WSSET
World Society of Sustainable Energy Technologies

NEWSLETTER

Volume 14, Issue 3, September 2022

Inside this issue

6th WSSET Innovation Awards 2022: Winners announced - *cover page*

SET2022 and SET2023 Announcement – *page 2*

~~~~~ ~~~~~ ~~~~~ ~~~~~

Articles

Application of phase change material as heat storage device for control of Varroa mites in beehives – *page 3*

Overview of Thermochemical energy storage materials and processes – *pages 4 & 5*

Impact of chimney design on the performance of solar chimney power plants – *Pages 5 & 6*

Double pass photovoltaic / thermal air solar collector with asymmetric compound parabolic concentrator (ACPC) for façade application – *Page 7*

~~~~~ ~~~~~ ~~~~~ ~~~~~

Other News

~~~~~ ~~~~~ ~~~~~ ~~~~~

Associated Journals: discount on OA publication fees for WSSET members in IJLCT & FC&E - *page 8*

~~~~ ~~~~~ ~~~~~ ~~~~~

Important Notices – *page 9*

SET2023

20th International Conference on Sustainable Energy Technologies

---

Bangkok, Thailand
15-17 August 2023

6th WSSET Innovation Awards 2022

Winners announced

Winners of the **6th WSSET Innovation Awards 2022** were announced at the SET2022 gala dinner in August. The Innovation Awards recognise the achievements of both private individuals and organisations in new sustainable technologies and encourage the wider application of these new developments. The recipients were as follows:

Renewable energy systems
Mohammad Shahriar Ahmed Chowdhury, Centre for Energy Research (CER), Bangladesh: Smart Solar Irrigation System (SirriS), a smart, automated field water irrigation system based on solar energy;

Energy efficiency
Bernhard Adler, ecop Technologies GmbH, Austria: Innovative Rotation Heat Pump "REHEAT", the first economically effective heat pump with temperature range 100°C to 150°C not requiring refrigerants with Global Warming Potential (GWP);

Renewable energy systems
Wan Nur Adilah Wan Roshdan and Hasila Jarimi, Solar Energy Research Institute (SERI), Universiti Kebangsaan Malaysia: Double pass photovoltaic / thermal air solar collector with asymmetric compound parabolic concentrator (ACPC) for façade application;

Agri-food technologies
Emmanuel Tapia Brito, University of Nottingham, UK: Application of phase change material as heat storage device for control of Varroa mites in beehives;

Renewable energy systems
Avinash Kumar Agarwal, Indian Institute of Technology Kanpur, India: Developing transport and energy solutions using green methanol to reduce emissions of GHGs, particulates and gaseous species.

Submissions for the 7th Innovation awards will be welcomed soon.

Pictured from left: Prof. Zafer Utlu (Halic University & co-chair of SET2022), Mohammad Shahriar Ahmed Chowdhury, Wan Nur Adilah Wan Roshdan, Bernhard Adler, Emmanuel Tapia Brito, Prof. Saffa Riffat (University of Nottingham & co-chair of SET2022)

Volume 14, Issue 3, September 2022

SET2022 a great success!

SET2022 took place in Istanbul, Turkey, on the 16-18 August 2022 after being postponed for 2 years. Topics covered a wide range within the broad scope of Energy Technology and Renewables; Energy Storage and Conversion; Low Carbon Buildings, Architecture and Sustainable Cities; and Policies and Management.

Almost 400 abstracts were submitted and almost 200 delegates attended the conference. Over the three days, 150 papers were presented with 8 Keynote Speakers and over 70 posters were displayed.

The Welcome Reception was held on a boat with delegates enjoying a cruise on the Bosphorus with music and dancing (pictured left).

The Gala Dinner was held at Boğaz Tepe Restaurant on the ridges of Tarabya overlooking the Bosphorus with a magnificent view of the bridge; an amazing setting!

The Welcome Reception and Gala dinner and, below, group photograph of delegates at SET2022

Awards for Best Paper and Best Poster were given during the Gala Dinner, as well as the IJLCT award 2020:

Best Paper Award

Asli Akyol Inada, Devrim Aydin & Marzieh Rezaei: Overview of thermochemical cool thermal energy storage materials and processes

Best Poster Award

Tristan Walker & Jean Duquette: Techno economic viability of hydroelectric energy storage systems for high-rise buildings

From left: Prof. Zafer Utlu, Tristan Walker, Marzieh Rezaei, Asli Akyol Inada, Prof. Saffa Riffat & Devrim Aydin

IJLCT Award for Best Article Published in the International Journal of Low Carbon Technologies in 2020 was awarded to Erdem Cuce, Pinar Mert Cuce, and Harun Sen for Performance Assessment of solar chimney power plants with the Impacts of divergent and convergent chimney geometry.

