Newsletter 32

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KIPP & ZONEN
SINCE 1830

Content

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Contact

If you have a news item for the newsletter or want to share your experiences with Kipp & Zonen applications and contribute to our next issues, please e-mail the editor: kelly.dalu@kippzonen.com

Renewable Energy and Fossil Fuel

Renewable energy is a must. One thing we know for sure about fossil fuel reserves is that we are running out of them. How much time (or fuel) we have left, is uncertain, but whether our children and our children's children, when they reach our age, will still be using them the way we are is highly unlikely. Availability is one thing; the continuous and increasing emission of CO_2 into the atmosphere is changing our climate rapidly. Possibly, to the 'point of no return'.

Wind energy is well-known nowadays. Turbines can be seen anywhere in the world, and the science and engineering for wind energy has been developed much more than for solar energy. However, wind energy and turbines also have distinct disadvantages; landscape pollution, noise, bird unfriendly, expensive transmission lines are required, large scale installations, etc.

Solar panels can be employed at a domestic scale, they do not dominate the landscape, prices have dropped dramatically in the last few years and transportation of electricity is not required if the panels are installed on our roofs. Solar energy developments should catch up with wind soon and it should outgrow wind energy altogether.

When in 2005 solar energy started to take off, there was an enormous growth rate of annual installed capacity; globally a compound annual growth of 56.4% from 2005 to 2011. Over the period 2012-2020 a CAGR of 15.9% is expected. These numbers come from a research report (GBI Research GBIAE0023MR, Oct. 2012), and they confirm that solar energy is a serious renewable energy source. Which is great, 3-0 for solar energy versus wind energy!

In the first quarter of 2015 the oil price has varied from 47 to 62 US$ per barrel and there is over-production. This is great for car owners, but not for renewable energy initiatives. More CO_2 in the atmosphere, more climate change, a downward spiral; it seems is like going back 30 years in time!

However, oil and gas prices should recover in the medium term and there are other reasons for investing in solar energy; such as security of supply, localised power generation at different scales, and the obligation to meet internationally agreed greenhouse gas emission reductions.

So let's not focus on price and the short term, but think about our world, our future.

Foeke Kuik - C.E.O.
Kipp & Zonen B.V.

The New SOLYS Gear Drive Sun Tracker, Simply the Best

By Ruud Ringoir, Kipp & Zonen - Some climates and applications ask for more. More strength, a wider operating temperature range and more payload to hold more, and heavier, instruments. We are proud to present the perfect sun tracker for these more demanding circumstances; the SOLYS Gear Drive. Its high torque and large temperature range make it suitable for the harshest climates and carrying heavy loads. Thanks to its high precision gear drive system this new sun tracker does not require maintenance, making it ideal for operation in remote locations.

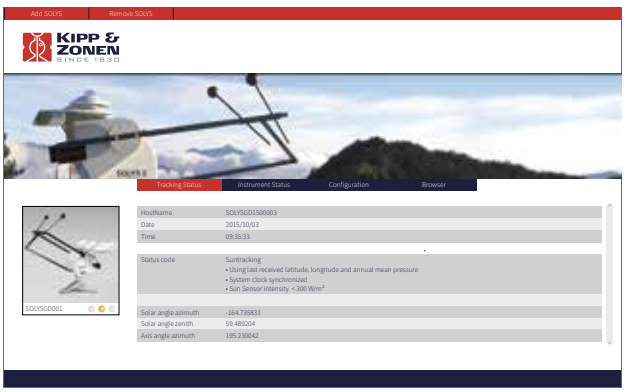
The integrated GPS receiver automatically provides location and very accurate time information. The GPS data, tracker status information and the position of the sun can be accessed over the Ethernet or RS-485 interfaces. This makes remote checking of the tracker performance very easy. The dual power supply makes it possible to use AC or 24 VDC power and the tracker can switch from AC to DC back-up power, enabling un-interrupted operation.

