



Apprise yourself with the latest technological innovations

Highlights

- Mobile training unit for CO₂
- CO₂ based condensing unit
- Industrial strength cleaner and degreaser
- Researchers study effectiveness of water mist
- Supercritical CO₂ foaming
- Researchers evaluate sulfuryl fluoride



The **Asian and Pacific Centre for Transfer of Technology (APCTT)**, a subsidiary body of ESCAP, was established on 16 July 1977 with the objectives: to assist the members and associate members of ESCAP through strengthening their capabilities to develop and manage national innovation systems; develop, transfer, adapt and apply technology; improve the terms of transfer of technology; and identify and promote the development and transfer of technologies relevant to the region.

The Centre will achieve the above objectives by undertaking such functions as:

- Research and analysis of trends, conditions and opportunities;
- Advisory services;
- Dissemination of information and good practices;
- Networking and partnership with international organizations and key stakeholders; and
- Training of national personnel, particularly national scientists and policy analysts.



The shaded areas of the map indicate ESCAP members and associate members

Cover Photo

Clean agent Inergen fire suppression system
(Credit: PROFIRE, Poland)

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Researchers study ozone climate coupling

In a study, a team of researchers from Japan Agency for Marine-Earth Science and Technology, Japan, have focused on the response of the climate to the temporal evolution of the ozone hole. In this analysis they employed the Earth System Model for Interdisciplinary Research on Climate with interactive chemistry (MIROC-ESM-CHEM) comprehensive of a coupled atmosphere-ocean general circulation model as well as sea ice, marine ecosystem and land ecosystem components.

Because of the prohibitive computational cost of the interactive chemistry, only few previous experiments adopted a similar complex configuration to investigate this topic, while the majority of them included the ozone hole climatology in the atmospheric component. Nevertheless, the standard configuration causes the dynamics of the model evolving without being coupled with the ozone chemistry feedback and this potentially prevents a correct evaluation of the feedbacks.

Two ensembles covering the period 1960-2050 were examined: the first ensemble includes all forcings as prescribed in the standard historical Coupled Model Intercomparison Project Phase 5 simulations while the other ensemble is analogous but with ozone

depleting substances (ODS) held fixed at 1960 levels. Here the researchers showed their difference that represents the response of the climate to ozone forcing.

According to previous studies, the results point to a driving influence of the ozone hole on the climate of the Southern Hemisphere with an evident impact on all the components of the climate system in summer during the historical period (i.e. 1960-2005) and an overall effect counteracting the greenhouse gas forcing during the future decades (i.e. 2006-2050) under the RCP 4.5 scenario.

Source: <http://www.nipr.ac.jp>

New mechanism converts nitrogen to GHG

Researchers at Cornell University, the United States, have discovered a biological mechanism that helps convert nitrogen-based fertilizer into nitrous oxide (N₂O), an ozone depleting greenhouse gas (GHG). The paper has been published online Nov. 17 in the *Proceedings of the National Academy of Sciences*. "The first key to plugging a leak is finding the leak. We now know the key to the leak and what's leading to it. Nitrous oxide is becoming quite significant in the atmosphere, as there has been a 120 percent increase of nitrous oxide in our atmosphere since pre-industrial times," said Kyle Lancaster, senior

author on the research.

Researchers showed that an enzyme made by the ammonia oxidizing bacterium *Nitrosomonas europaea*, cytochrome P460, produces N₂O after the organism turns ammonia into an intermediate metabolite called hydroxylamine. *N. europaea* and similar "ammonia-oxidizing bacteria" use hydroxylamine as their fuel source, but too much hydroxylamine can be harmful and the resulting production of N₂O is a chemical coping strategy. Researchers theorize that when ammonia-oxidizing bacteria are exposed to high levels of nitrogen compounds, such as wastewater treatment plants, then N₂O production via cytochrome P460 will ramp up.

In the atmosphere, GHG are a soup of many species, and that N₂O has 300 times the potency of carbon dioxide (CO₂). "That's a staggering number. Nitrous oxide is a really nasty agent to be releasing on a global scale," said Lancaster. He added that N₂O is photochemically reactive and can form free radicals – ozone depleting agents – which aggravates the issue of blanketing Earth's atmosphere with more gas and raising the globe's temperature. The United States is among the world leaders in importing nitrogen fertilizer, according to the U.S. Department of Agriculture's Economic Research Service.

Source: <http://www.news.cornell.edu>

New OzonAction Multimedia Video Application Refrigeration and Air-conditioning Technician Video Series

OzonAction has launched an exciting new application which hosts series of short instructional videos on techniques, safety and best practice for refrigeration and air-conditioning technicians. This application, consisting of short instructional videos on techniques, safety and best practice, serves as a complementary training tool for refrigeration and air-conditioning (RAC) sector servicing technicians to help them revise and retain the skills they have acquired during hands-on training. Additional videos will be added regularly.

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India approves Kigali stand on HFCs

At recent negotiations at Kigali, Rwanda, the government of India gave its ex-post facto approval to the India's position over the issue of phasing down the climate-damaging refrigerants hydrofluorocarbons (HFCs). The Kigali meet took place during October 6-14 where India had successfully negotiated the baseline years and freeze year for phasing down the use of HFCs. The country's position is aimed at allowing sufficient room for growth of its domestic sectors using refrigerants.

Freezing year is the year when use of HFCs will peak before being scaled down while the baseline years are the years for which the average production/consumption quantity of HFCs is taken as the upper limit (serves as a level). It was agreed at Kigali that there would be two set of baselines years for developing countries. India along with nine other countries will have baseline years of 2024-26 while other developing countries including China (largest producer of HFCs in the world), Brazil and South Africa will have 2020-22 baseline. The developed countries, led by the US, will on the other hand reduce use of HFCs over a 2011-13 baseline.

