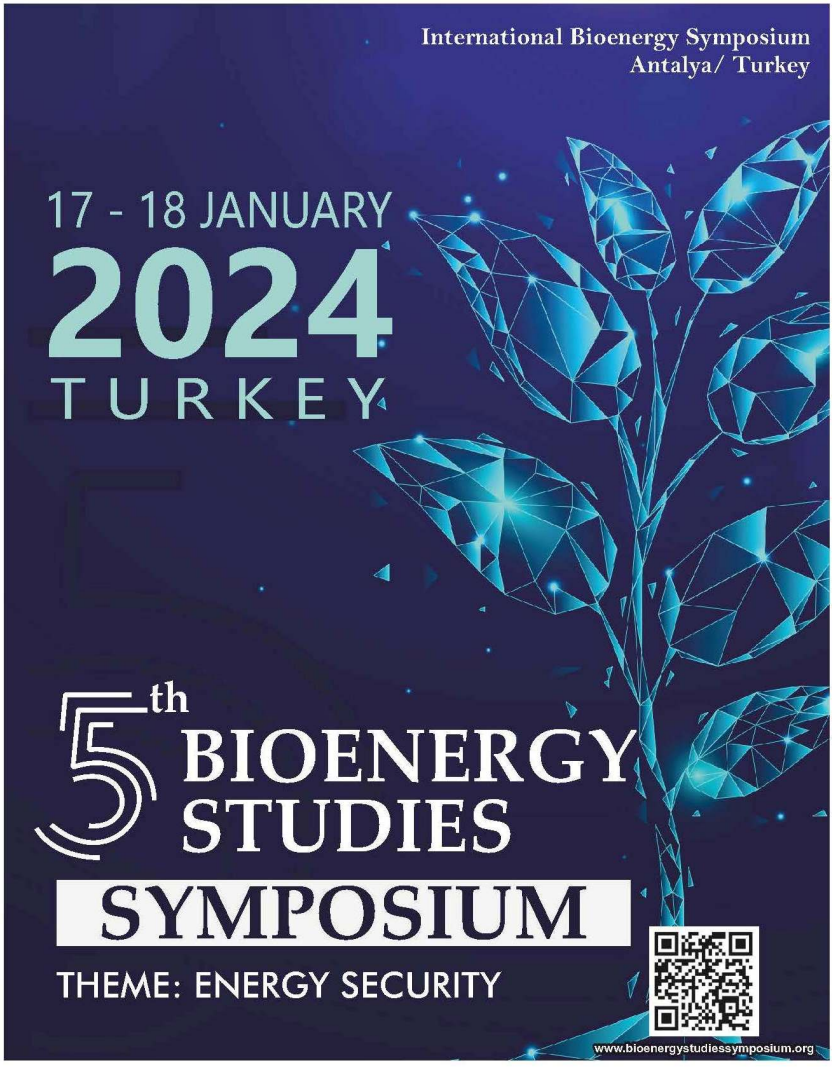

ABSTRACTS OF PAPERS

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“ Sustainable Biomass Use Project to Support the Development of the Turkish Economy towards Green Growth”

5th Bioenergy Studies Symposium
17-18 January 2024 – Antalya / TURKEY

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17 - 18 JANUARY 2024

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	10:00	Group Photo	
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11:00	**11:30**	**Invited Speaker**	**Prof. Dr. Nuri AZBAR** Decarbonization and Defossilization Opportunitiesin Agricultural Sector Towards European Green Deal
11:30	**12:00**	**Invited Speaker**	**Prof. Dr. Martin KALTSCHMİTT** Emission Reduction during Solid Biofuel Combustion – Possibilities and Constrains of Fuel Additives
12:00	**12:30**	**Invited Speaker**	**Prof. Dr. David HERAK** Palm Oil As A Potential Source of Biomass Energy: A Stakeholder's Perspective Informed by Two Decades of Experience
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AHMAD NAWAZ
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HAYAT A HADDAD
Co–Pyrolysis of Microalgae Biomass With Plastic Waste Towards Clean Fuel and Valuable Chemicals

GÖRKEM AKINCI
Statistical Evaluation of the Viability of Biodegradable Solid Waste and Agricultural Waste Biomass for Biochar–Focussed Pyrolysis in the Aegean Region–Turkey

AYTEN ATEŞ
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AĞAH YILDIZ
High–Pressure Gas Uptake Performance of Activated and Non–Activated Hydrochar

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AHMET ALP ŞENOCAK
Bioenergy Network Design Using Forecasting, Spatial Analysis and Mathematical Modelling

SEDA ŞAHİN
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MUHAMMED ÇELİK
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OSMAN EMRE ÖZKAN
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ÇAĞRI OLGUN
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ORAL PRESENTATION ABSTRACTS

PAPER : 01

High-pressure gas uptake performance of activated and non-activated hydrochar

Ağah Yıldız,* Utku Dereli , Murat Kılıç, Esin Apaydın Varol

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Abstract

In this work, hydrochar was prepared from hazelnut shell via hydrothermal conversion and then activated using KOH as an activating agent for its potential utilization in environmental applications. The CO_2 adsorption capacities of activated hydrochar (HTCAC) and non-activated hydrochar (HTCHC) were investigated at three representative temperatures (0°C, 15°C and 25°C), and the temperature-dependent CO_2 adsorption results were obtained. HTCHC showed adsorption results of 0.588 mmol/g (0°C), 0.430 mmol/g (15°C), and 0.359 mmol/g (25°C) at 1 bar pressure. Meanwhile, under the same conditions, HTCAC demonstrated better results compared to HTCHC, with 4.579 mmol/g (0°C), 3.780 mmol/g (15°C), and 3.322 mmol/g (25°C). The CO_2 adsorption of HTCHC was the highest at 0°C (3.959 mmol/g), followed by 15°C (2.384 mmol/g) and 25°C (1.959 mmol/g) at 30 bar pressure. A similar trend was observed in the CO_2 adsorption results of HTCAC, where the highest adsorption occurred at 0°C (8.108 mmol/g) at 30 bar, followed by 15°C (6.896 mmol/g) and 25°C (6.575 mmol/g). In addition, HTCAC exhibited moderate isosteric heat, fast adsorption kinetics, and stable recyclability. Also, it had a serious potential for CO_2 adsorption applications that contribute to carbon neutrality and circular economy.

Keywords: Biomass, carbon dioxide uptake, chemical activation, hydrochar, hydrothermal conversion

PAPER : 02

Impact of temperature severity on hydrothermal carbonization: Fuel properties, kinetic and thermodynamic parameters

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Abstract

The current study intended to explore the impact of hydrothermal carbonization temperature (180, 230, and 280 °C) on the fuel properties, kinetics, thermodynamics, and reaction mechanism of sunflower stalks (SS). Hydrochars obtained at different temperatures were pyrolyzed in a TGA (Thermogravimetric analyzer) at three distinct heating rates. The impact on functional groups, surface morphology, and crystallinity was examined based on the characterization methods such as FTIR, FE-SEM, and XRD. The kinetic parameters were estimated based on the isoconversional methods of Kissinger Akahira Sunose (KAS), Ozawa Flynn Wall (OFW), and Vyazovkin (VZK), whereas the reaction mechanism was deduced employing Z(α) master plot method. The mean value of activation energy obtained for the raw-SS, SS-180, SS-230, and SS-280 was (188.71, 189.06, and 176.4 kJ/mol), (165.6, 167.33, and 155.54 kJ/mol), (219.77, 218.78, and 206.83 kJ/mol), and (299.37, 296.6, and 281.02 kJ/mol) based on KAS, OFW, and VZK method, respectively. The findings of the study can be used to develop and design pyrolysis reactors for clean biofuel generation from SS.

Keywords: Low value biomass; Hydrothermal Carbonization severity; Pyrolysis; Kinetics

PAPER : 03

Bioenergy network design using forecasting, spatial analysis and mathematical modelling

Ahmet Alp Senocak, Hacer Guner Goren

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The role of renewable energy sources to compensate global energy demand has been increasing day by day. Renewables, which are less harmful to environment than fossil fuels, have been supported by governments, organizations and scientists.Biomass can be considered as a prominent source, which includes various wastes can convert to gaseous, solid and liquid products via chemical and physical processes. One of the drawbacks of bioenergy is the necessity to transport high volumes of raw materials. Therefore, effective design of bioenergy network is crucial for system profitability.This study proposes a three-phased integrated approach for biomass supply chain network design. In the first stage, various biomass resources have been forecasted using an artificial intelligence (AI) method, support vector regression (SVR). Then utilizing geographic information systems (GIS) and a multi criteria decision-making technique,Decision Making Trial and Evaluation Laboratory (DEMATEL), potential areas for location of biogas facilities have been determined. In the final phase, considering annual net present value streams,the biomass supply system has been designed via a mixed integer linear programming model. The proposed integrated framework was applied in Denizli province and the results showed that the proposed approach can be efficiently used in forecasting biomass raw materials and determining locations of biogas plants precisely.

Keywords: Biomass forecasting, facility siting, support vector regression, geographic information systems, multi criteria decision making.

PAPER : 04

Dark Fermentation from Waste Fig (*Ficuscarica*): Determination of the Effect of Substrate Concentration

Alime Şenocak[1], Hidayet Argun[1]

[1] Environmental Engineering Department, Engineering Faculty, Pamukkale University, 20020, Denizli, Turkey

In this study, biohydrogen production experiments were conducted from waste fig(*Ficuscarica*) by dark fermentation. In order to determine the effect of initial fig concentration in fermentation experiments, liquid fig syrupwith sugar concentrations of 5 g/l, 10 g/l, 20 g/l, 30 g/l and 50 g/l was used. All experiments were performed in duplicate at 37°C. Stock fig syrup solution containing 130 g/l sugar was obtained by boiling powdered figs in water. Solutions with different sugar concentrations used in fermentation experiments were prepared by diluting the stock solution. According to the test results, the highest cumulative hydrogen production; 722 mL was obtained at a substrate concentration of 30 g/L. Cumulative hydrogen and time data for 30 g/L substrate value, which has the highest cumulative hydrogen value, were correlated with MATLAB R2019b (trial version) software to determineGompertz coefficients; The lag phase was determined as 1.49 hours, the hydrogen production rate was 9.17 mL/hour, and the maximum cumulative hydrogen volume was 711 mL.

Keywords: Hydrogen production, dark fermentation, waste fig.

PAPER : 05

Effect of iron precursorson the properties of magnetic biochar composites for H_2O_2 sensing

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[b]Sivas Cumhuriyet University, Faculty of Engineering, Department of Metallurgical and Materials Engineering, Sivas, Türkiye

Iron-containing biochar has recently become very attractive for various applications such as pollutant removal, catalysts, sensors, supercapacitors, etc.due to its promising properties. Depending on the application area, the production method can be changed, e.g. by co-precipitation, direct pyrolysis of biomass and metal salts, impregnation pyrolysis, ball milling, hydrothermal carbonization, reductive co-deposition, microwave-assisted pyrolysis and cross-linking of biochar and iron oxides.In addition, the pyrolysis conditions, the biomass source, the iron precursors and the preparation technique can affect the properties of the composite material and the development of iron oxides in the biochar.For this purpose, magnetite-biochar composites were synthesised in this study using different iron salts, $FeCl_2.4H_2O$ (Fe(II)), $FeCl_3.6H_2O$ (Fe(III)), $C_{15}H_{21}FeO_6$ (Fe-AA) and $NH_4FeSO_4.4H_2O$ (Fe-NS), were prepared using a solid-state method involving mechanical mixing of iron salt and hazelnut shell biomass followed by pyrolysis at 550 °C for 3 hours under a nitrogen atmosphere. All prepared samples were characterised by XRD, SEM-EDS, XRF, N_2 adsorption-desorption and FTIR.The XRF results showed that the iron content of the composite material at 1/6 (w/w) iron/biomass ranged from 7.0 to 10.5 wt. %. The SEM images of the composites showed that the iron salt significantly influenced the morphology of the composites: leafy structure with Fe-NS, flower-like structure with Fe-AA, precipitation of iron oxides in the structure of the biochar for Fe(III)) and Fe(II).The surface area and pore properties of these samples were altered as a function of the iron precursors. The highest surface area and pore volume were obtained with Fe(III) at 566.3 m^2/g and 0.31 cm^3/g, respectively. When the ferrous biochar was used for an

electrochemical sensor platform to detect H_2O_2, the highest detection behaviour was obtained with Fe-NS despite the lower surface area of the material. This could be due to the effect of sulphur and nitrogen together with iron oxides on the formation of OH.

Keywords: Biochar; iron oxides, H_2O_2 sensing

Acknowladgment : This project was supported by Cumhuriyet University Scientific Research Fund with project number M-2021-825.