From left: Prof. Zafer Utlu, Harun Sen, Erdem Cuce, Prof. Saffa Riffat

SET2023: The 20th International Conference on Sustainable Energy Technologies 15th – 17th August 2023, Bangkok, Thailand

Bangkok is one of the world's top tourist destinations with royal palaces and temples as well as museums constituting its major historical and cultural tourist attractions. Shopping and dining experiences offer a wide range of choice. The city is also famous for its dynamic nightlife and markets such as Sampeng Market, Yaowarat and Phahurat night market. Cruises and boat trips on the Chao Phraya and the canals of Thonburi offer views of some of the city's traditional architecture and ways of life on the waterfront, including the Taling Chan Floating Market. The website for **SET2023** will be live soon so look out for more details and start preparing your papers now! www.set2023.org

Volume 14, Issue 3, September 2022

Application of phase change material as heat storage device for control of Varroa mites in beehives

Emmanuel Tapia-Brito and Saffa Riffat

Department of Architecture & Built Environment, Faculty of Engineering, University of Nottingham, Nottingham, NG72RD, UK

Honeybees (Apis mellifera) are commonly thought to be useful only for honey production. However, due to its labour as pollinator, it is the most commercially important species on the planet. The major goal of this project was to employ sustainable energy technologies to eliminate the most serious threat to bees, Varroa mites, by designing a practical prototype that is easy enough for beekeepers to use, and to show that heat treatment is a non-harmful technique for bees and their products.

There are two main approaches to Varroa control namely: biotechnical, and chemical. The biotechnical method involves trapping the mites in combs of brood, which are then removed and destroyed. The main limitations of the method are: it is labour-intensive, time consuming, requires a high level of bee husbandry skills, and is only suitable for restricted periods. The chemical method uses miticides that must be applied carefully to minimize the contamination of honey that might be consumed by humans. Miticides are typically available without a prescription from a veterinarian, and so may not be applied properly which may lead to resistance in the long term.

The thermal treatment (thermotherapy) method is relatively new compared to the aforementioned. It entails the use of heat at various intervals to remove Varroa infestation see Figure 1. The thermal tolerance of Varroa mites and honeybees differs, with mites showing a much greater sensitivity to higher temperatures than honeybees. Research shows that mites can be killed during all development stages if they are exposed to temperatures ranging between 40°C to 47°C for ~ 150 minutes. These temperatures are safely tolerated by honeybee brood and adults and do not damage the honeycomb. Thus, heat treatment is seen as an effective method to control Varroa mites.

The current study investigates the possibility of using phase change materials (PCMs) as a heat source for thermal treatment. Following a study of PCMs, it was determined that Sodium Acetate trihydrate (SAT) was the best material for thermal treatment applications due to its thermal, physical, and chemical capabilities. In this study, a basic mathematical model that approximates the thermal interaction was developed. CFD simulations aided in forecasting PCM pack thermal behaviour, identifying temperature distribution, and estimating the time required to reach the thermotherapy temperature.

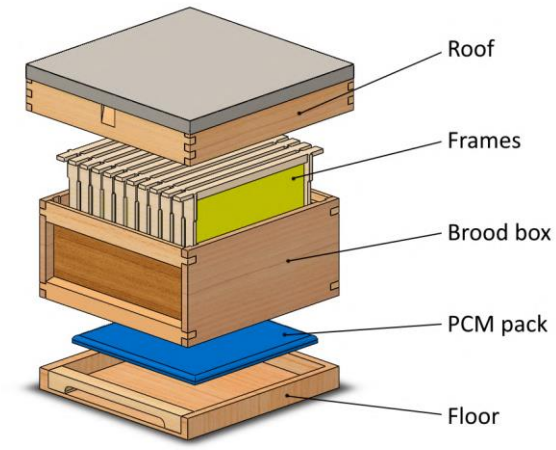


Figure 1: Diagram of the PCM application in a beehive

Afterwards, a series of experiments were undertaken. The aim of the experiments was to evaluate and analyse the heat flow of the prototype pack (PCM pack). Different configurations were tested to see which one could get the temperature for the thermotherapy (40-47°C) in the centre of the beehive. In total, 74 experiments were carried out in laboratory and 29 in field.