The freeze year for India will be 2028, with a condition that there will be a technology review in 2024/2025 and, if the growth in the sectors using refrigerants is above certain agreed threshold, India can defer its freeze up to 2030. The freeze year of China, Brazil, South Africa and others will be 2024. As per the decisions taken in Kigali, India will complete its phase down in four steps with cumulative reduction of 10% in 2032, 20% in 2037, 30% in 2042 and 85% in 2047. On the other hand, the developed countries

including the US, Japan and west European nation will reduce production and consumption of HFCs by 70% in 2029 and 85% by 2036.

Source: <http://www.timesofindia.indiatimes.com>

India bans manufacturers from emitting GHG

The government of India has issued directions prohibiting certain manufacturers from emitting a potent greenhouse gas (GHG) with high global warming potential (GWP) into the atmosphere. "The government has issued orders on October 13, 2016 directing manufacturers of hydrochlorofluorocarbon (HCFC-22) not to emit or vent hydrofluorocarbons (HFC-23) in the atmosphere," said Environment Minister Anil Madhav Dave. HFC-23 gas is a by-product of the process of manufacture of HCFC-22 gases.

Under the orders, the producers of HCFC-22 are mandated to file their report on production of ozone depleting substances (ODS) under Ozone Depleting Substances Rules, 2000 as amended from time to time and to certify the status of HFC-23 production in each category being incinerated or used as feedstock or used for any other purpose on annual basis. The state pollution boards concerned will ensure compliance of this order while renewing Consent to Operate or through their regular inspection.

At a crucial climate conference on HFCs in Kigali in Rwanda, India had announced that it will eliminate the HFC-23 gas as part of its commitment to combat the threat emanating from climate-damaging HFCs. Giving the go-ahead for releasing the order for incinerating HFC-23 by producers of HCFC-22 gas, Dave said, "HFC-23 gas, a

potent greenhouse gas with global warming potential 14,800 times more than carbon dioxide (CO₂) is produced as a by-product of HCFC-22 manufacturing, and if vented out is a threat to the environment".

Source: <http://www.indiatoday.intoday.in>

Solar energy air conditioner launched

Videocon, the consumer electronics and home appliances company in India, has unveiled a Hybrid Solar Air Conditioner (AC). The company claims it's the world's first AC to run on solar energy. "With the ability to be operated with naturally obtained energy, Solar Hybrid AC is the future," said Akshay Dhoot, Head of Technology and Innovation, Videocon at the product launch.

Videocon Hybrid Solar ACs eliminate the need to consume electricity from the grid, allowing 100 per cent power savings and a lower carbon footprint in contrast to the energy guzzling conventional ACs. However, if the battery runs out of charge, "Its solar panel comes with 25 years' of linear power output warranty and 10 years of panel warranty. The newly launched AC provides efficient cooling without any fluctuations with the least load on grid," said Sanjeev Bakshi, COO - AC Division, Videocon.

With the launch of this eco-friendly AC range, Videocon aims to capture 13 per cent of the AC market in India by end of FY 2017 from the current 9 per cent, said Bakshi. The AC sector is expected to grow by 25 per cent to 5 million units in 2016/17. The AC comes with R-410A refrigerant and also has features such as digital display, auto restart, turbo cool mode and copper condenser.

Source: <http://www.businesstoday.in>

Pakistan enduring to phase-out HCFC

The Ministry of Climate Change, National Ozone Unit in collaboration with Pakistan Heating Ventilation Air Conditioning & Refrigeration (HVACR) Importer & Traders Association organized an interactive workshop. The sector is leading to phase-out hydrochlorofluorocarbs (HCFCs) and choice for ozone and climate friendly refrigerants and technologies with a focus on their safe usage as per International standards.

The objective of the meeting was to promote code of good practices in refrigeration & air-conditioning sector (RACs) among the stakeholders. They deliberated on reducing refrigerants leakage rates and preventing other environmental impacts, design and maintenance of equipment's, adoption of the environmentally friendly alternatives, manufacturing, transportation, storage, installation, maintenance and disposal of the waste material.

In Pakistan, there is no indigenous production of HCFCs, however imports of these ozone depleting substances are made to meet the industrial and domestic requirements. The focused HCFC phase-out efforts on the refrigeration and air conditioning (RAC) servicing sector will contribute significantly to ozone layer protection. Promoting good practices in the refrigeration servicing sector has proved to be a successful tool for phasing-out HCFCs, and is one of the most important components of HCFC Phase-out Management Plans (HPMPs).

Source: <http://www.pakobserver.net>

Central Asian countries tackle HCFC phase-out

According to government representatives responsible for implementing their Montreal Protocol commitments gathered in Chişinău, Moldova on 8-10 November, Central Asian and Caucasus countries have an opportunity to leapfrog from HCFCs to climate friendly solutions. The thematic meeting on implementing HCFC Phase-out Management Plans (HPMPs) – also attended by HVAC&R industry representatives – took account of survey findings in discussing the transition towards climate-friendly alternatives to HCFCs.

Inga Podoroghin, State Secretary in Moldova's Environment Ministry, argued that the Amendment could prevent 0.5 degree Celsius of warming by the end of the century, representing a major contribution to achieving the goals of the UNFCCC Paris Agreement. Podoroghin said the Republic of Moldova is supporting the Protocol and called on other countries in the region to promote alternatives to HFCs.

Georgi Arzumanyan, of UNDP Moldova warned that increased HFC emissions may put in danger the success of international actions already taken to diminish climate change and argued that the HFC phase-down is a top priority. UNDP-backed survey findings presented at the event highlighted the contribution that natural refrigerants can make in replacing f-gases. Attendees also discussed enhancing legislation, adopting safety standards and providing training to companies.

