BPS 2023

BioPhys Spring 2023

22nd International Workshop for Young Scientists

June 15-16, 2023, Gödöllő, Hungary

BOOK OF ABSTRACTS

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Institute of Agrophysics Polish Academy of Sciences, Lublin, Poland
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Additional supporting and sponsoring organizations

Hungarian University of Agriculture and Life Sciences
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Hungarian Solar Energy Society

Foundation of the Polish Academy of Sciences

Perfect Science

Ministry of Science and Higher Education, Poland

"Conference co-financed from the state budget under the program of the Minister of Education and Science entitled Perfect Science – project number DNK/SN/549935/2022 – co-financing amount 50 548,40,00 zł, total project value 56 368,40 zł."

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Book of Abstracts

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Hungarian University of Agriculture and Life Sciences

Gödöllő, 2023

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This event was supported by the Doctoral School of Mechanical Engineering, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

Published by

Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

H-2100 Gödöllő, Práter Károly u. 1.

Tel.: +36-28/522-000

https://www.uni-mate.hu

Under the supervision of Prof. Dr. Csaba Gyuricza

ISBN 978-963-623-053-1 (print)

ISBN 978-963-623-054-8 (pdf)

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INTRODUCTION

Dear Friends and Colleagues,

It is really my great pleasure to welcome you in attending the 22nd International Workshop for Young Scientists "BioPhys Spring 2023" (BPS 2023) which, this time, to be held in Gödöllő, Hungary during June 15-16, 2023.

The meeting continues the tradition of previous workshops oriented on training of young researchers and exchange of professional experience in the field of physics applied to biological, agricultural and food systems as well.

It is cordially invited the young scientists to participate in the activity of BPS 2023 Workshop, and to present their results of research in application of physics to life sciences.

The abstracts of contributions are published in an ISBN numbered printed BPS Book of Abstracts. Additionally selected papers can be submitted for publication in the Journals issued by the participating institutions.

It is my pleasure to invite you to spend a few days of June 2023 in friendly atmosphere between specialists in Gödöllő.

During your stay, you may visit the facilities of the Hungarian University of Agriculture and Life Sciences, Szent István Campus, the laboratories and installations of the Institute of Technology and Institute of Mathematics and Basis Science, and of course, the city of Gödöllő and its area.

Special thanks are devoted to the Doctoral School of Mechanical Engineering, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary for the support of organising the event of BPS 2023.

Prof. I. Farkas

Chairman, BPS 2023

SCIENCIFIC BOARD

LECTURES

IMPROVING THE PERFORMANCE OF FLAT PLATE SOLAR COLLECTOR BY USING NANOFLUID

A.M. Ajeena[1], P. Víg[2] and I. Farkas[3]

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Renewable energy sources have gained considerable attention in all countries throughout the past several years as a result of the limitation of traditional energy resources. Solar energy has grown as a major application field, especially for solar collector heating systems. Flat-plate solar heaters are the most useful, although they have low outlet temperatures and low efficiency generally. Recent optimization techniques, along with improvements in nanomaterials, allow for higher efficiency in such solar systems (Ajeena et al., 2022).

Nanofluid as working fluid is a critical aspect of all types of flat plate solar collector. The working fluid is mainly responsible for absorbing and transferring an increased amount of solar heat when it flows through the absorber plate's pipes. As the working fluid circulates around the system, a gradual increase in the outlet water temperature occurred. Nanofluid thermo-physical properties are influenced by the nanoparticle and base fluid's physical and chemical characteristics. All tests in flat plate solar collector were conducted around solar noon 10 am – 15 pm. These tests took several days of observation with a clear sky and moderate wind speed. The base fluid is used at different solid volume concentrations of nanofluids and different flow rates in the experimental results which also show the efficiency of the Flat plate solar collector. After completing the tests and taking pertinent readings in the experiments, it is possible to estimate the net useful heat gain as well as the efficiency of the collector. Subsequently, the standard working fluid and prepared nanofluids can be compared.

The outcomes revealed a rise in the thermal efficiency of the solar collector at higher flow rates due to the lesser surface contact time of fluid and consequently lower temperature under such conditions. Moreover, As the solar radiation became more intense, the solar collector became highly thermal efficient at the hight volume flow rate. Additionally, the findings indicated that an increase in the reduced temperature parameter (Ti-Ta)/G value caused an increase in the outlet temperature. The outlet temperature rose as a result of adding nanoparticles, a trend that was observed for both flow rates. The increase in outlet temperature results from the thermal conductivity augmentation in line with the concentration of particles. At lower flow rates, the temperature gradient is higher.

Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Ajeena, A.M., Víg, P., Farkas, I.: A comprehensive analysis of nanofluids and their practical applications for flat plate solar collectors: Fundamentals, thermophysical properties, stability, and difficulties, Energy Reports, Vol. 8, 2022, pp. 4461–4490.
https://doi.org/10.1016/j.egyr.2022.03.088

DEVELOPMENT OF SOLAR TRACKER USING MICROCONTROLLER SYSTEM

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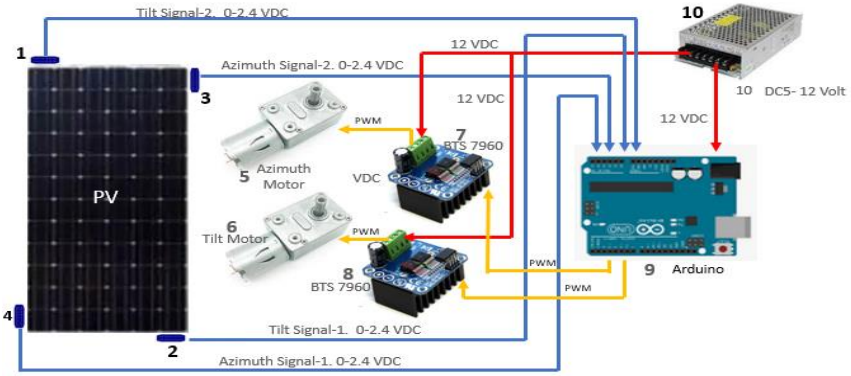
There are a few ways to improve the photovoltaic (PV) module efficiencies, such as by cooling the PV module's surface, cleaning the PV module's surface routinely, focusing the incoming sunlight with a glass concentration device, and using Solar Tracker System (STS) control system.

Based on a previous study, STS can improve the PV's efficiency at a range of 20-40% for monocrystalline technology, and it showed better compared to the previous (16-20%). The new efficiency depends on the axis application during operation, and it can be a single or dual axis. The dual-axis STS will give more efficiency than the single axis due to its accuracy in searching sunlight but need more electric power to rotate PV at any angle (Fathabadi, 2016).

Gear or pulley transmission must be provided to reduce the motor's rpm and to improve torque to rotate PV slowly at high torque. The design mechanism pivot of PV to turn the PV will depend on the value of motor torque needed, and it must be designed at the central line of mass to reduce the torque needed. The rpm of PV must be lower than 1 rpm, 0.5 rpm is better, it is intended to stop PV at a right angle (Azimuth and Tilt angles), which means the sunlight is perpendicular to the PV's surface. The lower speed of PV's rpm has any other purpose, it is intended to be easily controlled by a control system. An electronic system, Programmable Logic Controller (PLC), and Microcontroller became alternative control systems, in order to control the movement of the PV. The usage of a microcontroller became a good alternative because of using coding, which makes it simple in troubleshooting by modifying the program rather than in the hardware of an electronic system and has a competitive price to PLC. Nevertheless, the coding of microcontrollers is relatively more difficult rather than coding for PLC.



Acknowledgements

The short synopsis of this research is released as an outcome of a multidisciplinary international partnership between ITENAS Bandung, Indonesia, and MATE Gödöllő, Hungary.

References

Fathabadi, H: Comparative study between two novel sensorless and sensor based dual- axis solar trackers. Solar Energy 138 (2016), pp. 67–76.

PRODUCTIVITY ENHANCEMENT OF PV MODULE BASED ON A SOLAR TREE

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The solar PV tree (SPVT) is an artificial tree mixed between PV technology and aesthetics. SPVT consist of a single stem from metal or wood and solar modules as a leaf distributed on a single layer directed toward the sun.

The aim of this research is to increase the electricity productivity of the SPVT by using the simple solar tree type because of it has a best efficiency performance compared with other SPVT types (Almadhhachi et al., 2022).

As shown in the figure below, SPVT southern oriented with 45-degree tilt angle has been examined and compared the results with flat PV module southern oriented with 45-degree tilt angle.

This study examined the impacts of the PV module temperature on the electricity generating. The result shown the SPVT can generate more power by 20% compared with flat PV module with the same surface area of PV system and same weather conditions.

The highest temperature recorded for the flat PV module is 49.8 °C at 11:50, while the highest temperature in the center of the SPVT is 38.05 °C at 11:50. The SPVT slightly affected by heating process, however, the SPVT works in the operating temperature range. The branches in the sunflower let the air goes through the solar tree arms to ventilate the PV modules and reduce the temperature.

Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Almadhhachi M., Seres I., Farkas I.: Significance of solar trees: Configuration, operation, types and technology commercialization: Energy Reports, Vol. 8, 2022, pp. 6729-6743. https://doi.org/10.1016/j.egyr.2022.05.015

HEAT TRANSFER ENHANCEMENT OF PARABOLIC TROUGH SOLAR COLLECTOR BY PASSIVE METHODES

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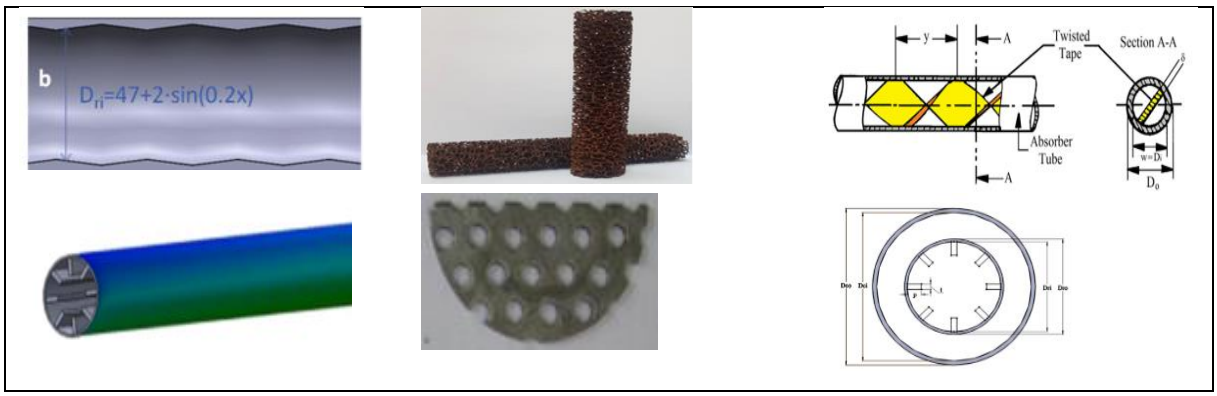
The parabolic trough solar collector (PTSC) is one of the prominent applications in solar energy, and it takes the radiant energy from the sun and converts it to useful thermal energy in the heat transfer fluid that circulates through a metal tube (receiver). Therefore, the receiver tube is one of the key practical devices of PTSC (Al-Rabeeah et al., 2022a).

The goal of this research is increasing the thermal performance of PTC by passive methods such as porous, fins, twisted tapes, wire coils, wavy inserts, and customized surfaces such as corrugated, dimpled, arc-shaped, cavity receivers etc. boost heat transfer, secondary flows and heat transfer area. As shown in the figure below, some passive methods that used in receiver tube (Al-Rabeeah et al., 2022b).



Therefore, passive method is one of the effective techniques of heat transfer enhancement for PTSC. It has been concluded that the receiver tube and geometrical changes of receiver tube are efficient strategies for increasing thermal performance of PTSC system.

Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Al-Rabeeah, A.Y., Seres, I., Farkas, I.: Recent improvements of the optical and thermal performance of the parabolic trough solar collector systems, Facta Universitas, Series: Mechanical Engineering, Vol. 20, No 1, 2022, pp. 73–94.
https://doi.org/10.22190/FUME201106030A

Al-Rabeeah A.Y, Seres I., Farkas I.: Selective absorber coatings and technological advancements in performance enhancement for parabolic trough solar collector, Journal of Thermal Science, 31(6), 2022, pp. 1990–2008.
https://doi.org/10.1007/s11630-022-1634-5

PERFORMANCE COMPARISON OF THE HYBRID PHOTOVOLTAIC THERMAL MODULES ENHANCED BY WATER AND GLYCOL AS A COOLANT

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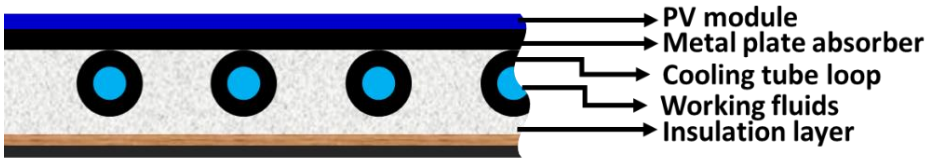
The real challenge facing photovoltaic modules is the increase in cell temperature, which negatively affects conversion efficiency. Besides, this temperature increase causes the module to heat up and transfer to the surrounding area (Alshibil et al., 2023). Photovoltaic thermal (PV/T) modules are the most promising technology investigating this heat for further application in space heating and hot water systems. A photovoltaic thermal combination is a form of renewable energy technique that simultaneously provides electricity and heat (Alshibil et al., 2022).

Liquid-cooled type is the most used configuration of the PV/T module to remove the heat generated by the photovoltaic modules. Different designs of tube loops were mounted to the PV module either directly or via a metal plate absorber, as shown in the following figure.



This study compared the thermal and electrical performance of the liquid-based PV/T module using two working fluids (water and glycol) as coolant circulated into the tube loops behind the PV module to enhance the performance of the photovoltaic module.

As a result of this study, the glycol-cooled PV/T module was efficient in heat removal compared to the water-cooled module used. The glycol-cooled PV/T unit also enhanced the electrical and thermal efficiency due to the decrease in the cell temperature of the photovoltaic module.

Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Alshibil, A.M.A., Farkas, I., Víg, P.: Thermodynamical analysis and evaluation of louver-fins based hybrid bi-fluid photovoltaic/thermal collector systems, Renewable Energy, Vol 206, 2023, pp. 1120–1131. https://doi.org/10.1016/j.renene.2023.02.105

Alshibil, A.M.A., Farkas, I., Víg, P.: Multi-aspect approach of electrical and thermal performance evaluation for hybrid photovoltaic/thermal solar collector using Trnsys Tool, International Journal Thermofluids, Vol 16, 2022, pp. 100222.
https://doi.org/10.1016/j.ijft.2022.100222

EFFECTS OF VARIOUS ENVIRONMENTAL FACTORS ON PHOTOVOLTAIC-THERMAL SYSTEMS

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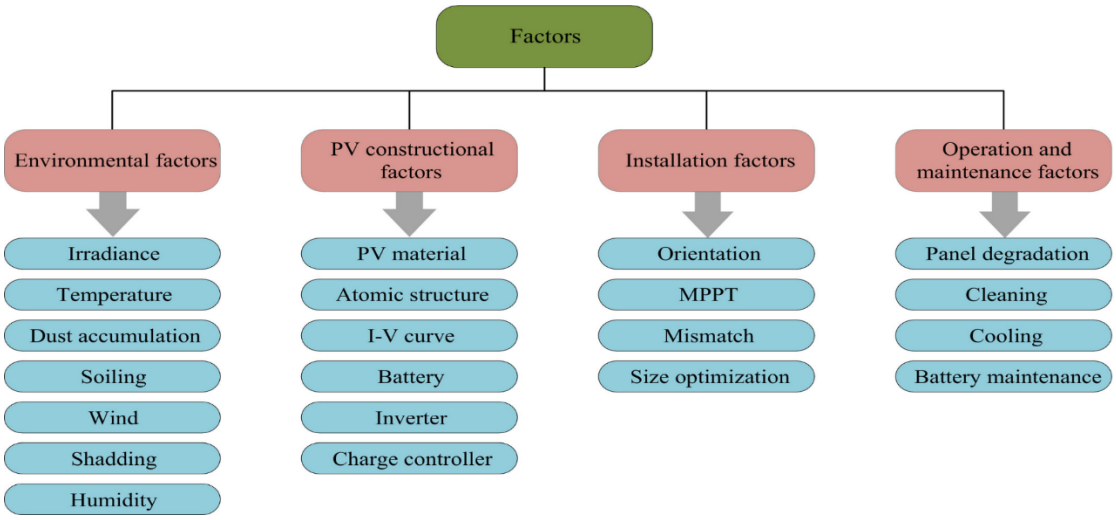
This rise in energy demand is the result of developing countries' quick industrialization and expansion. It is anticipated that by 2030, it will have increased globally by more than 50%. As a result of its enhanced dependability, PV systems are now being considered as a viable alternative for supplying the world's energy demands (Mustafa et al., 2020).

Environmental variables as irradiance, temperature, dust distribution, soiling, wind, shade, humidity, etc. have a significant impact on the performance and efficiency of the PV module.

This primary objective of this study is to investigate the substantial effects that various variables have on the power produced by the vast majority of PVT systems.

In this assessment, as shown in the figure below, it is indicated that there are numerous factors those have an impact on a PVT system's efficiency.



As because the solar cells to have a long life when functioning outdoors, they must be protected from various environmental conditions such as temperature cycling, dust, rain, and so on. To protect solar cells and provide a long running duration, PV modules have the following components: Transparent front glass, encapsulated solar cells string, EVA layers, and back sheets.

Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Mustafa, R. J., Gomaa, M. R., Al-Dhaifallah, M., Rezk, H. (2020). Environmental impacts on the performance of solar photovoltaic systems. Sustainability (Switzerland), 12(2). https://doi.org/10.3390/su12020608.