PAPER : 06

The Requirements of Credit Providers for Financing in Bioenergy Projects

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Abstract:

Among renewable energy sources, bioenergy holds a more advantageous position in terms of circularity compared to other energy sources. Particularly in agricultural lands, the collection of less suitable, woody, and high-calorific-value residues for the production of solid biofuels as an alternative to coal can significantly reduce the use of lignite.

In Turkey, the legislation for sustainable energy is based on the Renewable Energy Law (YEK) enacted in 2005. As part of Turkey's domestic and national energy policy, the "Renewable Energy Resources Support Mechanism (YEKDEM)," established and implemented since 2011, provides various incentives for market players to invest in renewable energy sources. Since then, numerous financiers, including private and public banks and leasing companies, have supported the implementation of energy projects by providing credit, benefiting from the confidence instilled by the state's purchase guarantee.

Sustainable energy facility projects are costly endeavors. Therefore, a significant portion of investors seeks support from financiers and programs that provide grants to realize their projects, as many investors may not wish to use their entire capital for these projects.

Lenders request investors to provide them with project-related information to review and assess its suitability before offering support. Within this framework, the demands of lenders from investors and the key points that investors should pay attention to in these requests have been examined.

Keywords: Investment, Incentive, Bank Loan

PAPER : 07

Biochar on the path from biomass energy to regenerative agriculture

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Abstract

The transition from conventional agriculture and energy production to sustainable and regenerative practices is of paramount importance in addressing the global challenges of climate change, soil degradation, and resource depletion. One promising technology at the intersection of these critical issues is biochar, a carbon-rich product resulting from the pyrolysis of biomass. This paper summarizes the multifaceted role of biochar in bridging the gap between biomass energy generation and regenerative agriculture.

Because of its high carbon content and exceptional soil-enhancing properties, biochar holds great potential for mitigating greenhouse gas emissions by biomass energy production while simultaneously rejuvenating soil health. Through its incorporation into agricultural soils, biochar not only sequesters carbon but also enhances nutrient retention, water holding capacity, and microbial activity, thereby fostering a more resilient and productive agroecosystem.

In the context of biomass energy, the utilization of biochar helps to reduce carbon emissions, as it locks carbon in a stable form and can displace fossil fuel-based energy sources. This duality of biochar's application aligns with the principles of a circular economy, where waste is transformed into a valuable resource.

Furthermore, the use of biochar fosters a closed-loop system when integrated into agroforestry and bioenergy projects, promoting the sustainable management of biomass resources. By creating synergy between biomass production, energy generation, and soil improvement, biochar embodies a holistic approach to land use that emphasizes ecological restoration and long-term agricultural resilience.

This paper underscores the potential of biochar as a key element in the transition towards regenerative agriculture, where soil health and carbon sequestration become cornerstones of sustainable land management. The exploration of biochar's role in biomass energy production and its application in regenerative agriculture will help realize a more resilient and carbon-neutral future. However, it is crucial to address potential challenges and optimize application techniques to unlock the full potential of biochar in this integrated approach.

Keywords:sustainable agriculture, carbon sequestration, soil health, circular economy.

PAPER : 08

Evaluation of SorghumBiomass Components for Drought Tolerance at Seedling Stage in Polyethylene Glycol (PEG)

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Sorghum (Sorghum bicolor L. Moench), which is the fifth most important cereal crop worldwide, has high biomass yield potential for bioenergy production.Drought is a prominent environmental factor that significantly effects the growth and biomass of sorghum. This study was conducted to evaluate sorghum biomass components for drought tolerance at the seedling stage in various concentrations of PEG (polyethylene glycol). The experiment was carried out with one sorghum cultivar seeds that were subjected to water stress using PEG 6000 (0%, 10%, 15%, 20%, 25%, and 30%) with three replications. After eight days data were recorded for root length, shoot length, shoot weight and fresh weight while germination rate was recorded daily. The findings of the study indicated a negative correlation between PEG concentration and germination energy, wherein an increase in PEG concentration from 0 to 30% resulted in a reduction in germination rate. Moreover, it was determined that higher PEG concentrations extend the duration of germination. The development of roots and shoots exhibited a significant decrease with increasing concentrations of PEG, while the biomass weight was at its maximum at peg concentrations of 15%. Understanding the morphological effects of drought stress in the seedling stage for biomass components provides valuable insights into the biological mechanisms that influence productivity. This knowledge may contribute to the enhancement of bioenergy production in sorghum.

Keywords: Drought, Bioenergy, polyethylene glycol, Sorghum.

PAPER : 09

Developing microalgae-based sustainable CO_2 reduction strategies and investigating the potential of microalgal biomass as biodiesel, biodegradant and biosorbent-based green energy source-1001 project sample

Burcu ERTİT TAŞTAN[1,2], Günnur ORHAN[2], Orhan CANBOLAT[1,3], Ülküye Dudu GÜL[4], Adviye Gülçin SAĞDIÇOĞLU CELEP[5], Bahtiyar BAKIR[2]

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One of the majör problems in the environment is climate change and it affects all livings. The continuous increase in emissions of many greenhouse gases, including carbon dioxide (CO_2), water vapor, methane and nitrous oxide, is affecting climate change. The increase in these emissions is mostly related to anthropogenic activities and fossil fuels are the biggest contributors. In particular, efforts are made worldwide to reduce CO_2 emissions, but the availability of a widely accepted technology still cannot be mentioned. Microalgae are the primary producers of biomass and contribute to the sustainability of the Earth by converting CO_2 to O_2. Moreover, the valuable biomass produced through wastewater treatment and cleaning of flue gases can potentially contribute to the bioeconomy by developing new applications with microalgal biotechnology. As a solution to the increasing global CO_2 and flue gas emissions, which are a great

threat to the environment; Microalgae species can be a savior. In this Project sample we aimed to optimization for high efficiency biomass production with the effect of the use of modified wastewater, use of algal biomass to be obtained under optimum conditions as a biodegradant in the removal of triclosan pesticide by biodegradation, determination of biodiesel production capacities with FAME analyzes, use of the remaining material after biodiesel production as a biosorbent in the biosorption of triclosan pesticide.

"Zero pollution action plan for air, water and soil", which is the most important output of the Green Consensus, aims to consider environmental pollution as the primary criterion, to realize economic growth in a way that does not cause environmental pollution, to review air quality and water quality standards, and to reduce pesticide input. is based. The project proposal has a work plan in line with the Green Consensus and takes the goal of zero pollution for air, water and soil, which the action plan addresses, as the primary objective. In addition, the 11th Development Plan addressed "The increasing pressure on the environment and natural resources, environmental problems such as environmental pollution, climate change and loss of biodiversity, accelerated climate change with the effect of high greenhouse gas emissions, posing a serious threat to humanity and sustainable environment and natural resources. It includes targets and actions in line with the topics of "the construction of the new administration gaining importance" and many articles of the 11th Development Plan, and the results are aimed to be a reference in the national and international arena.

Keywords: Biodiesel, biosorbent, CO_2 emissions, flue gas, green energy, microalgae, pesticide, waste water

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PAPER : 10

Ammonium sulfate fertilizer production and water recovery from liquid digestate with mechanical vapor recompression technology

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ABSTRACT

Biogas is a sustainable energy source produced by anaerobic digestion (AD) of biologically degradable organic feedstocks such as highly loaded wastewater, organic fractions of municipal solid waste, agricultural and animal waste, and energy crops generally rich in organic matter. Most anaerobic digesters currently produce electricity and heat using either electricity-only, heat-only, or combined heat and power. AD is an important process used not only in the production of biogas but also in the stabilization of wastes. Aside from generating energy and stabilization of wastes, the anaerobic digestion of biodegradable residue provides the production of fertilizer from solid and liquid digestate.Although digestate could be useable as fertilizer without any pretreatments, the storage, handling, and transportation of digestate create visible costs for farmers because of its very low dry matter content and large volume. Hence, one of the major issues of the AD process is the disposal or re-using of digestate which contains only 2.5% dry matter,while the solid phase of digestatecontains 20-25% dry matter.

This study aims to address environmental threats, especially those arising from liquid digestate, and to create economic value by

transforming it into valuable fertilizer resources. Within the scope of this study, mechanical vapor compression (MVR) technology was used to convert ammonia to ammonium sulfate ($(NH_4)_2SO_4$), recoverwater like purewater quality, and obtain organic fertilizer containing low aqueous phosphorus and potassium. Since the temperature in the proposed process is around 100°C, pathogenic risks are also eliminated.In order to remove impurities in the evaporation process, the ammonia that comes with the evaporated water is washed with sulfuric acid while it is at a temperature higher than the boiling temperature of the water, that is, it is not allowed to condense, and pure steam is obtained by converting the ammonia gas into ($(NH_4)_2SO_4$). Obtaining pure steam is an important factor for reusing the same steam as a heat source. Since the condensate of purified water vapor is pure, it makes it possible to reuse it both as water needed for preparation of solid waste to digestion for dilution. According to the XRD analysis, high-purity($(NH_4)_2SO_4$)fertilizer was obtained. Additionally, pH, conductivity, chemical oxygen demand, total nitrogen and phosphorus analyzes of condensate water were performed.

Keywords: Ammonium sulfate fertilizer, Anaerobic digestion,Liquid digestate, Mechanical vapor recompression, Water recovery

PAPER : 11

The utilisation of biomass in forestry for energy production by considering carbon balance

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Abstract

In the context of global imperatives for sustained growth, crises are deemed inevitable, extending beyond purely economic dimensions. The imperative for continual growth precipitates a concomitant demand for increased energy resources. This confluence is evident in rising energy costs, events impacting energy supply security, the evolution of alternative energy modalities, and policy initiatives directed at abating fossil fuel reliance to mitigate climate change effects. Consequently, there is a growing prevalence of renewable energy sources, notably biofuels, within the energy production landscape. Despite the manifold advantages associated with these bioenergy production methodologies, there exists a misalignment with desired benchmarks concerning energy production and utilization from herbaceous-woody and animal materials, along with their byproducts. A parallel situation is discernible in the domain of forest biomass. The nexus between forests, wood, and energy has assumed heightened significance in contemporary discourse. In forestry, bioenergy production is considered an alternative energy generation method to mitigate the adverse effects of climate change. This involves i. energy forestry, ii. the utilization of wood production residues in forests, iii. the use of forest industrial wastes, and iv. recyclable wood materials. The trajectory of climate change, precipitated by anthropogenic activities, notably the intensification of fossil fuel utilization and deforestation, is affecting unparalleled alterations in the global climate. Among terrestrial ecosystems, forests play a pivotal role in mitigating climate change by attenuating atmospheric carbon levels. A comparative evaluation underscores the environmental advantages of wood pellets, a prominent commodity in the biofuel market. Relative to wood pellets, the production of 1MWh of energy using natural gas results in a threefold increase in

carbon dioxide emissions, fuel oil generates emissions five times greater, and electric heating yields emissions ten times higher. In response to these considerations, regulatory frameworks governing the production, utilization, and trade of biofuels are currently being instituted.

Keywords: Carbon reduction, waste and residues, energy demand, forest biomass

PAPER : 12

Chemical Characterization of *Sambucusnigra* Wood as a Lignocellulosic Raw Material within the scope of Bioenergy Studies.

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In this study, the utilization potential of the Black Elderberry (*Sambucusnigra*) wood, which is widespread along the Black Sea coast in Turkiye, was investigated as a biomass energy source. For this purpose, the three different elderberry tree wood samples were obtained from Kastamonu province. The ash, lignin,holocellulose, alpha-cellulose content, and ethanol-water (2:1 v/v), hot water, cold water, and 1% NaOH solubility's of *Sambucusnigra*woods were determined according to standard test methods. The ICP-OES (mineral substances) and elemental analysis (C, H, and N percentages) were performed on wood samples.Iron (Fe) was found to be the most abundant heavy metal (between 3.60 and 8.69 ppm), while cobalt, copper, and arsenic minerals were not detected in *Sambucusnigra* wood samples, whose values were suitable for pellet production according to the EN 14961-1 standard.In addition, although the percentage of the N component varies depending on the growing location of the samples, it was found to be within the limit values of EN 14961-2 for wood pellet production for non-industrial uses.It has been concluded that it can be used in pellet and briquette production with its high lignin content (between 27.65% and 29.96%), appropriate ethanol-water solubility content (between 5.67% and 8.52%),and ash content (between 0.60% and 0.76).

Keywords: Biomass, mineral substances, elemental analysis, pellet production.