Source: <http://www.ammonia21.com>

UNIDO to help Iran phase-out ODS

United Nations Industrial Development Organization (UNIDO) aims to assist Islamic Republic of Iran in assessing impact of energy, environmental policies on industrial development. From the 1990s, UNIDO has been assisting Iran in the implementation of international environmental agreements, such as the Montreal Protocol on substances that deplete the ozone layer, and the Stockholm Convention on Persistent Organic Pollutants.

With regard to Montreal Protocol, with the assistance of UNIDO, the Government of Iran was one of the first to meet the 2015 HCFCs phase-out target. Hydrochlorofluorocarbons (HCFCs) are ozone-depleting substances (ODS) which are utilized in everyday life, including in refrigerators and air conditioning devices.

In this regard, in an effort to integrate ozone-layer protection with industrial development, UNIDO introduced hydrocarbon technology in Iran's polyurethane foam production. This technology protects the ozone layer and reduces the negative impact of polyurethane foam manufacturing on climate change. In addition, the project has created a number of jobs because the equipment used is entirely manufactured in Iran.

Source: <http://www.en.mehrnews.com>

Global industrial refrigeration systems market

Research and Markets, Ireland, has announced the addition of the "Industrial Refrigeration Systems Market by Equipment, Refrigerant Type, Application, & Geography –

Global Forecast to 2022” report to their offering. The global industrial refrigeration systems market is expected to reach USD 23.22 Billion by 2022, at a CAGR of 5.24% between 2016 and 2022. The market is expected to grow substantially owing to factors such as the stringent regulatory standards towards the adoption of environmentally-friendly or natural refrigerants.

The equipment market of industrial refrigeration systems has been segmented into compressors, condensers, evaporators, controls, vessels, pumps, valves, and auxiliary equipment. The compressors market has been further classified into screw and reciprocating compressors. The Condensers market has been segmented into evaporative, and air-cooled and water-cooled. Air-cooled and liquid chillers are different types of evaporators available.

Among the overall equipment market of industrial refrigeration systems, the market for controls is expected to grow at a higher rate because of the increasing significance of controls and software in the future, especially in improving the energy efficiency of existing refrigeration systems. The market for the CO₂ refrigerant-based industrial refrigeration systems is expected to grow at the highest rate by 2022.

Source: <http://www.prnewswire.com>

Workshop for RAC technicians

The Institute of Brunei Technical Education Jefri Bolkuah Campus (IBTE JBC) recently conducted a workshop for the training of refrigeration and air-conditioning (RAC) technicians on good practices during servicing and installation. The workshop was held

on December 21-22, in joint collaboration with the Department of Environment, Parks and Recreation (JASTRe) and the United Nations Environment Programme (UNEP).

This is the 16th workshop related to Brunei Darussalam’s Hydrochlorofluorocarbon Phase-Out Management Plan (HPMP), in addition to issues on global warming and ozone depletion under the Montreal Protocol. JASTRe has already worked with IBTE JBC in raising awareness on the importance of proper procedures for service technicians, while educating them on the impact of ozone-depleting substances (ODS) and greenhouse chemicals.

More 200 RAC technicians attended the two-day course, to upgrade their knowledge on current environmental, health, safety and handling issues. More training programmes will be conducted throughout 2016 and 2017, to accommodate all service technicians from registered RAC service companies in Brunei Darussalam.

Source: <http://www.borneobulletin.com.bn>

Eco-friendly fridges in Bangladesh

Walton Electronics, Bangladesh, has launched eco-friendly fridges which would not use harmful gases. Abdullah Al Islam Jakob, deputy minister of the environment and forest ministry, launched the products at a ceremony in Gazipur. “Bangladesh is producing fridges that are based on latest technology. It’s a matter of joy and pride for us,” said the deputy minister.

“The company has stopped using hydrochlorofluorocarbons (HCFCs) in fridges since 2012,” said SM Ashraf Alam, at Walton Hi-Tech

Industries Ltd. Instead, the company uses R600A, a refrigerant gas also known as green gas, to make its products environment-friendly. These new fridges will now save 30-40 percent electricity. The project for manufacturing the eco-friendly fridges at Walton was implemented with the partial funding from the USAID and the assistance from the environment and forest ministry.

Source: <http://www.thedailystar.net>

Montreal Protocol may prevent skin cancer

The Ministry of Climate Change, National Ozone Unit in collaboration with Pakistan Standards and Quality Control Authority (PSQCA) organised a workshop to prevent skin cancer from the country. The workshop was aimed to highlight the global efforts of Pakistan for preserving the Earth and its fragile atmosphere.

Pakistan has made a major headway to achieve targets fixed under the Montreal Protocol for phasing out the use of ozone depleting substances (ODS) and conversion of ODS-based industries into ozone-friendly technology. “It is significantly important to strengthen Refrigeration and Air Conditioning sector (RACs) in the country,” said Muhammad Ashraf, Additional Secretary, Ministry of Science and Technology.

“Protection of ozone Layer is the ultimate objective of the Montreal Protocol on substances that deplete the ozone layer which allows life on earth to prosper. While highlighting its benefits, he said that, by year 2030, the Montreal Protocol may be preventing 2 million cases of skin cancer each year,” said Dr. Zaigham Abbas, National Programme Manager,

National Ozone Unit, Ministry of Climate Change.

Source: <https://www.thenews.com.pk>

Europe phases down fluorinated gases

According to a new report published by the European Environment Agency (EEA), the production, import and export of fluorinated-gases (F-gases) continued to decline in the European Union. F-gases, which are mainly used in cooling and heating equipment, have a high global warming potential and their phase-down is therefore essential to global efforts to mitigate climate change.