The SOLYS Gear Drive has been extensively tested by our research and development department and in our climate chambers. The tracker complies with CE and FCC requirements and is tested and protected against even higher levels of ESD, EMC and surge disturbances.

What do you get?

The SOLYS Gear Drive comes pre-fitted with the mountings for one pyrheliometer and, with sufficient direct solar radiation, the included sun sensor will automatically correct misalignment of the sun tracker. The SOLYS Gear Drive is supplied without a tripod stand. It can be used with the cast aluminium SOLYS Tripod Floor Stand for lighter duty applications. However, for the intended use in extreme conditions and with high loads the Heavy Duty Tripod Floor Stand from the 2AP sun tracker is recommended.

The SOLYS Gear Drive has a payload of 80 kg, allowing for the use of multiple and/or heavy instruments. Both the Ethernet and RS-485 connectors are waterproof and protected. They can be permanently connected for remote communication with the tracker.



The SOLYS Gear Drive comes with new user interface software allowing remote monitoring and logging of the tracker status, sun zenith and azimuth angles, GPS time and date and more. The software can also be used to set the communication parameters such as fixed or manual IP address and baud rate. The integrated Web Interface can be used to visualise (get and set) operational parameters, download history log files or upload new firmware when available.

Hot or cold?

The internal heater runs from AC power and has higher capacity than the SOLYS 2. For extremely cold regions an insulated cold cover is available that allows use in temperatures down to -50 °C and with wind speeds up to 20 m/s. The cold cover is easily fitted using Velcro® fastenings.

For extremely hot regions the SOLYS Gear Drive can be fitted with a sun shield. This protects the housing from heating by direct solar insolation and extends the upper operating temperature range to +60 °C.

Accessories

The shading ball assembly, mounting accessories and instruments that fit the very successful SOLYS 2 sun tracker are compatible with the SOLYS Gear Drive.

The SOLYS Gear Drive is available from April 2014 and will replace the 2AP sun tracker. The SOLYS 2 sun tracker with the belt drive system continues in production for the less extreme applications ■

Energy Balance in a Forest Ecosystem

By Daniel Berveiller, Research Engineer, CNRS, France - Amongst the many and varied ecosystems around the world, forests represent a large surface area and are at the center of concerns regarding climate change, carbon balance and pollution. To better understand the importance and the functioning of these ecosystems, our research team conduct investigations on a mature oak stand located 70 km South-East of Paris, in the Barbeau state forest. The station is equipped with a 35 m high tower, heavily instrumented with sensors, probes and devices that put the forest under a microscope.

The measurement tower in Barbeau forest

The top of the tower is about 5-6 meters higher than the tallest trees. Several parameters of micro-meteorology are monitored above the canopy, including; air temperature and relative humidity, rain, dew point, air pressure, wind speed and wind direction.

In a vertical profile up the tower air temperature, humidity, wind speed and direction are measured at six heights and air gas concentrations (CO_2, H_2O, O_3) are sampled at eight heights.

Below the canopy, at ground level or underground, variables of soil micrometeorology such as soil temperature, soil water content, soil heat flux (G), soil CO_2 efflux (i.e. soil respiration), tree trunk growth and sap flow rates are measured.

More details of the station and the instrumentation, including real-time data, can be found at **www.barbeau.u-psud.fr**.

Data collected from monitoring allow us to interpret and explain the fluxes of energy and mass between the forest and

