Volume 4, Issue 1, Newsletter March 2012

WSSET
World Society of Sustainable Energy Technologies

NEWSLETTER

Latest news from WSSET – SET 2012

INSIDE THIS ISSUE:

The International Conferences on Sustainable Energy Technologies series has reached its 11th edition, taking place on September 2-5, 2012 in Vancouver, Canada, at Delta Vancouver Airport Hotel. The SET 2012 will include plenary sessions, keynote lectures and several specialized sessions on a variety of topics related to sustainable energy technologies. Professor Ibrahim Dinçer, Conference Chairman this year, is encouraging participants from industry to attend and exhibit their products.

Professor Saffa Riffat, President of WSSET, on the 2012 SET Conference: "*On behalf of the organizers of SET-2012, I would like to invite everyone who is interested in the concepts of energy, the researchers, scientists, academicians and industry for their contributions to* SET-2012."

Please visit www.setconference.org for registration, key dates, submission and program. The deadline for the one-page abstract submission has been extended to **April 30, 2012** and the abstract template can be downloaded through the website. Requests for Visa Letter of Invitation can be made through the Visa Information section on the same website. For more information or any queries, do not hesitate to contact info@setconference.org.

Technologies and Products

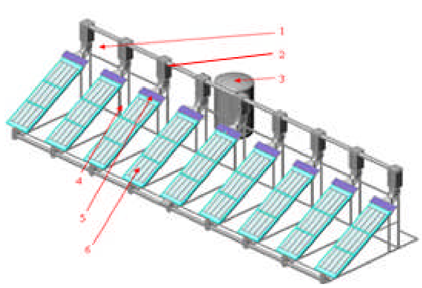


Figure 1- Universal solar water heating system (UniSHeat) with rated productivity 1500 liters of water heated up to 90^{0}C per day or 150 liter of steam at the temperature T≤120^{0}C, when solar insulation equals ≈1000 W/m^{2}s. 1 – Water Heating Unit, 2 – Water steam separator, 3 – Heat accumulating sub-unit, 4 – Supporting frame, 5 – PV-cell, 6 – Solar module

UNIVERSAL SOLAR WATER HEATING SYSTEM (UNISHEAT)

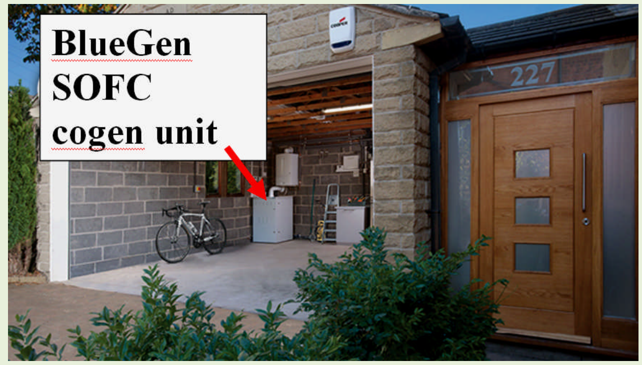
The UniSHeat is a solar powered water heating system operating in solar tracking mode. It uses high temperature tubular through evacuated solar collectors. Three or four connected in parallel collectors with parabolic mirror concentrators are installed in the solar module. Three modules having total solar absorbing surface area equal to 3 m^2 are connected in series and fixed at the supporting triangular frame. A special gear provides orientation of the modules to the sun during the day and turns the modules back to the "morning" position after the sunrise. UniSHeat heats the water up to 100°C or boils the water and produces steam during single pass of the water through the collector. Hot water appears to be available in 15-20 min and steam in 30-35 min after start of operation.

Hot water could be effectively stored for night time use. High temperature of water heating allows significant expansion of its application. The application of steam as a heat carrier allows efficient usage of the heat produced by the system. The productivity of UniSHeat remains practically stable during 8-hour-long working day and is 25-30% higher than productivity of the water heating systems with flat stationary collectors.