F-gases were in many cases introduced to replace chemicals that were found to be harming the ozone layer. Currently, F-gases are mainly used in refrigerators, heat pumps and air-conditioning equipment in buildings and in cars. The EEA report 'Fluorinated greenhouse gases 2015' tracks progress towards the EU target of reducing F-gas emissions by two thirds by 2030, compared to 2010 levels.

According to the report, the production, imports, exports and supply of F-gases in the EU decreased in 2015, both in physical amounts as well as in amounts weighted by the global warming potential of the gas in question, measured in CO₂-equivalent tonnes (CO₂-eq.). The F-gas share of the global warming potential of the EU's overall greenhouse gas emissions was 3% in 2014, but this share has been on the increase.

Source: <http://www.eea.europa.eu>

HFCs in ocean

A joint paper published in the *Proceedings of the National Academy of Sciences* reveals that

HFCs make a larger contribution to rising sea levels than first thought. Using climate modelling, researchers at the Massachusetts Institute of Technology the study showed that short-lived climate pollutants (SCLPs) like HFCs contribute to thermal expansions in the ocean far longer than originally thought – and long after they have decayed in the atmosphere. F-gases like CFCs, HCFCs and HFCs are commonly referred to as SCLPs due to their relatively short half-life in the atmosphere. Yet once they have decayed from the atmosphere, the researchers found that they contribute to thermal expansion, causing sea levels to rise.

The report seeks to demonstrate what would have happened if the Montreal Protocol had not come into force by surmising that without it, a considerable amount of additional sea level rise would have occurred (approximately 14cm by 2050). It also noted an ongoing link between HFCs and thermal expansion for up to 500 years. The report demonstrates that climate mitigation measures, like the phase down of ozone depleting substances, need to be prioritised to protect the oceans just as much as they are needed to protect the atmosphere.

Climate change is often linked to air pollution, but it has a dramatic impact on the oceans of the world too. Oceans help to mitigate climate change, reducing the amount of CO₂ in the atmosphere by storing carbon atoms. Continued global warming causes thermal expansion and sea level rises at a faster rate than oceans can keep up with. Fijian President Voreqe Bainimarama, who will preside over COP23 climate talks in Bonn, Germany on 6-17 November 2017, recently drew attention to the effect of rising sea levels on low-lying areas – highlighting the re-

cent devastation caused by tropical cyclone Winston.

Source: <http://hydrocarbons21.com>

New Zealand increases HFC taxes

On 1 January 2017, the island country increased its synthetic greenhouse gas (SGG) levy rates for imported goods and vehicles by 295.5% compared to the previous year. Two years before it is expected to start phasing down HFCs under the Kigali Agreement, New Zealand has (SGGs) by 295.5% compared to last year. SGGs include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).

Raising the price from \$0.30 per unit (as applied in 2016) to \$9.85 from 1 January 2017 is increasing the tax burden on importing HFCs into New Zealand. The levy targets common goods like fridges, freezers, heat pumps and air conditioners, as well as refrigerated trailers and motor vehicles whose air-conditioning units contain HFCs.

The move should significantly help New Zealand to meet the first step of its HFC phase-down obligations under the Kigali Agreement. New Zealand's environment minister, Dr Nick Smith, said following October's Kigali deal: "The Ministry for the Environment will work closely with industry in New Zealand to implement the phase down over the next 20 years."

The New Zealand government has begun consultations on a proposed extension of the Synthetic Greenhouse Gas Levy. This would extend the levy to HFCs imported as components in formulated polyol, used in the manufacture of polyurethane foam.

Source: <http://ammonia21.com>

Mobile training unit for CO₂

The new Mobile Training Unit from Danfoss, Denmark, is equipped with CO₂ technology and interactive learning modules, is responding to this demand worldwide. "Danfoss is a leading provider of CO₂ solutions, and we encourage the use of this sustainable refrigerant. Our mobile training unit will go a long way in promoting the benefits of CO₂," said Hans Ole Matthiesen, at Danfoss.

The natural refrigerant CO₂ is replacing climate-damaging HFCs around the world as retailers look for environmentally friendly alternatives amid the f-gas phase-down. Although the technology and mechanisms for CO₂ refrigeration is readily available today, professionals working on these systems such as builders, refrigeration contractors, service technicians, installers, and the technical departments of end users need to be properly educated. Increasing the level of proficiency will help to harvest the full potential of CO₂ systems.

The CO₂ solutions presented in the mobile training unit range from simple gas-bypass systems to more complex parallel compression solutions with or without heat reclaim. The training unit introduces Danfoss' brand new ejector technology. Ejectors are recognised by industry experts as playing a key role in the evolution of transcritical CO₂ refrigeration systems. They can boost system efficiency by up to 20% on the hottest days of the year, helping to broaden uptake of transcritical CO₂ systems in warmer climates.

Source: <http://www.r744.com>

Air-cooled chillers

Daikin, the United Kingdom, has developed the EWAD-TZ B range of air-cooled chillers as 'pushing the boundaries of design to meet the challenges of green-building efficiencies and new legislation though the application of advanced technologies, resulting in a host of new features'. The refrigerant is R134a. These chillers area available as single or twin-circuit units with cooling capacities from 170 to 700 kW.

The screw compressor has integrated inverter technology combined with a technology that enables them to modify their own geometry, varying the condenser pressure charge to maintain the highest compression efficiency. The advanced design of the heat exchanger delivers a high heat-transfer coefficient while minimising pressure drops. There are three levels of efficiency to choice from, offering the best compromise between efficiency and price.

