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WSSET World Society of Sustainable Energy Technologies NEWSLETTER

Featured article

Inside this issue:

A VERY MERRY CHRISTMAS from everybody here at WSSET

Firstly, a very merry Christmas and happy new year to you all from everybody here at WSSET. We wish you all the very best in the coming new year!

A date for everybody's diaries - SET 2017, Bologna, Italy

WSSET is proud to announce the 16th International Conference on Sustainable Energy Technologies (SET 2017). SET 2017 will be hosted by the Alma Mater Studiorum – Università di Bologna, the oldest university in the Western world. The conference will take place 17th – 20th July 2017.

SET 2017 is a multi–disciplinary, peer-reviewed international conference on sustainable energy sources and technologies that provides a forum for the exchange of latest technical information, the dissemination of high-quality research results, the presentation of new developments in the area, and the debate and shaping of future directions and priorities for sustainable development and energy security.

Contributions are invited on the topics within the conference scope of sustainable energy technologies. All contributions should be of high quality, original and not published elsewhere or submitted for publication during the review period. All accepted papers will be presented orally or by poster, and included in the conference proceedings. Selected papers will be published in our partner journals.

Abstract submission is by 10th February 2017. All WSSET members will get a 20% discount on conference registration fees. Please visit the website for more information including a timeline for abstract, paper submission & registration www.set2017.org WSSET looks forward to seeing you in Bologna!

Articles WSSET recommends

A NOVEL HEAT PUMP AIR HANDLING UNIT WITH DEHUMIDIFICATION BY DESICCANT COATED HEAT EXCHANGER

Institute of Refrigeration and Cryogenics, Shanghai Jiao Tong University, Shanghai, 200240

The research team in Shanghai Jiao Tong University has developed a novel heat pump air handling unit with dehumidification by desiccant coated heat exchanger. The system consists of two subsystems by its function: the heat pump subsystem and the dehumidification subsystem. The heat pump is used for providing heat for regeneration of the desiccant, as well as for minimizing the adsorption heat effect in desiccant dehumidification. The core component of the system is the Desiccant Coated Heat Exchanger (DCHE), which is a kind of fin-tube heat exchanger coated with desiccant materials. The test rig is shown in Fig1.

The main components of the heat pump subsystem includes compressor, two exchangers, controlled circuit and other accessories for monitoring operation. This subsystem is designed to provide heating and cooling for DCHEs. The dehumidification subsystem includes DCHEs, fans, water pumps and other accessories. The system is designed for dehumidifying fresh or return air based on the principle of desiccant dehumidification. The hot water and cold water from the heat pump flow through the tubes of DCHE A and DCHE B separately. The Principle of the dehumidification is shown in Fig2. Two DCHEs run in parallel with two modes: dehumidification mode and regeneration mode. During the first half cycle, DCHE A runs dehumidification mode and DCHE B runs regeneration mode. Cooling water from the evaporator of heat pump is pumped into DCHE A and the process air can be dehumidified and cooled at the moment. Meanwhile, the adsorption heat could be moved by the cold water. Outlet supply air from DCHE A is supplied to the conditioned room. At the same time, DCHE B works in regeneration mode. The DCHE B is heated by hot water, and therefore, desiccant material is regenerated.

