of November). The earliest formation of a steady snowpack in the north of the Republic was recorded on the 3rd-9th of October and the latest one - on the 18th-24th of December. Thus, an amplitude of the set dates when the steady occurrence of snowpack at the reviewed area has been recorded was about 70 days, and the mean-square deviation varies from 10 to 15 days.

The destruction of a steady snowpack lasts for two months - March and April. The earliest destruction of a steady snowpack in the north of the country was seen on the 20th of February - 5th of March and the latest - on the 25th-28th of April. Steady snowpack slides down from the 1st till the 10th of April almost on the whole territory of Northern Kazakhstan. The values of the mean square deviations of the dates for the steady snowpack slide-down are about 7-12 days. Amplitude of fluctuation of these dates does not exceed 60 days.

The duration of the snowpack stratification in Northern Kazakhstan is one of its most important characteristics, - the information on which is being used as on the operational practice as well as when resolving scientifically applied tasks. The average duration of the snowpack stratification is 145 days and it is changing from north to south from 162 to 115 days. The minimal number of days with a snow at the reviewed territory is 77 days and the maximal is 187 days.

For duration of the snowpack stratification the trends of -1.2 day/10 years and -3.8 day/10 years were calculated which indicated the tendency of decreasing the duration of the snowpack stratification and that was quite visible in the period of time of 1971-2008. The duration of the stratification is decreasing due to a later formation and earlier destruction of the steady snowpack.

The calculated trends indicate to more serious tendency of much later terms of formation of the steady snowpack (0.20 – 0.28 days/year). At the researched territory the weak tendency in

deviation of the time for the snowpack slide to earlier dates (0.10-0.17 day/year) has been seen, but these trends are not statistically significant.

The coefficient of correlation between the date of the snowpack formation and the air temperature of October-November was 0.54, and between the date of the snowpack slide and the air temperature of March-April this coefficient of correlation was 0.55.

In the last decades during the conditions of regional climate warming the distinct tendency towards the decrease in duration in steady snowpack stratification was recorded due to later formation and earlier destruction of the steady snowpack.

CITYOPT – Holistic Simulation and Optimisation of Energy in Smart Cities – Vienna Study Case

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68% of the European Union population lives in urban areas, this proportion is growing as the urbanisation trend continues, this presents us with an opportunity to reduce individual carbon footprint providing the city is designed in an efficient way. This energy demand currently represents 70% of the total. This highlights the importance of the development of more sustainable urban areas which are more energy and resource efficient, the use renewable energy sources, reduction of the carbon footprint, infrastructure development, engagement of the stakeholders and users, removing administrative and regulatory barriers and new business models.

CITYOPT is a collaborative project supported by the European Commission through the Seventh Framework Programme (FP7) the main goal of which is to create a set of applications to optimise the energy system in different life cycle phases to support planning, design and operation of energy systems in urban districts. In particular, CITYOPT planning tool will support analysing, simulating, optimising and communicating various city planning alternatives. This holistic approach will integrate, among others, energy dynamics of local grids, buildings and consumption behaviour and patterns, energy storages, and local energy production using renewables. In this paper, the CITYOPT planning tool and the methodology behind it for the test site of Vienna is presented. This study case is based on three office buildings which lie in close proximity to the Rail Tec Arsenal Fahrzeugversuchsanlage (RTA) Climatic wind tunnel. This facility is intensively used for aviation, road- and rail-vehicle testing. During these tests a huge amount of waste heat is rejected from the chillers. The objective of the Vienna study case is to utilise this waste heat with the existing thermal energy supply systems of the office buildings in an optimal way. Thermal energy storage is also considered to be linked to this network to maximise the use of the waste heat matching on this way heat production and demand. For this, several configurations of the district heating network will be modelled in APROS, a multifunctional dynamic simulation tool and linked to the CITYOPT tool which will optimise the design to determine the best solution in terms of energy, CO_2 emissions and economic efficiency. Additionally, due to the novelty and complexity of such system a new business model has been developed to outline its economic viability.