PAPER : 13

Production of Biochar by Biomass Gasification

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Abstract

Biochar is a product rich in organic carbon, produced by the thermal decomposition of biomass in the presence of sub-stoichiometric oxygen. The high carbon content and porous structure of biochar offer a wide range of uses such as soil conditioner in agricultural applications. The aim of this research is to characterize the biochar obtained as a by-product during the gasification of various agricultural biomass wastes and their conversion into energy. In the study, BET, SEM, EDS, XRD, FTIR analyzes were performed on biochar obtained as by-product by gasification of various biomass wastes (oak wood, walnut shells, coffee grounds) to produce syn- thesis gas for green energy production. BET analysis performed in the study showed that there were significant changes in the surface areas of biochar obtained from oak wood, walnut shells and coffee grounds. While EDS analysis confirmed the unique elemental compositions of biochar samples, differences in structure depending on biomass were revealed by XRD analysis. While SEM spectra showed differences in microporous structures between samples, FTIR re- sults showed variations in chemical compositions of different biochar samples. These results provide comparative analyses of the structural properties of different biochar samples, provid- ing important information regarding their potential and flexibility of use. This research study aims to contribute to our understanding of the differences between various biomass-derived biochar by providing detailed characterization of the biochar.

Keywords: Gasifier, Syngas, Green, Renewable, Energy

PAPER : 14

Biyokütle Enerjisinin Düşmanı: Köyden Kente Göç

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Türkiye'de 1927 yılında gerçekleştirilen nüfus sayımında şehirlerde yaşayan nüfus oranı ,2 iken, 1940 yılında bu oran ,4 ve takip eden 10'ar yıllık periyortlarla bu oran ,0; ,9; ,5; ,9; ,0; 64,9; ,3 şeklinde artış göstererek 2020 yılında ,0'a yükselmiştir. Diğer bir ifade ile belde ve köylerde yaşayanların oranı yıldan yıla azalış eğilimi göstererek adrese dayalı nüfus kayıt sistemi sonuçlarına (ADNKS) göre 2022 yılında %6,6'ya gerilemiştir. Şehirlerde yaşayan hane halkının enerji ihtiyacının hemen tamamı ücret mukabilinde karşılanmaktadır. Köy yaşantısında biyokütle kullanımı ile ilgili durum tespiti Kayseri, Yeşilhisar, Kovalı Köyü örneği üzerinden yarı yapılandırılmış görüşme ile veri toplanarak yapılmıştır. Buna göre, köyde mısır, arpa buğday gibi hububat sapları, ayçiçeği sapı ve kafası, budanmış meyve ağaçları, tezek, orman ürünleri vb. gibi çok farklı biyokütle kaynağı kullanılmaktadır. Bu biyokütle kaynaklarından bir kısmı atık maddelerden oluşmaktadır. Bu kaynaklardan elde edilen biyokütle enerjisi ısınma, yiyecek üretimi, farklı ürünlerin üretim süreçleri gibi çok farklı amaçlarla kullanılmaktadır. Köyde yaşayan nüfusun azalması nedeniyle biyokütle kaynaklarından faydalanma oranında da düşüş meydana geldiği belirlenmiştir. Bu azalışta köyde yaşayan nüfus oranındaki azalışın yanı sıra yaşam tarzı, demografik yapı değişimleri gibi faktörlerin de etkili olduğu ortaya çıkartılmıştır. Türkiye'de biyokütle enerjisi kullanımına yönelik teşvikler ve tedbirler söz konusudur. Kentten köye tersine göçün teşvik edilmesi biyokütle enerjisinin arttırılmasına büyük katkı sağlayacağı açıktır. Bunun yanı sıra enerjide büyük oranda dışa bağımlı olan ülkemizde köy yaşamının özendirilmesinin ülkenin enerji maliyetinin azaltılmasına da katkı sağlaması mümkündür.

PAPER : 15

The Future and Policy Needs of Biomass Energy in Türkiye

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Abstract

Turkey stands at a pivotal juncture in its energy landscape, facing the dual challenge of meeting rising energy demands while transitioning towards sustainable, renewable sources. Among these, biomass energy emerges as a promising alternative, harnessing the country's abundant agricultural residues, forestry biomass, and municipal solid waste. This paper explores the current status, potential, and policy imperatives for the future of biomass energy and its conversion methods within Turkey.

Highlighting the existing utilization of biomass resources and their contribution to the energy matrix, this study delves into the untapped potential of these resources for significant energy generation. It assesses the technological advancements in biomass conversion methods—such as anaerobic digestion, pyrolysis, incineration and gasification—and their adaptability within Turkey's unique socio-economic context.

In addressing the challenges of scalability, economic viability, and environmental impact associated with biomass energy, the paper advocates for tailored policy interventions. It evaluates the current policy landscape, identifying gaps and proposing targeted incentives and regulations to accelerate the growth of the biomass energy sector.

Drawing insights from successful international case studies, this paper offers a roadmap for leveraging best practices in biomass energy implementation and adaptation to Turkey's specific conditions. Ultimately, it underscores the critical importance of strategic policies and technological innovation in fostering a sustainable and diverse energy portfolio for Turkey's future.

As Turkey navigates its energy transition, embracing the potential of biomass energy through informed policies and innovative approaches stands as a transformative opportunity, driving both economic growth and environmental stewardship.

Keywords: biomass, bioenergy, policy, Türkiye.

PAPER : 16

Production and characterization of boron-added biochar for its potential utilization in agriculture

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Biomass, a renewable energy source, has attracted the attention of scientists because of its various applications. Biochar, a product of the thermochemical degradation of biomass, has the potential to decrease carbon emissions and enhance agricultural yields via soil amendment. Tailored biochar production is crucial in agriculture to meet plant nutrient requirements. The incorporation of boron minerals, which are essential nutrients for plant growth, into agricultural biochar guarantees the retention of boron in the soil for an extended period, thereby preventing its loss during irrigation. This study, it is aimed to produce boron-enriched biochar samples for utilization in soil applications.Sunflower waste, a plant that requires boron minerals during its growth, was used as a biomass source. Before pyrolysis, boron minerals at ratios of 10, 20, and 30% were impregnated to the biomass and subsequently subjected to slow pyrolysis in a nitrogen atmosphere, where the temperature was maintained at 500 °C and heated at a rate of 10 °C/min. The resulting biochar samples were then characterized to establish the optimum loading ratio that produced the most effective boron enrichment. As the amount of boron increased, a gradually increasing trend was observed in the solid product yield from 29.8% to 49.4%, whereas a steady decreasing trend was observed in the liquid product yield from 21.9% to 9.5%. Furthermore, there was a significant change in the pH of the biochar owing to increasing boron addition. While the pH of the biochar obtained from the unloaded biomass was 7.35, it was found that upon boron impregnation, the pH ranged between 9.49 and 9.84, resulting in an increase in the alkalinity of the biochar.

Keywords: Sunflower waste, pyrolysis, biochar, boron, soil nutrients

PAPER : 17

Comparative Analysis of Measurement Methods of Greenhouse Gas Emissions from Manure in Dairy Cattle Farms

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Abstract

In developing livestock, the share of greenhouse gases such as methane (CH_4) form manure in global warming has increased and emission reduction studies have accelerated. CH_4 occurring in ruminants accounts for 37% of global CH_4 emissions. In the development of emission reduction strategies, it is emphasized that the gasses are measured directly at the emission source. In this study, commonly used emissions measurement methods in manure management in dairy cattle were compared in terms of sensitivity, convenience and cost. The flux chamber is a traditional method of emission measurement and is successful in determining the spatial distribution of gases. With this method, low gas fluxes can be measured with high precision. However, excess gas samples are required and there is a risk of deterioration until the samples are analyzed. In recent years, trace gas measurement systems, in which the gas collector head and gas chromatography are integrated, have been used. These systems can make an instant, direct and precise measurement at the emission source and do not require much labor, but are expensive. Micrometeorological methods are used to measure the total emission in the farm. However, there is a risk of contamination with emissions from neighboring livestock in these measurements.

Keywords: Methane, nitrousoxide, fluxchamber, chromatography, tracegas.

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PAPER : 18

The Role of Microalgae in Agricultural Waste Management and Bioenergy

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Abstract

Microalgae can play a versatile role in the management and recycling of agricultural waste. This offers significant potential for both environmental sustainability and increased efficiency in agricultural practices. Microalgae are known to be successful in wastewater treatment as well as having versatile outputs such as biofertilizer production, soil improvement and bioenergy. The utilization of microalgal biomass in bioenergy has significant advantages in terms of sustainable agriculture and sustainable environment. These include; (I) Lipid content of microalgal biomass can be used for biofuel production, especially providing potential for biodiesel production, (II) Microalgae can be used in anaerobic digestion for biogas production, (III) Certain strains of microalgae can be an important source for bio-hydrogen production. (IV) Biofuel from microalgal biomass can be used as an alternative to traditional fossil fuels. (V) Microalgae can be used to absorb CO_2 from industrial waste gases. CO_2 in waste gases from industrial plants can be absorbed by microalgae and utilized in the process of photosynthesis. Thanks to these features, it contributes to both the reduction of greenhouse gas emissions and the recycling of CO_2 to be used in bioenergy production. Since microalgae have the potential to reduce carbon emissions, store carbon and reduce CO_2 levels in the atmosphere, they are expected to play an important role in the future in the fight against climate change.

Keywords: Sustainable agriculture, sustainable environment, carbon capture, greenhouse gas emissions, anaerobic digestion

PAPER : 19

Development of Electrically Conductive Ink with Carbon Derived from Tea Waste Biomass

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Carbon in the field of electrical/electronics has been applied in many different products, from sensors to optoelectronics, biomedicals, pharmaceuticals, energy storage and agricultural applications [1]. The most important advantage of electronic applications of carbon materials as alternatives to metallic ones is to be utilized for developing flexible, lightweight, small, wearable, touch-sensitive devices. On the other hand, such carbon materials are usually synthesized or obtained from fossil sources. Considering the depletion of fossil resources and their negative effects on climate change, there is a need for alternative, clean, renewable and sustainable developed carbon sources.

Refinedcarbon materials can be derived from biomass, which is the only renewable, sustainable, economical and environmentally friendly carbon source [2]. In this study, conductive carbon ink was prepared withcarbonaceous material derived from industrial tea waste biomass and PEDOT:PSS. The conductivity value of the developed ink is 3.58 S/cm that is comparable with the ink prepared with graphite (13 S/cm). Flexible, light, small, wearable and printable technologies can be developed by carbon derived from tea waste biomass as a sustainable and renewable energy resource.

Keywords: industrial tea waste, biomass, conductive ink, PEDOT:PSS,

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PAPER : 20

Statistical Evaluation of the Viability of Biodegradable Solid Waste and Agricultural Waste Biomass for Biochar-Focussed Pyrolysis in the Aegean Region-Turkey

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ABSTRACT

The Aegean Region of Turkey is home to a population of 11 million with 90,251 km2 of land suitable for agricultural activities where 56% of its soils have minimal organic matter (<1%), and 38% display notably low organic carbon levels. In addition to large municipal waste generation in the region, in Izmir province alone, the total livestock population includes 1,715,000 cattle and sheep and 22.5 million poultry.

In the pursuit of climate change mitigation and carbon emission reduction, soil emerges as a critical medium for carbon sequestration by enhancing organic carbon levels. Despite common landfilling practices for municipal and animal waste, the efficiency of landfill gas collection varies widely (13% to 86%), leading to significant emissions. Hence, adopting low-emission techniques for biodegradable waste valorization is considered prudent. Pyrolysis technology, distinguished by minimal emissions and the production of biochar—a solid end product facilitating carbon sequestration—stands out as an environmentally friendly waste processing method.

This study rigorously analyzed biodegradable municipal waste, cow, and chicken manure samples (n=54) from Izmir, Aydın, and Manisa provinces. Proximate and ultimate analyses were conducted, followed by TGA-DTA analyses to identify temperature ranges for mass losses, exothermic reactions, and char formation. Pyrolysis at 350, 500, and

700°C yielded biochar products, with subsequent measurement of elemental compositions and BET surface areas. Statistical analysis (SPSS 25.0) demonstrated that higher pyrolysis temperatures correlated with larger biochar surface areas ($p<0.000$). Higher waste ash content increased biochar yield ($p<0.000$), with smaller surface areas ($p<0.007$) and decreased carbon content ($p<0.000$). Biochar carbon content primarily related to waste fixed carbon ($p<0.000$), while P and N contents strongly correlated with waste volatile matter. Principal Component Analysis (PCA) highlighted waste C and H content (43.2%) as the key factor influencing biochar quality, followed by N and S levels (24.2%), and pyrolysis final temperature (13.4%).

Keywords: waste, carbon sequestration, biochar, sustainable development goals, climate action.