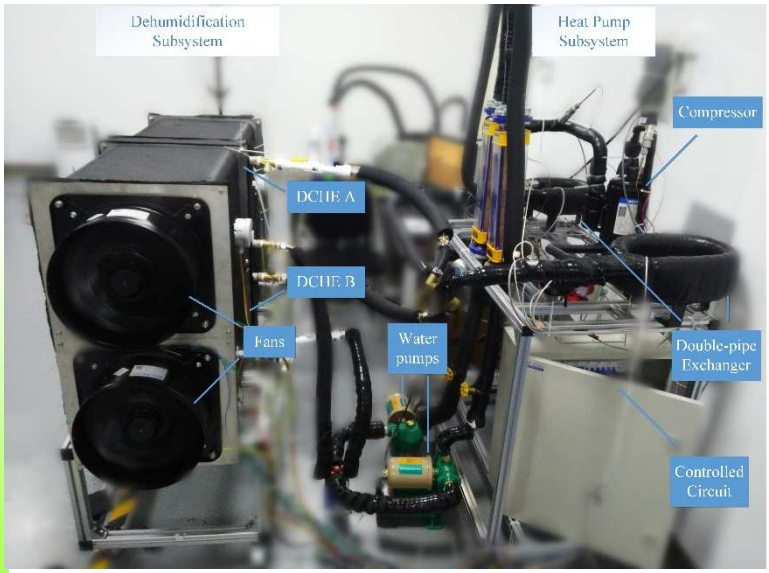


Fig 1 – Air handling unit with dehumidification by desiccant coated heat exchanger

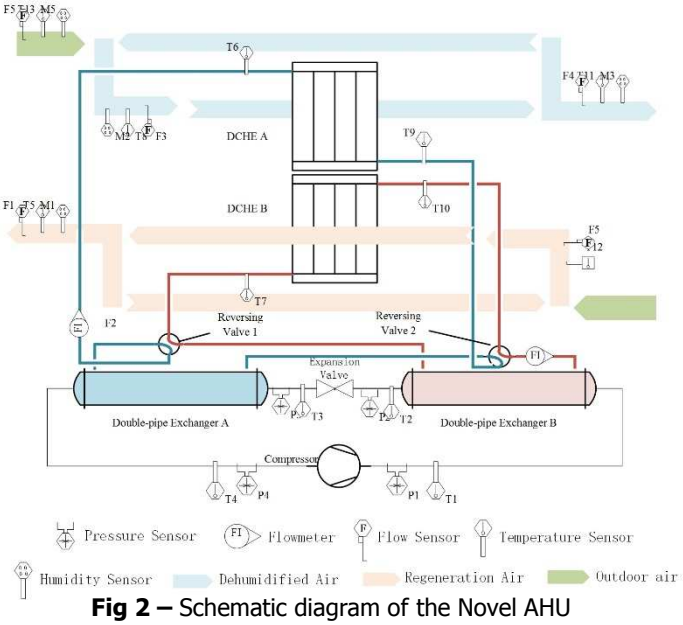


Fig 2 – Schematic diagram of the Novel AHU

The exhaust air with high temperature and high humidity ratio from DCHE B is exhausted to the environment. In the second half cycle, DCHE A and DCHE B are switched into regeneration process and dehumidification process. By switching between the first and the second cycle, thus dehumidification system realizes a continuous process of moisture removal and cooling. Compared with the traditional dew point dehumidification, the novel unit can save electricity by about 30%-50%. It will be of great potential for application in energy saving of air handling unit, as well as improving the indoor air quality in near future.

For more information please contact: Dr DAI Yanjun (Y.J.DAI) yjdai@sjtu.edu.cn

Articles WSSET recommends

WELFARE ENHANCED LIVING CONDITIONS FOR HEALTHIER CHICKENS (WELCHIC)

Professor Saffa Riffat, Theo Elmer, Yuanlong Cui

To date, there has been a distinct lack of innovation in poultry house heating, ventilation and air conditioning (HVAC) system design that addresses both animal welfare issues and energy efficiency. This article presents an innovate HVAC system design for poultry house applications. The novel system aims to (1) improve the welfare living conditions (VOC levels, thermal comfort) for chickens in poultry houses, leading to increased productivity, and (2) improve the energy efficiency of HVAC systems employed in such applications. The novel system provides highly efficient heating using a photovoltaic thermal (PVt) array employing a new type of inexpensive polyethylene heat exchanger (PHE) coupled to a highly efficient heat pump and ground pipe array. Cooling is provided by a psychometric heat and mass exchanger core (PEC) unit. The system provides a highly efficient solution to improve thermal regulation and air quality control in poultry house applications. The work presented is part of an InnovateUK AgriTech Catalyst funded project named 'Welfare Enhanced Living Conditions for Healthier Chickens (WelChic)'. Although the current work has focussed on poultry house applications, the developed system is applicable to any livestock buildings requiring heating and/or cooling. Fig. 1 shows a simplified schematic of the WelChic system.