Experimental features of an Organic Rankine Cycle based micro-CHP system for domestic boilers

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Micro-scale toping cycle cogeneration schemes (i.e., producing less than 2 kWe of electric power), such as those based on Organic Rankine Cycle, are among the approaches that are being looked forward for application in domestic combi-boilers. For powers over 50 kWe this scheme of cogeneration technology has already reached the maturity, but several problems are creating difficulties to its size reduction. Among these problems, we mention in particular the non-availability of both suitable vapor expanders and direct-fired working fluid vaporizers. As for the vapor expander, inverted compressors (typically of the scroll type) are being used with moderate success. To overcome the second problem, different kinds of indirect vaporization are being used but are clearly not the best option for a combi-boiler, in which the response time is crucial.

In this work, some of the most interesting experimental features of a simple low pressure (less than 15 Bara) ORC based micro-CHP combi-boiler during the transient (start-up) and steady-state phases of operation are described. The working fluid is R-245fa. A direct-fire vaporization gas burner and a scroll expander are used. The facility is heavily instrumented, allowing semi and fully automated controlled modes of operation of the micro-CHP.

During the transient phase, an unexpected (and potentially dangerous) overshoot of the superheated vapor temperature at the vaporizer's exit was observed. The features (e.g., high sensitivity to the composition of the natural gas used as the burner's fuel), physical nature and control of this overshoot are described, explained and achieved, revealing, namely, important differences between "cold" and "hot" (i.e., a short time after the last shut off) start-ups. The influence of the control variables (nominal heat power rate of the vaporizer's burner and speed of the pump) are also investigated.

In the steady-state phase, clearly the most interesting phenomenon observed is a small (c.a. 30 kPa) pressure rise of the working fluid across the vaporizer, instead of the expected pressure drop (e.g., observed during the transient phase in simple boiler operation mode). Plausible physical explanations are offered for it but its full understanding still requires more accurate and detailed experimentation. The steady state behavior of the micro-CHP (e.g., global thermodynamic efficiency, hot water temperature, maximum working fluid temperature and pressure) is also fully characterized in the control planes of (pump speed) versus (nominal heat power rate of the burner) for given (expander speeds), for various sceneries of cold water temperature and mass rate.

Heat transfer enhancement in a channel with new longitudinal vortex generators

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Abstract

In plate-fin or fin-tube heat exchangers the flow between the plates can be considered as a channel flow. For reduction of the thermal resistance, the heat transfer coefficient needs to be augmented. The heat transfer coefficient can be increased by longitudinal vortex generators (LVGs), which can be punched from the main plates or attached to them. In this study, the augmentations of heat transfer in a rectangular channel with triangular and rectangular vortex generators are evaluated. A longitudinal vortex generators (LVGs) on heat transfer surface is one of the most widely employed heat transfer enhancement techniques. This technique is used for thermal equipment such as heat exchanger, internal and blade cooling of gas turbine. A new punched triangular vortex generators (PTVGs) and punched rectangular vortex generators (PRVGs) are developed. The triangular and rectangular vortex generators were punched directly from the longitudinal winglet at attack angles of, 15^o, 45^o, and 75^o, respectively. Measurements are carried out for a rectangular channel of aspect ratio AR=2, winglet transverse pitch (S) to longitudinal winglet height (e) ratio of S/e=0.59, and a winglet height (e) to channel height (H) ratio of e/H= 0.8. The Reynolds numbers considered for the channel flow case. The heat transfer results were obtained using an infrared thermal imaging technique. The heat transfer results of the vortex generators are compared with those of a smooth plate. Also pressure drop results are compared with those of smooth plate. The best heat transfer performance was obtained with the PTVGs.