MONTHLY AVERAGE SOLAR ENERGY GENERATED BY SEMI-TRANSPARENT SOLAR MODULES

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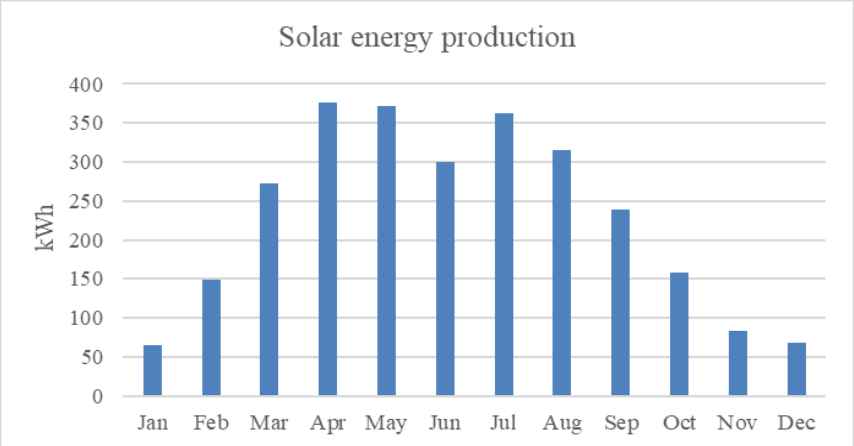
Photovoltaic (PV) systems use the photovoltaic effect to directly turn solar power into electric power. Photovoltaic modules are categorised as conventional or semi-transparent; most standard modules are constructed of monocrystalline and polycrystalline silicon.

This research aims to evaluate the performance of semi-transparent photovoltaic modules with the combination of actual measurement and simulation results. The semi-transparent modules were installed at the Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary. The systems consist of 2x10 pieces 165 Wp Solarwatt Vision with the total of 3,3 kWp. The PV modules were oriented south with an inclination that matched the site and angled to a fixed physical support outside the Aula building (Anggraeni et al., 2022).

The following chart shows the monthly average solar energy production for a period of from June 2017 to October 2021. Obviously, it can be realised that in winter, the energy produced is reasonably less than in spring, and especially in summer. The electrical energy produced in summer is 5.75 times greater when compared to winter period.



The amount of solar energy produced can be used as a reference to determine semi-transparent photovoltaic performance and efficiency for each month.

Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Anggraeni, N.D., Seres, I., Farkas, I.: Approaches to the performance evaluation of semi-transparent photovoltaic modules, Facta Universitas, Series: Mechanical Engineering, Vol. 22, No 1, 2022, pp. 116–124.

EXTRACTION OF ADDED-VALUE COMPOUNDS FROM SEAWEEDS FROM BLACK SEA ORIGIN

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The Romanian coastlines of the Black Sea have abundant seaweed resources although it is not used in any industrial application. In the summer period when algae blooming occurs, more than 50000 tonnes of green algae are usually collected at the Romanian Coast and deposited at the local landfill deposits. If left uncollected in the seashore, the natural degradation process of the organic material will produce volatile compounds creating significant problems for tourist activities and the environment. As such, to minimize the negative impact of algae blooms, proper and rapid collection and management processes must be put in place. In 2022 July in only one week period around 800 tonnes of green algae were collected in the South part of the Romanian coastal area (Antena 3 – news. 2022).

Marine biomass has a huge potential for industrial applications. In the countries from the Atlantic Coast, seaweed can find a lot of biorefinery technological developments in the use of this marine biomass in the pharmaceutical, cosmetics and fine chemistry industries.

In the present work, it will be presented some experimental data and integrated biorefinery technological schemes applied to the seaweeds from the Romanian Costal area. The marine biomass was collected at Agigea Coastal Area in "Golful Pescarilor". The work started with the proximate and structural characterisation of the biomass, followed by seaweed treatment in an operation scheme where added-value compounds are extracted. In this work, the target product was "ulvan", a sulphated polysaccharide useful in the pharmaceutical industry (Alves et al., 2013). The proposed experimental matrix starts with the hydrothermal treatment of biomass, where the liquid stream obtained contains the dissolved ulvan and the corresponding solid stream was used in biogas production. The ulvan extraction yields were established reaching 7-9.5 % of dry biomass and the corresponding methane yield in the biogas production experiments was 250 litres CH_4/kg VS. Besides the extraction of added-value compounds and valorisation of the extracted solids, the present work also assesses water quality parameters of the Black Sea, which influenced the algae blooming process in the summer period, employing the evaluation of both dissolved oxygen content and chemical oxygen demand (COD).

Acknowledgements

This work was carried out under the BRISK2 project that has received funding from the European Union's Horizon 2020's research and innovation programme under grant agreement number 731101.

References

https://www.antena3.ro/actualitate/locale/marea-verde-marea-neagra-sute-tone-de-alge-sud-litoral-645564.html, (accessed April 29. 2023)

Alves, A., Sousa, R., Reis, R. L., 2013. A practical perspective on ulvan extracted from green algae. J Appl. Phycol (2013), Vol. 25, pp. 407–424

COMPLEX DIELECTRIC PERMITTIVITY SPECTRUM OF DIFFERENT TYPE OF SOIL AND SELECTED AGRICULTURAL RAW MATERIAL IN RELATION TO DENSITY AND MOISTURE CONTENT

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Complex dielectric permittivity is an electrical property of materials expressed by the real part which describes the polarization of water molecules under the action of an external electric field. Measuring the dielectric permittivity spectrum of agricultural materials enables determining its moisture content. Soil, due to its three-phase structure, is characterized by frequency-dependent dielectric permittivity. Measurements of the frequency dependence of dielectric permittivity are part of dielectric spectroscopy in its broadest sense, where it is crucial to obtain this dependence over the widest possible frequency band. Simple reflectance measurement methods typically achieve narrow bandwidths of 20 MHz to 200 MHz (Szerement et al. 2019), while sophisticated transmission systems are capable of achieving bandwidths of several tens of MHz to even several GHz (Szypłowska et al., 2019).

The objective of the study was to evaluate the effect of soil density and moisture content on the dielectric permittivity spectrum. Several types of soils with different grain size and granular composition were measured. In addition, preliminary results of dielectric permittivity of Lavatera biomass obtained after pre-sowing exposure of seeds to He-Ne laser light will be presented. The research was carried out in a system with six coaxial cells constructed by the Institute of Agrophysics, Polish Academy of Sciences in Lublin, as well as with the use of an open-ended antenna probe. The system uses R60 vector reflectometer (Copper Mountain Technologies) and a multiplexer that allows six measurement cells to be connected to it. Dielectric permittivity spectra were calculated by a dedicated MATLAB script, based on S-parameters and calibration data obtained from the VNA. As a result of the measurements, the dependence of the dielectric permittivity on the density and moisture of the samples in the studied frequency range was observed. Samples with higher density and moisture content show higher dielectric permittivity.

Acknowledgements

The research is supported under the project “System for complex dielectric-permittivity-spectrum measurements of powdery, liquid, and solid materials in 1 MHz – 3 GHz frequency range” funded by the National Centre for Research and Development. Grant No. TANGO-V-C/0007/2021-00.

References

Szerement, J.; Woszczyk, A.; Szypłowska, A.; Kafarski, M.; Lewandowski, A.; Wilczek, A.; Skierucha, W. A seven-rod dielectric sensor for determination of soil moisture in well-defined sample volumes. Sensors (Switzerland) 2019, 19, 1646.

Szypłowska, A., Lewandowski, A., Jones, S.B., Sabouroux, P., Szerement, J., Kafarski, M., Wilczek, A., Skierucha, W.: Impact of soil salinity, texture and measurement frequency on the relations between soil moisture and 20 MHz–3 GHz dielectric permittivity spectrum for soils of medium texture. J. Hydrol. 2019, 579, 124155.

THE EFFECT OF PH ON SORPTION CAPACITY OF MIXOTROPHIC EPS SYNTHESISED BY MICROALGAE

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Unicellular algae are generally autotrophic organisms. However, some species are known for their ability to grow in mixotrophic conditions. The literature indicates that the addition of organic carbon source to the growth medium increases the productivity of extracellular polymeric substances (EPS) by microalgae (Babiak and Krzemińska, 2021; Cheirslip et al., 2016). The sorption properties of autotrophic microalgal EPS have been studied (Naveed et al., 2019; Ciempiel et al., 2022). However, there is limited information about metal sorption potential by EPS produced in mixotrophic conditions.

The aim of the current study is determination of sorption capacity of EPS produced in mixotrophic conditions by unicellular algae: *Chlorella vulgaris*, *Parachlorella kessleri* and *Vischeria magna*.

For this purpose the isolated EPS were dissolved in Pb(II) solution with pH adjusted to 4, 5 and 6. The samples were incubated at 25°C for 5, 30 and 60 min. After this time the samples were collected, centrifuged, and filtered with PTFE filters (0.45μm) to remove EPS. The concentration of residual Pb(II) ions in filtrates was measured using optical emission spectrometry with inductively coupled plasma (ICP-OES iCAP 6500 Duo). Based on the obtained results, sorption capacity and removal potential were calculated.

The results showed that EPS produced by *C. vulgaris* and *P. kessleri* are effective Pb(II) sorbents after 5 min, while in case of *V. magna* the maximum sorption was observed after 60 min. The highest Pb(II) removal potential was observed of EPS produced by *C. vulgaris.*

The results indicated that mixotrophic EPS produced by *C. vulgaris* and *P. kessleri* showed the potential for effective Pb(II) removal from aqueous solution.

References

Babiak W., Krzemińska I.: Extracellular polymeric substances (EPS) as microalgal bioproducts: A review of factors affecting EPS synthesis and application in flocculation processes, Energies, Vol. 14, 2021, 4007. https://doi.org/ 10.3390/en14134007

Cheirslip B., Mandik Y.I., Prasertsan P.: Evaluation of optimal conditions for cultivation of marine *Chlorella* sp. as potential sources of lipids, exopolymeric substances and pigments, Aquacult. Int., Vol. 24, 2016, pp. 313–326. https://doi.org/10.1007/s10499-015-9927-2

Ciempiel W., Czemierska M., Szymańska-Chargot M., Zdunek A., Wiącek D., Jarosz-Wilkołazka A., Krzemińska I., Soluble extracellular polymeric substances produced by *Parachlorella kessleri* and *Chlorella vulgaris*: Biochemical characterization and assessment of their cadmium and lead sorption abilities, Molecules, Vol. 27, 2022, 7153. https://doi.org/10.3390/molecules27217153

Naveed, S., Li, C., Lu, X., Chen, S.; Yin, B., Zhang, C., Ge, Y.: Microalgal extracellular polymeric substances and their interactions with metal(loid)s: A review. Crit. Rev. Environ. Sci. Technol. Vol. 49, 2019, pp. 1769–1802. https://doi.org/10.1080/10643389.2019.1583052

ROLE OF PHOTOVOLTAIC TECHNOLOGIES TRANSITION TOWARDS RENEWABLE ENERGY

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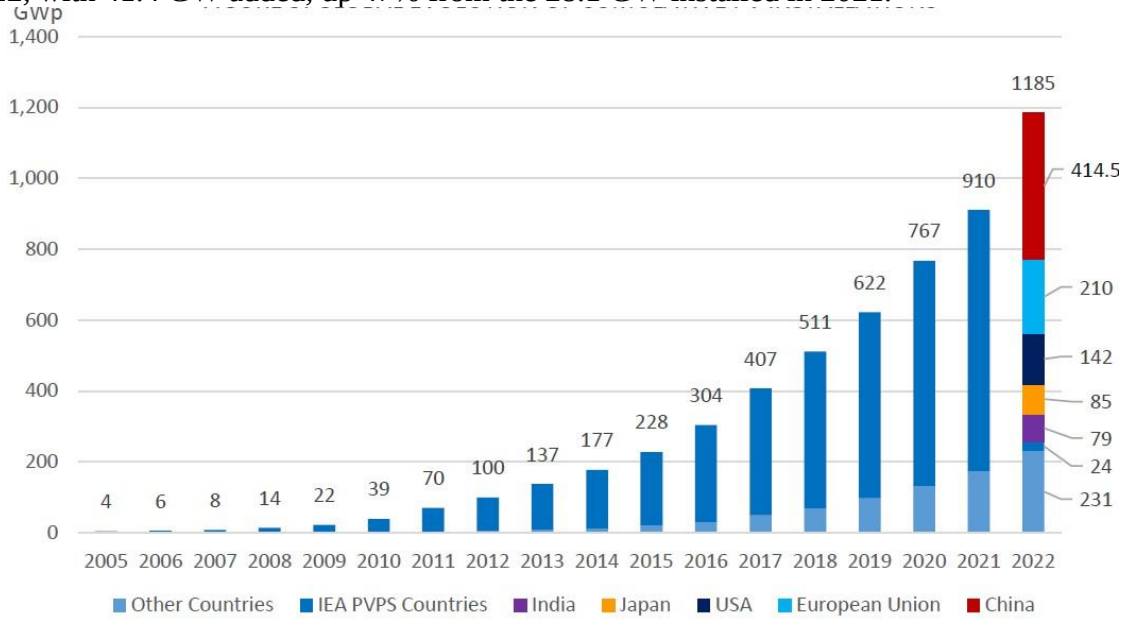
The recent paper is dealing with the role of the rapidly developing field of solar photovoltaic technologies towards renewable energy.

In 2022, the solar PV market increased by about 26% reaching the global capacity of 1185 GW passed the symbolic 1 TW mark along with the annual additions of 243 GW (Renewables 2023; IEA PVPS, 2023). The EU saw a significant increase in solar power capacity installed in 2022, with 41.4 GW added, up 47% from the 28.1 GW installed in 2021.



Solar PV Global cumulative installed capacity - 2022

Some of the application areas showed a significant increase. As an example, the global investment in electric vehicles and related charging infrastructure surged 53.6% in 2022 to reach USD 466.1 billion, which is a remarkably high yearly development.

In 2022 the agricultural PV projects were continued, especially in China. In Europe, among France, Greece, the Netherlands, Spain, and Italy are the main actors in in this field. Similarly, the floating PV plants also continued to expand with installed capacity exceeding in 2022. The world's largest floating PV plant in China. In Europe, Portugal held an auction for 500 MW of floating solar to be located at hydropower dams (Renewables, 2023).

Unfortunately, since the middle of 2020, the solar module prices have become increasingly unpredictable and changeable, especially due to the supply chain disruption. At the same time, according to the recent NREL report (2023) the best research-cell efficiency achieved 47.6%.

References

Renewables 2023 - Global Status Report, Energy demand, REN 21, Renewable Energy Policy Network for the 21th Century
Snapshot of global PV markets 2023, Report IEA PVPS T1-44, 2023
NREL report, May 1, 2023

EFFECT OF GLYPHOSATE ON RESPIRATORY ACTIVITY OF AGRICULTURAL SOILS

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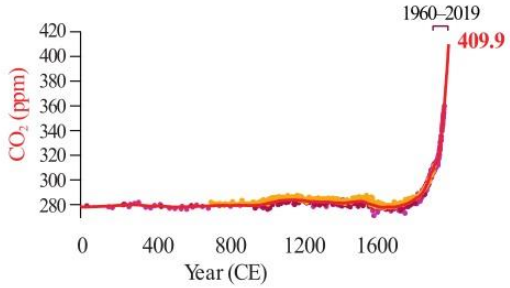
In the last century there has been a significant increase in the concentration of atmospheric CO_2, which significantly contributes to global warming (figure below). Most of CO_2 emissions are related to industrial development, but natural processes, including microbial soil respiration, also play an important role in the global balance. Studies conducted for decades have shown that the balance of greenhouse gases in the soil-atmosphere system is strongly conditioned by anthropopressure, which one of the manifestations is the chemicalization of agriculture. Both fertilizers and plant protection products affect the composition and activity of soil microbiomes and CO_2 emission (Shukla et al., 2022).



One of the most widely applied herbicides is glyphosate (GF), known by its commercial name Roundup Its annual production exceeds $8.25*10^8$ kg and continues to grow (Benbrook, 2016). Despite being a foliar herbicide, GF in considerable amount accumulate in the soil through indirect spraying or plant shoot to root translocation. It was already shown that GF increases soil microbial activity, resulting in enhanced CO_2 emissions, yet knowledge in this area is still insufficient.

In the present study, the effects of a wide range of Roundup™ concentrations on fluvisol and murcky soil CO_2 emission are presented along with discussion concerning possible metabolic pathways responsible for the biodegradation of GF.

Acknowledgements

This work was supported by the Project "*Effect of glyphosate on the biological methane oxidation in agricultural soils*", No. 2021/41/B/NZ9/03130 which was financed by National Science Centre.

References

Shukla, P.R., et al.: IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK and New York, NY, USA. https://doi.org/10.1017/9781009157926

Benbrook, C.M.: Trends in glyphosate herbicide use in the United States and globally, Environmental Sciences Europe, Vol. 28, No 3, 2016, pp. 1–15. https://doi.org/10.1186/s12302-016-0070-0

THE POSSIBILITIES OF THE RADNANO DOSIMETERS IN MEDICAL DEVICES AND BIOLOGICAL EXPERIMENTS

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Ionizing radiation is present in our environment, and the living organism has adapted to the permissible level, but it cannot be detected by our senses and can be dangerous in many cases. In many areas of our lives, it is increasingly necessary to measure, monitor and control the intensity of ionizing radiation in laboratories, hospitals, various power plants and in our environment due to artificial applications. There are various methods for detecting and measuring the intensity of radiation, currently there is a growing demand for semiconductor-based instruments due to the proliferation of electronic devices and their many advantageous properties such as small size, reasonable power consumption and the endless possibilities for high-tech portable and remote applications such as space research, nuclear industry, medical applications and others.

RadNano is an innovation of a tiny integrated circuit designed to measure radiation levels, which is currently the world's smallest active dosimeter. Thanks to its design, it can be easily integrated into any intelligent electronic system, be it a phone, airplane, drone, or even a space probe. It is under continuous development, its current dimensions are comparable to a smaller coin. The figure shows the real size of a RadNano unit.

Since electronic devices are much more tolerant of ionizing radiation than living creatures, these devices can help detect and assess dangerous situations without endangering living organisms. The small size and power consumption made it possible to include this instrument in battery powered and remote applications and to achieve better than ever spatial resolution in sensor networks that is beneficial in numerous applications.