The micro-channel condenser coil uses 30% less refrigerant charge. All components are sealed in an insulated housing with compact electrical panel. The refrigerant cooling system keeps the electrical circuits at a constant temperature, extending the life and reliability of the system. *Contact: Daikin Airconditioning UK Ltd, The Heights, Brooklands, Weybridge, Surrey KT13 0NY, UK.*

Source: <http://www.modbs.co.uk>

Refrigerator uses waste heat to cool things

Researchers from Tokai University, Japan, have demon-

strated an innovative refrigerator that employs a thermoacoustic engine to cool things down to a minimum temperature of -107.4 °C. This sort of heat engines based on sound waves have been researched since the 1990s for generating clean energy but it's only recently that they're proving to be efficient. The 'sound wave refrigerator', for instance, works on waste heat alone which can be as low as 270 °C.

A thermoacoustic (TA) engine's operating principle is centered around the heating, cooling, and oscillation of gases enclosed in dedicated cavities. Typically, helium is used. A Stirling engine works by shifting cool air to a hot heat exchanger. As the air is heated, it expands driving some kind of machinery. This hot air then comes in contact with a cold heat exchanger, contracting and yet again turning the piston, for instance.

The new engine designed by Shinya Hasegawa and colleagues at Tokai University, however, operates at less than 300 degrees Celsius which is the temperature of more than 80% of industrial waste heat. At this source heat, the TA engine could produce gas oscillations at 85 degrees, lower than the boiling point of water. The TA's configuration consists of three etched stainless steel mesh regenerators fixed in optimal positions. The diameters of the regenerators ranged from 0.2 to 0.3 mm.

Source: <http://www.zmescience.com>

Propane/glycol mini-chiller

Tecumseh Products, the United States, has introduced an "eco-friendly" mini chiller using propane (R290) as the primary

refrigerant and glycol as the secondary refrigerant. Tecumseh unveiled a prototype of the system at the Chillventa trade show 2016, Germany. The system is slated to undergo field tests. "Two years ago we came to Chillventa with a concept; [this year] we came with a prototype," said Christian Brac de la Perrière, at Tecumseh.

The outdoor plug-and-play chiller, which contains 12 l of R290, is designed primarily for convenient stores and small supermarkets, but can also be used in restaurants, fast-food outlets, service stations, bakeries, warehouses and other public and private buildings. Its capacity ranges from 6 kW to 36 kW, and it employs Tecumseh's compressors with a variable-speed drive. "The chiller serves temperatures ranging from 30 °F to 10 °F, and can be used as a condenser for a lower-temperature system," said Brac de la Perrière.

Source: <http://www.hydrocarbons21.com>

New hydrocarbon freezer

Panasonic, Japan, has launched the VIP Ultra, a low-temperature freezer aimed at the medical sector. The ECO line of low-temperature freezers uses hydrocarbon refrigerants, minimise energy consumption, reduce environmental impact and save money. Panasonic tests revealed up to 55% reduction in energy use, which translates into energy cost savings of € 5,000 over 10 years.

The freezers go to temperatures of -86°C and a medical device certification (Class IIa) certifies its ability to keep research and clinical samples at the right temperature. It is also designed to provide 30% more storage capacity for a

given floor area, saving laboratory space. The freezer operates a Dual Cooling System, which is two independent refrigeration circuits working together like a cascade system within the freezer.

However, the dual cooling technology differs from conventional cascade refrigeration technology. The two independent refrigeration systems work together to provide a reliable -86°C ultra-low temperature environment, but, if one system unexpectedly fails, the other can maintain the freezer in the -70°C range. The compressor is on a regulated on-off cycle that automatically responds to cooling demand to minimise compressor-running time and to save energy.

Source: <http://www.hydrocarbons21.com>

CO₂ based condensing unit

Mitsubishi Heavy Industries Thermal Systems Co. Ltd., Japan, has announced its entry into the highly competitive food retail market with a 10 HP CO₂ condensing unit (the HCCV1001). The new unit – equipped with MHI's patented two-stage scroll-rotary compressor technology – will be available in Japan from April 2017. According to Nikkei Sangyo Shimbun, MHI plans to sell 100 units in the first year.

The unit will first be available in Japan but the company is interested in introducing the technology in other fast-growing CO₂ markets too. The development of the condensing unit sees MHI build on the success of its CO₂ commercial heat pump water heater, the 'Q-Ton', which uses the same compressor technology. The two-stage compressor uses scroll on the high side and rotary on the low side of compression.

The two stage scroll-rotary compressor with mid-pressure gas injection is the world's first such type. The HCCV1001 can operate in ambient temperatures of -15°C to +43°C and can cover cooling needs ranging from -45°C to -5°C. With the new CO₂ unit, Mitsubishi Heavy Industries is targeting small cold stores and the food retail sector (convenience stores and supermarkets), a market dominated by Panasonic and to a lesser extent by Sanden in Japan.

Source: <http://www.r744.com>

Low-GWP chillers with R-513A

Johnson Controls, the United States, has announced two platforms of high efficiency chillers available with low global warming potential (GWP) options. It has extended its portfolio of YORK® chillers to include two product families that use the refrigerant alternative R-513A: YORK YVWA water-cooled screw chiller and YORK YMC2 magnetic bearing water-cooled centrifugal chiller. The offering covers a broad range from 433 to 3,516 kW (120 to 1,000 tons) for water-cooled applications.

The company showcased these models at the Chillventa trade show 2016, Germany. The work to develop and launch broad offerings using R-513A and to advance research on the use of mildly flammable refrigerants is part of the company's overall environmental commitments to the White House Council on Environmental Quality. R-513A is a nonflammable (A1) azeotropic, high efficiency, low-GWP alternative refrigerant that reduces the direct refrigerant GWP by 56%.