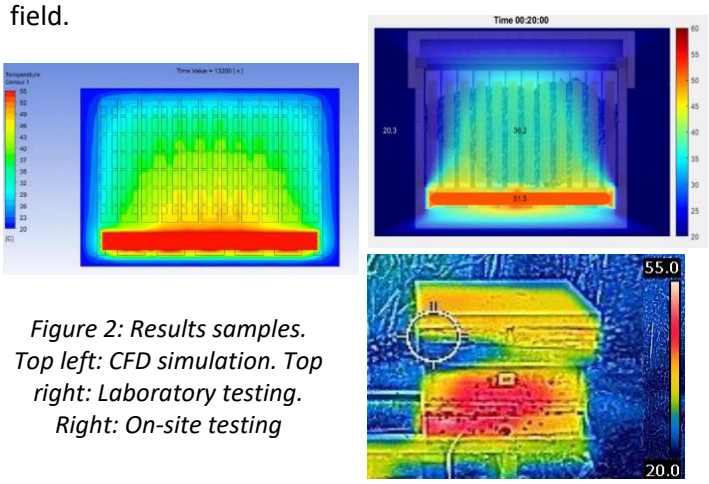


Figure 2: Results samples. Top left: CFD simulation. Top right: Laboratory testing. Right: On-site testing

The prototype developed will help in the reduction of Varroa mite infestations in UK apiaries, which will improve bee living conditions, will not harm other species with harmful chemical substances, will be reusable and thus environmentally friendly, bee losses will be reduced, Varroa mites will cease developing pesticide resistance and pollination of agricultural products that are critical for human sustenance.

Figure 3: PCM pack prototype produced

In conclusion, it was proved that the Varroa mite, the principal pest that threatens bees in the UK and around the world, can be eradicated using sustainable energy technology such as PCMs. This research could lead to a lot of additional work, such as improving the prototype and developing an in-depth assessment approach to confirm that this technology effectively eliminates the Varroa mite from the brood box.

Volume 14, Issue 3, September 2022

Overview of thermochemical energy storage materials and processes

Aslı Akyol İnada[1], Marzieh Rezaei[2], Devrim Aydın[1]

[1]Department of Mechanical Engineering, Eastern Mediterranean University, G. Magosa, TRNC Mersin 10, Turkey, asli.akyol89@hotmail.com, devrim.aydin@emu.edu.tr

[2]Department of Mechatronics Engineering, Near East University, Nicosia, TRNC Mersin 10, Turkey, marzieh.rezaei@neu.edu.tr

With the increase in global warming, there is increased need for heating and cooling, and in order to meet this need, it is necessary to seek new environmentally friendly technologies that provide sustainable air conditioning. In this context, development of new materials and technologies for thermal energy storage plays a vital role in reducing fossil fuel-based energy use.

In the concept of thermochemical energy storage (TCES), energy is stored via desorption of water and released by sorption of water (for heating) or reaction with water (for cooling) of the utilized salt. TCES systems could be more promising compared to sensible and latent heat systems with their advantages such as high energy density, long storage duration and low volume requirement. In TCES systems, energy is stored in substances such as carbonates, metal hydrides, salt hydrates, hydroxides and ammonia. There are two types as sorption and reaction-based systems [1]–[3]. TCES systems are classified as heating and cooling applications, and the operation of thermochemical heat storage (THS) and cool storage (TCS) are shown in Figure 1. Material selection and reactor design are important in TCES systems. Composite materials are formed by the combination of matrices and inorganic salts.

Generally, vermiculite, pumice, silica gel, alumina are used as matrix, and TCES materials for heating applications are generally composed of CaCl2, MgCl2, LiCl, SrCl2, MgSO4, CuSO4, LiBr, SrBr2 and LiNO3 salts. N.Yu et al. [4] indicated that LiCl/H2O has the best energy storage density (1219 Wh/kg) among the working pairs LiCl/H2O, LiBr/H2O, KOH/H2O, NaOH/H2O and CaCl2/H2O. In TCES systems, reactors are divided into two as open and closed systems. There are fixed bed, moving bed and fluidized bed reactor types. Fixed bed reactors are commonly used [5]. Improvements have been proposed in the literature to overcome some limitations such as heat transfer and pressure drop in fixed bed reactors [5]–[7]. In TCES systems, technologies such as heat pumps or solar collectors can be integrated to enhance renewable energy utilization. For instance, Aydin et al. [8] proposed a heat pump driven sorption storage heater that can be operated using both PV sourced electricity and off peak electricity using thermochemical materials. As a result, the system enabled the use of PV panels or low cost electricity tariff to store heat.