Electricity consuming devices of the system are powered by 1.5 m^2 of PV-cells installed at the solar modules. The system is managed automatically at all stages of working cycle and during off normal events. It is capable to satisfy variety of hot water, heat and steam demands of family houses, hotels, hospitals, restaurants, schools, villas, apartment houses, various enterprises events. The modular principle of system composition allows assembling of the systems of needed capacity.

L.Begrambekov, A. Gordeev, A. Zakharov, S.Vergasov, National Research Nuclear University, Russia **END**

Installation of Fuel Cell CHP unit in the UK



A recent television programme on Channel 4 in February 2012 described the first installation of a solid oxide fuel cell (SOFC) cogeneration unit in a Sheffield family home in the UK. The device fitted in the garage as shown in the picture, and ran on natural gas to provide hot water and electrical power to the home.

The device has been developed over the past 20 years by the Australian company CFCL based on a zirconium electrolyte membrane with nickel anode and perovskite cathode, operating near 800°C to generate an electrochemical voltage and current for the home power demand. Each zirconium cell is interleaved with stainless steel interconnector plates to give a stack with 2kW of electrical power and 1kW of hot water output. A power converter produces 240V AC current to supplement the grid power entering the house from the utility, E.ON in this case, or to export out to the grid when there is a surplus.

The electrical power can be turned down to zero while the heat production drops to 400W as the unit continues to provide hot water. Under normal operation, the device runs continuously, but it can be turned off, taking 3 days to cool down completely. Subsequent start-up requires mains power and takes about one day to reach its operating conditions.

The most interesting feature of this unit is its high power to heat ratio of 0.6 which looks very appealing for modern well-insulated buildings. Alternative CHP products tend to have too little power to heat, typically ranging from 0.15 to 0.3 for Sterling engines and polymer fuel cells.

BlueGen has received approval under the Micropower regulations and consequently can receive the feed in tariff which is rising in October above 10p per kWh as announced recently by the Government. A few tons of carbon can be saved each year in a house using this efficient technology compared to gas heating and grid power generation. If 1million units are installed by 2020 as predicted, then several million tons of carbon will be saved.

Kevin Kendall, School of Chemical Engineering, University of Birmingham, UK **END**

Research and Development Projects

A TRU-STONE PROJECT

A Tru-Stone Ltd was recently involved in a London based project where the architect was looking for an internal shuttered concrete finished, yet the structure of the building wasn't strong enough to take the weight of the proposed traditionally made concrete panels. It is just this sort of project where Tru-Stone Ltd comes into its own and looks for suitable solutions.

Made from predominately waste limestone fines, Tru-Stone looks, feels and weathers like real stone or brick. Compared to alternative products on the market, Tru-Stone does not contain polymers or resins and derives its strength from a unique mix of natural minerals. It can be sprayed, cast or moulded, and when pigments are added it can replicate a huge variety of different surfaces, such as stone, concrete, brick and terracotta, and even wood. The use of mainly waste products and the fact that solvents, resins or polymers are not used in the matrix also gives the product impeccable green credentials.

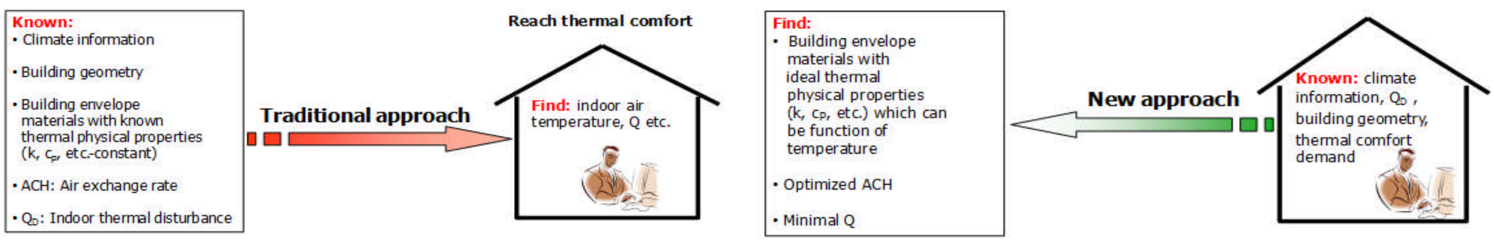
In this instance, panels were cast that looked and felt like the specified finish. Moulds were made, Tru-Stone was spayed into them, to a 3-4mm thickness, backed by self leveling concrete, which in turn was backed by lightweight boards. The finished panels were approx 3m high by 1m, yet were light enough to be carried and installed by hand by two men. The client got exactly the look and feel of what they wanted yet Tru-Stone were able to deliver an innovative and cost effective solution.