The presentation will give an overview of the possibilities with this next-generation instrument with a few planned experiments including medical devices, biological experiments and space research.

Acknowledgements

This work was supported by 27G-Technology Ltd., by the ESA-BIC Hungary program, and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

THE EFFECTS OF SOIL SPLASH PHENOMENON

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Soil is a very important component of many ecosystems, but as a non-renewable natural resource of the Earth it may be subjected to various degradation processes. The reasons for degradation depend on many different factors, which can be categorized as chemical, physical and biological. One of the types of physical degradation is water erosion. This process can be initiated by the splash phenomenon related with the impact of raindrops onto soil surface causing the detachment and transport of soil material. The problem of soil protection against erosion is still increasing, thus a thorough understanding of the mechanisms governing this phenomenon at all stages could contribute to the improvement of effective methods for preventing the water erosion. The aim of this study was to present the environmental effects of soil splash phenomenon.

As was mentioned, the main aspect of soil splash phenomenon is detachment and ejection of soil particles which are transported over different distances. As a consequence, this could lead to the loss of soil material e.g. in streams and rivers. The other effect is the breakdown of soil aggregates by impacting drops influencing the soil structure. One of the aspect of splash is the deformation of soil surface (cratering) and formation of the crusted surface with limited infiltration. Soil splash is also responsible for the dispersal of microorganisms, pathogens, and pollutants within the ejected particles.

This study presents the environmental effects of soil splash phenomenon based on the obtained methodologies and studies conducted in the Institute of Agrophysics, Polish Academy of Sciences.

Acknowledgements

This research was financed by the Statutory Research of Institute of Agrophysics Polish Academy of Sciences.

References

Beczek, M., Ryżak, M., Sochan, A., Mazur, R., Polakowski, C., Hess, D., Bieganowski, A.: Methodological aspects of using high-speed cameras to quantify soil splash phenomenon. GEODERMA 378, 2020

Mazur, R., Ryżak, M., Sochan, A., Beczek, M., Polakowski, C., Bieganowski, A.: Soil Deformation after Water Drop Impact—A Review of the Measurement Methods. Sensors 23(1), 121, 2023

Beczek, M., Mazur, R., Ryżak, M., Sochan, A., Polakowski, C., Beczek, T., Bieganowski, A.: How much raindrop energy is used for transportation of the two-phase splashed material? GEODERMA 425, 2022

Beczek, M., Ryżak, M., Sochan, A., Mazur, R., Bieganowski, A.: The mass ratio of splashed particles during raindrop splash phenomenon on soil surface. GEODERMA 347, 2019

EFFICIENCY ASSESSMENT OF SELECTED PLANT SPECIES IN REE PHYTOEXTRACTION

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Rare earth elements (REE) are a group of 17 metals consisting of 15 lanthanides and 2 scandium metals. REEs are widely distributed in nature, but only a small amount of them can be extracted for economic purposes.

In recent years, the demand for the use of rare earth elements has been increasing. Accumulation of REE in soil, sediment and water can have harmful effects on living organisms. This leads to the need to assess the degree of enrichment of the environment with the metals in question, and in the case of their excessive amounts, methods enabling the reclamation of the environment. One of the natural methods of cleaning the environment is phytoextraction. Phytoextraction is a technique that uses plants to recover metals from the soil and bioaccumulate them in above-ground parts. The experiment is aimed at evaluating the effectiveness of individual plants in the REE phytoextraction process, depending on the type of substrate. In the pot experiment, four variants of the substrate were used, representing soils, ashes and metallurgical waste rich in REE, which were mixed with compost and peat. Eight plant species were tested: yarrow (*Achillea millefolium*), maruna odorless (*Triplerosperum maritimum*), tall fescue (*Festuca arundinacea*), marigold (*Tagetes* sp.), maize (*Zea mays*), mustard (*Sinapis* sp.), red clover (*Trifolium pratense* L.), autumn fern (*Dryopteris erythrosora*). The experiment was conducted in a greenhouse. After harvesting, the plant samples were cleaned and dried. Then the samples were subjected to the microwave method of mineralization. Samples were analyzed using an ICP-MS spectrometer.

Among the studied plant species, the autumn fern uptake of REE was the most effective. The highest REE content in the above-ground part for this species was obtained for substrate 1. The least efficient for the tested process were cane fescue, white mustard, maize and marigold, for which the contents of La, Eu and Gd were at the limit of detection, and the contents of La were in the range 0.1-0.4 mg/kg.

In this experiment, the tested plants took up rare earth elements by phytoextraction, but in small amounts.

Acknowledgements

The work was carried out as part of the project of the National Science Center OPUS, project number 2019/35 / B / ST10 / 03244. "Study of the environmental effects of the occurrence of rare earth elements, antimony and vanadium in soils and waste".

DOES POST-FERMENTATION SLUDGE AFFECT SOIL STRUCTURE AND POROSITY

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The area of degraded soils is constantly increasing as a result of natural or anthropogenic processes leading to the loss of the intrinsic physical, chemical, and/or biological quality of soil (Nunes et al., 2020). For this reason, new methods of soil properties improvement are sought and include the application of organic materials such as sewage sludge, compost, lignite, or materials from agricultural biogas plants. The quality and value of post-fermentation sludge depends on dry organic matter content, the type of raw materials used for fermentation and the presence of inhibitors (pesticides, growth hormones, heavy metals, antibiotics) (Kasprzycka et al., 2016). The content of organic matter has a large impact on the physical properties of the soil in each textural group (Shepherd et al., 2002), and the number, size, configuration, and distribution of soil pores are used to assess the soil's physical condition. For a better understanding of post-fermentation amendments values, the effect of digestate application on soil structure and porosity should be characterized.

The research aims to determine the effect of post-fermentation sludge on soil structure and porosity. The organic material was taken from the agricultural biogas plant. Then digestate was lyophilized, sieved through a sieve with a mesh size of 1 mm, and added to soil at different rates. From that mixtures the model soil aggregates were prepared. The soil used in the study was chemically degraded Abruptic Luvisol and was located close to Basznia - Eastern Poland. The parameters characterizing porosity and pore size distribution were determined by the mercury porosimetry method. The calculations were made assuming a cylindrical pore model.

The results revealed that post-fermentation material application affected the pore size distribution of the tested soil. The addition of digestate caused an increase in the total pore volume and total pore area and diminished aggregate bulk density. The observed changes were related to increasing digestate concentration. The highest doses of post-fermentation sludge caused the reduction of smaller pores and a shift of distribution towards the pores of a larger diameter.

Acknowledgements

This research was funded in whole by National Science Centre, Poland within grant number 2021/43/D/ST10/01656.

References

Nunes, F.C., Alves, L.J., Carvalho, C.C.N., Gross, E., Majeti, P., de Marchi Soares, T.: Soil as a complex ecological system for meeting food and nutritional security. In Climate Change and Soil Interactions; Prasad, M.N.V., Pietrzykowski, M., Eds.; Elsevier: Amsterdam, The Netherlands, 2020, pp. 229–269.

Kasprzycka, A., Lalak, J., Tys, J., Chmielewska, M.: Selected methods for management of post-fermentation sediment. The use of extrusion processing in digested sludge management (a review). Acta Agrophysica, Vol. 23, 2016, pp. 51-65.

Shepherd, M. A., Harrison, R., Webb, J.: Managing soil organic matter–implications for soil structure on organic farms. Soil use and Management, Vol. 18, 2002, pp. 284-292.

ANALYSIS OF BEV ENERGY GAIN MEASUREMENT DATA FOCUSING ON BATTERY CHARGE LEVEL

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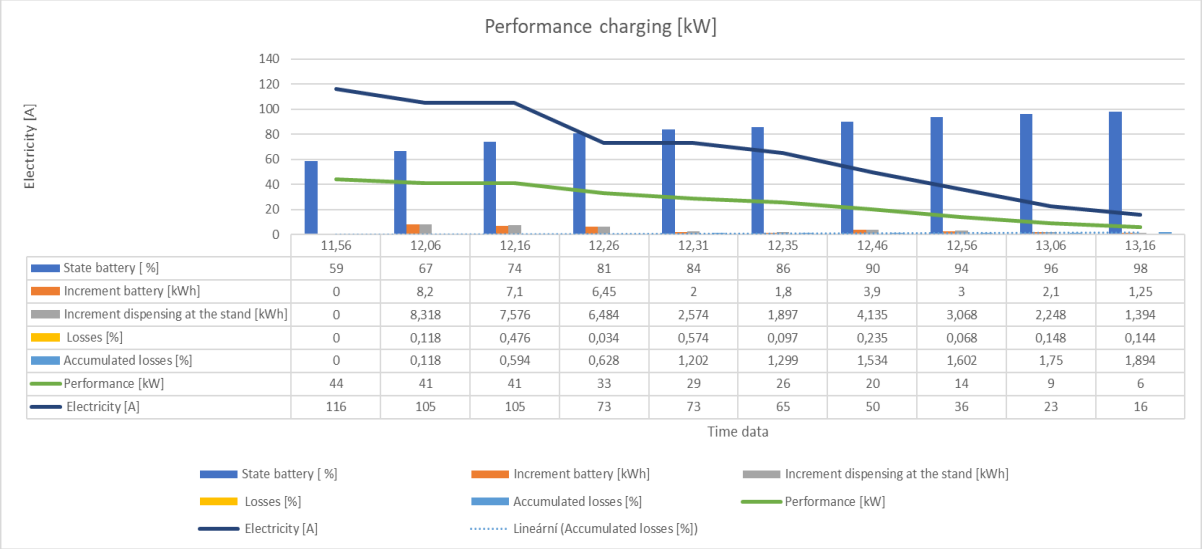
The power source for recharging a Battery Electric Vehicles (BEV) can be 230 V (400 V) AC or 400 V DC. However, this study worked with a DC source with a maximum current of 125 A and voltage of 400 V. High current charging causes the battery to heat up. This temperature must be reduced by cooling. However, this cooling causes charging losses and affects the "health" of the battery. On the other hand, it is possible to reduce losses at the expense of time spent recharging. Therefore, BEV manufacturers, in cooperation with battery manufacturers, design their own battery management software.

Wang et al. (2021) also focused on an active control strategy for the battery system. Our study investigated how Tesla solves the trade-off between charging speed and charging losses.

The data was obtained while charging a BEV Tesla S 100D at an outdoor temperature of 3°C in January 2022. The charging device was an ABB stand with a maximum output of 50 kW. The data was read from the Tesla mobile app, Tesla infotainment, and the charging device. Readings took place at 10 min intervals. Charging started at 59% battery level and ended at 96%. Figure shows the performance of charging.



	11,56	12,06	12,16	12,26	12,31	12,35	12,46	12,56	13,06	13,16
State battery [%]	59	67	74	81	84	86	90	94	96	98
Increment battery [kWh]	0	8,2	7,1	6,45	2	1,8	3,9	3	2,1	1,25
Increment dispensing at the stand [kWh]	0	8,318	7,576	6,484	2,574	1,897	4,135	3,068	2,248	1,394
Losses [%]	0	0,118	0,476	0,034	0,574	0,097	0,235	0,068	0,148	0,144
Accumulated losses [%]	0	0,118	0,594	0,628	1,202	1,299	1,534	1,602	1,75	1,894
Performance [kW]	44	41	41	33	29	26	20	14	9	6
Electricity [A]	116	105	105	73	73	65	50	36	23	16

It can be stated from the figure that the Tesla battery management is aimed at saving possible losses from cooling versus extending the charging time. This also proves the company's claim about the ecological orientation of the use of BEVs.

Acknowledgements

This work was supported by the department of Machinery Utilization, Faculty of Engineering, Czech University of Life Sciences Prague, Prague, Czech Republic

References

Wang, S., Fan, Y., Stroe, D.-I., Fernandez, C., Yu, C., Cao, W., & Chen, Z. (2021). Battery system active control strategies. *Battery System Modelling*, 313–340. https://doi.org/10.1016/B978-0-323-90472-8.00006-8

COMPARISON OF SENSORS IN AUTOMATIC SPRINKLER

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The automatic sprinkler has been built as part of the smart farming device using the Internet of Things (IoT) (Hartawan et. al, 2022). The sensors in automatic sprinkler are the soil moisture sensor, DHT11, Voltage sensor, and current sensor. The automatic sprinkler is attached to a photovoltaic to charge the battery (Anggraeni et. al, 2022).

The aim of this research is to compare the sensors with the measuring device, due to not all manufacturer's calibration equations predict accurately.

As shown in Figs. below, the automatic sprinkler has been built and the process compared with the measuring device.

The result shows that DHT11 for Air Humidity, Voltage and Current sensors are higher than the measuring device, but DHT11 for Air Temperature and Soil Moisture sensors are lower.

Sensors	Mean difference
Soil Moisture	-2.4%
DHT11 Temperature / Humidity	-0.42 °C / 1.2%
Voltage sensor	0.708 V
ACS712-5A Current sensor	1.02 mA

There is a small difference between automatic sprinkler sensors, but for better results, the calibration equation must be applied, especially for Soil Moisture sensors.

Acknowledgments

The short synopsis of this research is release as an outcome of a multidisciplinary international partnership between ITENAS Bandung, Indonesia, and MATE Gödöllő, Hungary.

References

Hartawan, L., Shantika, T., Anggraeni, N. D., Rusirawan, D., Farkas, I.: Smart farming application based on automatic sprinkler and Arduino IoT cloud, 28th Workshop on Energy and Environment, 2022, pp. 35–36.

Anggraeni, N. D., Hartawan, L., Shantika, T., Rusirawan, D., Seres, I., Farkas, I.: Photovoltaic utilization as energy Source for automatic sprinklers in agriculture, 28th Workshop on Energy and Environment, 2022, pp. 21-22.

EFFECT OF FAT CONTENT ON RHEOLOGIC PROPERTIES OF CREAM

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Modelling the physical properties of materials by simulated identification is a currently discussed topic in the research community. The non-conventional methods allow us to use the knowledge of the physical properties of materials in their digitalization in Agriculture 4.0.
Cream is a concentrated emulsion of milk fat. Milk fat also remains in the cream in the form of fat globules, but their distance is reduced by concentration, e.g. in cream with a fat content of 40 % from the original about 7 μm to 1 μm (Scott et al., 2003).

Two types of cream with different fat content (12% and 33%) were measured at temperatures from 4 °C to 25 °C. Density was determined by pycnometric method. Weighing of pycnometer was done on scales with precision 0.0001 g. Measuring of dynamic viscosity was performed by digital rotational viscometer Anton Paar (DV-3P), which measuring principle is based on dependency of sample resistance against the probe rotation.

We observed that density is linearly decreasing with the temperature increase. Density of cream is also influenced by amount of fat content. The higher fat content had caused the lower density. Similar result was obtained for milk by Kumbár and Nedomová (2015). Dynamic viscosity of cream has declined with temperature. Larger amount of fat had led to higher viscosity, due to poorer mobility of fat molecules. Similar findings were obtained by more authors (Scott et al., 2003; Kumbár and Nedomová, 2015).

Acknowledgements

This contribution was supported by the Operational Program Integrated Infrastructure within the project: Demand-driven research for the sustainable and innovative food, Drive4SIFood 313011V336, cofinanced by the European Regional Development Fund.

References

Kumbár, V., Nedomová, Š.: Viscosity and analytical differences between raw milk and UHT milk of Czech cows, Scientia Agriculturae Bohemica, Vol. 46, 2015.p. 78 – 83.

Scott, L. L., Duncan, S. E., Sumner, S. S., Waterman, K. M.: Physical properties of cream reformulated with fractionated milk fat and milk-derived components, Journal of Dairy Science, Vol. 86, No 11, 2003, pp. 3395-3404.

DEM MODELLING OF THE IMPACT OF STRESS STATE IN BULK OF PARTICLES ON MASS DISCHARGE RATE FROM A FLAT BOTTOM SILO

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Precise prediction of the discharge rate of granular solids from the discharge orifice of a silo is of great importance for industrial applications in areas ranging from civil engineering to agriculture and pharmaceutical processing (Nedderman et al., 1982). Attempts to establish a proper physical law describing the dynamics of discharge of granular solids have been made by researchers for decades (Mankoc et al., 2007). Beverloo et al. (1961) proposed the most widely accepted law for the prediction of the mass flow rate of grains through a circular orifice in cylindrical hoppers as related to the orifice diameter in power of 2.5.

This abstract summarizes the results of studies performed by Horabik et al. (2022). The objective of the study was to explore the impact of dynamic particle–particle contact interactions in the vicinity of the orifice on the discharge flow rate from a model silo by means of DEM (Cundall and Strack, 1979) simulations. Special attention was paid to the impact of the orifice size and pressure exerted by particles on the bottom. The DEM simulations were performed with an assembly of spherical particles poured into the flat bottom cylindrical model silo. The bottom pressure was changed by two methods: 1) changing the height of the bedding deposit (up to 1.58 kPa) and 2) depositing an additional layer of very dense particles on the top of the bedding of primary particles (up to 97.5 kPa) to avoid Janssen's saturation effect (Horabik et al., 2022).

The results of simulations indicated that the discharge rate was affected by both the orifice diameter and mean bottom pressure during storage. The two components of the driving force of moving particles: gravity force and the resultant contact force govern the accelerated movement of particles in the vicinity of the orifice. Acceleration of particles in the vicinity of orifice was found larger than acceleration of gravity. It increased linearly from 13 m s^{-2} in the case of the lowest height the granular bedding (corresponding bottom pressure of 0.53 kPa) up to approximately 700 m s^{-2} in the case of the bottom pressure of 97.5 kPa. The correction coefficient derived from the integral of the dimensionless acceleration of particles along the dimensionless movement path allowed obtaining very good approximation of the discharge rate using the Beverloo equation in the entire range of change of the orifice size and bottom pressure.

References

Beverloo W. A., Leniger H. A., Van de Velde J.: The flow of granular solids through orifices, Chem. Eng. Sci., 15, 1961, 260–269.

Cundall P. A., Strack O. D.: A discrete element model for granular assemblies, Géotechnique, 29, 1979, 47–65.