PAPER : 21

Sustainable Valorization Of Manure And Waste Sludge As Phosphorus Source

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Today, there are serious problems with the disposal poultry manure and waste sludge.Combustion and anaerobic digestion are the most suitable alternative methods for proper management of these wastes. The use of these wastes as a source of phosphorus,which is listed as a critical raw material in Europe, is also important for new policies regarding “Zero Waste” and “Circular Economy Package”. This study presents the evaluation of raw wastes and by-products (ash) obtained from theircombustion as a P source within the scope of the DEASPHOR and PHIGO projects.Ashes were supplied by 5 different companies, having fluidized bed combustion system and were investigated for their phosphorus content.In addition, the ashes were obtained from bone meal, as representative of slaughterhouse waste, at different combustion temperature using a laboratory-scale system. All ashes were investigated for their phosphorus content. It was observed that the phosphorus content of the ashes varies depending on both waste type and the ash collection areas in the combustion systems. To assess the production of potential P-rich fertilizer, the key fertilizer characteristics of poultry manure, its ash and chars from the point of P-fertilizer quality was also investigated.It was concluded that chars obtained from poultry manure, rather than poultry manure and its ash, could be used as P-rich soil conditioner.

PAPER : 22

Eview Of The Provisions Of The Turkish Climate Change Bill Related To Zero Waste Practices

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This research is an effort to review the practices of the "Zero Waste" Project in Turkey taking into account the provisions of the Climate Change Bill. In this context, documents in Turkish law, European Union law and international law besides Zero Waste Project practices were taken into consideration in the research.

In Turkish Renewable Energy Sources Law numbered 5346, various waste types such as vegetable oil waste, agricultural waste without food or feed value, as well as municipal waste are included within the scope of the definition of biomass. The "Zero Waste" project, initiated in 2017, is an important step taken by Türkiye in the field of biomass in the context of its commitments to combat climate change within the framework of compliance with both the Paris Agreement and the acquis communautaire. Thanks to the achievements of Türkiye within the scope of the Project, the Zero Waste Project of Türkiye was awarded with "Sustainable Development Goals Action Award" by the United Nations Development Programme in 2021.

The Turkish Climate Change Bill regulates important provisions regarding Zero Waste practices, which was recently submitted to the Turkish Grand National Assembly. Within the framework of the relevant provisions, the policies relating to expanding zero waste practices and increasing the waste recovery rate to 60% by 2035 and performing works to reduce greenhouse gas emissions were determined as mandatory policy targets for both the central government and local governments. Thus, the Zero Waste Project, which was initiated in 2017 and a relevant regulation was published in 2019, will become one of the decisive actions in Türkiye's biomass policies in combating climate change, in case the Turkish Climate Change Bill is approved by the Turkish Grand National Assembly and comes into force.

Keywords: Zero Waste Project, biomass, Turkish Climate Change Bill, Paris Agreement.

PAPER : 23

Comparison Of The Bioenergy Focused Smart Specialisation Potentials Of The Nuts-2 Regions Of Türkiye

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SUMMARY

Smart specialisation, as a Science, Technology and Innovation (STI) policy, has been considered as the basic approach to regional development in the EU for the last 15-20 years. Smart specialisation is the smartly design of each region's specialisation process to prioritise certain areas of expertise based on its specific needs and existing resources, and to concentrate the region's resources in these areas, taking into account circularity. Smart specialisation requires a bottom-up process involving businesses, research institutions, public authorities and NGOs. The operationalisation of this process, defined as the Entrepreneurial Discovery Process (EDP), is difficult for most regions. To facilitate the challenges of achieving smart specialisation, the EDP is carried out through policy documents called Smart Specialisation Strategies (S3).

With climate change becoming one of the main risks for the sustainable future of the world and humanity, and the subsequent publication of the European Green Deal, the EU's commitment to the Sustainable Development Goals (SDGs) has increased. As part of this new orientation, it is stated that the focus on sustainability should also change the perspective on smart specialisation and influence the scope and objectives of S3s. In this context, the S3s become "Smart Specialisation Strategies for Sustainability (S4)".

Bioenergy, as one of the main clean energy sources, is a key sector in the global clean energy transition. Regions in Europe are carrying out smart specialisation studies to exploit their bioenergy potential and aim to contribute to their regional development.

In this study, the bioenergy focused smart specialisation potentials of NUTS-2 regions in Türkiye were evaluated against each other according to the criteria of good smart specialisation practice developed by the Energy Thematic Working Group of the EU Smart Specialisation Platform (S3 Platform) called S3PEnergy. The evaluation was carried out qualitatively using the method of difference analysis in the light of the data obtained through literature research. The results of this evaluation, which was carried out in an interdisciplinary manner in the fields of regional development and clean energy, are expected to contribute to the smart specialisation studies that have recently gained momentum in Türkiye.

Keywords: Bioenergy, Clean Energy, Renewable Energy, Smart Specialisation, Regional Development, Clustering, Climate Change.

PAPER : 24

Co-pyrolysis of microalgae biomass with plastic waste towards clean fuel and valuable chemicals

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Abstract

The quest for sustainable energy alternatives has led to the exploration of innovative methods for biofuel production. In this study, the potential of microalgae biomass with plastic waste as a feedstock for biofuel production was investigated through co-pyrolysis in a laboratory based pyrolyzer. The feedstocks were first characterized based on their physicochemical characterization such as proximate, ultimate analysis, and higher heating value etc. Further, the functional groups were determined based on the FTIR analysis. Important pyrolysis factors such as temperature, heating rate were optimized to determine the highest amount of bio-oil yield. Characterization of the bio-oils using Fourier-transform infrared spectroscopy (FTIR) highlighted the presence of varied functional groups. Moreover, Gas Chromatography-Mass Spectrometry (GCMS) analysis under optimized conditions revealed an enriched composition in the co-pyrolyzed bio-oil, indicating its superior fuel properties. Concurrently, the produced biochar exhibited suitable characteristics that make it a promising material for diverse industrial and agricultural applications. This research underscores the efficacy of co-pyrolysis of microalgal biomass and plastic waste emphasizing its potential as a renewable source for high-quality biofuel and valuable byproducts.

Keywords: Co-pyrolysis; microalgae; plastic waste; bio-oil; biochar

PAPER : 25

Current and Future Biomass Pathways of Turkey

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The economic evaluation of biomass, or from a broader perspective, the sustainable roadmap of biomass, is directly related to policy pathways. This situation primarily covers the issues of what the biomass-related infrastructure is like in the focused country, how biomass terminology is defined in the relevant country legislation, and the relationship between biomass and waste taxonomy.

Our evaluations show that, in the Turkish experience, biomass is primarily defined in the renewable electricity roadmap. In this regard, it is observed that the term "Biomass" was created within the scope of the Renewable Energy Resources Support Mechanism in the current legislation. The approach within the current legislation aims to protect the organic carbon content of the soil and prevent the conversion of biomass, which can be obtained as food and feed, into electricity.

The reflections of the Green Deal and EU Carbon Border Adjustment Mechanism on the industry and energy sectors may mark the beginning of a new era for the biomass sector. This process creates the need to reconsider and renovation of existing roadmaps with a focus on high efficiency of the related system, not only economically but also ecologically. In this process, biomass may create new opportunities for itself, especially in the hydrogen and methanol roadmaps. Among renewable energy sources, biomass is the primary source that offers energy-electricity supply, multiple products, and carbon capture opportunities simultaneously. Within the scope of the study, the main elements of Turkey's current biomass experience and possible future opportunities are clearly stated.

Key Words: Biomass potential, biomass pathways, biomass policy, sustainability

PAPER : 26

Algae Based Biological Battery

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ABSTRACT

In this study, an algae-based cellular biological battery was designed that can be used as an alternative to today's chemical batteries and silicon solar panels.

Instead of chemical electrolytes, live algae, which has no harm to humans and the environment, was preferred in the designed battery. As a result of the measurements, it was observed that the algae used in the battery cells continued their vitality activities during the use of the battery and increased the energy efficiency by growing and multiplying.

In the study, microscopic and spectroscopic measurement methods were applied and a prototype modeling system was created.

With this method, in which an alternative electrolyte is used, an alternative battery system to chemical batteries has been developed in a cheaper and cleaner way. These developed batteries are an environmentally friendly, low-cost energy source that does not pollute the environment and constantly renews itself thanks to live algae, thus extending the life of the battery. The designed algae battery has the potential to be used easily in every field where today's batteries are used.

As a result, it is predicted that algae can be an alternative, organic-based and lower-cost system to silicon-based solar panels in cellular panels.

Keywords: Algae-based biological battery, bioenergy, battery, electrolyte

PAPER : 27

Productıon Of Renewable Energy Biomass Briquettes From Fiberboard Manufacturıng Wastes And Hazelnut Shells

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In recent years, in order to prevent the negative effects of global warming, countries have started to make encouraging decisions to utilize sustainable and renewable energy sources instead of fossil fuels that create a greenhouse effect in the atmosphere, as well as effective energy management policies. Especially recently, high-quality fuel briquettes and pellets have been produced from agricultural and annual biomaterials.

In this context, non-reusable wood fiber, sandpaper dust and bark fibrous waste materials are formed in the production stages of today's wood panel industry. It is quite difficult to store and protect these materials from moisture in factory areas. Therefore, it is aimed to produce environmentally friendly, storable, renewable, and high-calorific value biomass briquettes by taking advantage of the compressibility properties of the wastes as an alternative to fossil fuels. In addition, it is aimed to reduce production costs by using the produced briquettes in energy centers. For this purpose, briquettes were produced by pressing mixtures obtained from three different biomass raw materials (waste fiber, sandpaper dust, hazelnut shell) in a hydraulic press briquette machine.

Moisture content, volumetric compression ratio, calorific value, and ash content of the obtained briquette samples were measured

according to the relevant standards. It was determined from the test results that the use of hazelnut shells at similar moisture values increased the calorific values of the briquettes. It was also observed that calorific values vary depending on humidity. As a result, it has been understood that waste materials from fiberboard production can be used as an environmentally friendly and sustainable energy source in briquette production.

Keywords: Biomass, briquette, renewable energy, fossil fuels, calorific value

PAPER : 28

Impact Of Increases In Bıoenergy Resource Use On Energy Security And Food Security: Turkey Example With System Dynamics Approach[1]

Muhammed ÇELİK[2]

Bioenergy; It is a type of organic energy obtained from agricultural and forestry products, municipal wastes, biological materials, animal wastes and industrial wastes. In recent years, the impact of fossil fuels on global climate change has begun to be seen more clearly and it has been observed that the trend towards bioenergy supply, as well as other renewable energy sources, has increased rapidly globally. Turkey, which is a global supplier in agricultural production, is highly dependent on foreign sources for energy supply, even though it has a very high bioenergy resource potential. Considering this situation, bioenergy supply policies to be implemented to meet the increasing energy demand and reduce energy dependence have the potential to negatively affect our country's food security. In this study; Our country's energy model and food and bioenergy submodels were created using the system dynamics simulation method. Various dynamic scenarios were tested depending on the resources to be used for bioenergy supply through these created models. In these scenarios, relationships between agricultural production for energy purposes and agricultural production for food purposes were observed, depending on the source to be used while increasing bioenergy supply in Turkey. As a scenario, the situation of bioenergy supply, food security and energy security until 2050 is determined if a certain part of agricultural production is transferred to production for energy purposes, the waste-based bioenergy supply policy is implemented and the current situation is maintained. As a result; depending on the transfer of a part of agricultural production as a resource to bioenergy

1 This study was carried out by Prof. Dr. Under the supervision of Zehra Vildan SERİN, Dr. It is derived from the doctoral thesis titled "The Effect of Increases in Bioenergy Resource Use on Food Security, Energy Security and the Environment: System Dynamics Approach" prepared by Muhammed ÇELİK.

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production, it has been revealed that the bioenergy policy creates competition between agricultural production for food purposes and agricultural production for energy purposes, and although it affects energy security to a limited extent, it seriously affects food supply security. Therefore, it is necessary to create a policy in which waste is used as a resource for bioenergy supply in a way that protects food security.

Keywords: Biyoenergy, Simulation, Food Security, Energy Security.

PAPER : 29

New Road Map in Biofuels for Türkiye "Biofuel Logistics"

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The main purpose of energy is sustainability. Sustainability: Meeting today's needs while not compromising the ability of future generations to meet their own needs. The middle class population is expected to be 2 billion for the future and 5 billion for 2030. Accordingly, water need will increase by 30% and energy need will increase by 50%. Water consumption in the world is 2600 km3/year. Our world is still dependent on fossil resources. 3 of the 9 Threshold limits for our planet have been exceeded.

9 thresholds are brought together and the bagel area within the circle creates a "safe activity area for humanity".

How far below the Social Foundation is our humanity?

- *Food security (undernourished population) 13%*
- *19% of the population without access to electricity*
- *39% of the population who cannot cook clean food*
- *13% of the population who cannot access good drinking water*
- *39% of the population who cannot access good sanitation*
- *Insufficient income (Limit 1.25 USD/day) is 21%.*

Biofuels – Not a Reason for Increase in Food Prices! Because 30% of the food produced in the world is

- *In the post-harvest processing process*
- *In shopping mall chains*
- *11% is wasted by consumers (35% of 30%).*

Biofuel or biomass energy can generally be defined as "all kinds of biological fuel obtained from terrestrial and aquatic living organisms, of which at least 80% of their content by volume has been collected within the last ten years."