Keywords: Punched vortex generators; Heat transfer enhancement; Infrared camera; Pressure drop

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Experimental investigation of impingement heat transfer on a smooth and helical shaped ribs plate

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Abstract

Impingement heat transfer is considered as a promising heat transfer enhancement technique. Impinging jets have received considerable attention during the last decade. The reason is mainly due to their inherent characteristics of high rates of heat transfer besides having simple geometry. Among all convection heat transfer enhancement methods, it provides significantly high local heat transfer coefficient. Due to their widespread applications ranging from electronics equipment and turbine blade cooling to drying of textiles and glass tempering, impinging jets have been studied extensively in the literature. The heat transfer measurement over a surface with helical shaped ribs by a circular impinging jet was investigated using thermal infrared camera. Jet in the array should exhibit the same initial velocity profile. A plenum section is constructed that met this demand. The impingement section is open on all four sides providing free outflow of the spent air. The rib pitch (p) to rib height (e) ratio is 4.6. Helices were cut from aluminum material has a diameter of 100 mm. During the experiments, the different Reynolds number and different jet-to-plate distance spacing was studied. The heat transfer results of the helical shaped ribs are compared with those of a smooth plate. The presence of the helical shaped ribs on the target plate produce higher heat transfer coefficients than the smooth plate.

Keywords: Helical shaped ribs; Confined impinging jets; Heat transfer; Infrared camera.

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Obtaining of a new yeast strain of *S. cerevisiae* for improved production of the 2nd generation bioethanol.

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Today, one of the most widely used biofuel is the second generation bioethanol. It is produced from lignocellulosic raw materials by enzymatic hydrolysis and ethanol fermentation. During the production of bioethanol, yeasts play an important role, which yeasts may be exposed to adverse environmental conditions, what consequently may affect negatively the efficiency of the fermentation process. The environmental stresses may include increased concentration of ethanol, increased formation of toxic by-products during the process, and high osmotic pressure associated with the increase in the concentration of sugar and minerals.

In the case of simultaneous enzymatic hydrolysis and fermentation the difference between optimum temperature for enzyme action and growth of yeast cells is one of the difficulties. The main problem for the yeast is efficient fermentation of pentose. Undoubtedly, yeast cells are the most sensitive link in the whole process of industrial production of bioethanol.

In order to develop an efficient fermentation process it is necessary to intensify works on improvement of currently available industrial strains of yeasts for increased fermentation activity and tolerance to environmental stress. Literature on the subject in recent years refers to a new method of genetic modification known as genome shuffling. This method is based on chemical mutagenization of initial strains and further selection of mutants characterized with exceptional technological properties, which characteristics can be regarded as advantageous for developing of a new efficient strain. The mutants with exceptional enhanced characteristics (e.g thermotolerance, resistance to toxins and high osmotic pressure) are subjected to protoplastization i.e. removing of their cell wall. Then cell fusion is carried out in hope that the hybrids will have simultaneously a few of the features present in single mutants. As a result of genome shuffling at least two or three technological features will appear that are better than in the initial cells.

The paper presents the results of a genome shuffling - were created hybrids, which were then subjected to the screening test for the volumetric ethanol productivity, toxin resistance.

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Comparison of cellulolytic enzyme effect on hydrolysis in bioetanol production.

Dominika Pieprzyk-Kokocha, Jolanta Batog, Aleksandra Wawro

Renewable sources of energy and innovative technologies determine the economic development to higher and higher degree. Currently, bioethanol produced from plant biomass is considered the basic alternative energy source. The process of producing bioethanol form lignocellulosic materials can be divided into a few stages. The final result of the whole process depends very much on pretreatment stage, which involves preparation of the material for enzymatic hydrolysis and ethanol fermentation processes. The pretreatment process of plant biomass includes two phases: mechanical disintegration of the material and subsequent physical-chemical treatment. The main technological challenge is the complexity of chemical composition of the lignocellulosic materials. The lignocellulosic complex consists of cellulose (a glucose homopolymer), which is the fraction most useful for the bioethanol production, hemicelluloses (copolymers of carbohydrates), which constitute a fraction only partially useful, and also of lignin (a polymer formed from phenol derivatives), which is a fraction that inhibits biomass processing and is totally useless in bioethanol production. The most commonly used physical-chemical treatment of biomass is alkaline treatment allowing for removal of lignin and partial degradation of hemicelluloses and also acid treatment which results in efficient hydrolysis of hemicelluloses, what allows for preparation of the cellulose fraction for enzymatic digestion. Subsequently, it is important to exposure of monomer sugars obtained by enzymatic hydrolysis to the action of distillers yeasts in fermentation proces. Synergistic action of enzymes in the process involves their attack on cellulose by attaching to cellulose fibres (microfibrils) in amorphic sites, cleveage of cellulose chains, cutting off large chain fragments, followed by their decomposition until obtaining of glucose.