The innovative WelChic system has been installed and trialled in a real poultry house in Newark, UK. The shed has a floor area of 500m2 and houses around 6,500 chickens. Currently the shed is heated using gas burners. The WelChic heat pump heating system supplements these gas burners. Fig. 2a shows the installed WelChic heating system plant room containing heat pump, buffer tank and system controls.

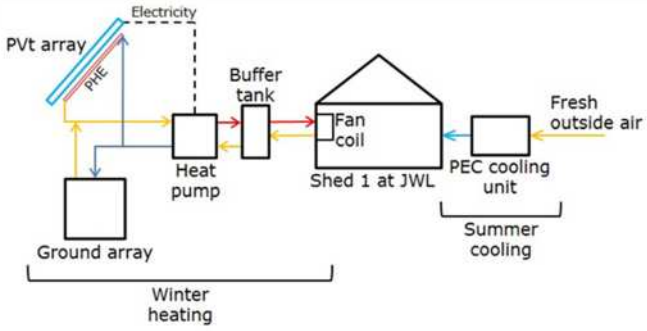


Fig 1 – WelChic system schematic

Summer overheating is currently addressed through large ventilation rates using high speed fans. The WelChic cooling system will provide active cooling to the shed. Because the WelChic cooling system is not replacing a current cooling system the performance will be assessed based on improvement to bird welfare, primarily feed conversion and mortality rates. Fig. 2b shows the installed WelChic PEC cooling system.

Fig 2 – (a) WelChic heating system plant room containing heat pump, buffer tank & controls, and (b) WelChic PEC cooling system

Annual simulations verified by experimental evaluation of the prototype WelChic system show an annual operating cost saving of 89% (£2983) and an annual carbon saving of 52% (8.94 tonnes of CO2), compared to the original gas burner only system. Furthermore, the system generates annual revenues of £2537 through PV feed in/export tariffs and the renewable heat incentive. When these revenues are accounted for the WelChic system provides a 164% reduction in annual operational costs. The WelChic system has been sized based on the particular application. However, the technologies and system methodology are scalable. The end product can be tailored to any particular application. The WelChic system is a low cost, highly efficient, scalable HVAC system that can bring about significant operational cost and emission savings in poultry houses or any livestock application. Future work will focus on longer term (full year) field trialling of the WelChic heating system. Furthermore, the WelChic cooling system will be operated during the summer overheating period.

Please contact Professor Saffa Riffat for more information: saffa.riffat@nottingham.ac.uk

Articles WSSET recommends

TWELVE DEGREES COOLING WITH ZERO ENERGY

Dr Ben Hughes

Dr Hughes and his team at the University of Sheffield have been developing low energy cooling systems for deployment in the Middle East region over the last 5 years. Initially funded by the Qatar National Research Fund in collaboration with Qatar University ($1 Million USD) they develop a concept based on traditional middle-eastern wind catchers which utilised wet cloth for temperature control.

The newly developed system operates by introducing hot external air from the environment through the wind tower due to wind driven flow. As the air passes through the wind tower, it comes into contact with heat pipes. Heat pipes are a sealed fluid heat transfer devices that move heat from a heat source to a heat sink using an evaporator and condenser section. The heat source evaporates the fluid within the heat pipe, increasing the pressure and moving the fluid to the heat sink. The heat sink causes the fluid to condense, transferring heat to the heat sink. The temperature of the heat source decreases as the temperature of the heat sink increases. The heat sink for the design will be a constant flow of water through the top hat of the wind tower. The operation of this can be seen in Fig 1.

The team undertook successful proof of concept testing from CFD modeling, wind tunnel testing and full scale field trials in the United Arab Emirates., by partnering with the Ras Al Khaimah research centre, and the American University of Ras-Al-Khaimah. The team built a test room and installed a 1m square prototype to gather operational data over a 2 month period, shown in Fig 2. Following on from this success Dr Hughes partnered with the Zayed Future Energy prize to install a prototype in a local school in Abu Dhabi to undertake Post Occupancy Evaluation in 2015, whilst patenting the system and forming a university spin-out company, free running buildings.