- *Resource reserve problem*
- *Environmental pollution-Climate Changes*
- *Countries*
- *Evaluating own resources*
- *Providing resource diversity*
- *Achieving energy supply and demand security*
- *Carrying out sustainable development*
- *Goals to earn economic returns*

It shows us the necessity of biofuel. In this study, suggestions have been made regarding location, raw material, production pattern selection and logistics in line with today's world policies in our country, from the field to the power plant.

PAPER : 30

Parametric Study on theHydrogen-RichSyngas Production by Catalytic Gasification of Tobacco Waste

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Effective utilization of the waste ofthe tobacco industry, whichhad a production volume of 82,000 tons in the year 2022 in Turkey, is of great importance in terms of increasing sustainable bioenergy useand reducing fossil fuel-based carbon emissions. Tobacco waste can be thermochemically converted to hydrogen-rich syngas by gasification. This study investigates the effect of various parameters on the yield and composition of the resulting syngas. Effects of the gasification parameters such as time (10, 15, and 20 min.), temperature (650, 750, and 850 °C), catalyst type (Na_2CO_3, $CaCO_3$, CaO, $Ca(OH)_2$, NaOH, and K_2CO_3), catalyst-to-tobacco waste ratio (without catalyst, 20%, and 40% by wt./wt.)air feed rate (2, 3, and 4 L dry-air/h), biomass particle size (unground, 374 μm, and <56 μm,) and moisture-free biomass were investigated. The tobacco waste was characterized by TGA, elemental, and proximate analysis (extractives, hemicellulose, lignin, cellulose, moisture, and ash content). The highest hydrogen yield was obtained as 5.9 moles H_2/kg biomass at; 20% wt./wt. Na_2CO_3, 3 L/h air feed rate, 15 min. reaction time at 750 °C. Experimental results show that readily available commercial catalysts can effectively convert tobacco waste into hydrogen-rich syngas. Within the scope of this study, it was seen that gasification of tobacco waste can play an effective role in biomass utilization and bioenergy production.

Keywords: Biomass, Catalyst, Gaseous Product

PAPER : 31

Dry Fermentatfon Technfque In The Conversfon Of Agrfcultural Resfduals Into Envfronment-Frıendly Energy And Fertilizer

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In this study, it is aimed to introduce dry fermentation technology in order to provide a practical solution and management of agricultural residues in the conversion into environmentally friendly bioenergy and fertilizer. In this technique, high solid substrates (various types of agricultural residues including animal manure) are fed into a garage type cell in which mesophilic and/or thermophilic anaerobic degradation takes place for about 10-20 days. Several cells are built together in order to provide a continuous harvesting of biogas. Each cell is spreaded intermittently by a mature anaerobic consortium from a seed bioreactor. After a certain fermentation time which takes around 10-20 days depending on the operational temperature, each cell is emptied respectively and reloaded for another round of biogas production. Residual organic waste is suitable for use on the farm lands as compost material which is a good promising soil conditioner. Dry fermentation has other several advantages such as very easy operating conditions and providing a sustainable solution for liquid digestate management problem of wet digesters. This is a relatively new technique and there is no single application in Turkey yet.

PAPER : 32

What is the contribution of the pretreatment process to the net energy gain in ethanol and methane production from switchgrass?

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Electrified transportation is expected to increase in the future; however, implementing its use will not happen everywhere, in every industry, and all at once. Therefore, it is predicted that liquid and gases biofuels will be extremely necessary for the ensuing decades. Renewable fuel technologies focused on lignocellulosic biomass as promising substrates for producing biofuels. Due to increased energy security demands coupled with climate change mitigation, the world's biofuel production has also drastically expanded. In this context, for describing the biofuels derived from a non-edible crop containing high-carbohydrate which can grow large amounts of biomass, the "second-generation biofuel" term has emerged. The majority of these second-generation biofuels utilize lignocellulosic biomass. As one of the most promising lignocellulosic biomass, switchgrass *(Panicum virgatum L.)* has attracted attention in the past few years. Due to its high amount of carbohydrate-rich biomass production potential up to 11-13 tonnes/ha, switchgrass is a suitable feedstock for second-generation biofuel production. Despite these positive aspects, there is a significant drawback to the usage of switchgrass as a feedstock in biofuel production, which is its lignocellulosic structure. Therefore, the application of a pretreatment process is crucial to reach the fermentable sugars in the cellulose and hemicellulose fractions.

In this study, optimization of the environmentally friendly version of H_2O_2 and HAc pretreatment on switchgrass for subsequent ethanol and methane fermentation was investigated from the point of positive energy gain. Maximum ethanol production was observed in 2% H_2O_2,

0% HAc, 24h, and 100°C pretreatment conditions as 81.65 mgEtOH/gTS (103.49 LEtOH/tonneTS), corresponding 49.55% of the theoretical ethanol yield. Maximum methane production was observed in 2% HAc, 0% H2O2, 100°C, 6h conditions as 363.82 mLCH^gVS. In terms of net energy production, cost-optimum pretreatment was found the most beneficial condition with 67.5% energy recovery. Although biofuel production in the maximum biofuel optimization condition was higher, it was found that the cost optimization condition had higher net energy gain.

Keywords: Biofuel, Energy crop, Ethanol, Methane, Pretreatment

PAPER : 33

The significance of biogas generation from biomass in villages and its effects from diverse perspectives

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The increment of the word population requires the higher amount of fresh water and food with the higher energy consumption. Academia and industry have been trying to figure out these issues by using sustainable solution because water, food and energy have close relationship with each other. The environmentally benign and sustainable solution shouldincludeall of those key factor recycles, reuse and reduce for permanent and sustainable solution. The reducing of fossil-based fuels and recycling of organic wastes to the useful content provides new opportunities production of renewable energy and biofertilizers. Therefore, the potential of renewable energy from organic wastes has been concerned as an alternative source for responding global energy demands. Although renewable energy sources such as wind power, solar energy, and geothermal energy are available, there is more advantages to production of biodiesel and biogas from organic waste for alternative energy sources. In more detail, by producing biogas from distinctive wastes as an alternative domestic and industrial energy source, which reduces the amount of organic waste (biomass) andharvest biofertilizer during theprocesses.

In this study, the impact of biogas plants in villages will be assessed from various angles based on our previous studies.The amount of biogas can be increased and biofertilizer content can be changed depending on thedifferent biomass sources during digestion. Furthermore, household and agricultural wastes can be used for digestion processes that will be an efficient way to cleaner the environment. The biogas in the villages can be used both for electricity and heating that rises the life comfort in villages. Using biofertilizers instead of inorganic fertilizers can lead to an increase

in agricultural crop yield and improved soil health, as they prevent heavy metals from being deposited.Also, the use of biofertilizer can have a significant impact on reducing salt and drought stress by reducing water loss and promoting the plant antioxidant system. Finally, the biogas plant in villages has many of the advantages from different perspectives.

Keywords: Bioenergy, biofertilizer, alternative energy, clean environment

PAPER : 34

Assessment of Fiberboard Manufacturing Waste Biomassfor Briquettes Production

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The fiberboard industry produces large amounts of waste that is not reused in the manufacturing. These wastes can be listed as waste fiber, sanding dust and waste paper. The fiberboard manufacturing waste occupies large open areas in factories and is affected by moisture. Converting these wastes into briquettes saves space and minimizes the effect of moisture. Biomass briquettes are a proven way of generating energy from waste. This study investigates the development and characterization of biomass briquettes produced from different biomass feedstocks waste fiber, sanding dust and waste paper. Moisture content, volumetric compression ratio, calorific value and ash content were carried out on the briquette samples. As a result, positive results were obtained from briquette samples. This study shows that fiberboard manufacturing waste can be used for fuel briquette production, which is a source of sustainable energy generation. It is environmentally friendly, cost effective and affordable compared to fossil fuel.

Keywords: Low-carbon energy, Sustainable energy, Renewable energy sources

PAPER : 35

Hydrogen rich gases from olive tree pruning by two-step gasification

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Biomass gasification is a promising technology for hydrogen production. The study presents the olive tree pruning (OTP) gasification, combining biomass gasification and tar reforming, with a fixed dual-bed reactor. The thermal steam gasification of OTP is performed at 850°C, followed by the catalytic gasification of volatiles at different temperatures. Red mud (RM), Dolomite (Do) and their nickel loaded forms (Ni-RM and Do-RM) were used as catalytic bed material.The effects of different operating parameters, i.e. catalytic bed temperature, catalyst preparation method (prereduction&without reduction), and nickel ratios on the hydrogen yield are investigated. The results indicates that the catalytic bed temperature has a significant effect on the H_2 yield.

The reduced RM alone shows almost the same activity with Ni (7.5%)-RM on the H_2 yield; 1076 mL gas/g OTP and 1128 mL gas/g OTP, respectively. The results of present study suggested that magnetite in reduced RM had as much catalytic activity as nickel in steam reforming of tar in gasification of OTP. In contrast to RM, the loading of Ni on Do increased its activity. The obtained H_2 yields were found as 844 mL gas/g OTP and1048 mL gas/g OTP, respectively.As considering that reduced RM has a negligible price cost compared to nickel and is non-toxic, this study suggests that reduced ARM is effective for

H_2 production from biomass for both economic and environmental reasons. Although dolomite is a mineral abundant in nature, it needs to add Ni to provide effective performance.

Keywords: biomass,steam gasification, red mud, dolomite,H_2 production

PAPER : 36

The Pelletizing Properties of Spent Coffee Grounds and Spent Tea Wastes

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Due to coffee and tea being the most consumed beverages in the World, there are remarkable amounts of residue called spent coffee grounds (SCGs) and spent tea wastes (STWs). Because of their high level of consumption, the residues are of great importance because of the environment and becoming raw material for new production processes. In this study, the pelletizing properties of SCG and STW were determined.

Moisture content, bulk density, and granule size distribution of the dried SCG and STW were determined, and five mixtures from the SCG and STW were prepared with weight basis as 100% SCG, 75% SCG + 25% STW, 50% SCG + 50% STW, 25% SCG + 75% STW and 100% STW. The five SCG and STW mixtures were pelletized in a laboratory-scale pelletizing test machine with two-level moisture content (10±1%, 15±1%), two pellet diameters (6 mm, 8 mm), and three repetitions. During the pelletizing process, energy consumption (kWh) and material capacity (kg/h) of the machine were measured. According to the results, the specific energy consumption (kWh/kg) was calculated for each experiment. The properties of pellets that were successfully shaped during the experiments were tested for values of the length (mm) and diameter (mm), moisture content (% wet basis), mechanical durability (%), and bulk density (kg/m3) according to ISO standards.

According to the results, two different mixtures moisture and pellet diameter statistically affect the power requirement of the pellet machine (P<0.001). The effect of 10±1% or 15±1% moisture on the working capacity (kg/h) of the machine is statistically significant. On the contrary, it was determined that the moisture of the raw material effect on the specific energy consumption (kWh/kg) and material capacity (kg/h) of the machine were not statistically significant (P<0.01). In addition, the effect of the pellet diameter of 6 mm or 8 mm on the specific energy consumption (kWh/kg) and material capacity (kg/h) of the machine are statistically significant (P<0.01). It is understood that the mechanical durability of all pellets is much lower than the limit value of 97.5%.

Keywords:Urban and industrial waste, Biomass processing technologies, Mechanical durability, Bulk density.

PAPER : 37

Recycling Automation System: Waste Sorting and Identification with Artificial Intelligence

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This study offers a revolutionary solution in waste management by integrating Image Processing and Artificial Intelligence techniques with bio-gel sensors. The automation system has the capability to automatically classify wastes. Compared to traditional waste management processes, this study provides a faster, more accurate and environmentally friendly solution, presenting a unique approach to waste-related issues. It utilizes from Image Processing algorithms implemented with the OpenCV library and bio-gel sensors to classify wastes. This method is designed to ensure accurate waste classification and to efficiently optimize waste management processes. Additionally, it incorporates different Machine Learning models such as Support vector machine, Decision Tree, KNN to enhance waste classification with higher accuracy. As a conclusion, developing the waste classification Bioenergy model with sensor integration can be guided for different studies by hybrid usage of Image Processing and Machine Learning methods. At the same time, the waste classification Bioenergy model has a big importance on the research studies which are related with renewable energy management systems and energy efficiency studies.

