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Grundfos invited visitors to step into virtual reality to learn about their intelligent and energy efficient pumps. Grundfos GO REMOTE lets technicians parameterize pumps and monitor or set them remotely. The hydraulic balancing is done through a smartphone.

An Interconnected World at ISH

BY WS COMSTOCK, CONTRIBUTING EDITOR, EUROPE & MIDDLE EAST

FRANKFURT, GERMANY—There are number of reasons why the ISH trade fair is so big—190,000 visitors and more than 2,500 exhibitors. Among the reasons are the legacy of manufacturing and distribution based on distinct European markets, historic strength of German exports and domestic demand, size of the plumbing, heating and sanitation sectors in Europe, and the tradition of delivering technical expertise at the stand to support sales. Regardless as to why, ISH is big. This year's edition of the biennial HVAC + Water event held March 11–15 occupied 12 exhibit halls, some with several floors.

HVAC and sanitation sales increased in Germany last year by 3.3% compared to 2017, according to research conducted for the show's organizers by the ifo Institute. As a

whole, the sector's sales exceeded the previous year's figures by €1.9 billion and will end the 2018 business year with a cumulative turnover of around €58.9 billion.

The reason for renewed growth is the current economic climate in the building market. Real estate investment rose in 2018 by 2.5%. Spending on commercial buildings rose by 1.0% and by 3% in both the residential and public buildings sectors.

Taking a deeper dive into the numbers, the bathroom market is being driven by the need for modernization with greater need for age-appropriate, ambient-assisted living spaces. The heating sector, according to the research, is spurred by new construction in spite of state subsidies for increases in energy efficiency and the use of renewable energies.

For 2019, ifo Institute expects further positive developments—around 2.6% growth and to some €60 billion. In regard to real estate investment in building construction, ifo predicts an increase of 0.7%.

“ISH has once again demonstrated that it connects all international players from the sector. Only together is it possible to achieve the climate targets—naturally in a personal dialogue here at ISH,” said Wolfgang Marzin, President and Chief Executive Officer (CEO) of Messe Frankfurt.

While the ISH organizers targeted connecting people, the theme of many exhibitors was another type of connectivity, connectivity to the cloud, where both people and equipment are connected in ways that could lead to fundamental changes to the building services business model.

Danfoss, its stand emblazoned with “A Connected World,” was among those exhibitors.

Danfoss presented smart heating concepts with integrated automatic hydraulic balancing. The Danish company is increasingly focusing on the topics of digitization and intelligent building control. At ISH, it demonstrated how heating systems can be controlled via intelligent valves and thermostats and at the same time hydraulically balanced without calculation and valve pre-setting. Danfoss showcased intelligent valve components for dynamic hydraulic balancing in apartment buildings and utility buildings.

Ziehl-Abegg showed its new ZBluefin fan, continuing the company's focus on applying bionic principles to fan technology. The ZBluefin combines features of the

humpback whale and the owl wing to reduce resistance and the root system of a tree to provide stability. They achieve an energy saving of from 10% to 15% and lower operating noise. With the physical structure of the humpback whale transferred to the new radial impeller, the leading edge of the fan blade has an undulating profile modelled on the golf-ball sized bumps on the whale's fins to avoid excessive turbulence, reducing both flow losses and noise. The bionic profile has no gaps which would allow dirt or condensation to penetrate and which would not only lead to corrosion but also create an imbalance.

"One reason we achieve efficiency is because our new centrifugal fan is light," said Peter Fenkl, Ziehl-Abegg's CEO. "It uses less material and at the same time it is more stable."

The company also displayed its solution for predictive maintenance. The ZABlue galaxy offers a 360° overview of all networkable devices, from fans and motors to complex elevator systems. Customers can get a real-time view of all their networked products remotely, receiving warnings by e-mail, SMS or WhatsApp. "Whether the fans are in San Francisco or Beijing, the customer can see how they are performing from their office. They can monitor a hundred, thousand or 10,000 fans for temperature, vibration, or motor parameters to know exactly what the fan is doing, how many hours it has worked, and what is its remaining life. All communication is via the cloud. Customers have the information they need to decide upon maintenance systems," Fenkl said. "We are learning more about what we can do with the data, creating algorithms to get a result from the data. This provides additional value to our customer base," Fenkl said.