In TCES systems for cooling applications, fertilizer-based salts, which are activated by mixing with water and create cooling effect through endothermic reversible heat of the solution, are used. Fertilizer-based salts are promising in terms of cooling effect, as they can be reused as fertilizer after being used to create a cooling effect. It is suggested that fertilizer-based salts, known as NPK fertilizers, can often be used for cold pack applications using mixtures of (phosphorus (P), nitrogen (N) and potassium (K)) [9]. Some fertilizer-based salts such as ammonium nitrate (NH4NO3), ammonium chloride (NH4Cl), urea ((NH2)2CO), K2SO4 and KNO3 are salts used for cooling. Desai et al. [9] experimentally investigated 14 different NPK salt mixtures such as NH4Cl, K2SO4, (NH4)2CO, NH4NO3, KNO3, NaNO3 and NH4H2PO4 as TCES materials for refrigeration applications. When the salt was dissolved in water, it produced a cooling effect in the range of 200-400 kJ per kg salt.

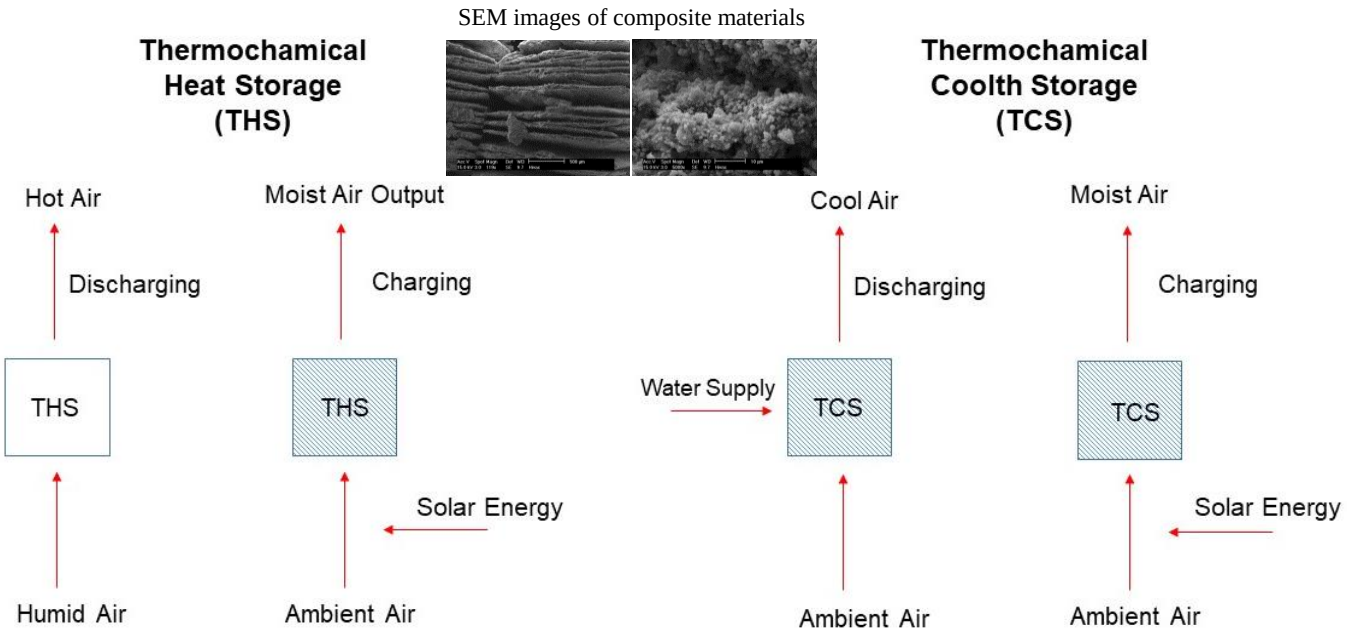


Figure 1: Operating principles of thermochemical heat and cool storage systems

Cont.

Cont.

When 60-80 g of water was added to the salt mixture, there was a sudden decrease between 24°C and 28°C on average. Wang et al. [10] provided cooling by dissolving NH4NO3 salt in water in the conversion and storage of solar energy to provide cooling without electricity consumption. As a result, fertilizer-based salts are an important opportunity to store abundant solar in the summer for space cooling. In addition, composite materials, including salts, are an important potential for TCES systems and correct material characterization is an important element for material selection.

Acknowledgements

This work was supported by the Scientific and Technological Research Council of Turkey (TUBITAK) (project number: 119M073), and authors would like to thank to TUBITAK for their support.

References

[1] P. A. J. Donkers, L. C. Sögütoglu, H. P. Huinink, H. R. Fischer, and O. C. G. Adan, "A review of salt hydrates for seasonal heat storage in domestic applications," Appl. Energy, vol. 199, pp. 45–68, Aug. 2017, doi: 10.1016/J.APENERGY.2017.04.080.