Horabik J., Parafiniuk P., Wiącek J., Kobyłka R., Molenda M., Stasiak M.: DEM modelling of the impact of pressure on the discharge rate of granular materials from a model silo, Powder Technol., 403, 2022, 117402, 1–9.

Nedderman R. M., Tüzün U., Savage S. B., Houlsby G. T.: The flow of granular materials—I: Discharge rates from hoppers, J. Chem. Eng. Sci., 37, 1982, 1597–1609.

Mankoc C., Janda A., Arévalo R., Pastor J. M., Zuriguel I., Garcimartín A., Maza D.: The flow rate of granular materials through an orifice, Granul. Matter, 9, 2007, 407–414.

INFLUENCE OF ENZYMATIC MODIFICATIONS OF DILLUTED ALKALI SOLUBLE PECTIN (DASP) FRACTION STRUCTURE ON RHEOLOGICAL PROPERTIES

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Diluted alkali soluble fraction of pectin (DASP) deposited on mica showed characteristic kinked rods-resembled structures and regular network (Cybulska et. al, 2015). Further studies indicated, rhamnose is an important factor affecting the formation of the characteristic shape of DASP molecules on mica by creating interspersions or short rhamnogalacturonan I segments in homogalacturonan chains. The higher mobility of the linear sections and segments in DASP pectin network, increase the number of possible interactions with surrounding molecules and thus improve its ability to form gels (Pieczywek et. al, 2020).

In these studies, an attempt has been made to investigate the role of rhamnose and arabinose units on flow behaviour and viscoelastic properties. Aqueous solutions of pectins extracted from apple *(Malus domestica* Borkh.) and carrot (*Daucus carota* subsp. *sativus*) were subjected to selective modifications with RG-I acetyl esterase (RGAE), rhamnogalacturonan endolyase (RGL), arabinofuranosidase (ABF) and their mixtures. In order to determine rheological behaviour of obtained networks, oscillatory tests and flow behaviour measurements were performed.

All samples were characterized as pseudoplastic shear-thinning fluids with apparent viscosity decreasing with increasing shear rate. The ABF treatment led to a large decrease in the storage modulus combined with an increase in the loss factor of pectin aqueous solutions. Both results indicated a weakening of the network binding forces and a significant decrease in elastic properties of pectin. Results suggested that arabinose (Ara) side chains could be involved in macromolecular entanglements in DASP fraction of native pectin. An increase in pseudoplasticity and viscosity after simultaneous deacetylation and removal of arabinose and rhamnose may indicate a greater freedom of particles movement, which was limited by the entanglements of side chains attached to the rhamnose units before enzymatic cleavage.

It can be suggested that association of DASP pectin chains in aqueous solution involves side chains attached to Rha residues as binding-points or smooth HG regions, with extended conformation in deionized water, favouring interactions between the chains.

Acknowledgements

This study was supported by the National Science Centre, Poland (Project No.2019/35/O/NZ9/01387).

References

Cybulska, J., Zdunek, A., Kozioł, A.: The self-assembled network and physiological degradation of pectins in carrot cell walls. Food Hydrocolloids, Vol. 43, 2015, pp. 41–50. https://doi.org/10.1016/j.foodhyd.2014.04.032

Pieczywek, P. M., Kozioł, A., Płaziński, W., Cybulska, J., Zdunek, A.: Resolving the nanostructure of sodium carbonate extracted pectins (DASP) from apple cell walls with atomic force microscopy and molecular dynamics. Food Hydrocolloids, Vol. 104, 2020, pp. 105736. https://doi.org/10.1016/j.foodhyd.2020.105726

CONCENTRATION OF SELECTED HEAVY METALS IN *HERMETIA ILLUCENS* LARVAE FED ON DIGESTED SEWAGE SLUDGE

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Municipal sewage sludge is a waste whose annual production is estimated at about 359.4×109 m^3 (Jones et al. 2021). Their management raises a problem. Municipal sewage sludge can be utilized for soil restoration and as a fertilizer. However, its usage for this purpose has to be restricted due to its hazardous heavy metal concentration and potential for build-up in the soil (Singh and Agrawal, 2008). Other management methods include incineration, disposal in hazardous waste landfills, or dumping in the ocean (Kelessidis and Stasinakis, 2012). Studies of the elemental content in sludge indicate that there are large fluxes of elements on an annual basis (Folgueras et al. 2018). This raises the question of whether it would be possible to recover them in some way?

The aim of the experiment was to test whether larvae of *Hermetia illucens* (Diptera: Stratiomyidae), known for their ability to bioaccumulate various elements, are able to utilize sewage sludge as a feed source and bioaccumulate diverse elements from it.

In the experiment, 200 seven-day-old *H. illucens* larvae were used and fed on digested sewage sludge at a dose of 500 mg dry weight of sludge per larva. The experiment was performed in boxes with lids equipped with ventilators that allowed air exchange. Bioconversion of digested sewage sludge by *H. illucens* was conducted for 49 days. Insect parameters were weighed and measured, to determine their biomass and their ability to survive on the sludge. The sludge after the experiment was dried to calculate the percentage of utilization. Inductively coupled plasma optical emission spectrometry (ICP-OES) analysis was performed to determine the elemental content of the insect samples.

The results indicate that *H. illucens* are capable of developing and growing on such unfavourable and nutrient-poor feed as digested sewage sludge. The ability to accumulate Cd by the larvae, Hg by the pupae, and Mn accumulated in the exuviae remaining after the flies emerged was demonstrated.

Acknowledgements

The research presented here was funded by NCN Sonata 15 grant No. 2019/35/D/NZ9/01835.

References

Folgueras M.B., Alonso M., Folgueras J.R., Lage S.: An overview of rare earth elements in sewage sludge and their ashes, Proceedings, Vol 2, No 23, pp.1462.

https://doi.org/10.3390/proceedings2231462

Jones E.R., van Vliet M.T.H., Qadir M., Bierkens M.F.P.: Country-level and gridded estimates of wastewater production, collection, treatment and reuse, Earth System Science Data, Vol. 13, No 2, 2021, pp. 237-254. https://doi.org/10.5194/essd-13-237-2021

Kelessidis A., Stasinakis A.S.: Comparative study of the methods used for treatment and final disposal of sewage sludge in European countries, Waste Management, Vol 32, No 6, pp. 1186-1195.https://doi.org/10.1016/j.wasman.2012.01.012

Singh R.P., Agrawal M.: Potential benefits and risks of land application of sewage sludge, Waste Management, Vol 28, No 2, pp. 347-358.https://doi.org/10.1016/j.wasman.2006.12.010

SYSTEM FOR COMPLEX PERMITTIVITY SPECTRUM MEASUREMENTS IN THE RADIO AND MICROWAVE FREQUENCY RANGE FOR POWDERY, LIQUID AND SOLID MATERIALS

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In agriculture, the measurement of the permittivity of agricultural materials, in particular soil, is a very important issue. The problem of measurement is particularly important because soil is a three-phase material, consisting of a solid organic and/or inorganic fraction, air and water filling the free space. This composition makes the permittivity of the soil dependent on the frequency of the applied electric field and may show significant dielectric dispersion in the MHz to GHz range. The frequency dependence of the complex permittivity is also affected by soil salinity. Knowledge of the complex relative dielectric permittivity could be beneficial for development and improvement of methods for determining moisture content, optimizing processes such as microwave heating and drying, and determining important food quality parameters (Lewandowski et al., 2019).

The best method of measuring the dielectric properties of both powdery and liquid materials is a sensor in the form of a transmission coaxial line, which simultaneously provides a wide frequency band and a large measurement volume. The system developed at the Institute of Agrophysics, Polish Academy of Sciences in Lublin consists of a coaxial cell connected through appropriate adapters with a single-port VNA and an electronic calibrator (ECU). The cell consists of a sample chamber in the form of two sections of stainless-steel pipes placed coaxially. The sample is supported on both sides by two sealed plastic supports (made from POM C), allowing the measurement of samples of any moisture content and liquids. The cell is placed vertically in order to prevent possible unfavourable gradients of sample moisture in the cross section of the cell. The developed system was tested in the measurements of soil (Lewandowski et al., 2019) and granular material in the form of rape seeds (Kafarski et al., 2022).

Acknowledgements

This research is supported by National Center for Research and Development within the scope of the project: “System for complex dielectric-permittivity-spectrum measurements of powdery, liquid, and solid materials in 1 MHz–3 GHz frequency range” within program TANGO V, agreement no. TANGO-V-C/0007/2021-00

References

Lewandowski A., Szypłowska A., Wilczek A., Kafarski M., Szerement J., Skierucha W., Robust Vector-Network-Analyzer Characterization of Soil Dielectric Spectrum, IEEE Trans. Geosci. Remote Sens. 2019, 57, 3661-3676.

Kafarski M., Szypłowska A., Majcher J., Wilczek A., Lewandowski A., Hlavácová Z. Skierucha W. Complex Dielectric Permittivity Spectra of Rapeseed in the 20 MHz–3 GHz Frequency Range. Materials 2022, 15, 4844.

THE ROLE OF SOFT COMPUTING APPROACH FOR ANALYSING SOLAR DRYING SYSTEMS

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The software-based approach is essential for building and examining the mathematical models and anticipates the potential of various solar drying systems. Solar dryer's working is enhanced by incorporating soft computing which also reduces the time spent in the experimentation process. It can also be used for predicting the crop temperature, moisture to be evaporated, drying speed and efficiency and color of the resulting dried sample (Prakash and Kumar, 2014).

Designing and controlling the operation of a drying system requires the use of modelling and simulation approach. Simulation can be used to determine the best parameters for the best design and operational circumstances. The development of mathematical models aiming to forecast air temperature, product temperature, water content, water evaporation, drying kinetics, and crop color for different solar drying systems makes excellent use of a variety of simulation tools, including CFD (Fluent/Ansys), MATLAB and COMSOL Multiphysics.

In addition, Origin Pro, sigma plot, and SPSS can be used for fitting the drying kinetics parameters. Another useful software which is called TRNSYS is a simulation program in the areas of solar energy, and the use of this program is to create and explain the drying characteristics of products in various types of dryers.

The design parameters of a solar dryer system can be optimized using simulation tools well before the development begins, and they also save time and capital investment in solar drying systems (Singh Chauhan et al., 2015).

This paper is mainly dealing with the CFD analysis of the drying chamber part of a modular solar dryer.

Acknowledgment

This work was supported by the Stipendium Hungaricum Programme and the Doctoral School of Mechanical Engineering, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Prakash, O. and Kumar, A.: Historical review and recent trends in solar drying systems. International Journal of Green Energy, 10(7), 2013, pp. 690–738. https://doi.org/10.1080/15435075.2012.727113

Singh Chauhan, P., Kumar, A. and Tekasakul, P.: Applications of software in solar drying systems: A review. Renewable and Sustainable Energy Reviews, *51*, 2015, pp. 1326–1337. https://doi.org/10.1016/j.rser.2015.07.025

THE POTENTIAL OF OCEAN THERMAL ENERGY CONVERSION IN THE NORTH SULAWESI SEA

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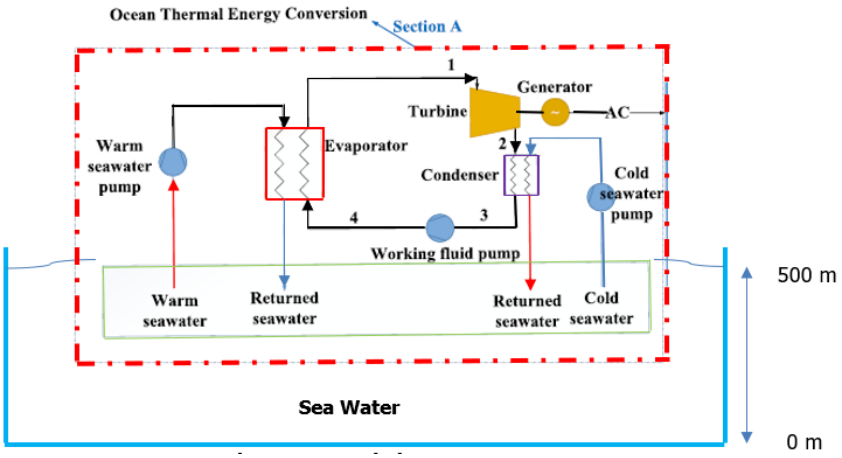
The biggest Ocean Thermal Energy Conversion (OTEC) potential in Indonesia is at the Sea of North Sulawesi. In this study, an evaluation of the potential of OTEC in the North Sulawesi Sea will be performed based on previous studies. The OTEC technology utilizes the temperature difference of warm temperature (Tw) on the surface and cold temperature (Tc) on the depth of seawater. Ammonia or another type of refrigerant is commonly used for working fluids in OTEC systems due to its having a low boiling point, and therefore it easily evaporates. The main components of the OTEC system can be seen in the figure below.



The suitable power generation in the OTEC system is the Rankine cycle (the main system of the steam power plant).

Based on data evaluation, it is found that in the North Sulawesi Sea, the average of Tw is 29,48 °C, Tc is 6,42 °C, and ΔT is 23,06 °C. These data can be used as a source of OTEC because the temperature difference is more than 22 °C in the sea depth of 0-500 meters. The summary of data included Carnot efficiency shown in the Table below.

Location	Tw (°C)	Tc (°C)	ΔT (°C)	Depth (m)	Carnot Efficiency (η)
North Sulawesi	29,48°C (302.48 K)	6,42°C (279.42 K)	23,06	500	0.08

Evaluation of the Rankine cycle as part of the OTEC system furtherly will be elaborated, using working fluid R134a, and the net power of the OTEC power plant can be estimated.

Acknowledgements

The short synopsis of this research is released as an outcome of a multidisciplinary international partnership between ITENAS Bandung, Indonesia, and MATE Gödöllő, Hungary.

References

Syamsuddin, M.L., Attamimi, A., Nugraha, A.P., Gibran, S., Afifah, A.Q., Oriana, N.: OTEC Potential in The Indonesian Seas, Energy Procedia 65, 2015, pp. 215 - 222.

ENHANCING BIOCHEMICAL PROPERTIES OF GLUTEIN PROTEINS THROUGH PHENOLIC ACID SUPPLEMENTATION

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Phenolic compounds found in plants are known to possess potent antioxidant properties, making them an essential component of the human diet. Epidemiological studies have demonstrated that diets rich in antioxidant fruits and vegetables can lower the risk of various oxidative stress-related disorders, such as cancer, diabetes, and cardiovascular disease. The antioxidant activity of phenolic compounds varies depending on the number and location of hydroxyl groups. Phenolic acids, which are natural aromatic compounds that contain a phenolic ring and a carboxylic group, exhibit structural variations based on the position and number of hydroxyl or methoxyl groups on the aromatic ring (Sivam et al., 2013).

The aim of the research was to evaluate antioxidant properties of gluten proteins after supplementation with hydroxybenzoic acid derivatives (4-hydroxybenzoic acid, protocatechuic acid, vanillic acid, syringic acid) and hydroxycinnamic acid derivatives (caffeic acid, synapinic acid, ferulic acid, coumaric acid). Model dough samples enriched with phenolic acids at concentrations of 0.05 %, 0.1 %, and 0.2 % were made in a farinograph. Gluten samples were washed out from model dough and lyophilized. To extract phenolic acids from the gluten network, a modified version of the method outlined by Kłosok et al. (2023) was performed. Briefly, 7.5 mg of gluten samples were subjected to extraction using 1.5 ml of methanol for a period of 16 hours. The resulting extracts were then subjected to centrifugation (14,000 × g for 3 minutes). The concentration of acids and antioxidant activity in the methanolic extracts were measured using UV-VIS spectroscopy.

Based on UV-VIS spectra analysis, coumaric acid was found to be the most highly extracted acid, suggesting that it may be less strongly linked to the gluten network. In both ABTS and FRAP experiments, gluten samples supplemented with phenolic acids exhibited greater antioxidant activity than control samples. The presence of the CH=CH–COOH group in hydroxycinnamic acids is thought to contribute to their superior antioxidative efficacy compared to hydroxybenzoic acids, which only contain a -COOH group. Additionally, the presence of a hydroxyl group (-OH) as an extra functional group had a significant impact on antioxidant properties. These findings suggest that phenolic acids could be utilized to produce wheat products with enhanced health-promoting properties, specifically stronger antioxidant capabilities.

Acknowledgements

The research was financed under the OPUS 18 Project obtained from National Science Centre, Poland, grant no. 2019/35/B/NZ9/02854.

References

Kłosok, K., Welc-Stanowska, R., Nawrocka, A., 2023. Changes in the conformation and biochemical properties of gluten network after phenolic acid supplementation. J. Cereal Sci. 110, 103651. https://doi.org/10.1016/j.jcs.2023.103651

Sivam, A.S., Sun-Waterhouse, D., Perera, C.O., Waterhouse, G.I.N., 2013. Application of FT-IR and Raman spectroscopy for the study of biopolymers in breads fortified with fibre and polyphenols. Food Res. Int., Stability of phytochemicals during processing 50, 574–585. https://doi.org/10.1016/j.foodres.2011.03.039

PRESENCE OF SOLID PARTICLES IN THE VEHICLE INTERIOR

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The cleanliness of the air has a great influence on the activity of the driver of a motor vehicle. Cleanliness means the removal of various pollutants from the air that may be present in it. Such pollutants are e.g., CO_2, which is produced by breathing, CO is produced by smoking in the vehicle, also benzene C_6H_6, various smells, etc. (Vitázek et al., 2021).

This article focuses on the measurement of solid particles (0.3 µm – 10 µm) in the interiors of three vehicles. It points to an increased concentration of solid particles in a smoker's vehicle compared to a non-smokers. The measurement was carried out on two vehicles of the same brand, modell and year of manufacture. As a third vehicle was chosen a non-smoking vehicle, but 10 years older than the previous vehicles.