Tru-Stone has many potential applications and we are currently working on a number of innovative developments including lightweight and thin insulation panels for the retro-fit market. In this instance Tru-Stone can be used to match a wide variety of finishes allowing customers to maintain architectural heritage. In a further development we have also produced a Tru-Stone finished panel incorporating PCM which is currently under test at the University of Nottingham. For further information please contact: ian@tru-stone.co.uk.

Ian Howard, Director at Tru-Stone Ltd., UK ***END***

New Approach for Developing Energy Efficient Wall with Phase Change Materials

The shortcomings or limitations of the traditional approach of developing energy efficient buildings are that it cannot determine: (1) the ideal thermo-physical properties of building envelope material, where “ideal” means that such material can use ambient air temperature variation and/or solar radiation efficiently to keep the indoor air temperature maintained in the thermal comfort range with no additional space heating or cooling; (2) the best natural ventilation strategy; (3) the minimal additional energy consumption of space heating in winter or air-conditioning in summer. In order to overcome the problems, some new concepts for developing energy efficient buildings have been put forward (Fig. 1). These are ideal thermo-physical properties of building envelope material, ideal natural ventilation rate, and minimal additional space heating or air-conditioning energy consumption. A new approach of determining them is also developed.



(a) (b)

Figure 1 - Comparison of the traditional approach and the new approach for space heating and/or cooling: (a) traditional approach; (b) new approach;

Different from the traditional approach (the thermo-physical properties of building envelope material are known and constant so that the relating equations describing the indoor air temperature tend to be linear differential equations), the new approach solves the inverse problem mentioned (thermo-physical properties etc. of a building are unknown), whose solution can be a function instead of a value. As a first step, the ideal specific heat of building envelope material for internal thermal mass is analyzed for buildings locating various cities in different climatic regions in China, such as Beijing, Shanghai, Harbin, Urumchi, Lhasa, Kunming and Guangzhou. It is found that the ideal specific heat is composed of a basic value and an excessive one which is of δ function for the cases studied. Some limitations that would need further studying are introduced in the end of the paper. Based upon the new concepts and approach, the energy efficient building walls with PCM can be designed and operated better.

Yinping Zhang, Department of Building Science, Tsinghua University, China **END**

International Research Staff Exchange Scheme

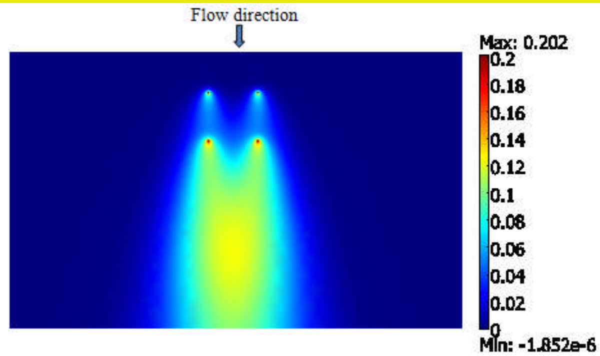
An EU Marie Curie International Research Staff Exchange Scheme—R&D in Sustainable Building Energy Systems and Retrofitting has been initiated. The kick-off meeting was held at The University of Nottingham, Ningbo Campus, China on 28th October 2011. Professor Saffa Riffat at University of Nottingham is coordinating the Scheme. The partner organizations include University of Nottingham (UK), De Montfort University (UK), Institute of Mechanical Engineering-Pole FEUP (Portugal), Aalto-Korkeakoulusäätiö (Finland), Queen Mary and Westfield College (UK), Alma Mater Studiorum-Universita di Bologna (Italy), Tsinghua University (China), Shanghai Jiao Tong University (China), University of Science and Technology of China, China Academy of Building Research, ZhongKai University of Agriculture and Technology (China) and Beijing University of Civil Engineering and Architecture (China).