[2] K. E. N'Tsoukpoe, T. Schmidt, H. U. Rammelberg, B. A. Watts, and W. K. L. Ruck, "A systematic multi-step screening of numerous salt hydrates for low temperature thermochemical energy storage," Appl. Energy, vol. 124, pp. 1–16, Jul. 2014, doi: 10.1016/J.APENERGY.2014.02.053.

[3] F. Desai, J. Sunku Prasad, P. Muthukumar, and M. M. Rahman, "Thermochemical energy storage system for cooling and process heating applications: A review," Energy Convers. Manag., vol. 229, no. December 2020, p. 113617, 2021, doi: 10.1016/j.enconman.2020.113617.

[4] N. Yu, R. Z. Wang, and L. W. Wang, "Sorption thermal storage for solar energy," Prog. Energy Combust. Sci., vol. 39, no. 5, pp. 489–514, Oct. 2013, doi: 10.1016/J.PECS.2013.05.004.

[5] A. Solé, I. Martorell, and L. F. Cabeza, "State of the art on gas–solid thermochemical energy storage systems and reactors for building applications," Renew. Sustain. Energy Rev., vol. 47, pp. 386–398, Jul. 2015, doi: 10.1016/J.RSER.2015.03.077.

[6] Y. N. Zhang, R. Z. Wang, and T. X. Li, "Experimental investigation on an open sorption thermal storage system for space heating," Energy, vol. 141, pp. 2421–2433, Dec. 2017, doi: 10.1016/J.ENERGY.2017.12.003.

[7] R. van Alebeek, L. Scapino, M. A. J. M. Beving, M. Gaeini, C. C. M. Rindt, and H. A. Zondag, "Investigation of a household-scale open sorption energy storage system based on the zeolite 13X/water reacting pair," Appl. Therm. Eng., vol. 139, pp. 325–333, Jul. 2018, doi: 10.1016/J.APPLTHERMALENG.2018.04.092.

[8] D. Aydin, S. P. Casey, X. Chen, and S. Riffat, "Numerical and experimental analysis of a novel heat pump driven sorption storage heater," Appl. Energy, vol. 211, pp. 954–974, Feb. 2018, doi: 10.1016/J.APENERGY.2017.11.102.

[9] F. Desai, A. Atayo, J. S. Prasad, P. Muthukumar, M. Rahman, and E. Asmatulu, "Experimental Studies on Endothermic Reversible Reaction of Salts for Cooling," Heat Transf. Eng., vol. 42, no. 13–14, pp. 1107–1116, 2021, doi: 10.1080/01457632.2020.1777002.

[10] W. Wang et al., "Conversion and storage of solar energy for cooling †," Cite this Energy Environ. Sci, vol. 15, p. 136, 2022, doi: 10.1039/d1ee01688a.

Impact of chimney design on the performance of solar chimney power plants

Erdem Cuce[a,b]*, Pinar Mert Cuce[b,c], Harun Sen[b]

[a]Department of Mechanical Engineering, Faculty of Engineering and Architecture, Recep Tayyip Erdogan University, 53100 Rize, Turkey
[b]Low/Zero Carbon Energy Technologies Laboratory, Faculty of Engineering and Architecture, Recep Tayyip Erdogan University, 53100 Rize, Turkey
[c]Department of Architecture, Faculty of Engineering and Architecture, Recep Tayyip Erdogan University, 53100 Rize, Turkey *erdem.cuce@erdogan.edu.tr

The rapid increase in the world's human population in the last century has increased energy use more than expected. Since energy use is generally obtained from primary sources, environmental pollution has become an inevitable problem. At this point, alternatives are mostly renewable energy sources. However, more time is required for the widespread use of renewable energy sources. For this, the efficient use of resources has been a common working point for researchers. The sun is one of the leading renewable energy sources with its current potential. The fact that electricity can be produced by different methods and used in wide geographies has led to much research on it. Solar cookers, solar dryers, solar ponds, solar air conditioning, solar stills, water purification and distillation, solar chimneys and solar power plants are some examples of solar applications [1]. The first example of solar chimneys as a solar energy system was in the 1980s [2]. It had been shown by experimental measurements that a semi-permeable collector area of 46,000m^2 consisting of plastic membrane and glass and could produce 50kW of power with a 194.6m high chimney [3-4]. The system is shown in Figure 1. After the first application, a lot of research was done on solar chimney power plants.

Figure 1: First application of a solar chimney power plant, Manzanares, Spain [2].

Cont.

Volume 14, Issue 3, September 2022

Cont.