The connected world concept was pioneered by ASHRAE's BACnet® decades ago. BACnet is the most popular open protocol found in building automation and energy management systems, allowing building owners and systems integrators the opportunity to choose BACnet compliant equipment from various vendors. According to BSRIA, BACnet has reached a global market coverage of 64%. Looking forward, supporters think it can be the platform to become the leading Building IoT standard with the possibility of combining all applications into one network. Recent developments have been to integrate indoor mobility, elevators and escalators and to use cloud systems.

Contemporary Controls was one of the companies exhibiting with the BACnet Interest Group Europe. The company showcased several new BACnet compliant



The Geerit Pluvia roof drainage system is based on a negative pressure suction system. It allows the complete drainage of a roof without the requirement of a slope in the pipe work. Large roof areas can therefore be drained through a single discharge stack.

devices, including the BASrouter 3.0, a BTL Listed compact BACnet multi-network router which provides versatile stand-alone routing between BACnet/IP, BACnet Ethernet (ISO 8802-3), and BACnet MS/TP networks. The BASrouter enhances network diagnostic capabilities with visual analytics. Diagnostics include a graphical MS/TP status table, routing status table, network errors count, and traffic statistics. These new features allow an integrator to install robust BACnet networks with ease.

For remote access solutions, the RemoteVPN is a service offered by Contemporary Controls that allows systems integrators remote access to systems from the convenience of the systems integrator's home or office. A cloud-based VPN server hosted by Contemporary Controls provides the critical connection between two VPN clients—one installed on the systems integrator's PC and the other permanently installed on Contemporary Controls' VPN router located at the remote location. Using this approach, two secure VPN tunnels are created with no concern for intervening firewalls. The Skorpion series of VPN routers offer models with wired and cellular connectivity options. Multiple remote sites can be accessed simultaneously using the service.

Sauter, another BIG-EU exhibitor, introduced its modulo 6 combining high performance with IoT architecture. Sauter modulo 6 is based on BACnet/IP and integrates all of the usual field bus protocols such as Modbus, M-Bus, KNX, BACnet MS/TP, etc., for the control of heating, ventilation, climate, lighting and energy, while combining all systems into one stable, secure overall system. Data can be stored automatically in the cloud as required or can be integrated with the local system from the cloud. The sees the cloud as providing new

opportunities for optimizing the operation of buildings. The analysis of data such as the level of usage of devices, actuators and valves provides predictive information on the expected serviceable life. Thus the maintenance can be planned predictively with the smallest possible effect on the daily usage.

Also keeping pace with IoT possibilities is Beckhoff. For almost three decades, PC-based control technology from Beckhoff has been used in all areas of industrial automation. The company says the idea of a “green building” based on sustainable, energy efficient construction and operation is now being realized with intelligent, integrated, cloud-based building automation. At ISH, it displayed its solutions for a universal, scalable building automation control system covering PC- and Ethernet-based controllers and a modular I/O system for logging all data points in buildings.

Among its new products is TwinCAT 3, the latest version of its software tool for building automation. It bundles all building services on one platform: from heating, ventilation and air-conditioning to shading, lighting and energy data acquisition. This results in synergy effects enabling energy-efficient building control and at the same time significantly simplifies engineering and control.

Other highlights at the Beckhoff booth included TwinCAT Speech, for processing voice signals in smart building control, and the implementation of BACnet Revision 14 in TwinCAT. It provides the user with improved alarm processing options.

“Connectivity to cloud systems is rapidly changing our industry,” said Frank Schubert, responsible for building automation marketing and training. “My personal perspective is that in the next 5 to 10 years local systems accessed only through a PC on the desk of facility manager will vanish, replaced by dashboard systems, databases in the cloud, and so on. With our automation stations we can send SMS or email messages directly from the controller,” he said. “It does not matter if you connect a machine to the cloud or the BAS.”

In an age where data is considered the fuel of the 21st Century business model, Schubert sees profound change coming to building services. “We could be transitioning to a model where building owners no longer purchase physical devices. With IoT, physical devices will only collect data and deliver service. For example, we partner with a lighting company on automation enabling them to sell light to a building owner not a



Listen to music. Catch up on news, appointments, weather. Or connect other smart devices to your mirror to get a quick look at your weight or level of skin moisture. The smart mirrors displayed at ISH get your day off to a connected start.

lamp. The physical item is the equipment necessary to offer the service but the business model is to deliver the service not sell the physical item.”