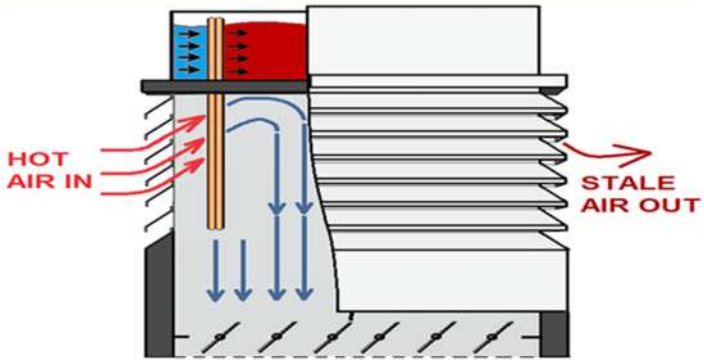


Fig 1 – Operation schematic of the multi-direction passive cooling wind tower

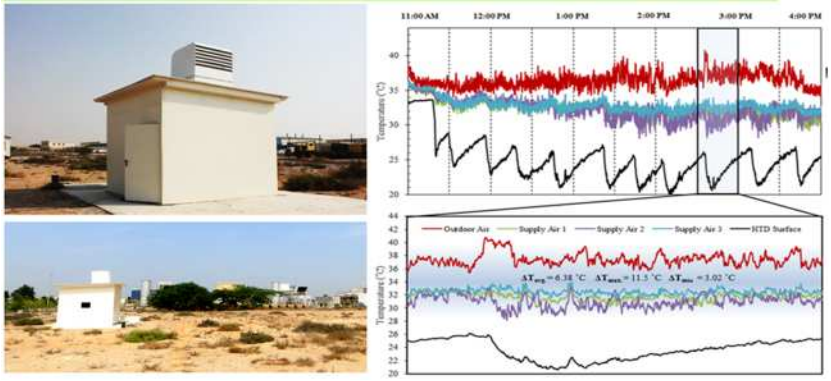


Fig 2 – Test site located in Ras Al Khaimah, to test the temperature drop using the uni-free wind tower

The system is capable of delivering the legislative ventilation supply rates whilst also reducing the temperature of an incoming airstream by up to 12°C without external energy input. This is beneficial to climates that experience high air temperatures and require significant amounts of cooling looking to lower energy use. Whilst these regions still require additional comfort cooling in peak season, during the milder months (Oct-April) it eliminated the requirement for HVAC, with initial test demonstrating a 45% decrease in end use energy demand.

Recently Dr Hughes was awarded an Energy Catalyst Late Stage Development Award from Innovate UK (£400,000 GBP) to develop the final product specification and develop the school into a demonstration site ahead of the Dubai 2020 world Expo. This project will commence in March 2017 and will establish the flat pack manufacturing method of the wind tower, to improve transportation and shipping of the design around the world. In partnership with the AMRC at the University of Sheffield, FreeRunningBuildings will deliver the wind tower as a flat packaged design that can be easily assembled and installed where desired. The expertise of the Building Energy Group will be used to assess the performance of 20 passive cooling wind towers mounted at the Shaikh Khalifa Bin Zayed Bangladesh Islamia School in Abu Dhabi as shown in Fig 2. This will provide the necessary data and feedback to optimise the design further using CFD modelling and further far-field testing and obtain Estidama certification in the region.

Articles WSSET recommends

INNOVATIVE HIGH TEMPERATURE PCM/BRAYTON CYCLE ENERGY STORAGE SYSTEM (HTPCM)

Dr Auwal Dodo and Professor Saffa Riffat

There is a clear market need to investigate and develop energy storage techniques, in order to bridge the gap between energy generation and consumption, to store excess energy produced which would otherwise be wasted. It is suggested that smart energy storage technologies could generate savings ranging from £5 billion to £11 billion up to 2050 in the UK alone. Currently the energy storage within the UK (and globally), is predominantly based around pumped hydro, accounting for more than half of the UK's current 3GW storage capacity. A further 7GW to 59GW of total grid connected electricity storage capacity is essential to meet UK's energy requirements by 2050, to enable a balanced and flexible grid. Phase Change Material (PCM) storage not only provides a commercially viable alternative, but also aligns with the need to reduce carbon dioxide emissions in the UK by at least 80% by 2050, as it enables more effective integration into the energy infrastructure of renewables and use of off-peak power contributing significantly to the reduction of CO2 emissions.