The main variables affecting the performance of the system can be considered as climatic and geometric parameters [5]. Climatic parameters are ambient temperature and radiation intensity, which directly affect the power output of the system. Geometric parameters are related to collector and chimney dimensioning. The sun enters the system through the translucent collector. Solar radiation reaching the ground causes an increase in the temperature of both the system air and the ground. System air, whose temperature has increased, is drawn upwards by the vacuum effect created by the chimney located in the centre of the collector. Meanwhile, the kinetic energy of the system air is converted into electrical energy by means of the turbine inside the chimney. Since the chimney is the driving force of the system and ensures that the system air is drawn upwards, the increase in its height directly increases the power output [6]. Similarly, increasing the collector size will increase the amount of energy entering the system, thus providing a direct increase in performance [7]. Not only the size of the collector and the chimney, but also the design is very effective in the performance of the system. Since the inclined structure of the collector will support the upward movement of the system air, it improves the performance of the system [8].

The same is true for the chimney design. By keeping the chimney inlet diameter constant, increasing the chimney outlet diameter will increase the power output as it will provide more air evacuation from the system. Researchers emphasize that keeping the chimney outlet area larger than the chimney entrance area will improve the performance of the system [9]. This study was based on the dimensions of the Manzanares pilot plant. The ratio of the chimney outlet area to the chimney entrance area was defined as AR. The effect of the change of AR value in the range of 0.5-10 on the system was evaluated. The findings were obtained with ANSYS engineering software by creating a 3D CFD model.

In solar chimney power plants, the chimney is the driving force of the system [10]. More air purge improves system performance. Therefore, the AR value is changed by altering the chimney outlet diameter. The power output and efficiency of the system versus the AR values for the pilot plant are given in Figure 2 [11]. It was seen that the divergent chimney structure increased the power output and efficiency of the system. However, it was also noticed that there was an ideal range of power output and efficiency for the pilot plant, and after a point, the increase in AR value negatively affected the performance of the system. When the power output of the pilot plant was at 50kW, it was seen that the power output approached 170kW when the AR ratio increased to 4. Similarly, it was understood that the yield value had increased from 0.2 to 0.8. With this study, it was seen that performance improvements can be made with some design changes on the system.

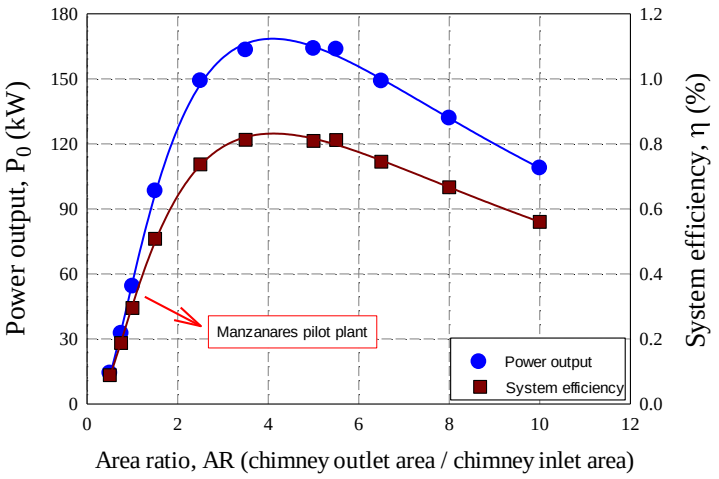


Figure 2. Power output and efficiency of the plant for different AR values

REFERENCES:

[1] Cuce E, Cuce PM, Carlucci S, Sen H, Sudhakar K, Hasanuzzaman M, Daneshazarian R. Solar chimney power plants: a review of the concepts, designs and performances. Sustainability 2022, 14; 3: 1450.

[2] Schlaich JR, Bergermann R, Schiel W, Weinrebe G. Design of commercial solar updraft tower systems—utilization of solar induced convective flows for power generation. Journal of Solar Energy Engineering 2005, 127; 1: 117-124.

[3] Haaf W, Friedrich K, Mayr G, Schlaich J. Solar chimneys part I: principle and construction of the pilot plant in Manzanares. International Journal of solar energy 1983, 2; 1: 3-20.

[4] Haaf W. Solar chimneys: part ii: preliminary test results from the Manzanares pilot plant. International Journal of Sustainable Energy 1984, 2; 2: 141-161.

[5] Cuce E, Cuce PM, Sen H. A thorough performance assessment of solar chimney power plants: Case study for Manzanares. Cleaner Engineering and Technology 2020, 1; 100026.

[6] Cuce E, Sen H, Cuce PM. Numerical performance modelling of solar chimney power plants: Influence of chimney height for a pilot plant in Manzanares, Spain. Sustainable Energy Technologies and Assessments 2020, 39; 100704.