Solar radiation sensors at the top of the tower

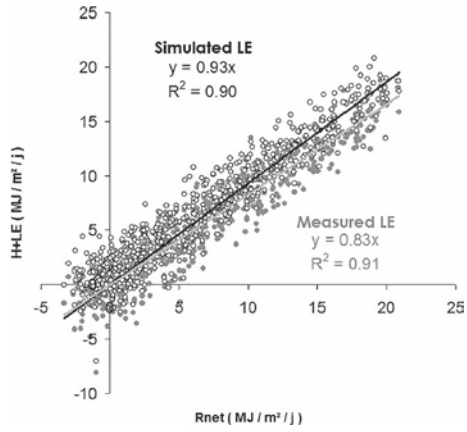
the atmosphere. Using the 'Eddy Covariance' approach, the measurement of fluxes of matter and energy consists of using a combination of two instruments, a three-dimensional sonic anemometer and a fast CO_2/H_2O analyzer. Monitored with a scanning frequency of at least 10 Hz, the vertical component of the wind speed is taken into account in co-variance with the monitored variables (CO_2, H_2O or air temperature). This enables calculation of the vertical CO_2 and H_2O turbulent flux (mass) and the vertical heat (H) and latent heat flux (LE) (energy) between forest and atmosphere.

In addition to the air variables described above, there are several solar radiation sensors installed above and below the Barbeau forest canopy. Light is indeed a very important parameter to take into account in plant functioning as it takes part directly in the leaf photosynthesis mechanism.

Thus, global radiation (R_g, Kipp & Zonen CMP 22) and net radiation (R_{net}, Kipp & Zonen CNR 4) ventilated sensors were installed at the top of the tower to know what is the part of energy coming from the sky, the part that is reflected by the vegetation (trees and soil) and therefore the part that is absorbed.

A difficult issue with the Eddy Covariance method remains to quantify estimates of the uncertainty of the reported flux values. These fluxes are in fact complex processes, and the estimates result from various measurements and calculations as well as numerous explicit and implicit assumptions. Hence, documenting the absolute accuracy of these values is somewhat problematic. However, one simple measure of internal consistency is to check for conservation of energy.

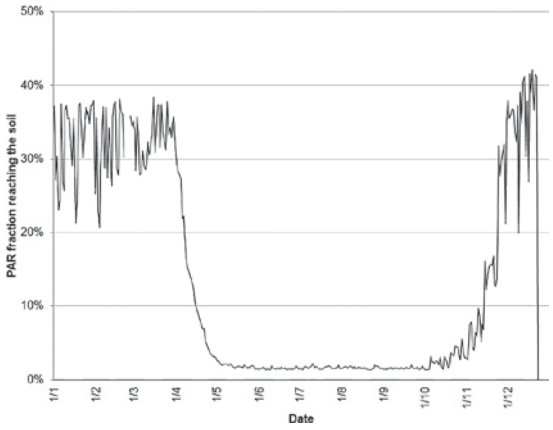
The sum of the turbulence fluxes of sensible and latent heat should balance the available energy: $R_{net} = H + LE + G$
where R_{net} is the net radiation, H the sensible heat flux, LE the latent heat flux and G the soil heat flux.



Shown is a typical relationship for a forest, using data from Tharandt forest station, Germany in 2006 and 2007 and adapted from N. Delpierre, 2009.

In addition, two Kipp & Zonen PQS 1 PAR (photosynthetically active radiation) sensors were installed back-to-back at the top of the tower to monitor the incoming PAR from the sky and the reflected PAR from the vegetation. Below the canopy, fifteen PQS 1 PAR sensors were distributed on the ground to measure the amount of the PAR reaching the soil. Hence, we can calculate the PAR fraction absorbed by the forest.

Barbeau is a deciduous broadleaf oak forest, so the leaves fall in autumn. In winter, the PAR fraction that reaches the soil corresponds to 35 % of incoming PAR and in summer, only 1 to 2 % reaches the soil, as shown in the graph. The PAR is intercepted by wood in winter (trunks, branches and twigs) and mainly by leaves in summer.



This interception can be directly correlated to the leaf area index (LAI, in m^2 of leaves per m^2 of soil) indicative of the forest density. The more leaves there are, the less light is reaching the soil.