Source: <http://www.ishrae.in>

Industrial strength cleaner and degreaser

Permatex, the United States, has developed an advanced biodegradable formulation designed to deliver tough cleaning performance with less scrubbing effort. Permatex's carbon-cutting technology completely removes tough carbon, oil, and grease without petroleum solvents, fumes, abrasives, or acids. A proprietary corrosion inhibiting formula leaves a clean surface.

Permatex Industrial Strength Cleaner and Degreaser is safe to use, non-flammable, volatile organic compound (VOC)-compliant, and safe for home disposal. It is ideal for engines, transmissions, rear differentials, undercarriage, machinery, tools, workbenches, garage floors/walls, asphalt, stainless steel, chrome, and exhaust hoods.

Source: <http://www.moderntiredealer.com>

Fluorinated precision cleaning solvent

AGC Chemicals Americas, Inc., the United States, has introduced Amolea AT2™, a fluorinated precision cleaning solvent that provides medical device manufacturers a safer, highly effective and environmentally friendly alternative to n-propyl bromide and trichloroethylene solvents. Amolea AT2 Solvent has no ozone depletion potential (ODP), low global warming potential (GWP) and is non-flammable.

Providing good solvency with variety of press, cutting, silicone and refrigerant oils, greases, asphalt pitches and fluxes, the solvent is approved as cleaner, defluxing agent, carrier solvent for silicone and fluorinated lubricants and mois-

ture displacement fluid. Amolea AT2 has no ODP, low GWP and is non-flammable, enabling manufacturers to more easily meet increasingly strict environmental regulations.

Using Amolea AT2 is energy efficient because of its low latent heat of vaporization. Amolea AT2 demonstrates excellent solvency with a wide variety of press, cutting, silicone and refrigerant oils; greases; asphalt pitches; and fluxes used in the electronics industry. It is approved for use as a precision cleaner, defluxing agent, carrier solvent for silicone and fluorinated lubricants, and moisture displacement fluid.

Source: <http://www.news.thomasnet.com>

Metal cleaning solvents

EnviroTech (Europe) Ltd, the United Kingdom, has developed DriPHOS TLT, a new solvent-based, single tank metal cleaning and pre-treatment process developed by EnviroTech Surface Technologies which uses Thin Layer Technology (TLT) to produce consistent high quality finishes. Completely different to conventional pre-treatment processes it uses only one tank to clean, pre-treat, rinse and dry components which emerge warm to touch and with a crystalline coating on the surface which improves adhesion and protects metals against corrosion.

DriPHOS metal cleaning can replace current aqueous multi-tank systems reducing energy usage by at least 50%, reducing process times to 5 minute cycles, increasing throughput and uses 60% less space releasing floor area for more productive work. This new system will be familiar to users of the vapour degreasing process on

which it is based but with the added benefit of surface pre-treatment in one tank. The footprint of the equipment will be the same as a vapour degreasing tank processing similar sized components.

DriPHOS TLT uses a proprietary blend of compounds in a stable low boiling point solvent carrier to dissolve the active chemicals which produce the protective crystalline structure on the metal surface. The DriPHOS TLT metal pre-treatment process cleans surfaces to a very high standard and produces a nano-thickness protective crystalline primer coating which is part of the metal surface. *Contact: EnviroTech (Europe) Ltd, 100a High Street, Hampton, Middlesex, UK, TW12 2ST. Tel: +44-0-20-8281-6370.*

Source: <http://www.envirotech-europe.com>

Cleaning and degreaser solution

TransRich Marketing (M) Sdn Bhd, Malaysia, has introduced GOX 7 pretreatment and surface preparation offers an extensive line of cleaning and degreaser solution to your painting surface preparation. GOX 7's AC 700 Heavy Duty Cleaner is a fast acting, industrial strength cleaner containing zero ozone depleting potential (ODP).

It is a heavy duty cleaner with strong flushing action which safe on all metal with no residue remains. It also is a high performance, non-chlorinated product designed to remove grease, oil, wax, road tar, dust, dirt, grime, silicone, carbon residues, industrial soils from any surface generally encountered in automotive and industrial parts. *Contact: TransRich Marketing (M) Sdn Bhd. Tel: +6017-582-1700; E-mail: gox7@transrich.com.*

Source: <http://www.gox7.com>

High performance eco-friendly cleaners

Techspray, the United States, offers cutting-edge technologies to improve your processes. Eco-dFluxer Water-based Inline & Batch Flux Removers Eco-dFluxer cleaners are water-based, environmentally friendly and designed to work in both inline and batch cleaning equipment. They are optimal combinations of solvents and saponifiers that lower surface tension for penetration under low stand-offs, and powerful cleaning action to remove all flux residues.

High compatibility with common PCB metals and plastics. Eco-dFluxer cleaners are highly filterable with long bath life. High performance cleaning gives you brilliant solder joints and allows you to increase dilution, increase line speeds, reduce waste water, decrease cost per board, and most importantly eliminate field failures due to ionic contamination. *Contact: Techspray, 8125 Cobb Center Drive, Kennesaw, GA 30152, USA. E-mail: tsales@techspray.com.*

Source: <http://www.geniegroup.com>

Heavy duty degreasing solvent

MicroCare Precision Cleaners, the United States, has developed heavy duty degreasing solvent which is a near-azeotropic solvent. This cleaner is an excellent replacement for most ozone-depleting and chlorinated solvents. Cleaning bearings, machined parts, stampings and precision assemblies is easy with MicroCare HDS. It is ideally suited for use in both vapor degreasing equipment and in "cold cleaning" applications.