[7] Sen H, Cuce PM, Cuce E. Impacts of Collector Radius and Height on Performance Parameters of Solar Chimney Power Plants: A Case Study for Manzanares, Spain. Science and Engineering 2021, 2; 2: 83-104.

[8] Weli RB, Atrooshi SA, Schwarze R. Investigation of the performance parameters of a sloped collector solar chimney model–An adaptation for the North of Iraq. Renewable Energy 2021, 176, 504-519.

[9] Xu Y, Zhou X. Performance of divergent-chimney solar power plants. Solar Energy 2018, 170; 379-387.

[10] Sen H, Cuce E. Dynamic pressure distributions in solar chimney power plants: A numerical research for the pilot plant in Manzanares, Spain. WSSET Newsletter 2020, 12; 1: 2-2.

[11] Cuce E, Saxena A, Cuce PM, Sen H, Guo S, Sudhakar K. Performance assessment of solar chimney power plants with the impacts of divergent and convergent chimney geometry. International Journal of Low-Carbon Technologies 2021, 16; 3: 704-714.

Volume 14, Issue 3, September 2022

Double pass photovoltaic / thermal air solar collector with asymmetric compound parabolic concentrator (ACPC) for façade application

Wan Nur Adilah Wan Roshdan and Hasila Jarimi*

Solar Energy Research Institute (SERI), Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia *hasila.jarimi@ukm.edu.my

Photovoltaic/thermal (PV/T) air solar collector integrates a power generating PV panel and solar thermal air heating panel within the same collecting surface, combining the benefits of solar thermal and PV technologies. Low-concentration concentrator collectors like compound parabolic concentrators (CPC), can increase the total useful energy (thermal and electrical) generated by concentrating the source of solar radiation from the large area into the small absorber area. However, due to different earth topography, the incidence angle is not symmetrical and changes depending on the collector's geographical location and time of the year. The proposed innovative technology involves the use of asymmetrical CPC geometry (ACPC), whereby the acceptance angle of the collector will subtend a range of angles of incidence, and hence its performance can be potentially optimized throughout the year regardless of its location. The asymmetric CPC or ACPC geometry for PV/T air solar collectors is vertical and suitable for building façade applications.

Figure 1 show the design of the proposed ACPC PV/T air collector. The key features of the proposed solar collectors include asymmetric CPC geometry reflector, a flat PV solar cells as the absorber, a tempered glass cover, double pass air channel (above and below the absorber) for PV cooling and air heating for building application and low DC air circulation fan for forced convection.

Figure 1: ACPC-PV/T double pass air solar collector

Preliminary numerical and experimental works have been conducted on the innovative technology. From the numerical analysis as presented in Figure 2 below, when compared with the conventional flat type, the average percentage increase in the average daily total power yield for the PV/T-ACPC is as high as 14% and 50% for the low, mid-latitude, and high latitude countries, respectively. For the PV/T CPC, the percentage of the average daily total power yield was slightly negative in value for low and mid-latitude countries, which indicates worse performance compared to the conventional type. While for the indoor experimental works, a solar PV panel was paired and tested with CPC and ACPC. It is found that the maximum power obtained for PV-ACPC geometry reached 3.77% higher than the PV-CPC and 6.5% higher than the flat type PV panel without any concentrator. Extensive research will be done on the PV/T-ACPC collector to provide more scientific contributions.