The aim of the study was to compare the action of commercially available enzymatic preparations: Flashzyme Plus 200 (AB Enzymes), Celluclast 1.5L (Novozymes), ACx3000L (Enzyme Supplies), Novozyme 188 and xylanase on lignocellulosic raw materials i.e. sorghum and miscanthus. The plant material was disintegrated and exposed to alkaline physical-chemical treatment at elevated temperature. The study included testing, according to Miller's method, the effect of the selected enzymatic mixtures on the content of released reducing sugars, what enabled to determine their usefulness in the process of enzymatic hydrolysis during bioethanol production.

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Comparison of acidic and alkaline treatment in saccharafication of sorghum biomass in ethanol production

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In recent years the increase in consumption of fossil biofuels, environmental pollution and threat of greenhouse effect have forced a dynamic development of alternative sources of energy. Currently, one of materials for bioethanol production (second generation biofuels) might be sorghum, an alternative plant for bioenergy production, which is characterized with high calorific value and high yields of dry biomass. Biofuel production from lignocellulosic materials requires degrading cell walls to specific polymers and hydrolysis of carbohydrates to monomer sugars. Cellulose, hemicellulose and lignin constitute three main lignocellulose components and are bonded together to for a complex matrix, highly recalcitrant to chemical and biological conversion. One of the main factors behind difficulties in biomass saccharification is lignin, which intertwines with hemicellulose covering microfibrils of crystalline cellulose. This forces subjecting the material to pretreatment, which affects significantly the course of the further stages of bioethanol production i.e. enzymatic hydrolysis and fermentation process, and determines the final efficiency of the process. The aim of the biomass treatment is disintegration of the solid phase and damage of compact lignocellulose structure. Additionally, it is aimed at enlargement of the surface area that is in contact with the enzymes and at limiting the crystallization and polymerization degree of the cellulose. Three main types of pretreatment methods are distinguished for lignocellulosic materials: physical, chemical and biological ones. Depending on the selected method different changes occur within the lignocellulosic complex. Chemical processes include dilute acid treatment (sulfuric acid, more rarely muriatic acid), alkali treatment (sodium hydroxide, calcium carbonate and also ammonia), neutral treatment (ionic liquids), organosolv process using organic solvents, SO_2-steam explosion, ammonia fiber explosion (AFEX), ammonia recycle percolation (ARP) and ozonolysis.
The aim of the study was comparison of acidic and alkaline pretreatment of sorghum biomass (of Sucrosorgo 506 variety) during preparation of the material for bioethanol production. The effect of sulfuric acid and sodium hydroxide on the value of released reducing sugars in Miller's method in the enzymatic test with the use of Celluclast 1.5L preparation (Novozymes). Subsequently, content of cellulose, hemicellulose and lignin was determined in the solid fraction formed after the treatment, while for the liquid phase (acidic treatment) toxins and pentoses were determined. Also, FTIR spectra analysis was run of sorghum biomass before and after acidic and alkaline treatment. To sum up, the alkaline pretreatment involved mainly delignification and partial degradation of hemicellulose, while the acidic treatment dissolved most hemicellulose and low amounts of lignin.

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The challenges in achieving biodiesel target of renewable energy policy in Thailand

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Energy consumption in Thailand has increased in line with the country's economic expansion and population growth. The imported energy is the main source of Thailand. Oil import has the highest proportion at 80% of total domestic oil consumption, with an increasing trend from 297 million barrels in 2010 to 318 million barrels in 2013. The value is over 1,000 billion THB (approximately 31 billion US dollars).

The Thai government has promoted the Renewable and Alternative Energy Development Plan for 25 percent in 10 years (AEDP 2012-2021) to develop alternative sources of renewable energy in order to replace fossil fuel and oil import, and to move towards the low carbon society. Palm-oil based biodiesel is one of the attractive renewable fuel in Thailand. The policy production target is set at 5.97 milliliter per day by 2021. Such that 880 thousands hectares of oil palm plantation will be required. In 2013, Thailand had approximately 720 thousands hectares of oil palm plantation with the target gap of 160 thousands hectares. In response to land availability for oil palm expansion, the strong legislation to protect the forest has effectively forced the expansion mainly taking place on pre-existing croplands, causing the risk of local crop lost and the competition for land utilization between energy crop and food crop.