Another smart product at ISH was the Phyn Plus smart water assistant offered by Uponor as a solution to reduce water waste in European homes. Uponor announced it will be available across Europe, starting with Finland, France, Spain and Sweden. Phyn Plus is a single connected smart water monitoring device that detects leaks anywhere in a home and can automatically shut off the main water supply to prevent costly damage. Phyn Plus also monitors water use, giving homeowners insight into how much water their homes and water using fixtures are consuming so they can conserve and save. “Supported by nearly a decade of R&D, Phyn is dedicated to advancing its technology to deliver the most accurate and reliable intelligent water monitoring solution and leak detector available on the market today,” said Ryan Kim, CEO of Phyn. “Users can rest assured they are doing their part to solve the global challenges facing water scarcity.” Phyn Plus is expanding its smart home capabilities by integration with home digital assistants. Homeowners can ask Amazon Alexa or Google Home to provide updates on their water consumption and even turn on and off their water using voice commands.

Collection and use of data was such as reoccurring theme at ISH, it was difficult to imagine a time equipment being smart was not a requirement for specification. And with interconnectivity the theme of seemingly every exhibitor, a time at future ISH’s where a visitor follows a path through the hall to one connected partner to another may not be far off. ■

Window Skins Heat, Cool Buildings

LOS ANGELES—A University of Southern California researcher and professor has developed several smart building material prototypes that act as skins. The responsive window system contains suspended thermobimetals that react to sunlight by turning at different angles. They can flip upside-down to block out the sunlight or let more in. This naturally heats or cools the building's

interior. The window system reduces energy use, especially air-conditioning, by between 28-42%.

The windows do not use energy, including motors, controls or computer chips. Instead, the sun's radiation influences the motion. The smart windows could reduce the size of HVAC systems needed to condition large buildings. If the windows were installed in a 12-story building,



SCOTT WARLEY, DAILY BREEZE/SCMG

The smart materials could change how buildings are constructed and reduce the industry's carbon footprint.

air-conditioning would decrease by 15%, which would save 360 metric tons of carbon dioxide.

Insulating Buildings With Waste

BATH, ENGLAND—The University of Bath is testing waste materials to see if their thermal performance can let them be potential materials for insulating buildings. Researchers from England and France are investigating a range of waste materials and bio-based co-products' performances as alternative building insulation materials. Materials being evaluated include wheat straw bales, rapeseed stalks and recycled duvets. The research team is comparing the thermal performance of each material by constructing three identical prototype



THE UNIVERSITY OF BATH

Waste materials could be used as insulation materials.

wall panels that contain one of the materials.

As the United Kingdom's construction industry is tasked with reducing its greenhouse gas emissions by half by 2025, the researchers are hoping using already existing waste materials or co-products can slash construction emissions and reduce the dependency on natural resources.

Retrofitting Systems for Renewable Energy

KARLSRUHE, GERMANY— Researchers are proposing retrofitting air-conditioning units as integrated, scalable and renewable-powered devices capable of decentralized CO₂ conversion and energy democratization. Adapting air conditioning systems to be able to capture and convert carbon dioxide and water into renewable hydrocarbon fuels can create oil wells. The oil wells can be tapped, shared and stored, with the option for the property owner to receive

payment for any excess fed into a renewable oil grid.

This method could reduce the carbon dioxide load emitted into the atmosphere while safely storing renewable electrical energy and heat as high-energy-density chemical fuel. Using distributed oil well technology could contribute to the practical realization of chemical fuels from carbon dioxide as feedstock in a circular sustainable future.

Using Algae for Heating, Cooling

SYDNEY—Researchers at the University of Technology Sydney are working on a technology for green buildings—algae building technology.



THE FIFTH ESTATE

The BIQ building in Germany uses algae façade panels.

A building in Germany has algae façade panels that produce solar thermal energy.

The panels, called photo bioreactors, produce solar thermal energy where the algae grow in water. Heat exchangers then extract and store the solar thermal energy below ground in a central plant. The plant heats a separate supply of water for use within the building.

The biomass created in the panels is harvested every three to four weeks and then is converted, off-site or on-site, to biofuel, which produces energy for heating and cooling and building services. The biofuel is used for hydronic heating and for hot water throughout the year.