Keywords: Artificial Intelligence, Bioenergy, Image Processing, Machine Learning, Waste Management

PAPER : 38

Physical and Mechanical Properties of Bio-Pellets Obtained from Walnut and Peanut Shells

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Abstract

Energy is considered a measure of development in today's world. In recent years, the increasing global population has led to a growing demand for energy. Due to the limited availability of fossil fuels and the environmental harm they cause, there has been a shift towards renewable energy sources worldwide. Among these renewable energy sources, biomass technology is clean, eco-friendly, and highly energy-efficient. Its implementation not only contributes to energy production but also plays a significant role in rural development.

Within the realm of biomass, the production of bio-pellets is essential for the sustainable utilization of healthy, eco-friendly, and organic waste materials for energy purposes. The pelletization process offers several advantages, including an increase in the volumetric heat value of the material, reduced transportation and storage costs, improved combustion characteristics, and a decrease in particle emissions into the atmosphere.

This study focuses on the production of bio-pellets by mixing walnut shell (WS) and peanut shell (PS) materials in five different ratios (100% WS, 50% WS + 50% PS, 75% WS + 25% PS, 25% WS + 75% PS, 100% PS). The moisture content, ash content, volatile matter content, fixed carbon content, and drop resistance of the obtained pellets have been determined.

PAPER : 39

An Overview Of Environmental Impacts Of Biofuel Production Processes

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Biofuels production, from waste materials is a promising technology that started to be used widely in developed countries. Especially; biogas, biohydrogen, bioethanol have various advantages, where wastes are valorized, value added products are produced and greenhouse gas emissions are reduced. An overview of the state-of the-art of different wastes to biofuels is presented in this study to compare their environmental impacts. Firstly, biofuels production pathways and the required process steps are summarized. Then, life cycle analyses (LCA) studies are discussed in terms of their environmental impacts.

It is difficult to completely compare these studies with each other due to differences in functional unit, system boundaries, analysis methods, impact categories, and software. However, as a result of the evaluation, some fermentation types offer benefits such as reduction of CO_2 emission, ozone depletion, human health, ecotoxicity and fossil depletion. Moreover, it is perceived that the integration of different pathways can be an attractive option to produce high heat efficiency and low GHG emissions instead of single stage processes. Energy producing strategies can be rearranged towards life-cycle philosophy helping for dissemination of renewable energy systems usage.

Keywords: Life cycle assessment, biohydrogen, biogas, biohythane, organic wastes.

PAPER : 40

Application of chemically and physically activated hazelnut shell biochar for supercapacitors

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The chemical and chemical activation of the biomass prior to pyrolysis leads to changes in the chemical composition, surface area, and porosity of the material, as well as many structural properties. These properties of the material lead to significant improvements in supercapacitor applications.Therefore, in this study hazelnut shell biomass was activated by a combination of physical ultrasonic and microwave activation with phosphoric acid activation and pyrolyzed in N_2 atmosphere at 700 °C for 3 hours. The produced biochar samples were characterized by XRD, SEM-EDS, FTIR, FTIR and N_2 adsorption-desorption.The electrochemical experiments were carried out with the Gamry instrument Potentiostat/Galvanostat/ ZRA in a three-electrode configuration. The working electrodes were prepared from the synthesized biochar. For the electrolytes KOH and Na_2SO_4, a saturated calomel electrode (SCE) and Ag/AgCl were used as reference electrodes. Cyclic voltammetry (CV) was used to measure the specific capacitance of the electrodes in a potential window (–1.2 to –0.2 V) and at different sampling rates (5–200 mV/s).The highest surface area and pore volume were obtained by the combination of ultrasonic activation and phosphoric acid activation: 2138 m^2/g and 2.21cm^3/g. The highest capacity in relation to surface area was achieved with hazelnut shell biochar activated with acid ultrasound using a 3 M KOH electrolyte at 175 F/g

The higher capacity of 3 M KOH compared to 6 M KOH could be related to the diffusion resistance in the pores. In addition, charge-discharge cycleresults showed that the biochar sample prepared

by acid-ultrasonic activationshowed most stability, which could be related to the stable pore structure and combinatintion of the biochar.

Keywords: Biochar, hazelnut shell, chemical activation, ultrasonication, microwave activation

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PAPER : 41

LCA Comparison of Bioethanol Production From Wastes by Different Pre -Treatment Methods

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The continuous increase in global energy demand and the need for new energy resources make it imperative to find new energy sources. In the context of sustainability goals and circular economy, renewable energy are promising technologies. In this context, bioethanol is known as the most widely used biofuel between 10-85% as a fuel additive. It is an innovative and sustainable technique for bioethanol production from fruit and vegetable wastes (FVWs) through yeast and bacteria fermentation. In this study experimental studies were performed for yeast fermentation, many pretreatment methods (acid, heat, acid/heat, and microwave) were contrasted. Saccharomyces cerevisiae was used to achieve maximum ethanol concentrations of 11.7 and 11.8 g L–1 by acid/heat and microwave treatments, respectively.

Life cycle analysis is a technique for revealing the environmental impacts of products and processes produced by different methods by considering environmental impact factors (global warming potential, eutrophication, acidification, etc.). In this study, the comparison of the environmental impacts of bioethanol production from fruit and vegetable wastes with ethanol produced by conventional techniques will be compared by life cycle analysis.

Keywords: biofuels, sustainability, life cycle assessment, bioenergy, fruit and vegetable wastes

PAPER : 42

Izolation and Idendification of Fungi Used in Biofuel Production

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With the increase in the world population, the need for energy also increases. Although the majority of the energy needed by the world is obtained from fossil fuels, the search for different energy sources continues due to the formation of gases that threaten human health as a result of the use of fossil fuels. In this context, biofuels are considered as alternative energy sources with their renewable properties. Recent studies have shown that fungi can be used as a biofuel source. In this study, it was aimed to determine the biofuel raw material content of the fungus isolated from the marine environment and molecularly identified. For this purpose, samples were first taken from the Marmara Sea and isolation studies were carried out by inoculating them in media. Molecular identification was made by isolating DNA from the fungal species obtained as pure culture. Afterwards, the biomass of the fungal species was produced in high quantities and the total oil content was determined. As a result of this study, the fatty acid profile of the fungus, which was newly izolated and identified, showed that the fungal biomass can be used efficiently as a raw material in biofuel production.

Key words: biofuel; fungi; identification; isolation

Biyoyakıt Üretiminde Kullanılan Mantarların İzolasyonu ve Tanımlanması

Dünya nüfusundaki artış ile birlikle enerji ihtiyacı da artmaktadır. Tüm dünyanın ihtiyacı olan enerjinin çoğunluğu fosil yakıtlardan elde ediliyor olsa da fosil yakıtların kullanımı sonucu insan sağlığını tehdit eden gazların oluşması nedeni ile farklı enerji kaynakları için arayışlar sürmektedir. Bu bağlamda biyoyakıtlar yenilenebilir özellikleri ile birlikte alternatif enerji kaynakları olarak değerlendirilmektedir. Son yıllarda yapılan çalışmalarda biyoyakıt kaynağı olarak fungusların kullanılabileceği gösterilmiştir. Bu çalışmada denizel ortamdan izole edilerek moleküler tanımlaması yapılan fungusun biyoyakıt hammaddesi içeriğinin belirlenmesi amaçlanmıştır. Bu amaç doğrultusunda öncelikle Marmara denizinden örnekler alınmış ve besiyerlerine ekim yapılarak izolasyon çalışmaları gerçekleştirilmiştir. Saf kültür olarak elde edilen fungus türünden DNA izolasyonu gerçekleştirilerek, moleküler tanımlama yapılmıştır. Daha sonrasında fungus türüne ait biyokütle yüksek miktarlarda üretilerek, toplam yağ içeriği belirlenmiştir. Bu çalışma sonucunda yeni izole edilen ve tanımlanan mantarın yağ asidi profili, mantar biyokütlesinin biyoyakıt üretiminde hammadde olarak verimli bir şekilde kullanılabileceğini göstermiştir.

Anahtar kelimeler: biyoyakıt; fungi; identifikasyon; izolasyon

PAPER : 43

Energy Journey of Biomass

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Abstract

Bioenergy – using organic materials from plants, animals and domestic waste to generate electricity and thermal energy – is emerging as a key sustainable energy source in Türkiye. Currently, the country is highly dependent on fossil fuels. Two-thirds of the energy generated is fuelled by gas imported from other countries, including Russia, and coal.

As Türkiye's economy and population grows, demand for energy is rising. More people means more demand for food, and industrial farming is expanding to meet this need, generating huge amounts of agricultural residues in the process. Disposing of organic residues without damaging the environment and people's health is a major challenge for Türkiye, and bioenergy offers a sustainable solution.

In this study; explanation of the biomass and alternative biomass resource, explanation of the alternative biomass burning boiler technologies to generate steam and electricity, project development strategies, construction commissioning, operation and optimization of the biomass burning plants with sampled plant and case studies.

Keywords: Biomass, RDF, Waste to energy, Economic development and Energy

PAPER : 44

Effects Of The Anaerobic Granular Seed Sludge Properties On Biogas Production

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In recent years,use of anaerobic digestion methods that resulted withbiogas production has increased rapidly.In this regard, anaerobic granular sludge (AGS) technology is frequently preferred because of the advantages of more effective digestion efficiency andbeing resistance to external conditionsthroughtheir compact and 3-dimensional structure.

In this study,biogas production potentials of AGS samples, which have different physical properties, were examined under static conditions.One of the sludge sample (R2) was kept in uncontrolled environmental conditions for 6-8 months.The other one was (R1) obtained from a UASB reactortreating brewery wastewater. Molasseswas preferred as the carbon source (2.5-4 gr COD /L.day),due to its high sugar content and being a cheap substart.The reactors were operated under static conditions for 3 months at 39°C. The methane-rich biogas mixture formed in the bioreactors was monitored daily with wet gas meters.The methane richness of the biogas was determined by gas chromatography analysis (Agilent 6890N Network Gas Chromatograph) with a TCD gas detector. Volatile fatty acids (VFAs) were analyzed with a FID detector by taking samples once a week from the reactors.The microscopic

analysis was made at both the beginning and at the end of the study by using stereomicroscope.

Gas meter and GC resultsshowed that, R1 and R2 reactors produced about 195 mL CH4/gr COD and 200 mL CH4 / gr COD, respectively, after 20days. Considering with the theorical gas amount (350 mL CH4 / gr COD)biogas producing efficacyof the reactors weredetermined as55 %(R1) and 57%(R2)levels.Microscopic results showed that no significant differences were occurredin the physical properties of the granules.In conclusion, the similar results suggest that also damaged sludges can be use in wastewater treatment systems after a short recovery period.

Keywords: Methane, wastewater, UASB, GC, VFAs.

PAPER : 45

Valorisation of wheat and corn bran as biosorbents for the removal of textile dyes: A

Design of Experiment Study

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Rapid industrialisation and population growth bring about many environmental problems such as increase in generated solid waste and pollution of fresh water sources with a wide spectrum of organic and inorganic pollutants (e.g. textile dyes, heavy metals, xenobiotics) thus limiting the access to clean water. Dyes used mainly in textile, paper and cosmetics industries are the major pollutants of water. There are many applications to get rid of those dyes from the wastewater. Biosorption is an emerging and trending method in recent years since waste materials originating from industry or agriculture could be employed as feasible and ecological biosorbents. Moreover, due to their high surface area efficient removal of textile dyes is possible. Agricultural wastes are good candidates of biosorbents since they are abundant and cheap. In Türkiye, 16.805 million tons of agricultural waste was produced from grain and industrial plants in 2022 (SÖZER, 2023). That amount of waste is usually discarded into nature or burnt to generate heat. In this work, we investigated the potential of wheat and corn bran to be used as biosorbents to remove dyes from the syntetic textile water. Different process parameters including pH, temperature, dye concentration and amount of biosorbent were investigated. We used the design of experiment methodology to study relationships among those variables.

Keywords: biosorption, lignocellulose, dye removal, wastewater treatment, design of experiment

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POSTER PRESENTATION ABSTRACTS

PAPER : 01

Investigation of the Usability of Nettle (Urtica Spp.) Stems as Biopellets

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Perennial nettle (Urticadioica L.) is a herbaceous plant native to Europe and Asia, growing in rural areas, forest edges, gardens and at the base of trees. The plant has been used for folk medicine, food, dye, fiber industry, fertilizer and cosmetic purposes from past to present due to the many bioactive components it contains. Today, nettle is rapidly becoming an important fiber plant worldwide, especially in Europe. Since it is essentially a weed, its competitiveness with other plants is high, there are no major diseases and pests that harm the plant, and it can easily adapt to areas that can be considered marginal for other cultivated plants, making it an attractive product for the textile industry where natural fibers are popular.

In this planned study, the usability of nettle for energy purposes was examined. The calorific value, ash, pellet making and technological analysis results of the pellets made in two different nettle materials were revealed, and the usability of the nettle stems in obtaining pellets was determined, thus providing a new raw material source to the pellet industry. The fact that no study with this content has been conducted in our country gives the study originality.