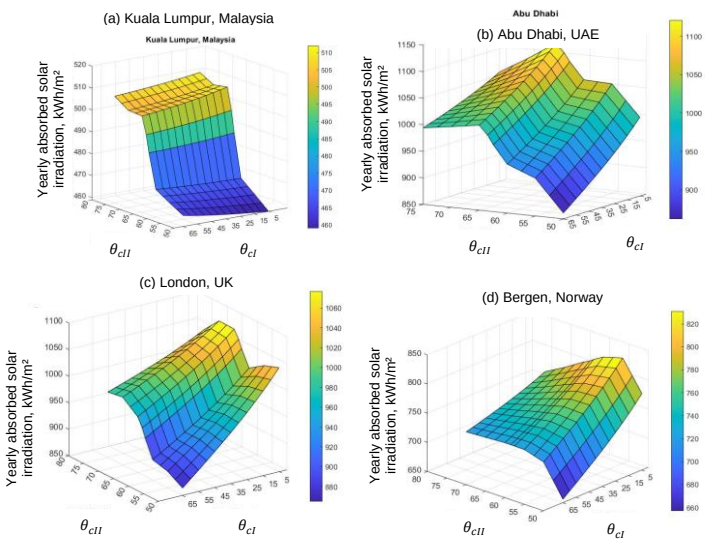


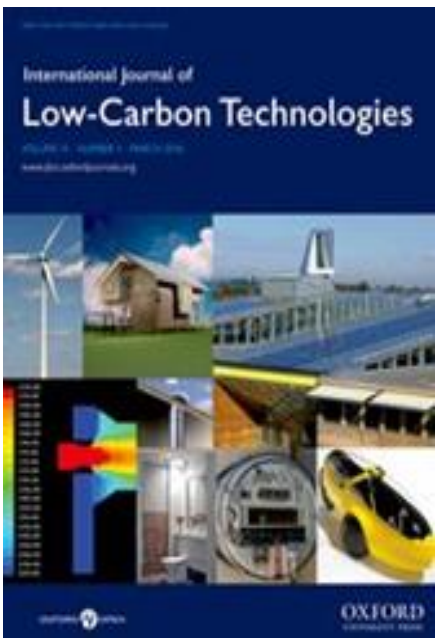
Figure 2: Numerical analysis: Total yearly absorbed solar irradiation for different pairs of half acceptance angle for Kuala Lumpur, Malaysia, Abu Dhabi, UAE, London, UK and Bergen, Norway

The key innovation of this project lies in the following aspects: A solar PV/T-ACPC system can simultaneously generate electricity and thermal energy on the same surface collector. The collector meets the variation in the solar incidence angle, which varies depending on the location and time of the year. Hence, this technology can avoid high-cost tracking system and benefits both economic and environmental aspects. Additionally, the vertical configuration of the ACPC PV/T solar collector is suitable for building façade applications includes cooling and air heating. The proposed research on the asymmetric CPC PV/T air solar collector attempts to fill in the gap in the study on CPC PV/T solar collector.

Acknowledgement:

The authors would like to thank Universiti Kebangsaan Malaysia for Young Lecturers Incentive Grant (GGPM) with grant number GGPM-2020-032.

Volume 14, Issue 3, September 2022



WSSET exclusive offer – IJLCT

The International Journal of Low-Carbon Technologies (IJLCT) is an Open Access SCI Journal published by Oxford University Press. In 2022, FCE's CiteScore has increased to 1.8 putting the journal into the 68th percentile in the category of Architecture, which means we're currently ranked #44 out of 138 journals in this field on SCOPUS. FCE offers a 20% discount to the APC (article processing charge) for WSSET members wishing to publish a paper in IJLCT (open access). This will cost WSSET members £915 (€1099) as opposed to the full charge of £1144 (€1373). Authors will need to state that they are WSSET members when paying.

Please visit www.ijlct.oxfordjournals.org to submit your articles.

WSSET exclusive offer - FCE

Future Cities and Environment (FCE) is indexed with SCOPUS and has an increased CiteScore of 1.0. In conjunction with WSSET, FCE have agreed a £25 discount to the APC for WSSET members wishing to publish a paper (open access). This will cost WSSET members £475 compared to the full charge of £500. Authors will need declare their membership details to the editorial team when it comes to payment before publication.

Please visit www.futurecitiesandenvironment.com to submit your articles.

Volume 14, Issue 3, September 2022

If you have recently moved, changed jobs, or changed email address, please remember to update your membership details or contact secretary@wsset.org with your new details.
If you no longer wish to be a member of WSSET or you want to unsubscribe from emails, please unsubscribe here.

Thanks

Donations are welcome and greatly appreciated!

We would like to remind our members that WSSET is a non-profit organisation, hence providing free membership. We would not be able to play a significant role in consolidating practical partnerships between academic and industrial organisations without the help of our members.

Whether you would like to get more involved or contribute financially, please get in touch with us at: secretary@wsset.org

Important for the reputation of WSSET

Neither the WSSET, nor any person acting on its behalf:

(1) assumes any responsibility with respect to the use of information of, or damages resulting from, the information in this WSSET Newsletter;

(2) gives any warranty or representation, express or implied, with respect to the accuracy of the information, opinion or statement contained here.

Contributing to WSSET newsletters and e-bulletins

All WSSET members are kindly invited to submit articles for publication in future WSSET newsletters. Articles can be on a range of topics surrounding the word of sustainable energy technologies. With nearly 2000 members, the WSSET newsletter provides a great opportunity to publicise new ideas, technologies or products – all free of charge!

Articles should be no more than 400-500 words and one or two photographs would be very much appreciated. Submissions should be emailed to secretary@wsset.org

Furthermore please contact secretary@wsset.org regarding any conferences, seminars or symposiums relating to topics of sustainable energy technologies that you wish to be advertised in the newsletter.

Once again, thank you for your continued support to WSSET.