Source: <https://www.precisioncleaners.microcare.com>

Nontoxic cleaning, disinfecting

In the United States, a small business R-Water has developed innovative nontoxic cleaning and disinfecting solutions. Rayne Guest, founder and CEO of R-Water developed the patented technology to prevent hazardous chemical containers from entering landfills and address the need for disinfection and cleaning while reducing hazardous exposure to chemicals, both for people and the environment.

R-Water's technology produces two water-based, nontoxic, environmentally-friendly cleaning and disinfecting solutions by means of a patented closed loop electrolysis process. The water based solution uses only undissociated hypochlorous acid (HOCl), a highly effective germ killer, at a concentration of only .02% HOCl in more than 99% water. The 5.5 pH solution of dilute HOCl is a weak acid typically formed when chlorine dissolves in water, and is produced in mammalian white blood cells to combat bacterial infection.

The second solution, FC+, is an 11 pH solution of diluted sodium hydroxide which acts as a degreaser and multi-surface cleaner. Sodium hydroxide (NaOH) creates soap when used on oils and fats in a process called saponification. It is a principle component in many soaps and detergents because it effectively eliminates grease. It can be used in products such as carpet cleaners and auto-scrubbers, as well as on floors and for cleaning grout.

Both solutions are free of volatile organic compounds, color, and fragrance (TK60 has a slight chlorine odor). More importantly, neither damages the environment nor poses a health hazard to humans.

Source: <https://therivardreport.com>

Precision cleaning and degreasing

Vertrel™ SDG introduced by The Chemours Company FC, LLC, the United States, is an engineered mixture of nonflammable hydrofluorocarbons (HFCs) and trans-1,2-dichloroethylene (t-DCE). Vertrel™ SDG is designed to replace trichloroethylene (TCE) and n-propyl bromide (nPB) and perform in applications where maximum cleaning power is needed. It can also be used as a substitute for other cleaners, such as HCFC-225 and its blends, HCFC-141b, HFEs, PFCs, CFCs, and aqueous cleaners, where safety and environmental concerns and/or floor space and cleanliness are at a premium.

Vertrel™ SDG has excellent solvency power for a wide range of soils, including oils, greases, waxes, and hydraulic fluids. The high solvency power, low surface tension, and nonflammability properties of Vertrel™ SDG make it an ideal ultrasonic vapor degreasing solvent. Features and benefits of the product include: • Excellent solvency power (Kb value = 95): Superior cleaning performance • Good solvency for silicone fluids • Fast drying: Increases productivity • Low surface tension: Able to penetrate and clean tight areas • Compatible with most plastics, elastomers, and metals • Zero ozone depletion potential (ODP) • Low global warming potential (GWP) • Existing equipment can be used with minor or no modification • No surfactants needed: Residue-free cleaning is promoted.

Vertrel™ SDG is ideal for a wide range of cleaning applications, including: • Oil, grease, and wax removal • Silicone carrier fluid • Silicone grease removal • Precision cleaning.

Source: <https://www.chemours.com>

Researchers study effectiveness of water mist

A team of researchers from Benha University and Egyptian University for Administration Science and Technology, Egypt, have investigated the effectiveness of water mist with various droplet sizes and various nozzle flow rate on fire suppression in hanger, taking into account extinguishing time, gas concentration, and temperature decay. Three nozzle flow rate with the same conditions were employed and different droplet size provided.

It was found that the extinguishing time decreases with the droplet size decrease and flow rate increase. The temperature decay rate was improved by decreasing the droplet diameter or increasing the flow rate. In addition, with an increase in the extinguishing time, the concentration of O₂ decreased while CO₂ increased. The study is carried out using Fire dynamic simulator (FDS) combined with PYROSIM and SMOKEVIEW programs.

Source: <https://www.omicsgroup.org>

Feasibility studies on use of water mist

Researchers from the Centre for Fire, Explosive & Environment Safety (CFEES), Defence R & D Organisation (DRDO) and Indian Institute of Technology (IIT) Delhi, India, studied the suppression of infrared signature of hot exhaust plumes. The IR suppressant considered in the study is water mist. The objective of the study was to explore and assess the efficacy of poly-disperse water mist for infrared signature suppression applications.

For this purpose, a series of experiment is conducted on a

lab scale experimental facility. The computational modeling and simulation work is carried out using Ansys Fluent v12.0 commercial code. The optimization of water mist parameters like droplet size, injection velocity, injection configuration and type of atomizer etc. with respect to infrared signature attenuation is included in the study.

The radiation attenuation of up to 67% is obtained using water mist injection. That means the water mist has remarkable ability to shelter the infrared radiation from the hot exhaust plume. This study suggests the use of appropriate poly-disperse water mist for IR suppression applications. The preliminary results suggest that a mist based plume cooling system is highly efficient in suppressing the IR signal strength. The research has been published in the *International Journal of Engineering Inventions*.

Source: <http://www.ijejournal.com>

Researchers study fire suppression capability

A team of researchers from Yokohama National University, Japan, studied the fire-suppression capabilities and corrosive properties of ferrocene dispersions. The motivation behind the present study was to develop a high-performance, phosphorus-free fire suppressant. Aqueous dispersions containing micron-sized ferrocene particles and surfactants were prepared using sonication techniques. In this study, Triton X-100 (TX), Noigen TDS-80 (NT), Tween 60 (T60), and Tween 80 (T80) were used as surfactants.

Suppression experiments involving pool fires clearly indicated that aqueous ferrocene dispersions containing TX and micron-sized ferrocene with a d₅₀=16.9 μm

exhibit shorter extinguishing times than a conventional wet chemical. Corrosion trials using steel plates immersed in ferrocene dispersions containing TX confirmed that there was no pitting corrosion, implying that ferrocene dispersions containing TX do not present a corrosion risk. The research has been published in the *Fire Safety Journal*.