All sensors are controlled, and data collected, by ten Campbell Scientific dataloggers (CR1000 & CR3000) connected through an Ethernet network. Data are uploaded to the laboratory servers through a satellite connection and displayed half-hourly on the Barbeau station website at **www.barbeau.u-psud.fr/realtime.html**

Reference:

Delpierre, N. (2009) - Unravelling the determinism of interannual variations of carbon exchanges between European forests and the atmosphere: a process-based modelling approach. With this PhD thesis he obtained the degree of Doctor of Science from the University of Paris XI Orsay.

http://max2.ese.u-psud.fr/publications/THESE_Delpierre.pdf

Testing Solar Ovens to Disinfect Water in Cameroon

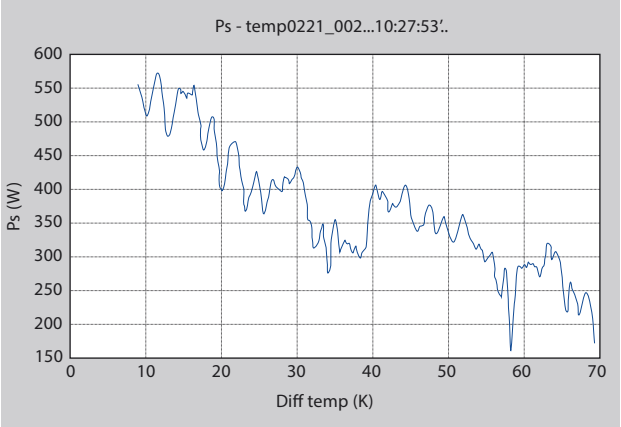
By Stefan Karnebäck of Ingenjörer utan Gränser (Engineers without Borders) in Sweden - Ingenjörer utan Gränser is running a water disinfection project in Cameroon, called WADIS. The main idea is to use solar energy to disinfect the water. It has been known for some decades that heating up infected water to 60 °C or 65 °C will kill most of the dangerous micro-organisms and especially E.coli (California State University)[1].

Busy staff members at DevICe with the CM 5 pyranometer recording solar irradiation

There is an even easier way to do this by using a PET bottle. After six hours of sun light the water is safe to drink concerning micro-organisms. That is the rule of thumb, but it can be much faster. The PET bottle has to be clear and unscratched. This method is called SODIS (Solar Water Disinfection, **www.sodis.ch**) and uses the UV light from the sun to de-activate the E.coli bacteria. The required temperature for this process is only 40 °C to 50 °C.

By using solar ovens or solar cookers you can improve the heating power by concentrating the energy from the sun onto the object. To be able to evaluate the efficiency of different solar ovens Engineers Without Borders (EWB) in Sweden has constructed an evaluation unit. This unit registers the solar irradiation, water temperature and air temperature. The wind velocity is 'watched' as, for this test; the absolute value of wind velocity is not required as long as it is noticeably low.

The setup closely follows the standardized test procedure presented by ASABE (American Society for Agricultural and Biological Engineering) in ASAE S580. This method calculates the normalized power as a function of the difference in temperature between water and air. The normalized power is calculated by dividing the instant power with the solar irradiation and multiplying by 700 W/m^2, which is used as a reference irradiation value.



Example showing absorbed normalized power (Ps) vs difference temperature (Difftemp) in a parabolic dish solar cooker.

Staff member Collins, showing the measurement setup in Tatum. The CM 5 pyranometer, a digital air thermometer and a ping-pong ball functioning as a wind velocity indicator

The equipment uses an Arduino microprocessor, digital temperature sensors and a CM 5 First Class pyranometer from Kipp & Zonen, together with their AMPBOX. The CM 5 was bought by the Energy Technology Department at KTH Stockholm more than 35 years ago. The pyranometer was a gift to Engineers without Borders for this project. Kipp & Zonen calibrated the unit and now it's working perfectly again, despite its age.

Data is logged every 4 seconds on a SD memory card. The water temperature is recorded at different places in the pot, or in several bottles in the same oven, to get a good average value. The air temperature is also logged as the main interest is the difference in temperature between the water and the air. The unit also comprises a Real Time Clock. Due to a very unreliable power network, solar panels and a 12 V battery are used to provide the necessary power to the equipment. Finally, water samples are taken for E.Coli analysis.