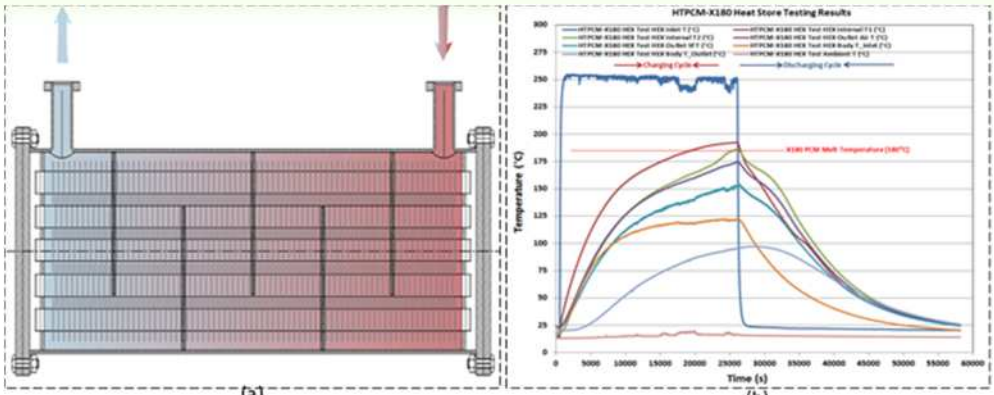


Figure 1 Design of X180 PCM Heat Store (a), Testing results (b)

The highly effective energy storage system which buffer renewable energy supply, possess the following desirable characteristics:

- Efficient charging and discharging cycles: to minimise power losses.
- Based on commercially available components: to minimise introduction time.
- Scalable: power storage units for small buildings, commercial installations (e.g. supermarkets), large plants (e.g. chemical works and power station buffers)
- Versatile: able to supply heating and cooling, as well as electrical power, when required.
- Able to support a very high number of charge/discharge cycles in order to effectively respond to requirements of renewable energy availability.

The project consortium comprises academic and industrial participants, including PAK Engineering Ltd as one of the UK's leading heat exchange manufacturers, SG Biodrying Ltd is the UK's leading anaerobic digestion facility developer, Geo Green Power specialises in the control systems for renewable energy. The University of Nottingham possesses innovative research expertise on PCM energy storage, electrical power generation and control systems. Environmental Process Systems Ltd – Project lead has unrivalled experience in the research, development, production and distribution of Phase Change Material technologies.

Project Website: www.pcmbrayton.co.uk

Contact: Professor Saffa Riffat, University of Nottingham, Nottingham, NG11 6AA.

Latest news from WSSET

WSSET INNOVATION AWARDS

Prof. Saffa Riffat

Industrial expansion, commissioning of new power plants and expansion of transport systems are changing our climate due to the emission of large quantities of carbon dioxide into the atmosphere. If greenhouse gas emissions are not brought under control, climate change will accelerate with devastating impact on civilisation. Urgent action is required if we are to avert the threat this poses to humans and the world's ecology. The 2015 United Nations Climate Change Conference held in Paris negotiated a global agreement on reducing climate change. The organisation committee has agreed to set a goal of limiting global warming to less than 2°C compared to pre-industrial level.