The results of the measurements show that in the interior of the (third) oldest vehicle, there are 49-90% more solid particles in the range from 0.3 µm to 1 µm than in vehicles 1 and 2. In the range of 1 µm to 5 µm, the number of particles was greater by 90-154%. In the second, smoking vehicle, particles in the range of 0.3 µm to 5 µm were measured in higher concentrations than in the non-smoking vehicle, but lower than in the oldest vehicle. A higher concentration of particles with a size of 10 µm was recorded in the vehicle of non-smoker (Vitázek et al., 2021). The table shows the differential count of each particticle sizes for Non-smoker car New, Smoker car New and Non-smoker car Old.

Particle size (µm)	Non-SM N (1)	SM N (2)	Non-SM O (3)
0.3	7809	78566	96682
0.5	4[illegible]0	56663	75133
1	1147	2539	3709
2.5	187	308	475
5	27	37	46
10	13	11	12

Acknowledgements

This contribution was supported by the Operational Program Integrated Infrastructure within the project: Demand-driven research for the sustainable and innovative food, Drive4SIFood 313011V336, co-financed by the European Regional Development Fund.

References

Vitázek, I., Tkáč, Z., Majdan, R.: Interior environment in vehicles: features and their evaluation (in Slovak). 1. releas. Nitra: Slovak university of agriculture, 2021. 133 p. ISBN 978-80-552-2424-4.

TEXTURE PROPERTIES OF PYROLYZED WHEAT STRAW BIOMASS

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Pyrolysis represents the access the organic material is thermally elaborated with extraction of the oxygen, air or the other gasificated, material. It is the thermic conversion of the organic material which is realized in the pyrolyze units. Product of the pyrolyze is the charcoal and biooil. Biomass can be converted into biochar through thermal pyrolysis, a life cycle assessment of pyrolysis biochar systems suggested that it is more environmentally and financially viable to make biochar from waste biomass (Roberts et al., 2010).

The aim of this research was to determine the texture properties of the pyrolyzed biomass produced from the wheat straw. Charcoal with the 80% contents of the carbon was produced by the pyrolysis in the pyrolyze unit Unipyr – SPU 1, at 350 °C, for 10 minutes.

As shown in the figure below, the texture parameters as perimeter, area, Feret's diameter, circularity, solidity, and roundness of the particles of the charcoal we needed to determine for the purpose of the obtaining of the biomass quality.

Distribution of the particles were realized. Small particles with the area smaller than 0.005 mm^2, with the perimeter 0.25 mm, with Feret's diameter to the 0.1 had the most representation. Half of particles had circular face with great solidity and roundness.

Acknowledgements

This publication was supported by the Operational Program Integrated Infrastructure within the project: Demand-driven research for the sustainable and innovative food, Drive4SIFood 313011V336, co-financed by the European Regional Development Fund.

References

Roberts, K.G., Gloy, B.A., Joseph, S., Scott, N.R., Lehmann, J., 2010. Life cycle assessment of biochar systems: estimating the energetic, economic, and climate change potential. Environ. Sci. Technol. 44, 827–833.

COMPARISON OF PHYSICOCHEMICAL PARAMETERS OF ACTIVATED CARBONS PREPARED FROM *ARONIA MELANOCARPA* USING CONVENTIONAL AND MICROWAVE HEATING

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Recently, activated carbons (AC) are very important materials in environmental protection. They are ecological, have good textural and surface properties, and can easily be produced from various waste, e.g., from agriculture or fruit-vegetable industry. Thanks to high adsorption abilities, activated carbons can bring many agronomic benefits. They can reduce bioavailability of heavy metals and pesticides or reduce nitrogen losses. The use of AC can also affect the storage of carbon in the soil (Ahmad, 2018; Ioannidou et al., 2007).

The main aim of experimental works was to determine the impact of heating method on physicochemical parameters as well as the sorption capacity of activated carbons obtained from chokeberry (*Aronia melanocarpa*) seeds. The biomass pyrolysis was carried out in microwave muffle furnace (Phoenix, CEM Corporation) and a conventional laboratory resistance furnace (PRW75/LM, Czylok) at 400 °C. The activation of biochars was performed using carbon dioxide, also in two types of furnaces, at 800 °C. The texture properties of the obtained materials were determined by the low-temperature method of nitrogen adsorption/desorption (Sorptomat Quadrasorb Si, Quantachrome). The chemical nature of the adsorbent surface (i.e., the content of acidic and basic functional groups) was determined using Boehm titration method. Adsorption tests were carried out at 25 °C, at pH 7, using a 0.001 M $CaCl_2$ solution as a supporting electrolyte and cadmium (Cd^{2+}) concentrations in the range of 10-250 ppm. The concentration of Cd^{2+} in the solution before and after adsorption was determined by atomic absorption spectroscopy (Analytic Jena ContrAA 800).

Microwave heating improved textural parameters and surface chemistry of activated carbons. The material obtained in microwave furnace was characterized by larger specific surface area, larger total pore volume, as well as higher content of surface functional groups than that obtained in a conventional way. The specific surface area (S_{BET}) of AC prepared in conventional furnace was 109 m^2/g, whilst S_{BET} of AC prepared using microwave was 395 m^2/g. The improvement in above mentioned parameters resulted in higher sorption capacity of AC relative to cadmium ions. This means that the materials prepared using microwave heating are more promising agents for remediation of contaminated soils and waters.

Acknowledgements

This work was financed by the National Science Centre, Poland (OPUS21, 2021/41/B/NZ9/03059).

References

Ioannidou, O., Zabaniotou, A.: Agricultural residues as precursors for activated carbon production—A review, Renewable and Sustainable Energy Reviews, Vol. 11, No 9, 2007, pp. 1966-2005. https://doi.org/10.1016/j.rser.2006.03.013

Ahmad, K.S, Evaluating the Adsorption Potential of Alachlor and Its Subsequent Removal from Soils via Activated Carbon, Soil and Sediment Contamination: An International Journal, Vol. 27, No 4, pp. 249-266. https://doi.org/10.1080/15320383.2018.1470604

USE OF DIFERENCIAL SCANNING CALORIMETRY IN THE ANALYSIS OF TIRES

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The goal of papers is to present the use of DSC in the analysis of the quality of automobile tires. The main goal of the analysis is to determine the change temperatures and decomposition temperatures of the individual components contained in the tires. In the research, we compared old and new tires.

Two samples of tyre of known rubber composition were heated in a DSC analyser under nitrogen at heating rates (50 $ml.min^{-1}$) from 5 to 80 $K.min^{-1}$. In additional, the major of two samples (new and driven) from which they were taken samples from the top (tire pattern), middle part and inner side of the tire of the cut sections. Thermal decomposition of tire could be using for pyrolysis. Pyrolysis is a technology with a promising future in the recycling of scrap tires. The char yields from the pure rubber components were all <4 wt %, suggesting that the carbon black component of the tyre is the main source of char. SBR decomposed mainly at higher temperatures of pyrolysis, NR at lower temperatures, and BR at both higher and lower temperatures. Over the years landfill and open dumping (stock piling) were the common ways in handling the problem of used tyres. However, landfills take up valuable land space due to the bulky nature of tyres which cannot be compacted neither does it degrade easily.

It was possible to conclude that the calorimetric method is a more efficient tool for the study of compatibility of polymer blends when compared to another methods (Yehai, 2005). The effect of contamination on the amount of residue remaining at various temperatures has been studied. The peak values of the 2 investigated samples differ only slightly, with a value higher by 1 °C for the new Kumho tire. The biggest difference was Onset with 316.76 °C for Kumho and 338.50 °C for Dunlop, a difference of about 22 °C. The maximum enthalpy difference is visually visible numerically with values of 403.69 mJ for Kumho and 1071.74 mJ for Dunlop. The second peak of the samples showed an exothermic process.

DSC methods we should be describe of decomposition individual components of tire. The values of the examined samples show that the old tire has higher material decomposition temperatures than the new tire. These temperatures distincts by a few tens of degrees Celsius for the tire interior sample and only a few units for the center and tread samples. Using the results of the work, we monitor whether the change in physical-chemical properties due to wear affects the decomposition temperatures of polymers. DSC method can also be used for studying other reactions exhibiting in the increasing of temperature.

Acknowledgements

This work was supported by the Implementation of technology of Industry 4.0 in education process in study program "Control Systems in Production Engineering" No. 006SPU-4/2021

References

Yehia, A., Mansour, A., Stoll, B.: Detection of compatibility of some rubber blends by DSC, Journal of Thermal Analysis and Calorimetry, Vol.48, No 6, 2005, pp1299–1310 https://doi.org/10.1007/bf01983440

PROLYL 4 HYDROXYLASES (P4Hs) AFFECT CELL WALL CHANGES DURING THE FRUIT RIPENING PROCESS

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Arabinogalactan proteins (AGPs) are proteoglycans with an unusual molecular structure, characterised by the presence of a protein part and sugar chains (Showalter A., 2001). AGPs as common components in the plant extracellular matrix are attached to the plasma membrane via glycosylphosphatidylinositol (GPI) anchors. During the AGPs synthesis pathway, an important function is performed by prolyl 4 hydroxylases (P4Hs) that catalyse proline hydroxylation (Perrakis et al., 2019). The development of transgenic lines with altered *SlP4H3* gene expression enables the determination of modification in the structure and arrangement of AGPs in the cell wall. The experiment showed that changes in P4H3 activity affected the content of AGP and the progress of their modifications during the ripening process. Analysis of transgenic lines has confirmed the presence of AGPs with high molecular weights (120–60 kDa) at all examined stages, but in the last stages of the ripening was found changed pattern of AGP's molecular features, compared to wild-type plants. Also, we focused on studies on low molecular weight AGPs (~30 kDa), which are markers of the finalisation of the ripening process in tomato fruit (Kutyrieva-Nowak et al., 2023). Interestingly, in the case of all transgenic lines, the mentioned specific bands were not present. In addition to the AGP molecular changes, in transgenic lines with the progress of the ripening process, morphological modifications of fruit tissue and alternations in the spatio-temporal pattern of AGP distribution have occurred. Changes in the continuity and durability of the cell wall affect the entire fruit tissue and the sequence of tissue transformation during the progress of the ripening process.

We conclude that the impaired P4H3 activity has an effect on the AGPs' molecular and structural features and consequently affects the degradation of AGP carbohydrate chains during the outgoing ripening process. We may suppose that the 'native' structure of AGPs, mainly their carbohydrate moieties, is important for the strictly scheduled extracellular matrix arrangement and is essential for the correct course of the fruit ripening process.

Acknowledgements

The authors gratefully acknowledge financial support by National Science Center Poland (NCN, 2020/39/D/NZ9/00232).

References

Showalter A. Arabinogalactan – proteins: Structure, expression and function. Cell Mol Life Sci 2001; 58: 1399–1417.

Perrakis A, Bita C.E., Arhondakis, S. et al.: Suppression of a prolyl 4 hydroxylase results in delayed abscission of overripe tomato fruits. Front Plant Sci 2019; 10: 1–11.

Kutyrieva-Nowak N, Leszczuk A, Zając, A, et al.: Arabinogalactan protein is a molecular and cytological marker of particular stages of the tomato fruit ripening process. Sci Hortic 2023; 310: 1–10.

PREDICTION OF SMALL-SCALE SOLAR POWER PLANT ENERGY PRODUCTION USING MACHINE LEARNING

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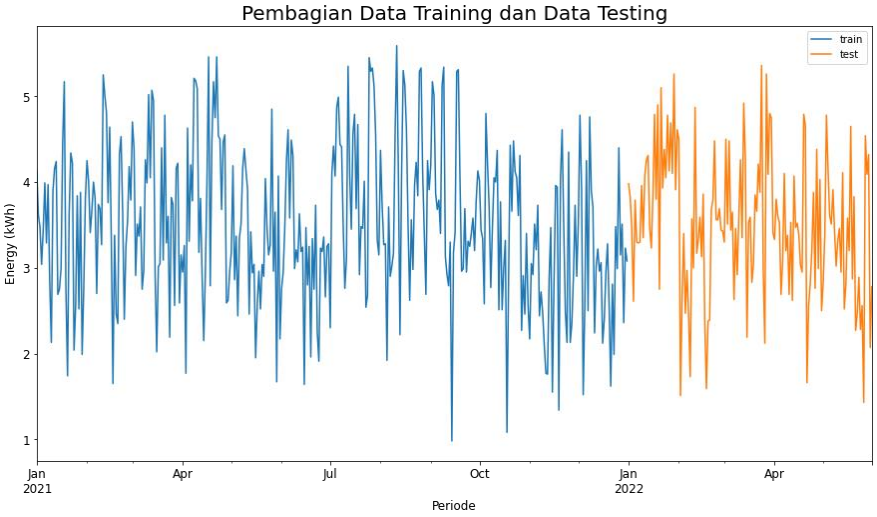
Modeling is one of the research activities in many fields, including the engineering field. By 2018, Institut Teknologi Nasional Bandung (ITENAS Bandung) has installed and operated a small-scale solar power plant (SPP) 1 kWp, using photovoltaic (PV) modules technology monocrystalline silicon, as one of the ITENAS Bandung research facilities.

Modeling of the PV can be performed in a lot of aspects through many ways and algorithms. Presently machine learning applications are wide and a prospective tool in modeling.

Machine learning models are computer programs that are used to recognize patterns in data and furthermore can be used to predict the future. Machine learning models are created from machine learning algorithms, which are trained using either labeled, unlabeled, or mixed data.

In this study, the prediction of the energy production of a 1 kWp solar power plant will be described using two (2) algorithms out of a lot of algorithms in machine learning, i.e., the Naïve Bayes and Support Vector Machine (SVM).

In machine learning models, generally, the model is always built with construction data, namely training data and test data. A sample of the energy production modeling results based on SVM algorithm modeling in a predetermined period is shown in the figure.



Acknowledgments

The short synopsis of this research is released as an outcome of a multidisciplinary international partnership between ITENAS Bandung, Indonesia, and MATE Gödöllő, Hungary.

References

Lidyawati, L., Dawammudin, M., Rusirawan, D., Farkas, I.: Time series model forecasting of energy production 1 kWp solar power plant (SPP) research and project activities in photovoltaic field at ITENAS Bandung. Book of Abstract the 27th Workshop on Energy and Environment, December 9-10, 2021, p. 24.

CFD MODELLING OF CHANNEL DEPTH EFFECT ON THE SOLAR AIR COLLECTOR EFFICIENCY

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The use of solar energy as a replacement fuel widely increased due to its availability, ease of use, and environmental safety. Solar energy can be utilized for several purposes via different technologies like solar air collector (SAC), which is used for heating and drying. These collectors have several drawbacks to overcome, leading to improve performance. The SAC usually consists of an absorber plate made of metal, a glazing cover, and proper insulation material to prevent heat loss (Mund et al., 2021). Improving the collector efficiency is highly desirable, which could be performed by introducing a proper shape for the collector air channel.

The present work investigates the effect of the air pass depth on the performance of a single-pass solar air collector. A CFD modelling using ANSYS Fluent was used to model the airflow process inside the collector. Three-dimensional CFD modelling was used to model the outlet temperature, the absorber plate temperature, and the flow process. The widely used viscous model k-ε (realizable) with (enhanced wall treatment) was used in the modelling process as reported in the literature (Yadav and Bhagoria, 2013).

The modelling process was validated initially with experiments conducted in the laboratory of the Hungarian University of Agriculture and Life Sciences. Gödöllő, Hungary.

The results showed that the outlet temperature has an inverse relationship with the channel depth, which decreases when the channel depth increases and vice versa. Since any change in channel dimensions affects the Reynolds number, directly affecting the Nusselt number at the end, increasing or decreasing the convective heat transfer coefficient and influencing the outlet temperature.

In addition, when the airflow is increased to a specific limit, the influence of channel depth on the outlet temperature will be negligible. While increasing the outlet temperature is desirable to improve the collector's performance as it directly increases the thermal efficiency.

The low channel depth will cause an increase in friction loss and then increase the pressure drop of the forced blower, while an increase in the channel depth will increase the heat loss from the collector.

Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Mund, C., Rathore, S.K., Sahoo, R.K.: A review of solar air collectors about various modifications for performance enhancement, Solar Energy, Vol. 228, 2021, pp. 140–167. https://doi.org/10.1016/j.solener.2021.08.040

Yadav, A.S. and Bhagoria, J.L.: A CFD (computational fluid dynamics) based heat transfer and fluid flow analysis of a solar air heater provided with circular transverse wire rib roughness on the absorber plate, Energy, Vol. 55, 2013, pp. 1127–1142. https://doi.org/10.1016/j.energy.2013.03.066

MEASUREMENT OF DISTANCE AS ASPECT OF PRECISION AGRICULTURE

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Knowledge of physical properties of various materials (agricultural, food and technical) is crucial for the implementation of many technological processes, especially at the monitoring of materials quality.

Distance measurement and special position measurement is a highly addressed problem in applied research in engineering.

This contribution aims to evaluate the uncertainty of distance measurement in a farm object using a patented measurement system (Lendelová et al., 2017). The results are compared with a laboratory experiment.

The experiment has been repeated in four repetitions. The distances were converted to a time variable, which was statistically processed. The measurement was performed by the impulse method with the use of ultrasound.

Statistically significant difference ($p \leq 0.01$) was observed between the set distance and the observed under laboratory conditions. In the farm object, a statistically insignificant difference ($p > 0.05$) was observed between the set distance and the observed distance. All experimental data have a goodness of fit with the normal probability distribution ($p > 0.05$).

Acknowledgements

This contribution was supported by the project of Ministry of Education, Science, Research and Sport of the Slovak republic: KEGA 006SPU-4/2021 Implementation of technology of Industry 4.0 in education process in study program “Control Systems in Production Engineering” and the Operational Program Integrated Infrastructure within the project: Demand-driven research for the sustainable and innovative food, Drive4SIFood 313011V336, which is co-financed by the European Regional Development Fund.

References

Lendelová, J., Cviklovič, V., Olejár, M., Pogran, Š.: Animal position identification logging system. Patent document. Slovak Republic, 2017. SK Patent No. 288467.