The photo shows a setup from Tatum in the North West Region of Cameroon where EWB started a small scale centre, DevICe (Development and Information Centre). The centre is run by a small team, mainly voluntary workers from the village with different backgrounds, using materials provided by EWB. The partner in Cameroon is Leéiyen Systems, a NGO that works in the area with children and health related projects. We started the tests in Sweden during the summer of 2014 but, as the summer in Sweden is too short to complete the tests, the work was continued in a sunnier place.

Recording the solar irradiation will take place every day, even if no tests will be performed. This provides a more accurate picture of the potential of solar radiation for water disinfection in a particular location than can be given by other available information sources. Engineers Without Borders looks forward to large scale applications of this simple method for water disinfection, as a result of this project ■

Engineers Without Borders is a customer of Toragon AB of Umeå, the Kipp & Zonen distributor for Sweden.

Bibliography:

[1] 'The Microbiology of Solar Water Pasteurization, with Applications in East Africa', Robert Metcalf, California State University, Sacramento, California.

The Development and Information Centre in Tatum, Cameroon

Chinese University of Hong Kong Studies Outdoor 3D Radiant Fluxes

By Mr. Alan Lai of the School of Architecture, The Chinese University of Hong Kong - The Mean Radiant Temperature (Tmrt) is one of the important indices governing human energy balance and thermal comfort of man as defined by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This is the uniform temperature of an imaginary enclosure in which radiant heat transfer from the human body equals the radiant heat transfer in the actual non-uniform enclosure.

Chinese University of Hong Kong

Measurements of the short and long wave radiation fluxes from six directions; up, down, and the four cardinal points, can be combined to give the most accurate outdoor Tmrt with appropriate corrections for the view factor coefficients. By mounting three CNR 4 net radiometers on a tripod, a mobile meteorological station for 3-dimensional radiant fluxes is set up within the outdoor urban environment in Hong Kong, one of the highest density cities on Earth.

Each CNR 4 consists of four sensors; recording both short and long wave radiation from two sides. One CNR 4 is mounted horizontally looking at the sky and ground; another is mounted vertically looking East and West, and the third looks North and South.

The CNR 4 mobile station will be surrounded by different combinations of tall buildings of different orientations, shapes, surface materials, and so on. The outdoor thermal comfort in the urban setting is being studied in terms of radiant fluxes and hence Tmrt.

An outdoor thermal model of the Hong Kong urban environment will be developed based on the global Tmrt equation in order to seek improvements in urban planning in high density cities ■

The three CNR 4 net radiometers mounted on tripods

New UV Stability Kit for the Brewer

By Clive Lee, Kipp & Zonen - For measurement of Ozone, Sulphur Dioxide and Aerosol Optical Depth the absolute value of the irradiance measured by the Brewer Spectrophotometer is not particularly important. If there are sufficient photons reaching the photo-multiplier tube (PMT) detector to produce an acceptable signal-to-noise ratio, it is the ratios of the signals at each of the six slit mask wavelengths that are used to calculate the values.

However, for ultraviolet measurements of UVA, UVB and UVE irradiances the absolute sensitivity is critical and this must be periodically calibrated. Normally, this is done indoors at the factory or during a site visit using a NIST-traceable spectrally calibrated 1000 W quartz halogen lamp. This is mounted at a critical distance from the Brewer input optics in a specific orientation, ventilated, and driven by a very precise, stabilised power supply.

It is necessary to periodically check that the Brewer UV response is stable with time. For many years, there has been a small, portable 'UV-B Stability Kit' available that uses 50 W quartz halogen lamps. However, the small lamp housing is mounted directly over the Brewer dome and cannot isolate the lamp well from the environment, so it is affected by wind cooling and temperature changes. In addition, the power supply is relatively unsophisticated and there is variability between lamps when newly calibrated of 2 to 3 %. Compared to the factory calibration, it is difficult with this kit to get closer than ± 5 % for an outdoor UV response check.