Solid Plastic Crystals Could Compete With Conventional Liquid Coolants

CAMBRIDGE, ENGLAND—Researchers have identified a solid that could replace the inefficient fluids used in most refrigerators and air conditioners. When put under pressure, plastic crystals of neopentylglycol (NPG) yield huge cooling effects—enough to make them competitive with conventional liquid coolants. Organic materials are easier to compress because of their chemical bonds. NPG has loose bonds in its microscopic structure, which allows the molecules to rotate relatively freely. Compressing NPG yields unprecedentedly large thermal changes due to molecular reconfiguration.

The temperature change achieved with NPGs is comparable with those achieved in hydrofluorocarbons (HFCs) and hydrocarbons (HCs.) The word “plastic” in “plastic crystal” refers to its malleability.

Lab Helps Address Shortage

PHILADELPHIA, PA.—Johnson Controls opened its Commercial HVAC Pathways Vocational Lab in April. Johnson Controls' Pathways program provides a curriculum and HVAC labs to prepare students for an HVAC career to combat the industry's labor shortage by providing training for the future workforce.

Flexible Cement Could Heal Itself

RICHLAND, WASH.—Cement used in geothermal wells is known to crack under pressure and in high-temperature environments associated with drilling for geothermal energy. Pacific Northwest National Laboratory's self-healing cement uses a flexible ingredient, a polymer, to repair fractured surfaces and fill cracks. This minimizes mechanical failure risks and offers a sustainable energy source. The technology could eliminate the need to remove, repair and replace cracked cement wells.

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INDUSTRY IN BRIEF

Ingersoll Rand to Spin Off, Merge Its Industrial Division

DAVIDSON, N.C.—Ingersoll Rand's industrial segment is combining with Gardner Denver, according to a company announcement in early May. The \$15 billion deal is reportedly creating the world's second-largest producer of industrial pumps.

Mitsubishi Electric to Acquire ICONICS, Inc. in United States

TOKYO—Mitsubishi Electric Corporation will acquire the remaining shares of ICONICS, Inc., a U.S. software company focused on SCADA, Internet of Things (IoT), mobile, analytics and cloud software

products for the manufacturing, industrial and building-automation markets, to make the company a 100% subsidiary within the Mitsubishi Electric Group.

New NYC Energy Mandate Aims To Cut Emissions by 40%

NEW YORK CITY—Large buildings, both old and new, in New York City may have to slash their greenhouse gas emissions through retrofits and other strategies. The city's goal is to reduce emissions by 40% in 10 years, and buildings are responsible for 67% of its greenhouse gas emissions. In April, the city council passed an emissions cap that will limit the amount of CO₂/ft² large buildings can legally emit.

No Cranes Needed to Create Concrete Walls

BOSTON—There is a new way to move heavy concrete slabs—with nothing more than human hands. A set of interlocking concrete puzzle pieces can be assembled into a solid wall and staircase in about 15 minutes.

Military Alliance to Test Energy-Efficient Equipment in NATO Exercise

THE HAGUE, NETHERLANDS—Air-conditioning systems, LED lights and power meters will be used alongside weapons of war at an upcoming NATO exercise. Officials will test whether energy-efficient equipment and hybrid diesel-solar power systems can be easily integrated into their operations. The increased focus on

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INDUSTRY NEWS

energy efficiency and reduced fuel consumption shows how militaries are adapting to intensifying natural disasters and other challenges.

AHRTI Begins New Project to Assess Refrigerant Detector Characteristics

ARLINGTON, VA.—AHRI's research arm recently launched a new research project to assess refrigerant sensor and refrigerant detector performance requirements for flammable refrigerants for use with indoor HVAC&R equipment, whether in an occupied space or a machinery room. Research project No. 9014, Assess Refrigerant Detector Characteristics for Use in HVACR Equipment, is designed to help clarify the necessary refrigerant detector requirements and how to specify them.

New Chemical Formula Improves Structure, Efficiency of Solar Cells

GOLDEN, COLO.—NREL researchers have produced a tandem perovskite solar cell that pushes the technology closer to its maximum efficiency. The new chemical formula boosts efficiency and improves the structural and optoelectronic properties of the solar cell.

Scientists at CERN Hunt for Greener Gases for Particle Detectors

MEYRIN, SWITZERLAND—During a planned shutdown of the world's largest particle accelerator, staff at the Large Hadron Collider (LHC) will make repairs and upgrade the accelerator. Researchers at CERN (the European Organization for Nuclear Research), which operates the accelerator, are

also using the shutdown as an opportunity to improve the facility's environmental footprint by plugging up leaks and, in some equipment, replacing the most pernicious greenhouse gases with less problematic alternatives.