In the study, Urticadioica and Urticagerardidiversifolia species from the nettle trials in the Kurupelit campus were used within the scope of the current nettle studies carried out by the Field Crops Department of Ondokuz Mayıs University, Faculty of Agriculture. Pellet studies were carried out at the Energy Agriculture Research

Center at the Black Sea Agricultural Research Institute. The project was supported under TUBITAK 2209-A.

The results obtained can be used by pellet producers and biomass power plants (BES) that produce electricity. In addition, nettle control is carried out with chemical spraying on the grounds that it causes problems, especially in the Black Sea Region. This causes serious environmental problems. This study aimed to help demonstrate that nettle is a friendly plant whose every part can be evaluated, rather than being destroyed by pesticides.

Key Words: Nettle, Pellet, Biomass, Energy

PAPER : 02

Türkiye'de Biyoetanol Kaynakları

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ÖZET

Dünyada Sanayi Devriminden bu yana Ülkelerin enerjiye olan ihtiyaç ve talepleri zaman içerisinde artmıştır. Bu artan ihtiyaç ve talepleri karşılamak için ilk zamanlarda fosil kaynaklardan elde edilen yakıtlar kullanılmıştır. Fakat ilerleyen süreçte artan nüfusla beraber enerji ihtiyaçlarının artması, hem fosil yakıtların çevreye verdiği tahribatın görülmesi, hemde kaynaklarında azalma başlaması sonucu ülkeler kendi alternatif ve yenilenebilir enerjilerini aramaya başlamıştır. Yenilenebilir enerji kaynaklarından olan biyoetanol gibi yakıtların üretilmesi ile devletlerin enerjide bağımsız olma isteği ve enerji çeşitliliğini arıtma eğilimleri başlamıştır. Biyokütle kaynaklı yenilenebilir olan biyoetanol, dünyada olduğu gibi Türkiye'de zaman içerisinde ivme kazanmıştır. Biyoetanol araçlarda benzine alternatif olarak kullanılabildiği gibi, benzinle farklı oranlarda karıştırılarak da kullanılabilmektedir. Türkiye'de Biyoetanol üretiminde biyokütle kaynağı olarak şeker pancarı yan ürünü Melas, Buğday ve Mısır kullanılmaktadır. Biyoetanol üretim prosesi kullanılan biyokütleye göre değişken olup, biyokütlenin hazırlanması, hidrolizi, fermantasyonu ve saflaştırma aşamalarından oluşmaktadır. Bu çalışmada Türkiye'de üretimi yapılan 3 farklı tesisteki yakıt biyoetanolünün biyokütle enerji potansiyeli, uygulama olanakları ve kıyaslamaları, üretim stratejileri ve farklı alanlarda kullanılabilirliği araştırılmıştır.

Anahtar Kelimeler: Biyoetanol, enerji, fermantasyon, yenilenebilir,

PAPER : 03

Ecosystem-Based Approaches to Energy Crops Farming: Regenerative Agriculture and Nature-Based Solutions

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The escalating demand for biomass energy necessitates innovative approaches that harmonize energy production with ecological sustainability. This abstract explores the integration of ecosystem-based practices, particularly regenerative agriculture and nature-based solutions, into biomass energy farming. By aligning energy cultivation with principles that prioritize ecological resilience and biodiversity, this approach aims to reshape biomass energy production within a sustainable framework.

Furthermore, the study explores nature-based solutions within biomass energy farming, assessing their potential to enhance the multifunctionality of these systems. It considers how such solutions can mitigate the environmental impacts traditionally associated with biomass cultivation. The emphasis is on promoting biodiversity, carbon sequestration, and resilience to climate change. In conclusion, by synergizing regenerative agriculture and nature-based solutions, this abstract envisions a sustainable future for biomass energy production, highlighting the interconnectedness of energy systems and environmental well-being.

This study underscores the imperative of embracing ecosystem-based approaches in biomass energy farming. By synergizing regenerative agriculture and nature-based solutions, we can not only address the growing demand for biomass energy sustainably but also contribute to environmental conservation and ecological restoration. This holistic perspective offers a promising direction for the future of biomass energy production, emphasizing the interconnectedness of energy systems and the natural environment.

Keywords: biomass energy, bioenergy, soil, remediation

PAPER : 04

The Effect of Domestic Solid Waste Compositions in the Landfill Areas of Tokat Province on Biogas Production

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Abstract

The utilization of domestic solid waste with high organic content in biogas production has become very common in recent years. These wastes undergo a decomposition process and produce gas compounds, such as methane (CH_4), carbon dioxide (CO_2), oxygen (O_2), or nitrogen (N_2). The high calorific value of especially CH_4 makes the resulting biogas a good renewable energy source among these gases produced. The amount and quality of biogas produced in landfills vary depending on the characteristics and density of domestic solid waste in the area.

This study was based on determining the amount of gas and gas content that would be produced by domestic solid waste put into six reactors, developed for measurements, in different proportions, and the solid waste composition that would yield the optimum result. Quantity and heat measurements of CH_4, CO_2, and O_2 were made as a result of the 60-day anaerobic treatment of solid waste of different amounts and densities used in each reactor. The results showed that the CH_4 content varied from 31.5% to 61.2%, CO_2 content from 24.7% to 46.3%, and the O_2 content from 1,3% to 2,9%. The highest CH_4 level was determined in reactor R4 (45,2-53,7°C), which had a density of 500 kg/m^3 and an organic content of 80%. It was found that different solid waste compositions used in the reactors affected the gas content formed.

Keywords: Biogas, energy production, landfill, methane gas, solid waste.

PAPER : 05

Developing Pelletizing and Pyrolysis Process of Spent Coffee Grounds and Spent Tea Wastes for Solid Fuel and Soil Improver

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With the increasing World population, renewable natural sources have been decreasing day by day, and scientists have been investigating the evaluation of new material from residues and wastes as a renewable source. At this point, the consumption of coffee and tea is increasing all over the world and their brewing residues called spent coffee grounds (SCG) and spent tea wastes (STW) is becoming highly interesting raw material for evaluating to develop new products.

The project aims to develop the optimum pelletizing and pyrolysis conditions for using Spent Coffee Grounds and Spent Tea Wastes mixtures as solid fuel and soil improvers. Firstly, pelletizing properties and parametric pyrolysis conditions of the related mixtures and characterization of the products will be examined. The obtained data will be used for the production by small-scale machines and production efficiency will be compared with parametric conditions.

Finally, the performance of the products will be tested as a solid fuel and soil improver.

The project has two partners respectively Turkish (Ege University) and German partners (Leibniz Institute for Agricultural and Bioeconomye.V. - ATB). The researchers of the project partners given above will contribute to the project through the determined studies in work packages.

The project will have thrown together partners that have deep experiences in distinctive R&D studies. The know-how change and infrastructure sharing between the partners will increase the technology readiness level of the project and the probability of new bilateral collaborations.

At the end of the project, the SCG and STW mixtures, their biocoal/biochar and biocoal/biochar pellets production processes will be attractive to the coffee industry and entrepreneurs. Biocoal pellets from SCG and STW mixtures will penetrate the renewable biomass energy markets. On the other hand, the market share of soil improvers is getting an increase in Turkey and Europe due to increased demand for soil improvers for agricultural purposes.

Keywords: Urban and industrial waste, Biomass processing technologies,Pyrolysis,Biomass burning technologies

PAPER : 06

Review Of The Bıoenergy Installations In The European Union And In Türkiye In Accordance With The Staistics Of International Renewable Energy Agency

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This research is an effort to assess the bioenergy installations in the European Union (EU) and Türkiye in the last decade (2013-2022) by reviewing the data of the International Renewable Energy Agency (IRENA), which regularly publishes the statistics related to the installed renewable energy capacity every year.

The installed renewable energy capacity in the EU increased from 337,583 MW in 2013 to 566,063 MW in 2022. Türkiye also achieved significant accomplishment and strengthened its installed renewable energy capacity in the last decade.

As a substantial renewable energy source which each Member State and Türkiye have an unexplored potential, bioenergy installationswere recorded as 33,839 MW in the EU and as 1,858 MW in Türkiye in 2022. Considering that Türkiye is a candidate countryfor the membership to the EU, it ranks seventh by the terms of having installed bioenergy capacity following Germany, Sweden, Italy, Finland, Denmark and France.It should be noted that among the EU Member States, Germany established more than a quarter of the total bioenergy capacity in the EU. This determination requires reviewing the strategies and administrative regulations followed by Germany regarding bioenergy investments.

Another country which established a considerable installation in bioenergy is the United Kingdom, which withdrewfrom the EU in 2020, also made a significant increase and succeeded to increased its bioenergy capacity to 7,393 MW in 2022 which was 3,791 MW in 2013.

In conclusion, it was found out that the installed bioenergy

capacity constitutes still an insignificant share of installed renewable energy capacity in both the EU and Türkiye yetand more ambitious targets for promoting the bioenergy investments are required in order to reduce greenhouse gas emissions and achieve the targets of the Paris Agreement.

Keywords: bioenergy, IRENA, statistics, Paris Agreement, greenhouse gas emissions.

PAPER : 07

Investigation of the Effect of Al2O3 Nano Particles on Engine Noise

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The noise and vibration created by the internal combustion engine are important for driving comfort. Internal combustion engine noise is basically divided into three parts. These are mechanical noises, auxiliary equipment noises and combustion noise. Vibration and noise created by auxiliary equipment are important in terms of in-vehicle noise and driving comfort. Combustion noise depends on injection delay, engine speed and engine torque. Mechanical noise generally consists of piston knocking, friction and sudden reactions of valves, gear structures, slipping of belt systems, bearings and oil pump. Mechanical noise is proportional to engine speed. Engine block structural resonance is related to noise propagation. The main reason for the noise emitted from the engine surface is the engine block surface and the surface of the oil tank located at the bottom of the engine. The cylinder head and cylinder head cause noise radiation. Aerodynamic noise; Includes fan noise, suction noise and exhaust noise. In this study, the effects of adding different amounts of Al2O3 and TiO2 nanoparticles to gasoline fuel on exhaust exhausts were analyzed. A 1.2 TSI engine with a direct in-cylinder fuel system was used experimentally. The experimental engine was connected to a hydraulic dynamometer. Experiments were carried out at full throttle opening. The results obtained are presented comparatively.

Keywords: nano particle exhaust noise TSI engine

PAPER : 08

Evaluation of the economic aspects of nutrient recovery as struvite from anaerobic digestion plants

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Abstract

Anaerobic digestion (AD) plants are important part of the current waste-to-energy initiatives to reduce the stream of waste going to landfills and the greenhouse gas emissions, recycle the organic material and the plant nutrients back to the soil, and increase renewable energy production. To produce biogas,mostAD plants are mainly fed withorganic feedstocks, including agricultural crops, animal slurries and manures, and waste and by-products from agro-industries. These plants can also precipitate and divert nutrients(nitrogen, N, and phosphorus, P) in a more concentrated form as struvite (magnesium ammonium phosphate, $MgNH_4PO_4.6H_2O$), which has a high nutrient value per unit weight and is highly effective as a slow-release fertilizer,

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becausedigestate from the AD processis rich in Mg, NH_4^+, and PO_4^{3-}, indicating its high potential for nutrient recovery as struvite. As an established eco-technology that lessens the adverse environmental effects of the digestate, struvite precipitation has been extensively investigated as a physicochemical treatment method due to its higher effectiveness for simultaneous recovery of N and P from digestates of the AD plants.Despite a vast number of studieson nutrient recovery from the AD plants by struvite precipitation process,the majority of the literature has focused not on the economic aspects of the process, but rather on the effect of operational conditions. This study intends to review the economic aspects of nutrient recovery as struvite from the AD plantsin terms of the cost of struvite production process using conventional reagents and unconventional low-cost sources and the agro-economic value of struvite as a fertilizer.

Keywords: Fertilizer, low-cost source, digestate

PAPER : 09

Some Pharmaceutical Properties Of Algal-Oil And Its Importance For Biodiesel

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Algal oil is a type of oil obtained from algae such as Crypthecodinium, Nannochloropsis, Schizochytrium, Prototheca and Ulkenia species.

In this study, some pharmaceutical properties of algae oil were investigated and the total oil ratios of some algae important for biodiesel were compared.

Preferred algae for algal oil are rich in specific fatty acids, including oleic acid, docosahexaenoic acid (DHA), and eicosapentaenoic acid (EPA).

Algae oil is recommended for use in the treatment of some diseases.

In the study, the importance of algae oil in terms of cardiovascular, dermatological, gastrointestinal, neurological, oncological and pharmaceutical sciences was examined.