EXPLORING THE EFFECTS OF MARIGOLD EXTRACT ON THE MORPHOLOGICAL ALTERATIONS OF *NEOSARTORYA* SPP. (ANAMORPH: *ASPERGILLUS* SPP.) USING SCANNING ELECTRON MICROSCOPY

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Fungal contamination in food and agricultural products is a significant issue worldwide. *Neosartorya* spp. (anamorph: *Aspergillus* spp.) is a common fungal contaminant that is responsible for spoilage and the production of mycotoxins, which can potentially cause severe health consequences in consumers of polluted agricultural products. Furthermore, several species have been described as heat-resistant which makes traditional temperature-based methods of food preservation futile (Yaguchi et al., 2012). In recent years, there has been increasing interest in the use of natural extracts as an alternative to synthetic fungicides for the control of fungal contamination. The use of natural antimicrobial agents may help to address the growing problem of antimicrobial resistance and pollution. One key area of focus is the reduction of chemical pollution, including the use of synthetic pesticides that have negative impacts on human health and the environment (Wesseler, 2022). So, the development and use of natural food preservatives, such as marigold extract, is important to achieve these goals.

Marigold is a plant with well-documented antimicrobial properties. Previous studies have shown that marigold extracts can inhibit the growth of various fungal species (Kasiram et al., 2000). However, the exact effects of marigold extract on the morphology of *Neosartorya* spp. fungi have not been explored. In this study, we investigated the effects of marigold flower dry extract on the morphology of *Neosartorya* spp. using scanning electron microscopy (SEM). Five *Neosartorya* spp. isolates were grown on Potato Dextrose Agar (PDA) at 30°C with and without marigold extract. The morphology of the fungi was studied after 10 and 30 days of incubation. Our results showed that the growth with marigold extract led to significant morphological alterations in *Neosartorya* spp. isolates. Specifically, we observed a significant increase in the amount of fungal spores, indicating environmental stress as well as alterations in the structure of fungal hyphae. These changes were observed in all five isolates, indicating that marigold extract has broad-spectrum effects on tested fungal strains.

In conclusion, our study provides new insights into the effects of marigold extract on the morphology of *Neosartorya* spp. fungi. The results suggest that marigold extract has significant inhibitory effects on the growth and morphology of these fungi, and may be a promising natural alternative to synthetic fungicides for the control of fungal contamination.

Acknowledgements

The work was supported by the National Science Centre, Poland, Preludium Bis-2, 2020/39/O/NZ9/03421.

References

Yaguchi, T., Imanishi, Y., Matsuzawa, T., Hosoya, K., Hitomi, J., & Nakayama, M. (2012). Method for identifying heat-resistant fungi of the genus *Neosartorya*. Journal of food protection, 75(10), 1806-1813.

Wesseler, Justus. 2022: The EU's farm-to-fork strategy: An assessment from the perspective of agricultural economics. Applied Economic Perspectives and Policy 44(4): 1826– 1843.

Kasiram, K., Sakharkar, P. R., & Patil, A. T. (2000). Antifungal activity of *Calendula officinalis*. Indian Journal of Pharmaceutical Sciences, *62*(6), 464.

STRUCTURAL PROPERTIES OF WATER-SOLUBLE CELL-WALL POLYSACCHARIDES OF TWO VARIETIES OF ONION

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Onion has been domesticated about 6000 years ago in Asia (Mehta, 2017). Currently, this is a popular vegetable valued for its nutritional and health-promoting properties (Kianian et al., 2021). The area of its cultivation in the world was about 6 million hectares in 2021 (FAO, 2023).

Polysaccharides are the constituents of plant cell wall. Molecular structure of these biopolymers affects both their biological function and potential applications (Ochoa-Villarreal et al., 2012). Information about the presence of characteristic groups in a macromolecule can be obtained from a Fourier-transform infrared (FTIR) spectroscopy, which is a non-destructive and rapid method (Chylińska et al., 2016, Hong et al., 2021,).

The aim of this research was to compare the structural properties of water-soluble polysaccharides extracted from the 'bulb' and assimilation leaves of white and red onion (*Allium cepa* L.), on the basis of their FTIR spectra.

Plants were received from a local producer. The particular organs were separated and next were crushed with a laboratory blender. The cell wall material and water-soluble polysaccharides were isolated as previously (Chylińska et al., 2016). The spectra of lyophilized polysaccharides were collected over the range 4000 – 650 cm^{-1} using a Nicolet 6700 FT-IR spectrometer (Thermo Scientific, Madison, WI, USA) with the Smart iTR ATR accessory. The data analysis allowed to identify the main functional groups of water-soluble polysaccharides and compare them in terms of the source of occurrence.

Acknowledgements

Research financed by the National Science Centre, Poland, grant no. 2021/43/O/NZ9/02382.

References

Mehta, I.: Origin and History of Onions, IOSR Journal Of Humanities And Social Science (IOSR-JHSS) , Vol. 22, No. 9, 2017, pp. 7–10.

Kianian, F., Marefati, N., Boskabady, M., Ghasemi, S.Z., Boskabady, M.H.: Pharmacological properties of *Allium cepa*, preclinical and clinical evidences: a review. Iranian Journal of Pharmaceutical Research, Vol. 20, No. 2, 2021, pp. 107–134.

FAO, 2023, FAOSTAT, Crops and livestock products. https://www.fao.org/faostat/en/#data/QCL

Ochoa-Villarreal, M., Aispuro-Hernández, E., Vargas-Arispuro, I., Martínez-Téllez, M.Á.: Plant cell wall polymers: function, structure and biological activity of their derivatives. In Polymerization, Vol. 4, 2012, pp. 63–86.

Chylińska, M., Szymańska-Chargot, M., Zdunek, A.: FT-IR and FT-Raman characterization of non-cellulosic polysaccharides fractions isolated from plant cell wall. Carbohydrate Polymers, Vol. 154, 2016, pp. 48–54. https://doi.org/10.1016/j.carbpol.2016.07.121

Hong, T., Yin, J.-Y., Nie, S.-P., Xie, M.-Y.: Applications of infrared spectroscopy in polysaccharide structural analysis: Progress, challenge and perspective. Food Chemistry: X, Vol. 12, 2021, 100168. https://doi.org/10.1016/j.fochx.2021.100168

NEW APPLICATIONS OF THE VARIATIONAL METHODS IN THE CASE OF THE CONVECTIVE FLUID FLOW

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Relevance of the directly solvable ordinary differential equations is indicated in the second-order variational calculus procedures within frame of the extended irreversible thermodynamics. After analyzing some well-known examples from continuum mechanics related to the same type of differential equations in a simple, but novel, unified manner, a stochastically further refined variant of its assigned to convection-diffusion processes is directly also directly solved and graphically presented.

Then, the second-order variation procedure is applied again for the case of the Fourier-type partial differential equation in linear approximation, and the Riccati - type differential equation derived in this manner is also directly solved.

Finally, the function obtained via deviation from the stationary solution is represented graphically and discussed in detail from the point of view of both theoretical and computer modelling type investigations.

References

Kirschner, I., Mészáros, Cs., Bálint, Á., Gottschalk, K., Farkas, I.: Surface changes of temperature and matter due to coupled transport processes through porous media J. Phys. A: Math. Gen. **37** (2004), pp. 1193-1202

Mészáros, Cs., Farkas, I., Gottschalk, K., Bálint, Á.: Relevance of the Riccati's differential equation in general symmetry theory of propagation phenomena in macroscopic dissipative continua Mech. Eng. Lett. **11** (2014), pp. 104-115

MONITORING OF THE ENERGY PRODUCTION IN THE PV POWER PLANT LOCATED IN THE SOUTH MORAVIA REGION

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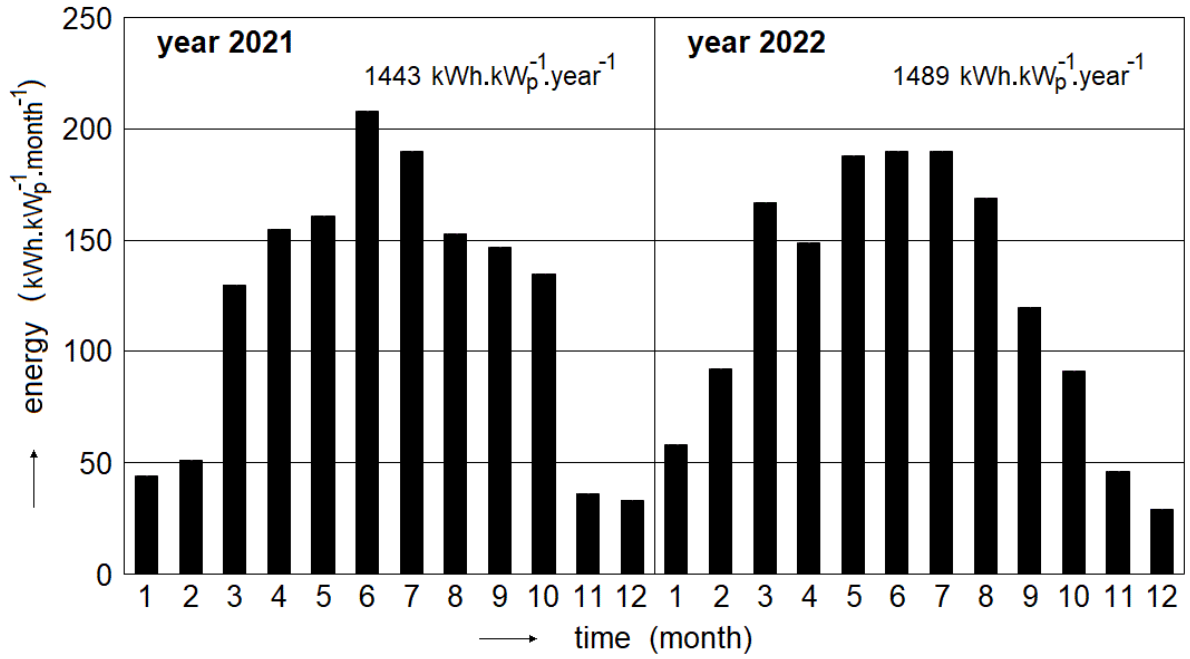
Electricity from photovoltaic (PV) power plants has an important place in the energy mix today. Electricity from photovoltaic systems is proving to be an important alternative source of energy. In this article, we present the data monitoring in the PV power plant located in the south Moravia region. We monitored the data through the monitoring system Solarmon (2.0) (Beránek et al., 2018) developed in cooperation between Czech University of Life Sciences Prague and the company Solarmonitoring, Ltd.

The figure shows the electricity production in the PV power plant located in the south Moravia region during last two years.



The coordinates of the mentioned PV power plant 48.8°N, 16.9°E and the nominal output power of 4026 kW_p. The PV power plant started the operation in 2015. For a better comparison, the values are converted per nominal peak power 1 kW_p. The expected value of the produced electricity is 1155 $kWh.kW_p^{-1}year^{-1}$ in the south Moravia region (according to the internationally used application PV GIS). So, the actual value is about 25% higher than the expected value. This testifies to the quality of the used PV panels with high efficiency of the photovoltaic energy conversion as well as to the quality of the construction of the entire PV power plant.

References

Beránek V., Olšan T., Libra M., Poulek V., Sedláček J., Dang M-Q., Tyukhov I.I. 2018. New Monitoring System for Photovoltaic Power Plants' Management. Energies, 2018, 11(10), Article No. 2495.

DECARBONISING THE ELECTRICITY SECTOR IN THE CONTEXT OF ERITREA

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Concerned by the climate change, global warming, diminishing fossil reserves and energy prices the need for energy transition is more important today than ever. In the previous decade the worldwide addition of renewables (solar, wind and hydro) increased significantly and particularly the installed solar and wind capacity have more than quadrupled in that decade (Humayun et al., 2022). The complete transition towards 100% renewable energy supply, however, needs a collaborative effort from different sectors including researchers, stake holders and policy makers. The complete transformation of the energy system is a gradual process and achieving 100% energy transition target may take decades to reach. The major energy sectors that need a special decarbonization focus includes but are not limited to electricity (power), transport, industry and heat (Hansen et al., 2019). Several research were conducted on the technical feasibility and economic viability of decarbonizing the complete energy system and/or specific energy sector in many countries.

In this paper decarbonising the electricity sector in the context of Eritrea was investigated. The area is located in North East Africa with abundant of wind and solar resources. The far southern coastal areas have a favourable wind resource where the wind speed can reach 8-10 m/s at 10 m height (Negash et al., 2020). Moreover, the solar potential is enormous in the whole country in all four seasons. In the current work optimally mixed solar PV and wind generations along with energy storage and other enabling technologies were employed to satisfy the energy demand of the country. A model was developed to simulate the hourly PV, wind and load profiles. A restricted storage was employed to store excess energy during surplus renewable generation and feed back to grid when renewable generation fails to satisfy the demand. In case the renewable generation exceeds the demand and storage capacity the excess generation was curtailed or dumped. In this way the renewable penetration was significantly increased.

The results of the analysis showed that the penetration was found to be influenced by different parameters and confirmed that technically it is possible to decarbonize the electricity sector in Eritrea solely by PV and wind mix along with energy storage. This solution shows satisfaction to the energy demands in economic aspects, however, will be addressed in future.

Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Hansen, K., Mathiesen, B.V., Skov, I.R. (2019). Full energy system transition towards 100% renewable energy in Germany in 2050. Renewable and Sustainable Energy Reviews, 102, July 2018, 1–13. https://doi.org/10.1016/j.rser.2018.11.038

Humayun Tai, Samandari, H., Pacthod, D., Polymeneas, E., Alex Bolano, S., Pratt, M.P., Lodesani, F. (2022). The energy transition: A region-by-region agenda for near-term action.

Negash, T., Möllerström, E., Ottermo, F. (2020). An assessment of wind energy potential for the three topographic regions of Eritrea. Energies, 13(7). https://doi.org/10.3390/en13071846

EDUCATIONAL BENEFITS OF EUROPEAN UNION PROJECTS

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Our university, Hungarian University of Agriculture and Life Sciences (MATE)**,** participates as a consortium partner in the European Union, Horizon, EMPIR 2020 (European Metrology Programme for Innovation and Research) "19ENV02 RemoteAlpha" project, in collaboration with a total of eight partner institutes and universities. The program of the project is also particularly relevant due to the events of today's war: the development of a detector system that implements the remote, real-time measurement of alpha-emitting radioactive materials and is able to detect a large-scale of contamination of these materials. The measurement principle used, which is optical one and based on a secondary effect, namely to so-called alpha-radioluminescence phenomenon in the air, is novel because the range of alpha particles is very small (3-7 cm in air) and their presence can only be detected with conventional detectors by direct source-detector coupling.

The objectives of the project were previously presented at international conferences (6th European IRPA Congress, 2022, Hungary, Budapest and 28th Workshop on Energy and Environment, 2022, Hungary, Gödöllő (EE 2022)). MATE primarily participates in the development of online course materials related to the project, which we also previously reported on EE2022, supplemented by the organization of workshops and dissemination lectures. In addition to a deeper knowledge of radioactive radiation, the development of the curriculum significantly affects both the practical and theoretical fields of modern optical and spectroscopic methods (e.g. molecular spectroscopy, fluorescence, Raman spectroscopy with the appropriate quantum mechanical basics), therefore, after the completion of our work, university education can be an integral part of it, which, according to our conviction, would also have a fertilizing effect on engineering education with a modern approach. This presentation aims to highlight in general sense to the benefits of EU projects in these respects.

Acknowledgements

This project 19ENV02 RemoteALPHA has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme. 19ENV02 RemoteALPHA denotes the EMPIR project reference.

References

RemoteALPHA, Remote and real-time optical detection of alpha-emitting radionuclides in the environment, 2020, https://www.euramet.org/research-innovation/search-research-projects/details/project/remote-and-real-time-optical-detection-of-alpha-emitting-radionuclides-in-the-environment/

Nikolényi, I.R., Bela, Gy., Gémesi, Z., Gál, P., Krasniqi, F.S. (2022): A Remote and real-time optical detection of alpha_emitting radionuclids in the environment , 6th European IRPA Congress https://static.akcongress.com/downloads/irpa/irpa2022-boa.pdf

Nikolényi, I.R. Bela, Gy., Gémesi, Z. (2022): An innovative training solution for radiation preparedness, 28th Workshop on Energy and Environment, Book of Abstracts, p. 49.

PROTON MOTIVE FORCE ACROSS THYLAKOID MEMBRANE IN LEAVES UNDER VARIABLE LIGHT CONDITIONS

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Photosynthesis as based on light induced movement of electrons results in rise of electrical potential (Δψ) and chemical gradient (ΔpH) across the thylakoid membrane that is the driver of ATP synthesis (Wilson et al., 2021).

The aim of the study was to evaluate impact of xanthophyll cycle and PsbS protein on the proton gradient and electric potential, both contributing to the proton motive force across (*pmf*) the thylakoid membrane in plants under light varying in intensity.

The study was conducted on Arabidopsis thaliana wild type and NPQ1 and NPQ4 mutants. NPQ1 is characterised by absence of zeaxanthin formation that is important in photoprotection in high light, while NPQ4 is lacking PsbS pigment-binding protein. The measurements of electrochromic shift (ECS) absorption at 515 nm was used to probe *pmf* in intact leaves.

The kinetic of leaf absorption was measured in leaves using Dual PAM 100 (Walz, Germany) with P515/535 modules, dark adapted leaves were subjected to light of increasing intensity or fluctuating of low-high phases, contribution of Δψ and ΔpH components were established at dark phase following illumination.

Our results show increasing contribution of chemical gradient in proton motive force with increase in light intensity, what was especially clear in NPQ4 plants. Results are of importance in regulation of photosynthesis and photoprotection under high light and will be discussed.