Sustainable development and innovative energy solutions are crucial to reducing climate change. The WSSET Innovation Awards recognise the achievements of private individuals and organisations in new sustainable technologies and encourage the wider application of these new developments. The WSSET Awards include innovations in the following categories:

- Renewable energy systems (e.g., solar, wind and biomass)
- Power generation technologies (e.g., CHP systems, fuel cells and anaerobic digestion plants)
- Energy efficiency (e.g., heat pumps and hybrid solar/gas systems)
- Low carbon buildings and future cities (e.g., low/zero carbon buildings, sustainable cities)
- Water treatment and desalination (e.g., solar water desalination)
- Sustainable materials (e.g., innovative composite materials and aerogels)
- Waste management and water recycling (e.g., households and construction waste management)
- Agri-food technologies (e.g., innovative greenhouses and food drying)

Please visit http://www.wsset.org/innovation-awards/ for a downloadable WSSET Innovation Award application form. You will need to provide a brief: project summary, project status, description of innovation, what makes your innovation distinctive, advantages/benefits of your innovation and innovation ownership. The Awards will be assessed by a panel of judges from academic institutions, industry and Government departments.

The second round of WSSET Innovation Awards are now open - deadline of entries Wednesday 1st March 2017. The winners will be announced at the SET 2017 conference in Bologna, Italy. A certificate and plaque will be awarded to the winners. The Awards will be widely publicised through WSSET website, newsletters and the media.

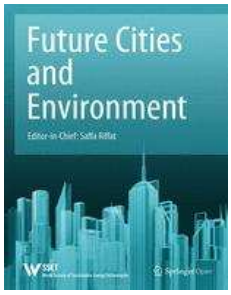
The first round WSSET Innovation award winners were announced at The 15th International Conference on Sustainable Energy Technologies (SET2016) in Singapore. The event was a great chance to celebrate outstanding work in the field of sustainable energy. Well done to all involved. Please see the WSSET website for photographs from the event.

The recipients of the WSSET Innovation awards 2016 were as follows:

- Renewable Energy Systems (Hydro) - MOHD FARRIZ BIN HJ MD BASAR, Universiti Teknikal Malaysia Melaka
- Energy Efficiency (Absorption cooling) - AZHER M ABED, Universiti Kebangsaan Malaysia
- Energy Efficiency (HVAC) - CHUA KIAN JON ERNEST, National University of Singapore
- Power Generation Technologies - HONGXING YANG, Hong Kong Polytechnic University
- Renewable Energy Systems (Solar Energy) - JI JIE, University of Science and Technology, China and XUDONG ZHAO, University of Hull, UK
- Sustainable Materials - DAVID MARTIN, Onyx Solar Energy S.L.
- Renewable Energy Systems (Solar PV) - Hui Lv, Jun Liao, Qinghua Lv, Benyuan Chen, Hubei University of Technology, China

Journals WSSET recommends - Future Cities & Environment

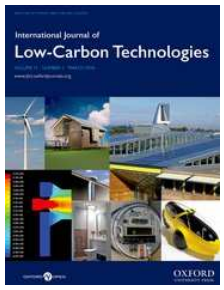
Along with the successful ***International Journal of Low Carbon Technologies*** (http://ijlct.oxfordjournals.org/), Professor Saffa Riffat would like to invite you to submit articles to his newest Journal from Springer publishers: ***Future Cities & Environment*** *http://www.futurecitiesenviro.com/*



Scope of the journal - Future Cities and Environment publishes high quality multi-disciplinary research which aims to reduce the environmental impact of cities. Considering research in the areas of transport, urban planning, architecture and design, and energy and infrastructure, it publishes fundamental and applied research, critical reviews and case studies. This includes experimental development, demonstration and computer modelling. Future Cities & Environment is an open access journal. Articles related to the topics of Future Cities & Environment are all welcome, and should be submitted using the above link.

WSSET exclusive offer – IJLCT

Exclusive article processing charges for WSSET members



WSSET in conjunction with the International Journal of Low-Carbon Technologies (IJLCT) are introducing a 50% discount to the APC (article processing charge) for WSSET members wishing to publish a paper in IJLCT (open access). This would cost WSSET members £375 as opposed to the full charge of £750. The authors will need to quote they are WSSET members when it comes to payment. Please visit: http://ijlct.oxfordjournals.org/

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 over 1000 active 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 secretay@wsset.org

Furthermore please contact secretay@wsset.org regarding any conferences, seminar or symposiums relating to topics of sustainable energy technologies that wished to be advertised in the newsletter.

Once again WSSET wishes to thank the continued support of its members.

Donations are welcomed 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.