Key words: Algal-oil, pharmaceutical alg-oil, biodiesel

PAPER : 10

Possibilities of Using Furniture Industry Waste inBioenergy

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Abstract

Global energy demand is constantly increasing with a rapidly growing population and developing industry. However, energy demand cannot be met with limited resources, and the gap between energy production and consumption is increasing. Today, traditional fossil fuels such as natural gas, oil, and coal constitute a significant portion of energy demand. On the other hand, these non-renewable energy sources have become increasingly threatening to the environment and human health. The amount of carbon dioxide (CO_2) produced as a result of the combustion of fossil fuels increases, thus preventing the reflection of sunlight together with other gases in the atmosphere. In this way, the greenhouse effect occurs, and global warming causes environmental problems such as climate change. As a result, finding sustainable energy sources that are environmentally friendly and clean, as well as having the ability to exist in every region of the world, has become increasingly essential. While biomass is of huge importance for renewable energy production, furniture industry wastes have a significant potential for new generation bioenergy and biofuel production. Transforming sawdust and other furniture waste into efficient and clean-burning fuel has emerged as a promising solution. One of the easiest and most effective methods to produce energy from furniture industry waste is to grind,dry,and press the

waste into pellets and use them as solid fuel. By pelletizing the material, the volumetric heat value increases, transport and storage costs are reduced, combustion properties are improved, particle emissions to the atmosphere are reduced, and a biofuel with unique properties of the same size and shape is obtained. The aim of this article is to evaluate the possibilities of using furniture industry waste in bioenergy, which is one of the renewable energy sources.Finally, the challenges, opportunities, and future directions will be discussed.

Keywords: Biofuels; Circular economy;Life cycle assessment; Renewable energy;Wood pellets

PAPER : 11

Investigating the Possibilities of Evaluating Urban and Industrial Food Waste, Loss and Waste in Terms of Sustainability

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ABSTRACT

Food waste is a concept that refers to the food loss that occurs at the end of the supply phase of the food chain and is associated with the behavior of retailers and consumers. Food waste is the failure to utilize food as a result of wrong practices in the production process or the produced food being thrown away before being consumed at the final consumption stage. Foods that are not consumed by humans and have lost their nutritional value are considered waste, even if they are used as biofuel, compost and animal feed. Leftover food on the plate, unfinished bread and sandwiches, misshapen vegetables, fruit and vegetable peels, vegetables and fruits with clipped parts that look bad visually, bones, and fat are among the leading food wastes. The fact that food waste is not handled within the framework of an effective and sustainable waste management and goes directly to garbage causes rotten food to spread methane gas in the soil and creates unnecessary greenhouse gas emissions, causing major environmental pollution such as global warming. In addition, when food is lost or turned into waste in this way, all resources used to produce this food, including water, land, energy, labor and capital, are wasted. In this context, food waste triggers not only environmental pollution, but also natural resources and problems such as hunger in society.

Food waste needs to be recycled as it will contribute to environmental sustainability in terms of reducing greenhouse gas emissions. In addition, it is not possible to completely prevent environmental pollution due to the burning process of waste during the evaluation

of waste as biofuel. Considering the difficulty of sustainably feeding the world population, which is expected to reach approximately 10 billion in 2050, the supply and installation of anaerobic digesters has become even more important in food businesses trying to minimize food loss and waste and recycle food waste on-site and recover energy. It is important to plan the menu while evaluating the ingredients in food and beverage businesses, which are one of the places where food loss is most intense, and to use the leftover ingredients, roots, stems and leaves of fruits and vegetables, as well as in making dishes, appetizers, salads, sherbets, jams and sauces. By minimizing the problem of food loss, which has become a global problem worldwide, within the scope of sustainability, the environmental, socio-cultural and economic damages caused by food waste will be prevented.

Keywords: Food Waste, Waste Management, Sustainable Gastronomy, Anaerobic digesters, Bioenergy

PAPER : 12

Determination of The Effects Of Isolated And Mutated Microorganisms On Biogas Volume By Means Of Balloon Test

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ABSTRACT

Enzymes increase reaction rates by acting as catalysts in chemical reactions. Microorganisms are the most preferred enzyme sources. However, since the necessity to increase enzyme yield has emerged, mutation processes continue to be developed. In order to increase enzyme activity and selectivity, random mutation processes are preferred due to their easy applicability. Chemical mutagens such as Ethyl Methane Sulphonate (EMS), N-methyl-N-nitrozourea (MNU), nitrous acid (HNO_2), N-methyl-N-nitro-N-nitrosoguanidine (MNNG), ethidium bromide (EtBr) and sodium azide can be used in random mutation processes.

In the study, 33 microorganisms were isolated using selective medium and purified by boot plate method. Using these isolates, a 2-stage biogas experiment consisting of 99 bottles was established. Among 33 isolates, 7 microorganism cultures showing the highest biogas output were identified. With these 7 microorganisms, the next stage of chemical mutagen treatment was started. The microorganisms were Trichloroacetic Acid, Dinitrosalicylic Acid, Phosphoric Acid and

Hydrochloric Acid. Concentrations of 1/1000, 5/1000 and 10/1000 of all chemicals were prepared. The isolated bacteria were inoculated in petri dishes and left for incubation.

In the study, it was observed that mutants of 3 of the 7 selected cultures (one isolated from straw and the other two from oil-fed cultures), after treatment with both parent and mutagen chemicals, increased the volume of biogas produced. Apart from these, there are also isolates in which mutant strains of these isolates showed a positive effect while the parent microorganism cultures showed a negative effect on gas production. As a result of the study, it was found that all other mutagenic chemicals, except Dinitrosalicylic Acid, had a positive effect on gas production. Dinitrosalicylic Acid chemical caused inhibition above 1/1000 concentration. Apart from this, almost all strains showed an effect increasing the gas volume with the 3 chemicals used.

Keywords: Chemical mutagen, Enzyme, Random Mutation

PAPER : 13

Drop-in Biofuels Production - Thermochemical and Biochemical

Conversion Pathways

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Abstract

The progress of liquid biofuels sector has been hampered by the high production cost of conventional biofuels and requirement of engine modifications. One of the best alternatives to existing liquid biofuels is through drop-in biofuels which can be used without any major engine modification and upgradation of existing fuel delivery infrastructure.

There are multiple pathways for production of drop-in biofuels, including oleochemical technologies, thermochemical conversion, biochemical conversion or by integration of the above methods. The oleochemical pathway for drop-in biofuels uses fats-derived feedstocks such as vegetable oils, used cooking oil and animal tallow.

Gasification and pyrolysis are the advanced thermal conversion technologies for the production of liquid or gaseous intermediates that can be upgraded to drop-in biofuels. After downstream hydroprocessing (hydrotreating and hydrocracking) the hydrocarbon-rich bio-oil and syngas can be converted to an efficient precursor for drop-in fuel.

The biochemical conversion of drop-in biofuels and their intermediates involves a wide array of raw materials, pathways and microorganisms. The typical feedstock for biochemical conversion technologies for production of drop-in biofuels are sugar, starch or cellulose. Bacteria, yeasts, and algae can utilize sugars derived from sugarcane, sugar beet, starch and cellulosic biomass. Major issue in the biological production of drop-in fuels is the higher market

demands of value-added products like carboxylic acid, polyols, and alcohol in the same biological pathway which can be produced by chemical manufacturers with lower operational requirements.

Lignocellulosic biomass is the largest feedstock available for the production of drop-in fuels. The biological conversion of lignocellulosic biomass is heavily dependent on the availability of monomeric C5 and C6 sugars during fermentation.

PAPER : 14

Characterization of Wood Vinegar Obtained from Tea Bush and Investigation of Its Use as Herbicide Against the Invasive Species Tradescantia Fluminensis Vell (Green Telegram Flower)

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Biomass, one of the renewable energy sources; It is a biologically based resource obtained from living or recently deceased organisms. Products obtained from the thermal conversion of biomass are renewable energy sources that can be used both as a chemical source and as fuel. In addition, products obtained from biomass are used in various industrial areas. One of the most important of these products obtained from biomass is wood vinegar. 80-90% of wood vinegar consists of water, and 10% consists of more than 200 organic compounds such as organic acids, alcohols, phenols, aldehydes and esters, especially acetic acid, which is one of the most important components of wood vinegar. Wood vinegar is an environmentally friendly product that can quickly degrade with the soil. Wood vinegar improves soil quality, reduces harmful microorganisms, and increases fruit yield. Wood vinegar is used in food additives, antibacterial drugs and pesticides. In this study, the use of wood vinegar obtained from tea bush, selected as biomass, as a herbicide against Tradescantia Fluminensis Vell, an invasive species, was investigated. For this purpose, the tea bush, which was crushed into particles smaller than 2 mm, was subjected to pyrolysis at 4 different temperatures in the presence of nitrogen gas, which was selected as the driving gas. The liquid products obtained as a result of pyrolysis were mixed with dichloromethane and kept for organic and aqueous phase separation. This aqueous phase, called wood vinegar, was separated and bottled and stored under appropriate conditions for later use. Column chromatography, GC, H-NMR, FT-IR were used for the characterization of the obtained wood vinegar after examining its water content, moisture, ash, volatile matter amount and calorimetric

value. The invasive species was soaked with different concentrations of wood vinegar in the same ratio every day, and the changes in the plant were examined daily. In line with the results obtained, it is thought that it will be a natural precaution against the invasive species, which is an important problem especially for tea producers, tea yield will increase and tea production that is harmless to our country's economy will be realized.

PAPER : 15

Residue Riches: Maize Biomass Biorefinery Solutions for Environmental and Economic Benefits

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ABSTRACT

Maize, a globally consumed cereal grain, stands as a dietary staple for millions, particularly in sub-Saharan Africa, providing essential carbohydrates, proteins, and nutrients. Beyond its role in human consumption, maize plays a crucial part in animal feed, industrial processes, and serves as a feedstock for biofuels. Post-harvest, maize residues—encompassing leaves, stalks, husks, cobs, and grain dust, collectively known as maize biomass—represent an underutilized resource with significant potential as a renewable energy source. The composition of these residues, influenced by factors such as maize species, environmental conditions, and harvesting techniques, contains substantial amounts of cellulose, hemicellulose, and lignin. Current disposal practices, including burning or leaving residues in fields, contribute to soil degradation and the release of greenhouse gases. In response to these environmental concerns, sustainable alternatives are gaining traction, notably the use of maize residues in biorefinery production. This approach not only addresses waste-related challenges but also aligns with circular economy principles, reduces dependence on fossil fuels, and promotes overall environmental sustainability. The biorefinery process, integrating biomass conversion technologies, facilitates the transformation of maize residues into valuable products, including biofuels, biochemicals, and other sustainable materials. Despite its promise,

several challenges hinder the widespread adoption of maize residues in biorefineries, including the variable composition impacting conversion efficiency, seasonal variations limiting availability, and substantial capital requirements posing challenges for small-scale farmers. This report aims to comprehensively survey the current state of maize residue applications in biorefinery processes, emphasizing the benefits, such as mitigating environmental issues, fostering a circular economy, and advancing sustainable development, while critically analyzing the constraints and limitations involved in practical application. Importantly, the report serves an educational purpose, aiming to raise public awareness of the inherent value of maize residues, especially in developing countries where agriculture, including maize farming, significantly sustains livelihoods. By fostering understanding and appreciation for sustainable practices and the economic opportunities associated with maize residues, the report endeavors to contribute to broader efforts in promoting environmentally conscious and economically viable agricultural practices on a global scale.

PAPER : 16

Turkey's Place Among Biogas Producing Countries

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ABSTRACT

Human beings have been in a constant search for energy from the past to the present in order to continue their lives, to adapt to the conditions required by the age and to live a more comfortable life. In the face of the increasing need for energy in parallel with the population, these searches have led to global problems such as the decrease in biodiversity, destruction of the ozone layer, acid rain, air, water and soil pollution, hazardous wastes, depletion of natural resources, sea and ocean pollution, which threaten the lives of not only humans but all living things. For this reason, the world has turned to renewable energy sources to meet its energy needs. Biogas from organic wastes such as plant and animal waste is one of the most important renewable energy sources. It is mainly used in heating, electricity generation and as fuel for vehicles. In this context, the European Union ranks first with 10.4 GigaWatts of production in the world, which reached a biogas production capacity of 15 GigaWatts in 2015. The European Union is followed by North America with 2.4 GigaWatts, Asia with 711 MegaWatts, South America with 147 MegaWatts and Africa with 33 MegaWatts.

In this study, the biogas production plant assets of the world's leading countries in biogas production and Turkey were investigated and their status was revealed. Although our country has a biogas production potential at a level that can compete with the world countries, the reasons for the existence of a small number of biogas production facilities and solutions to these problems are presented.

Keywords: Agricultural Structures, Animal Manure, Biosystems, Energy, Organic Waste.

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