References

Wilson, S., Johnson, M. P., Ruban, A.V. (2021). Proton motive force in plant photosynthesis dominated by ΔpH in both low and high light. Plant Physiology, 187(1), 263-275. https://doi.org/10.1093/plphys/kiab270

TEMPERATURE DISTRIBUTION PREDETERMINED CLASSROOM WITHOUT AND WITH AIR CONDITIONING

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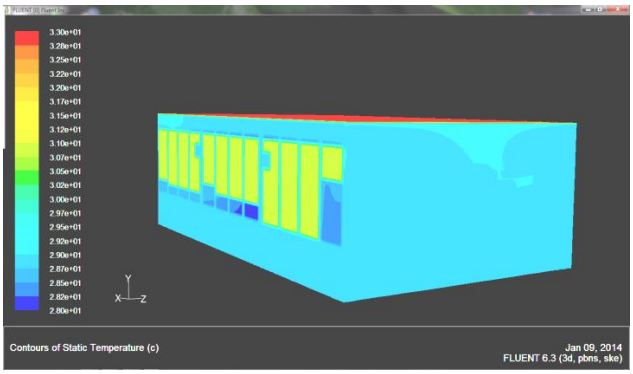
Hot air is inconvenient for activities, especially in a closed room with poor air circulation. In a closed classroom, sunlight that penetrates straight through the glass window, along with many students, raises the room's temperature, causing pupils to sweat easily, feel hot, and uneasy, disrupting student learning activities. As a consequence, students are unable to concentrate on their studies. In addition, indoor thermal settings greatly impact people's health and comfort. Furthermore, thermal comfort is critical for architects and engineers to ensure the comfort and health of building occupants (Nguyen et al., 2012). Therefore, thermal comfort is essential, which affects occupant performance.

This research aims to compare the temperature distribution in classrooms without and with Air Conditioning in tropical climates. In this study, Computational Fluid Dynamics (CFD) was used to perform simulations in order to achieve this goal.



As a simulation condition and assumption, the room is assumed to be empty or without occupants, simulation at steady-state operating conditions, the properties of fluids: density, heat capacity, thermal conductivity, viscosity etc., are constants. The simulation is carried out in several parts of the place in the horizontal and vertical directions with a certain distance.

From the simulation results in classrooms without Air Conditioning in the tropical climates, the temperature felt by classroom users is 29 ºC and 30 ºC, higher than the SNI standard recommendation is 25 °C±1 °C. Suggestion The solution to this condition is to install an Air Conditioning device (AC). Simulation results show that if the classrooms are given two AC units with closed doors and windows, the average temperature in the room is 21-22 ºC.

Acknowledgments

The short synopsis of this research is released as an outcome of a multidisciplinary international partnership between ITENAS Bandung, Indonesia, and MATE Gödöllő, Hungary.

References

Nguyen, A.T., Singh, M.K., Reiter, S. (2012).: An adaptive thermal comfort model for hot humid South-East Asia, Building and Environment, 56, 2012, pp. 291-300.

PHOTOPROTECTIVE FUNCTION OF XANTHOPHYLLS IN UNFAVOURABLE GROWTH CONDITIONS

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Light energy is essential to power the photochemical reactions of photosynthesis, but excess of excitation energy produces various radicals and reactive oxygen species that can damage the photosynthetic apparatus, leading to a decline in photosynthetic activity and productivity. This limiting process is called photoinhibition. Plants have evolved a wide variety of photoprotective strategies that alleviate photoinhibition which are associated with avoiding light absorption and successfully consuming or dissipating the light energy absorbed by light-harvesting pigments (Giossi et al. 2020). Xanthophylls, which are carotenoids containing oxygen (zeaxanthin, antheraxanthin and violaxanthin), are key pigments involved in photoprotective response of plants to the excessive light intensity due to the ability to undergo convertion into zeaxanthin under exposure to light intensities that exceed the amount of light energy that can be consumed by photochemistry at the moment. Zeaxanthin is synthetised by the enzyme violaxanthin de-epoxidase. It's activity is triggered when the pH in the internal space of the photosynthetic membranes drops, when light absorption exceeds the rate at which ATP, as a key product of the light reactions, can be consumed (Demming-Adams et al. 2020).

We conducted an experiment where control and drought-treated plants of *Arabidopsis thaliana* were examined by Chlorophyll Fluorescence System Imaging-PAM Maxi (Walz) in conditions of various light intensities to observe rates of non-photochemical quenching. Three different genotypes were used: wild type (wt); npq1-2 which is deficient in enzyme violaxanthin de-epoxidase and therefore exhibits greatly reduced nonphotochemical quenching due to absence of zeaxanthin formation under high light; npq4-1, deficient in protein PsbS and defective in pH-dependent nonphotochemical quenching of chlorophyll fluorescence. After one hour exposure to light of specified intensity leaf samples were obtained to run liquid chromatography measurements (Nexera LC 40 (UHPLC-PDA-ELSD), Shimadzu) to establish the content of photosynthetic pigments after each of the light treatment.

We observed more abundant zeaxanthin content in plants examined under high light intensity, both in cultivars wt and npq4-1. Drought treated mutants performed higher rates of non-photochemical quenching in comparison to control plants respectively, although the amount of quenched energy was lower than in wt plants in both watering regimes.

References

Giossi, C., Cartaxana, P., Cruz, S. Photoprotective Role of Neoxanthin in Plants and Algae. *Molecules*. 2020; 25(20): 4617. https://doi.org/10.3390/molecules25204617

Demmig-Adams B., Stewart, J.J., López-Pozo, M., Polutchko, S.K., Adams, W.W. III. Zeaxanthin, a Molecule for Photoprotection in Many Different Environments. *Molecules*. 2020; 25(24):5825. https://doi.org/10.3390/molecules25245825

SPECTROSCOPIC STUDIES OF CELL WALL POLYSACCHARIDES OF APPLE AT DIFFERENT STAGES OF DEVELOPMENT

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The plant cell wall is a complex and ordered natural polymer network. Its structure, which is influenced by the quantitative and qualitative composition of polysaccharides as well as the interactions between them, depends on many factors: species, organ, stage of development and maturity, environmental conditions, and others (Chylińska et al., 2017; Liu et al., 2021; Szymańska-Chargot et al., 2016). First and foremost, it has a protective function for the plant body and also plays a role in intercellular communication, water transport and, importantly, plant growth (Cosgrove, 2005).

A distinction is made between the primary and secondary cell wall, while our considerations will focus on the primary cell wall, whose main components are cellulose, hemicelluloses, and pectin. These polysaccharides undergo some modification during fruit ripening. Notably, there is a loosening of the polymer network, resulting in softening on a macro scale (Chylińska et al., 2017). Knowledge of these processes affecting mechanical properties is also important for consumer acceptance of storage fruit.

Identification of the cell wall polysaccharides of apples (two cultivars: Idared, Pinova) at different maturity and developmental stages was carried out. The aim of the study was to find out what changes occur in the polysaccharide structure at different developmental stages in apples that are visible using spectroscopic methods. The development phases of apples were selected: apples ripening on the tree (3 dates), from the optimum harvest date, and in post-harvest three-month cold storage (every month).

The study was based on infrared spectroscopy, Raman spectroscopy, and Raman microscopy. The results obtained were subjected to PCA statistical analysis. The spectroscopic spectra obtained showed similarities in polysaccharide composition between the two varieties. On the other hand, differences were found in the intensities of the characteristic bands for polysaccharides extracted from apples of different maturity dates. This conclusion is consistent with the assumption that the composition of polysaccharides in the plant cell wall changes with fruit growth and storage.

Acknowledgements

The work was funded by National Science Center-Poland project nr NCN PRELUDIUM BIS 2 2020/39/O/NZ9/00241.

References

Chylińska, M., Szymańska-Chargot, M., Deryło, K., Tchórzewska, D., Zdunek, A.: Changing of biochemical parameters and cell wall polysaccharides distribution during physiological development of tomato fruit. Plant Physiology and Biochemistry, 2017, 119: 328-337.

Cosgrove D.J.: Growth of the plant cell wall. Nat Rev Mol Cell Biol, 2005, 6.11: 850-861.

Liu, X., Renard, C. M., Bureau, S., Le Bourvellec, C.: Revisiting the contribution of ATR-FTIR spectroscopy to characterize plant cell wall polysaccharides. Carbohydrate Polymers, 2021, 262: 117935.

Szymańska-Chargot, M., Chylińska, M., Pieczywek, P. M., Rösch, P., Schmitt, M., Popp, J., Zdunek, A.: Raman imaging of changes in the polysaccharides distribution in the cell wall during apple fruit development and senescence. Planta, 2016, 243: 935-945.

ENERGY AND EXERGY ANALYSIS OF ORGANIC RANKINE CYCLE BASED ON TURA EXCESS STEAM

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A developing geothermal utilization is one of many Hungarian government efforts to generate electricity and heating applications from renewable energy sector. Geothermal utilisation for electricity generation has been implemented in Tura region and it is become the first geothermal plant in Hungary that producing electricity around 27 MW (Permana et al., 2021).

The excess steam from Tura geothermal power-plant is still have a potential energy that can converted to electricity and the objection in this study is to implementing a heat recovery from excess steam through organic Rankine cycle (ORC) analysis.

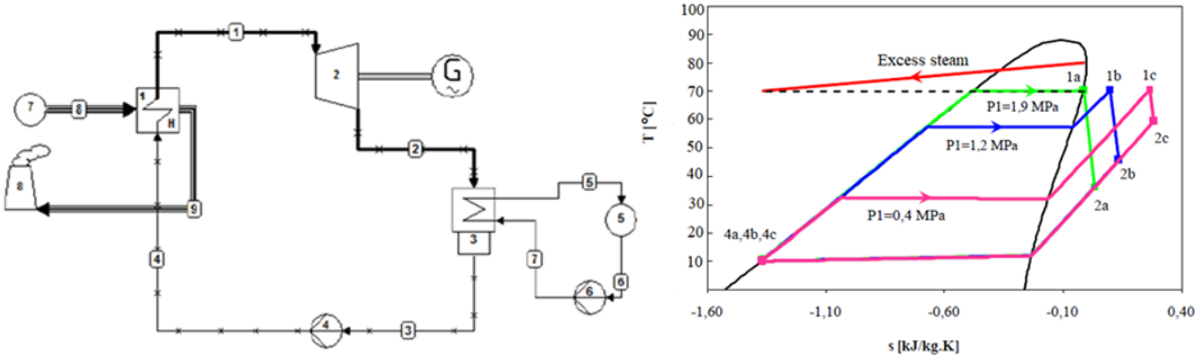

Figure left above depicts a basic design of an ORC, which includes an evaporator, turbine, condenser, and pump. The heat from the Tura geothermal plant injection is utilized to power the ORC process. This heat is removed via a heat exchanger, and heat transfer happens with the working fluid, which has low boiling temperature due to its thermo-physical qualities. The ORC's performance may be determined using the first and second principles of thermodynamics. The highest and lower limits of the cycle are shown in Figure right above at temperatures of 68 °C and 10 °C, respectively. In this study, however, a NIST Refprop database is employed to establish the characteristics of each working fluid.

This study presents not just energy and exergy analysis, but also environmental analysis utilizing the Exergetic Sustainability Indicator approach.

Acknowledgement

This work was supported by the Stipendium Hungaricum Programme by the Doctoral School of Mechanical Engineering, Hungarian University of Agriculture and Life Science, Gödöllő, Hungary and the Department Mechanical Engineering, Institut Teknologi Nasional, Bandung, Indonesia.

References

Permana, D.I., Rusirawan, D., Farkas, I.: Waste heat recovery of Tura geothermal excess steam using organic Rankine cycle, International Journal of Thermodynamics, Vol 24 No. 4, 2021, pp. 32-40, 2021. https://doi.org/10.5541/ijot.906128

DESIGN OF CONDENSER WITH AMMONIA-WATER MIXTURE AS WORKING FLUID AT NATURAL HOTSPRING POWERPLANT

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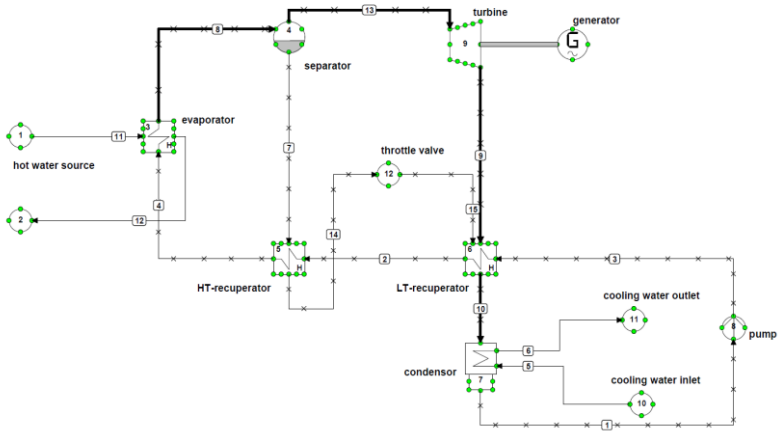
Natural hot spring has a large potential for electric generation. Due to fluid low temperature, a special system is required to generate electricity. The Kalina cycle is one of the systems that used an ammonia-water mixture as a low-heat working fluid in generating electricity. The Kalina cycle uses multiple heat exchangers such as the evaporator, recuperator, and condenser, as can be seen in the schematic diagram figure.



In this research, the condenser was designed using Log Mean Temperature Difference (LMTD) method and Tubular Exchanger Manufacturer Association (TEMA) standard. By the 13.31 kW of generated electric power and cooling water inlet temperature of 293 K, shell and tube type was chosen for the Condenser. The condenser was designed with 4 tube passes and 2 shell passes. A number of 488 tubes (each has a diameter of 25.4 mm and length of 3710 mm) made from cupro-nickel were used in this condenser. The shell components were also made from cupro-nickel with 885.36 mm in diameter and a thickness of 9.52 mm. The condenser has a capacity of heat transfer of about 250.76 kW with an efficiency of 96.72%. Moreover, the pressure drop along the tube and the shell were 0.00698 bar and 0.000261 bar, respectively.

Acknowledgments

This work was released as an outcome of a multidisciplinary international partnership between ITENAS Bandung, Indonesia, and MATE Gödöllő, Hungary.

References

Sirodz, M.P.N, Ridwan, M., Priambudi, A.: Evaporator design with ammonia-water mixture as working fluid for kalina KCS34 cycle on electric power plant. The 2nd Faculty of Industrial Technology International Congress (FoITIC), January, 28-30, 2020, pp. 59-65

Ganesh, N.S., Srinivas, T.: Development of thermos physical properties of aqua ammonia for Kalina cycle system. Int. J. material and product technology, Vol. 55, No. 1/2/3, 2017, pp. 113-141.

SOLAR ENERGY RESEARCH ACTIVITIES AT ITENAS BANDUNG

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Research activities of solar energy at Institut Teknologi Nasional Bandung (ITENAS Bandung) have been initiated since 2006, as a response to the global challenges in the environmental issue and depletion of conventional (fossil) energy.

Moreover, research intensively in this field was enlarged since the collaboration with Szent Istvan University, a predecessor of the Hungarian University of Agriculture and Life Sciences (MATE), Godollo campus. By 2018, ITENAS Bandung has operated a 1 kWp solar power plant (SPP), as a research facility for the PV thematic field. Until the present, some research work activities, for BSc and MSC students in ITENAS Bandung and PhD student in Godollo campus of MATE, have been implemented and can be summarized as follow:

- Modeling of the PV modules of the SPP by single and double diode model using Visual Basic for Application (VBA) Microsoft Excel and SIMULINK;
- Modeling of the PV modules characteristics using Fuzzy Time Series (FTS) Algorithm;
- Modeling of the PV modules using Seasonal Autoregressive Integrated Moving Average (SARIMA) Algorithm;
- Development of an SPP cooling system to increase the SPP performance;
- Modeling of the PV energy production using Machine Learning (Naive Bayes and Support Vector Machine Algorithms);
- Realization of a prototype Security System Based on IoT for village protection;
- Application of the PV and the Internet of Things (IoT) in the farming field;
- Application of solar energy in the Organic Rankine System;
- Development microprocessor-based of prototype solar tracker system.

The existing of SPP have been used also for training teachers and students from external, especially from senior high schools, as a part of capacity building program of the university. In the public service matters, some of projects have been executed, ranging from a feasibility study and detailed engineering design (DED) of the SPP for rooftop type in the existing building, especially for non-profit organization, in several islands in Indonesia (Rusirawan and Farkas, 2020), and a recent project is the feasibility study of substitution of steam power plant to solar power plant.

Referring all the above track records, this year the existence of the solar energy group will be registered officially, as one of research group under Research Institute of ITENAS Bandung. It is hope that with the existence as research group, the future activities, both in research or community services will be expanded, and give contribution significantly for the community.

Acknowledgments

The short synopsis of this research is released as an outcome of a multidisciplinary international partnership between ITENAS Bandung, Indonesia, and MATE Gödöllő, Hungary.

References

Rusirawan, D., Farkas, I.: Research and project activities in photovoltaic field at ITENAS Bandung. Book of Abstract the 26th Workshop on Energy and Environment, 2020, p. 7.

BIOPHYSICAL EXPERIMENTS UNDER LOW TEMPERATURE

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The application of low temperature is popular in several fields of Biophysics, such as a frequently used method for the food quality conservation, bioclimatology or electron microscopy. The authors decided to use experiments to demonstrate the importance of the practice and popularize Physics by demonstrating the behaviour of materials at low temperatures using dry ice (solid CO_2) and liquid nitrogen.

It is known that the carbon-dioxide does not have liquid state at normal pressure, it is normally gas, or at low temperature it is solid (dry ice). It sublimates (goes from solid to gas directly) at the temperature of -78,5 °C. The main usage of it is cooling without electric energy (e.g., during transport of goods), but it is used in fog machines and even for surface cleaning, as well. The nitrogen is a clear, colourless liquid, its boiling temperature is -196 °C. It is classified as a cryogenic fluid which causes rapid freezing, 3-4 times faster, than the mechanical freezing. The liquefied nitrogen is used for various industrial treatments. It is also used as a cooling technique for the preservation of biological samples.

During our presentation we plan to show different experiments with the above-mentioned mediums.

With the dry ice we demonstrate how strong is the sublimation (screaming metals), you can see liquid carbon-dioxide (under high pressure is a special plastic tank – PET proforma) but fog machines will be prepared, as well.