New Buildings in Los Angeles To Be Zero-Emission by 2030

LOS ANGELES—Los Angeles' mayor released the city's Green New Deal, which sets L.A. on course to be carbon neutral by 2050. Released in April, the deal includes targets such as building a zero-carbon electricity grid to reach an accelerated goal of 80% renewable energy supply by 2036 and toward 100% renewables by 2045.

While the authors highlighted several good technical points on the specific technology utilized in the testing, it does not provide sufficient detail on the differences between corona discharge and NPBI technologies. The technology and subsequent product used in the tests in the New York study are listed as a known ozone generator by the State of California. Furthermore, the same product was removed from the FEMA Trailer Study for Formaldehyde Reduction due to their high ozone output. Publishing a study from 2013 based on a known ozone producing technology does not reflect the current state of the art. The column fails to detail the differences between the technologies which has caused a lot of confusion, skepticism and concerns in the market. The column has done a great disservice to all that are dedicated to promoting the use of proven new technologies to deliver clean indoor air while delivering energy and cost savings.

Corona discharge systems have been operating since the late 1800s and were developed by Sir William Crooks. At the time they were called the “Crooks Tube,” as well as cathode ray tubes. Around 1928 William Langmuir changed the name to “plasma tube.” They are marketed as corona discharge tubes (CDT), or dielectric barrier discharge (DBD) systems. Many companies use CDT/DBD to generate ozone for odor control in unoccupied spaces. In short, there will be ozone when using corona CDT/DBD technology.

Figure 1 shows an example of a CDT. There is an inner filament, a glass tube, and an outer filament,

CHEMICAL	FORMULA	Electron Volt
Xylene*	C ₈ H ₁₀	7.89
Styrene*	C ₈ H ₈	8.46
Methyl Ethyl Ketone*	C ₅ H ₈ O	9.52
Ammonia*	NH ₃	10.07
Acetaldehyde*	CH ₃ CHO	10.23
Ethyl Alcohol*	C ₂ H ₅ OH	10.48
Formaldehyde*	CH ₂ O	10.88
Oxygen	O ₂	12.07

Glass tubes require >12.07 to break down the dielectric

* Typical contaminants of concern as contained within ASHRAE 62.1
 * Electron Volt Energy greater than 12Ev, creates ozone (O₃)

CORONA DISCHARGE TUBE

Figure 2. A sample of eV potential for several compounds.

very similar to the product used in the New York classroom study. The glass is the “dielectric,” or resistance to the voltage path to ground. The dielectric can be glass, quartz, mica, ceramic, or any material that has a high insulating value. For a corona discharge system to operate, the voltage and current must be high enough to breakdown the dielectric material to complete the electrical path to ground. When the power output is high enough, and the path to ground is achieved due to the dielectric breakdown, a corona discharge is formed. The corona discharge is easiest seen in darkness. It appears as a purple glow down the entire tube.

The power required to breakdown most dielectrics exceeds 12.07eV (electron volts). Every gas has an electron volt potential. Figure 2 shows a sample of eV potential for several compounds. Oxygen has a potential of 12.07eV. When the power input is greater than 12.07eV, ozone is created as oxygen is ionized. Understanding the relationship of power to eV is critical when designing air purification systems to produce the desired effect, while avoiding the formation of ozone and



Figure 3. NPBI electrode.

other by-products. NPBI is uniquely different from corona discharge systems. NPBI does not use a dielectric. It does not produce ozone. The power output is controlled to less than 12.07eV.

NPBI electrodes, or “needles,” are made from carbon fiber (Figure 3), titanium, silver, gold, stainless steel, and other corrosion resistant conductive materials. As you can see from the Figure 3, the electrodes are attached to the flexible circuit and there is no dielectric.

NPBI has been used for particle reduction, odor control, pathogen control and static electricity control for more than 10 years. The production of unwanted by-products, including ozone, associated with corona discharge air cleaners are avoided when using NPBI. The newer NPBI technology should NOT be associated with corona discharge. This should be made clear to all, especially the readers of the *ASHRAE Journal*.

Charlie Waddell, Associate Member ASHRAE, Chief Technology Officer, Global Plasma Solutions, Savannah, Ga.

Editor's Note: The authors of the column were contacted for a response, but none had been received by press time.