The main aim of the R&D in Sustainable Building Energy Systems and Retrofitting joint exchange programme is to develop and maintain long term partnerships between European and Chinese participant organizations by undertaking joint researches into the development of several zero (low) carbon cooling, heating and power generation technologies for building and promoting best practice and strategy for retrofitting existing buildings, by individual mobility of researchers between Europe and China. Eight industrial organizations from the EU and China are also involved in the project. Strong participation by enterprises will enhance industry-academia cooperation in terms of research training, career researchers and PhD students through the joint supervision between partners.

Professor S. B. Riffat, Project Coordinator, University of Nottingham, UK **END**

RECENT RESULTS ON THE LONG-TERM SUSTAINABILITY OF BOREHOLE HEAT EXCHANGER FIELDS WITH UNBALANCED SEASONAL HEAT LOADS

Due to the global climate change and the reduction of fossil fuel reserves, Ground Coupled Heat Pumps (GCHPs) are becoming an important technology for building heating and cooling. Vertical ground heat exchangers, called Borehole Heat Exchangers (BHEs), are the most widely adopted. They are usually composed of a drilled hole where either a single polyethylene U-tube or two U-tubes are inserted; water or a mixture of water and glycol flows in the tubes. The hole is then sealed by a proper grout. BHEs can also be composed of two coaxial tubes, namely an outer tube, usually made of steel, and an inner polyethylene tube.



Effect of a slow groundwater flow on the dimensionless temperature around a square field of 4 BHEs, with completely unbalanced seasonal loads, after 49.5 years. The value 0 corresponds to the undisturbed ground temperature

BHE fields are usually designed by means of the method recommended by ASHRAE. This method is based on numerical simulations which refer to a period of 10 years and do not consider any groundwater movement. A recent study showed that large BHE fields with unbalanced seasonal loads, in the absence of groundwater movement, can reach critical conditions in a few decades even if designed by the ASHRAE method. However, other studies revealed that the groundwater movement, even with a very low speed, has a marked effect on sustainability. In particular, Chiasson, Rees and Spitler showed that a groundwater speed of 60 m/year, typical for coarse sand, may have considerable effects in the long term sustainability, while higher speeds are required to influence the effective thermal conductivity of the soil. Zanchini, Lazzari and Priarone recently studied the effects of groundwater movement on large BHE fields, by considering the limiting case of infinite BHEs placed in a single line, in a double line or in a quadruple line.

This work points out that the groundwater movement, even with a low speed, can ensure the long-term sustainability of large BHE fields with unbalanced seasonal heat loads. For some geometries of large BHE fields the results, in form of dimensionless tables, can be used as a design method which takes into account the effects of groundwater movement. The method will be extended to BHE fields with any configuration. The figure illustrates the effect of a slow groundwater flow (speed of about 10 m/year, with reference to BHEs with a diameter of 15 cm) on the dimensionless temperature around a square field of 4 BHEs; it shows clearly the important energy transport along the flow direction.

Enzo Zanchini, Stefano Lazzari, Department of Nuclear and Environmental Protection Engineering, Bologna University, Italy **END**

Ramona Mihailescu has recently joined the WSSET secretarial support team. She is a fresh Master's graduate of the Civil Engineering Department at the University of Nottingham.

She is currently working on giving a new form to the WSSET newsletters and website, as well as helping out with organizing the 2012 SET conference in Canada. Please do not hesitate to contact her for any queries with respect to these matters at: ramona.mihailescu @nottingham.ac.uk.

WSSET supports its members in the advancement of sustainable energy technologies in various ways:

- Hosting international seminars and conferences
- Publishing technical journals
- Encouraging collaborative research projects in sustainable energy technologies
- Promoting work in sustainable technologies and eco-buildings
- Assisting industry with grant applications to various funding bodies
- Organising seminars/workshops and training programmes
- Publicising/advertising the work/products carried out by industry active in sustainable energy technologies