We are now supplying as an accessory for Brewers a new UV Stability Kit and Precision Power Supply with much better performance. This kit is supplied with three pre-aged and calibrated 200 W quartz halogen lamps that have little variation. The lamp housing is better protected environmentally and the effective aperture is the same as the 1000 W factory calibration setup.

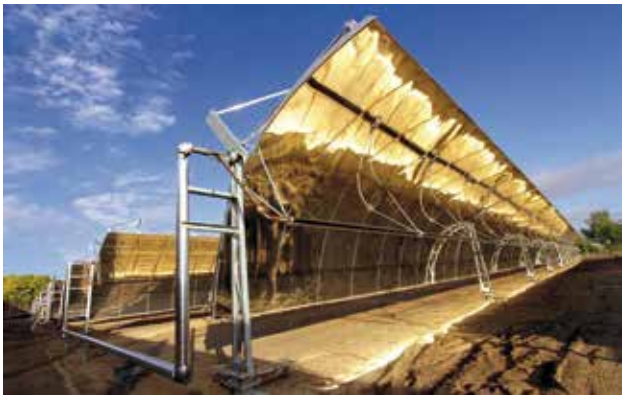
A specially designed very stable, temperature-compensated, AC-DC power supply is used to drive the lamp and a ventilation fan in the lamp housing. A keyboard and liquid crystal display (LCD) enable setting and display of output current and voltage, ramp time, cooling time and status.

Compared to the factory indoor 1000 W lamp calibration, it is possible with this new kit to obtain results within 1 to 2 % for an outdoor UV response check in reasonably stable weather conditions.

The part number of the new UV Stability Kit and Precision Power Supply is 3315001 and the price is the same as the original BA-C126 UV-B Stability Kit, which is now no longer available ■

Monitoring Canada's First Concentrating Solar Thermal Power Plant

By Collin Quarrie, Measurement Specialist - Industrial Group, Campbell Scientific Canada Corp. - The small southern Alberta city of Medicine Hat is the first city in the world to operate a concentrating solar thermal power (CSP/CST) system in a high-latitude, cold weather location. It's also the first city in Canada to have a solar powered steam generation system integrated into a combined cycle natural gas power plant. The system currently generates power on a demonstration basis and a scientific solar and environmental monitoring station will be closely keeping an eye on the performance.



The City of Medicine Hat was known as 'The Gas City' because it sits on sizable natural gas reserves. But several years ago, the city started an energy conservation and renewable energy program called 'Hat Smart'. One outcome of this program is this 1 MW CST demonstration system which began operation in November 2014.

This is the farthest north that a concentrated solar thermal project has ever been built; but, with an average of 2544 sunshine hours and 330 days of sunshine per year (Environment Canada)[1], Medicine Hat is one of the sunniest places in Canada. Medicine Hat also enjoys a suitably high solar resource of direct normal irradiance (DNI) of 5.1KWh/m^2/day (City of Medicine Hat)[2] making it an appropriate location for a CST plant. Now the Medicine Hat slogan is 'Canada's Sunniest City!'

Campbell Scientific Canada installed a Campbell Scientific environmental monitoring station and Kipp & Zonen solar radiation instrumentation to determine the solar resource available at the site. The station measures and collects data for global, direct, and diffuse solar radiation as well as other parameters, such as wind speed and direction, to alert the city if winds are too high to operate the arrays safely. The station is based on a Kipp & Zonen SOLYS 2 sun tracker that mounts two CMP 22 Secondary Standard pyranometers with ventilation units and a CHP 1 pyrheliometer.

Campbell Scientific provides data collection, hosting, quality control and reporting for this station through their Data Services department. Data Services collects the data remotely over a cellular modem based on a scheduled collection interval, and the data is uploaded to a Campbell Scientific server. Quality Control is provided to ensure data quality and integrity. The data is then compiled into monthly reports to help both the City of Medicine Hat and Natural Resources Canada (NRCan) determine the effectiveness of the station.