The average of oil palm fresh fruit bunch (FFB) yields and overall oil extraction rates (OER) in Thailand during 2005-2009 are 16.8 ton per hectares and 16.6%, respectively. Malaysia and Indonesia, the world leaders of oil palm producers, have a much higher rate above 40 ton per hectares of FFB and 25% of OER. The approximate value between this gap is several billion THB. This can be explained by that oil palm plantations in Thailand are mostly owned by local farmers and smallholders. Consequently, planting technologies and lacking capital are the main factors to lower yield and quality. Despite this, the Thai government is optimistically looking at the issues as an opportunity to stimulate economic systems in rural areas and thus providing farmers' income distribution and better quality of life.

To achieve the policy target, the Thai government has currently provided (1) subsidies in various forms to farmers as an incentive to convert their croplands to oil palm plantation, (2) cash grants for technology research and development, (3) research funds for a better practice in farm management and rural development studies, and (4) research funds for possibilities of exportation in the future, concerning with the international protocols such as RSPO. These strategies have been developed in consideration of lessons from the past on dramatic deforestation, massive biodiversity losses and extinction of species that have been occurring in other oil palm producing countries. These promising strategies are therefore the challenges.

Keywords: alternative energy policy, food and enery crop competition, biofuel, oil palm expansion, RSPO

Microalgae Cultivation with Livestock Waste for Continuous Production of Biofuels

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In response to energy crisis, global warming and climate changes, bioenergy has received much attention and will hopefully become one of the major energy sources for both developed and developing countries. Algal biofuels as the renewable and alternative energy types have come under increased research interest in an effort to work towards sustainable development. The growth of microalgae requires large amounts of chemical or organic fertilizers which are easily dissolved in rainwater or runoff, leading to the direct and indirect releases of nutrients into the environment. To avoid the above issues, cultivating microalgae with wastewaters as nutrient sources appears a promising option for nutrient removal and biofuel production. Microalgae can significantly improve water quality, since nutrients (mainly nitrogen and phosphorus) in wastewater can be absorbed and incorporated into microalgal cells, achieving contaminant removal. On the other hand, livestock production is rapidly increasing especially in developing countries because of increased consumption demands for meat. As a result, large quantities of animal wastes are left over, threatening environmental hygiene and becoming a barrier for development if not disposed of appropriately. Hence, effective management of livestock wastes is also extremely important. In this paper the feasibility of microalgae cultivation with livestock waste for continuous production of biofuels will be evaluated. In this concept, livestock waste compost will be chosen to cultivate microalgae and the biomass will be harvested to continuously produce biodiesel and biogas. Apart from biodiesel production, digestion of microalgal residues will be investigated as well in order to improve the economics of microalgal biofuels. Applying livestock waste compost to cultivate microalgae for biofuel production appears as a sustainable solution to realize both livestock waste management and biofuel recovery, thus driving the industry towards sustainable growth.

Keywords: microalgae; biofuels; livestock waste; microalgae biorefinery

Geothermal System: A pioneer project at the American University of Madaba (AUM)

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Abstract

Jordan is an energy importing country with about 98.8% of its needs being supplied from abroad as crude oil, gas and refined products. On the other hand, Jordan will be ready for nuclear energy by the year 2025 but until then its annual spendeture on imported energy will be about 4 billion Jordanian dinars. Thus, a radical solution has to be found. At the American University of Madaba (AUM) we are leaders in positive engagement with the environmental and human security issues, which have been addressed in the university vision, policy, and strategy. AUM campus is used a clean and renewable energy such as; green buildings, clean transportation, omit all burners, chimneys, and any system that cause pollution. In addition, we are using a geothermal system for heating and cooling purposes. This is the largest project in the Middle East. Geothermal system is an environmental friendly system which provides about 40% of the annual electrical energy.

***Keywords*: Geothermal Heat Pump; Feasibility; Coefficient of Performance**