Our main experiment with the liquid nitrogen: Meissner effect: a magnet levitating over a superconductor cooled with liquid nitrogen, because in low temperature the magnetic field expulsion from the superconductor to transition the superconducting state. We demonstrate the temperature dependence of the electric resistance with a Lenz cannon. We demonstrate how a bare light bulb (without glass cover) works in liquid nitrogen. We demonstrate the Charles law: immerse the balloon carefully and slowly in liquid nitrogen, the balloon drain off, with remove it from nitrogen slowly re-inflate. we develop a nitrogen fountain, prepare lollipop from palinka, you can taste it. We will freeze different materials: the biological macrostructure will have been damaged by the freezing process. and in the end, we prepare a nitrogen grenade launcher, and a nitrogen filled PET bomb will be exploded, as well. We hope, the experiments are not just interesting, but very spectacular and useful to understand special processes.

Acknowledgement

This paper was supported by the Doctoral School of Mechanical Engineering, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

EXPERIMENTAL STUDY OF CONTINUOUS GASIFIER WITH CORN COBS AS FUEL

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Development of gasification in small-scale power generation was conducted by Raman et al. (2013) and Bhoi et al. (2018) using an ash removal system. However, a little amount of charcoal is still falling from the reactor using this system.-This study aims to produce a small-scale corn cob gasifier with an efficient ash removal system.

The study started with a simulation to acknowledge the air-to-fuel ratio (AFR) and gas composition. With an AFR of 1.67, the syngas is composed of CO, H_2, and CH_4 with 0.162 %, 0,135%, and 0.029 %, by weight respectively. The syngas would generate 26,49 kW of power with a low heating value of 4.054 MJ/kg. The continuous gasifier was designed using *a* screw conveyor as a feeder and bottom ash removal. Cyclone was used to remove the fly ash as seen in Fig. 1. The fabricated gasifier as seen in Fig. 2 has a reactor dimension of 20,35 cm in diameter and 50 cm long. The screw conveyor feeder rotates at 10 rpm and delivered 0,455 kg/min of corn cobs. To remove the ash, a screw conveyor with a water shield was introduced.

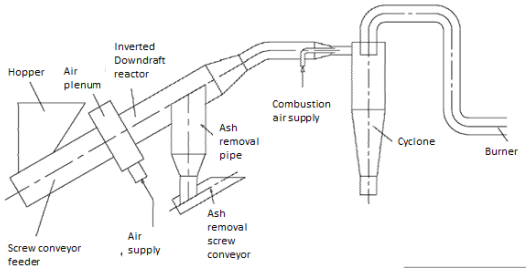

Fig. 1. Schematic diagram of continuous gasifier

Fig. 2. Fabricated continuous gasifier

The gasifier was tested with variation in airflow. The gasifier operates continuously with 0,0114 m3/s of air and a reactor temperature of 369°C. The syngas was burned at the burner resulting in blue coloured flame. Further research on gas composition is required to optimize syngas production.

Acknowledgments

The short synopsis of this research is released as an outcome of a multidisciplinary international partnership between ITENAS Bandung, Indonesia, and MATE Gödöllő, Hungary.

References

Raman, P., Ram, N.K.: Design improvements and performance testing of a biomass gasifier based electric power generation system, *Biomass and Bioenergy*, 2013, doi: 10.1016/j.biombioe.2013.06.004.

Bhoi, P.R., Huhnke, R.L., Kumar, A., Thapa, S. Indrawan, N.: Scale-up of a downdraft gasifier system for commercial scale mobile power generation, *Renew. Energy*, vol. 118, pp. 25–33, 2018, doi: 10.1016/j.renene.2017.11.002.

BIOCONTROL OF *NEOFABRAEA* SP. USING BACTERIA ISOLATED ON A MEDIUM SPECIFIC TO *BACILLUS* AND *PSEUDOMONAS* GENERA: AN INVESTIGATION OF ANTAGONISTIC PROPERTIES

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Bacillus sp. is a group of Gram-positive (Gram+) bacteria known for their ability to produce a wide range of secondary metabolites, including antimicrobial compounds. In this study, pure cultures of *Bacillus* sp. were isolated from soil collected from apple trees root zone using microbiological cultivation on Potato Dextrose Agar medium (PDA) and evaluating their antagonistic activity against *Neofabraea* sp. (synonym *Pezicula* sp.).

The obtained bacterial cultures were then grown on Tripticasein Soy LAB-AGAR (TSA), a specialized medium for the cultivation of bacteria belonging to the genera of *Bacillus* and *Pseudomonas*.

To evaluate the potential of the obtained isolates for biocontrol of plant pathogens, antagonism assays were carried out to investigate their ability to inhibit the growth of *Neofabraea* sp., a fungal pathogen that causes apples bull's eye rot (BER). It is a storage disease that can cause up to 50% of crop losses. The results showed that some strains of *Bacillus* sp. exhibited strong antagonistic activity against *Neofabraea* sp., suggesting their potential as biocontrol agents against this plant pathogen.

Overall, the results of this study suggest that *Bacillus* sp. can be a promising source of bioactive compounds with potential applications in sustainable agriculture, e.g. used in a biopreparation as an active ingredient. The isolation and characterization of *Bacillus* sp. strains with strong antagonistic activity against *Neofabraea* sp. can lead to the development of eco-friendly and effective biocontrol strategies. Further research is needed to develop effective biocontrol strategies for sustainable plant disease management.

Acknowledgements

This paper was financed by the National Centre for Research and Development within the framework of the project LIDER XII (acronym: APPAT(f)REE), contract number LIDER/7/0054/L-12/20/NCBR/2021

References

Duan, Y.; Zhou, Y.; Li, Z.; Chen, X.; Yin, C.; Mao, Z. Effects of Bacillus amyloliquefaciens QSB-6 on the Growth of Replanted Apple Trees and the Soil Microbial Environment. Horticulturae 2022, 8, 83. https://doi.org/10.3390/horticulturae8010083

Saul Carmona-Hernandez, S., Reyes-Pérez J. J., Roberto G. Chiquito-Contreras R. G., Gabriel Rincon-Enriquez G. Biocontrol of Postharvest Fruit Fungal Diseases by Bacterial Antagonists: A Review. Agronomy 2019, 9(3), 121. https://doi.org/10.3390/agronomy9030121

Lin H., Jiang X., Yi J., Wang X., Zuo R., Jiang Z., W. Wang, Zhou E. Molecular identification of Neofabraea species associated with bull's-eye rot on apple using rolling-circle amplification of partial EF-1α sequence. Canadian Journal of Microbiology, Volume 64, Number 1, January 2018. https://doi.org/10.1139/cjm-2017-0448

THE EFFECT OF THE GRAIN SIZE HETEROGENEITY ON THE BULK SOLIDS HANDLING AND PROCESSING TECHNOLOGY

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The increasing interest in granular materials and increase in the scale of their processing carry necessity of optimization of the technological processes involving granular materials. It has been estimated that over 75% of the raw materials that passes through industry are granular in nature. These include e.g. tablets, pellets, pharmaceutical powders, seeds and grains, food products, sand, coals and other minerals. Many of these solids display difficult handling behaviors, giving rise to considerable challenges in the design and operation of the handling and processing plants. The scientific insight into mechanical behavior of granular materials is required to apply the most efficient conveying, handling and processing systems.

Granular materials have different geometrical and mechanical properties. Most particle packings involved in industrial and natural processes is comprise of a broad range of particle sizes, which determines the geometrical and micromechanical properties of packings, which in turn strongly affect their structural and mechanical properties (Wiącek et al. 2014; Thanh Trung and Kien, 2023).

The degree of particle size heterogeneity strongly affects their mechanical response to external loads due to shear and compaction as well as the segregation and flowing behavior of particle mixtures during mixing and discharge processes. The differences between processes involving granular materials during storage, handling an processing require application of devices appropriate for materials of various properties. In the case of the pharmaceutical industry, in the production of medicines, prediction of the behavior of materials in various conditions and ability of design of technological devices affect the health and sometimes even life of the patients. Precision and knowledge, essential in the construction industry, ensure safety and durability of buildings. The limitation of the dangers and wastes resulting from inappropriate handling of granular materials is of great importance to the consumers and is a major challenge for materials technology and mechanical engineering. An interpretation of the effects observed in granular materials, to high extent determined by the heterogeneity in the grain size, requires more detailed information about properties of grain assemblies subjected to various technological processes. In recent years, a great deal of work has been done in the study of the effect of the grain size heterogeneity on the bulk solids properties (Wiącek et al. 2014; Thanh Trung and Kien, 2023), however, uunderstanding the relationship between the micromechanical and macromechanical properties of non-uniform granular materials is still one of the major challenges for physics and mechanics.

References

Wiącek J., Molenda M.: Effect of particle size distribution on micro- and macromechanical response of granular packings under compression, International Journal of Solids and Structures 51, 2014, 4189-4195, https://doi.org/10.1016/j.ijsolstr.2014.06.029

Thanh Trung, V., Kien, N.T.: Effects of the size polydispersity and friction coefficient on the compressive strength of wet granular materials. Journal of Science and Technology in Civil Engineering (STCE) - HUCE, 17(1), 2023, 58-66. https://doi.org/10.31814/stce.nuce2023-17(1)-05

REMOVAL OF HAZADROUS PESTICIDES FROM AQUEOUS MEDIA USING CARBON-MINERAL COMPOSITES WITH METALLIC ELEMENTS

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Pesticides are plant protection products used in agriculture, forestry and animal production. Their purpose is to protect plants from pests during growth, transport and storage. Pesticides can be of synthetic or natural origin and have diverse structure and properties. There are more than 1,000 various substances in this group. Plant protection products can be divided into: zoocides, herbicides, fungicides, bactericides, etc. In contact with the skin, pesticides can provoke toxic effects, e.g., endocrine disorders, dermatitis or even cancer. Due to the high mobility and toxicity of pesticides, their excess should be removed from surface and groundwaters. Three different methods can be used here – chemical, physical or biological ones (Kowalska, Kowalski, 2019).

This work focuses on the removal of pesticides from aqueous solutions using physical method, that is, the adsorption on the solid surface. This is a selective process based on interactions occurring between the adsorbent surface and impurities. It leads to reduction in bioavailability of heavy metals and other dangerous pollutants in the soil environment as well as enables separation of various xenobiotics from aqueous media. There are several groups of adsorbents, including natural materials (e.g., wood), modified natural materials (e.g., active biocarbons), and synthetic materials (e.g., carbon-mineral composites). In the experiments, two solids from the last group were applied. They are carbon-mineral composites with metallic elements, B4 (C/Mn/Ni/SiO_2) and B5 (C/Fe/Ni/SiO_2), prepared by carbonization of the mixture of phenol-formaldehyde polymer (PFP), fumed silica (SiO_2) and appropriative metal salts (manganese acetate and nickel acetate for B4; iron acetate and nickel acetate for B5) at 800 °C at a heating rate of 5 °C/min. Textural parameters of the adsorbents were determined by nitrogen adsorption/desorption method. Their sorption capacity was examined towards 2 pesticides, diuron and carboxin. The concentration of these plant protection products was measured using high-performance liquid chromatography (HPLC).

The obtained results indicated that specific surface area (S_{BET}) of B4 is 201 m^2/g, whereas that of B5 is 345 m^2/g. Both B4 and B5 are effective adsorbents of diuron and carboxin. The maximum adsorbed amounts of carboxin were 91.90 mg/g for B4 and 121.71 mg/g for B5, whereas the maximum adsorbed amounts of diuron were 99.03 mg/g for B4 and 136.97 mg/g for B5. The simultaneous presence of two pesticides in the examined systems limited their adsorption on the carbon-mineral composites due to the presence of competition between adsorbates.

Acknowledgements

This study was conducted within bilateral cooperation between Polish Academy of Sciences and National Academy of Sciences of Ukraine.

References

G. Kowalska, R. Kowalski: Pesticides - scope and risk of use, benefits and hazards. A review, Annales Horticulturae, Vol. 29, 2019, pp. 6-20, DOI: 10.24326/ah.2019.2.1

TEMPERATURE CHANGES OF THE PV ENERGY CONVERSION EFFICIENCY

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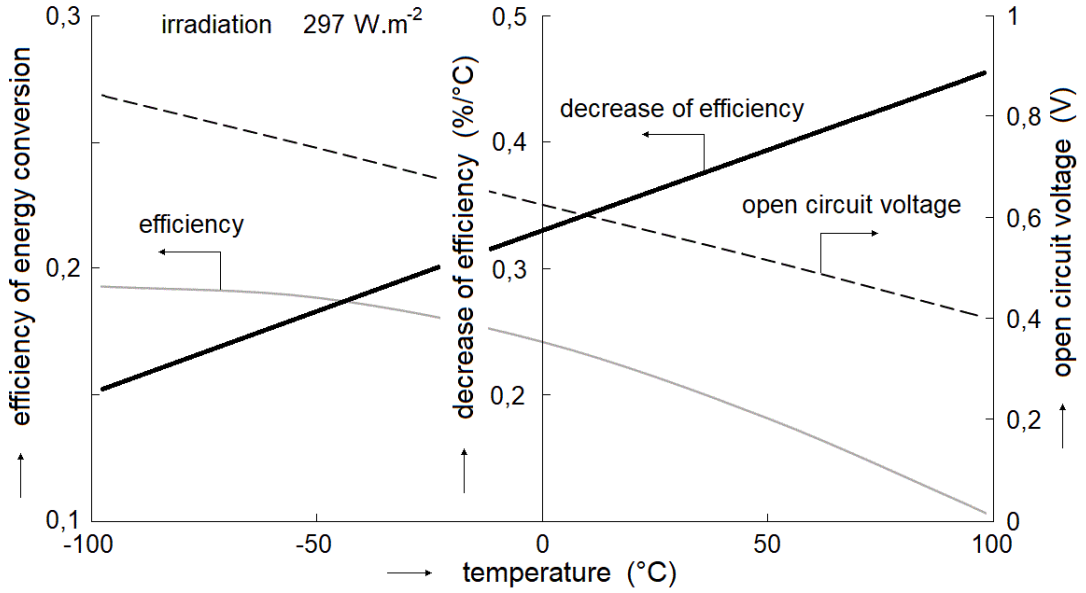
We monitored the behavior of important characteristics of the PV cell based on monocrystalline silicon in the wide temperature range. The efficiency of the photovoltaic energy conversion depends on the temperature significantly. Changes of *I–V* and *P–V* characteristics were discussed in terms of the theory of solids (Libra et al., 2021). The open-circuit voltage dependence is approximately linear over a wide temperature range. The increase of the temperature causes a reduction in the instantaneous power of the photovoltaic cell at a constant radiation intensity and thus a reduction in the efficiency of the photovoltaic energy conversion. In this article, we discuss the subsequent evaluation of the mentioned characteristics. The figure shows the dependences of open circuit voltage and energy conversion efficiency on temperature.



The figure shows that the characteristics of the PV cell measured over a very wide temperature range from −100 °C to +100 °C. If the PV system operates in locations with extreme climatic conditions, especially with extreme temperature changes during the year or even in space, the electrical voltage of the PV modules will change significantly as well as the instantaneous power. Thus, the efficiency of energy conversion and open circuit voltage can up to double on Earth in extreme climatic conditions during the year. In space applications, these values can triple in a single satellite orbit around the Earth. This must be taken into account in the design of the PV system, and the individual components must be carefully selected. Especially, electronic inverters tend to be sensitive to overvoltage or undervoltage.

References

Libra, M., Petrík, T., Poulek, V., Tyukhov I., Kouřím P. 2021. Changes in the efficiency of photovoltaic energy conversion in temperature range with extreme limits. IEEE Journal of Photovoltaics, 11(6), 1479-1484.

PREDICTING THE THERMAL PERFORMANCE OF A SOLAR DRYER USING ARTIFICIAL NEURAL NETWORK

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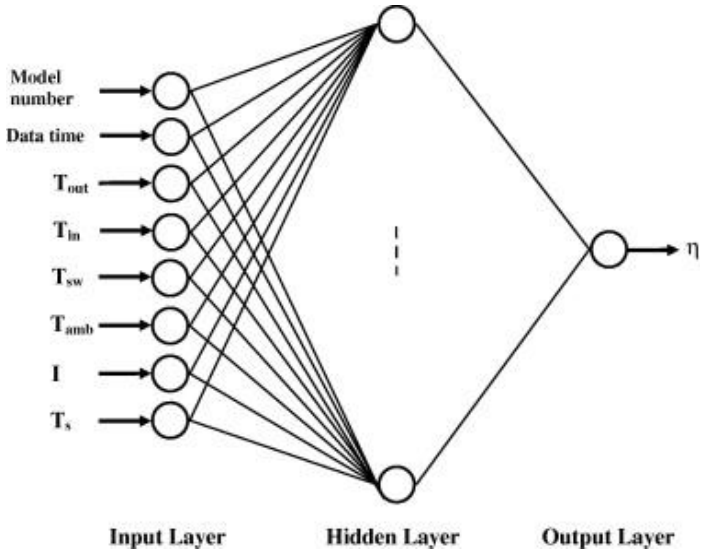
A solar dryer is a device used for drying food and other materials using the energy from the sun. It works by using solar radiation to heat the air and create a convection current that dries the materials inside the dryer.

During the drying process, thermal performance analysis of solar dryers is too difficult due to various measurements and heat transfer processes. To simplify the analysis and efficiently test the performance of the dryer, the computer code of the case study is used to estimate the performance of the system, a process that takes a lot of time to give an accurate prediction. In the past decade, many studies have focused on the application of artificial neural networks (ANN) in solar drying systems, which has gradually become a trend.

ANN is a type of machine learning algorithm that is designed to mimic the way the human brain processes information. It has a natural ability to store and compute experimental knowledge for modelling, predicting and optimizing the performance of different engineered systems. ANN generally consists of an input layer, some hidden layers and an output layer (Caner et al., 2011).

The architecture of the studied ANN is shown in the figure bellow. The ANN was trained, tested and validated on the data of the input variables to predict the performance of the dryer.



Acknowledgements

This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

References

Caner, M., Gedik, E., Keçebaş, A. (2011). Investigation on thermal performance calculation of two type solar air collectors using artificial neural network. Expert Systems with Applications, 38(3), 1668-1674.

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ISBN 978-963-623-053-1 (print)
ISBN 978-963-623-054-8 (pdf)