NRCan has loaned the solar instrumentation at the site to the City for the duration of the solar concentrating demonstration project as it serves both organizations in the collection of data. According to Reda Djebbar PhD. P.Eng. of NRCan, 'The measured data will be used by the City of Medicine Hat to assess and validate the expected versus measured performance of the CST system; and by NRCan, in collaboration with Environment Canada, to validate the satellite derived solar resource data used to generate weather design input data files for the engineering and scientific community to use for a wide range of applications including building heating, ventilation, and air conditioning (HVAC) applications and solar systems design.'

Go to **www.tourismmedicinehat.com** to find out more about Canada's Sunniest City ■

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[1] Environment Canada. 'Canadian Climate Normals 1981-2010 Station Data.'
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[2] City of Medicine Hat. 'Alberta Innovates Technology Futures.' Concentrating Solar Thernal Energy Workshop, 31 October 2011.
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Welcome to our CFO, Edo van Houten

“My name is Edo van Houten and in January 2015 I became the Chief Financial Officer of Kipp & Zonen. As a result of last year’s changes within the organisation, I was recruited to complete the management team. Together with Foeke Kuik and Patrick Akkermans we have a great period ahead of us to continue our leadership in solar radiation measurement solutions.

For the past seven years I have run my own company and worked on a contract basis for multiple customers. This was mainly in the role of CFO in a variety of business sectors (media, pharmaceuticals, chemical, information technology) but also project-driven activities such as fundraising, supporting start-up companies or reshaping finance teams and processes - all cases where a change had to be made.

Prior to my consultancy work I was the Vice President Finance for almost 8 years at Avantium, one of the leading technology companies in Europe in the field of chemicals and bioplastics. Avantium was for me a great learning experience in a highly innovative environment with an international scope and backed with private equity investors.

I’m very excited to be working for Kipp Zonen. It’s a leading authority and a highly respected specialist in its field and my experience matches nicely with the current development within the organisation. As the new CFO I will not only focus on the classic financial agenda but I will also strive to be a critical yet inspiring sparring partner for sales and marketing, production, R&D and to strengthen our innovation plans.

Part of my role is also investor relations and the ‘cash is king’ policy applies for me. In my responsibility for human resources my focus lies on our people and developing our great team to an even higher level” ■

Thank You for your Feedback

Kipp & Zonen thanks everyone who took part in our annual customer satisfaction survey. With all the responses and detailed answers we will be able to strengthen our performance and strategy for the coming year.

The average scores were close to excellent, but we have to stay focussed on maintaining our standards and to keep innovating in our products and processes. It was nice to see that the improvements we made last year, acting on suggestions from the previous survey, were recognized and appreciated. We commit ourselves to making further steps forward based on the outcome of this survey too.

We will continue to live up to your expectations and hope to get your feedback again next year! ■

Follow, Like and Share Kipp & Zonen

Did you know Kipp & Zonen is active on several social media platforms? If you can’t wait until the next newsletter, you should definitely like or follow us so you don’t miss the opportunity to get all the latest news and updates first hand!

We’re on Twitter, Facebook, LinkedIn, YouTube, Google+ and now also on Instagram. With a team throughout the organisation, from marketing to purchasing, logistics to research and development, we bring you a mix of topics and are available to answer your questions.

We hope to meet you through one of our networks soon! ■

Fairs & Events

Saudi Energy • Riyadh • Saudi Arabia	11 - 13 May
Solartech Indonesia • Jakarta • Indonesia	20 - 22 May
Meteohydex 2015 • Geneva • Switzerland	1 - 3 June
Intersolar Europe • Munich • Germany	10 - 12 June
Renewable Energy Asia • Bangkok • Thailand	10 - 13 June

Passion for Precision

Kipp & Zonen is the leading company in measuring solar radiation and atmospheric properties. Our passion for precision has led to the development of a large range of high quality instruments, from all weather radiometers to complete measurement systems.

We promise our customers guaranteed performance and quality in; Meteorology, Climatology, Hydrology, Industry, Renewable Energy, Agriculture and Public Health.

We hope you will join our passion for precision.

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