Source: <http://www.sciencedirect.com>

Properties of water mist droplet

In a study a team of researchers from Benha University, Egypt, set up a full scale model for the purpose of predicting the geometry of fire spread and water mist particles distribution and movement. The results are based on full scale model simulation for several properties of water mist droplet. The water mist droplet speed, mist flux, droplet size and droplet distribution are discussed. The research has been published in the *Journal of Civil & Environmental Engineering*.

It can be concluded that the water mist droplet movement, particle size and droplet distribution play a vital role to suppress fire. The study was carried out using Fire dynamic simulator (FDS) to perform the model of room fire scenario require to investigate and compute particle distribution, droplet velocity, mist flux and droplet size. The FDS program is used to simulate the fire compartment and show output results of the droplet velocity and diameter of droplet for several models.

Source: <https://www.omicsgroup.org>

Water mist extinguishers

The water mist extinguishers developed by Safelincs Ltd, the United

Kingdom, discharge de-ionised water in a super fine spray to form a mist jet. They have a broader fire-fighting capability than powder, foam or wet chemical extinguishers. The water mist technology used by the extinguishers allows them to produce over 22 billion water droplets from only 1 litre of water. The droplets are as small as 25 microns in diameter and create an ultra-fine mist which has superior fire-fighting capabilities.

The patented nozzle creates water droplets unlike any other extinguisher, producing mist that leaves almost no trace and no collateral damage. The extinguishers are capable of tackling almost all common fires including class A, B, C, F type fires as well as fires involving live electrical equipment of up to 1000V. The unique water mist has the cooling effect of water and creates a "mist curtain" cutting off the oxygen supply.

The droplets are so small that they have no adverse reaction on burning liquids and fats, allowing the extinguishers to be used on class B and F fires. The extinguishers can be used safely on paper, wood, soft furnishing, electrical equipment such as computers and printers, small oil and fat fires, clothing and gas flames and are therefore perfect for offices, workshops, churches, schools and homes. *Contact: Safelincs Ltd., Farlesthorpe Road Industrial Estate, Alford, Lincolnshire, LN13 9PS, UK.*

Source: <http://www.safelincs.co.uk>

High pressure water mist fire extinguisher

Researchers from Beijing University of Civil Engineering and Architecture (BUCEA), China, have introduced high pressure water mist fire extinguishing systems and latest research progress and developments in domestic and for-

eign, and the use of high pressure water mist extinguishing in Anylogic build system simulation model. It not only greatly reduces the high pressure water mist fire extinguishing system research equipment investment costs, but also makes up for the actual installation and commissioning of the entire system.

Meanwhile it can change poor, high costs less, and better apply the control theory in which high pressure water mist fire extinguishing system. This study presents a high pressure water mist fire extinguishing system simulation model based on system dynamics, and the model proposed for the high-pressure water mist control technology development in the country and improve the model it provides an important foundation.

Source: <http://www.ieeexplore.ieee.org>

Portable water mist extinguishers

AF rated portable water mist extinguishers are a new concept developed by Jewel Saffire (E-Series) of the United Kingdom. As a result households or professional kitchens end up with at least two types of extinguishers but in the future they will just need one type of extinguisher – water mist. Offices, general buildings, factories etc will obviously benefit from this new development as well. The simplicity of the water mist extinguisher and the fact that one extinguisher deals with all risks, also reduces the cost of extinguisher training.

The water mist extinguisher only contains de-mineralised water, hence leaving no residue and can therefore be used in food preparation areas and clean rooms. And disposal at the end of the extinguisher life is no issue. These extinguishers are therefore

perfect for indoor installation on small boats.

The extinguisher's supersonic nozzle disperses microscopic 'dry' water mist particles to suppress fires and extinguish burning materials. They are 100% safe for use on wood, paper, textiles, flammable liquids and fat fires. While water based extinguishers currently cannot be tested or classified for gas fires according to British Standards, the dry water mist extinguishers are actually great for extinguishing gas fires.

Source: <http://www.fireservice.co.uk>

Suppression of lithium battery fires

GelTech Solutions, Inc., the United States, an innovator in the use of polymers for fire suppression and prevention, announced that testing of its Firelce Fire Extinguisher by the Fire & Risk Alliance (FRA) has shown conclusively that Firelce was able to successfully suppress a lithium-ion battery fire in runaway as well as prevent re-ignition. In a controlled laboratory test conducted at the University of Maryland's Fire Testing and Evaluation Center (FireTEC), While both extinguishers were able to suppress the initial fire caused by an overheated lithium-ion battery pack, only the Firelce Fire Extinguisher prevented re-ignition and runaway.

Michael Reger, president of GelTech, stated "Firelce, which is already capable of extinguishing fires too hot for water or traditional extinguishers, has the ability not only to extinguish lithium battery fires, but can also stop batteries from going into runaway. Having successfully completed our side-by-side test at UMD, we are now actively exploring our options to bring a Firelce solution to the market."

Source: <http://www.firehouse.com>

Next-gen solutions for thermal insulation

Honeywell, the United States, has announced the availability of next-generation solutions for thermal insulation that can help Middle Eastern countries meet energy efficiency requirements. To meet its Montreal Protocol commitments, the region's foam industry is phasing out the use of polyurethane foam containing hydrochlorofluorocarbons (HCFCs), chemicals that are ozone-depleting and have high global-warming-potential (GWP).

Honeywell has commercialised a new hydrofluoroolefin (HFO) blowing agent that is both non-ozone-depleting and also low GWP. Honeywell gathered regulators, contractors, foam insulation manufacturers, regional stakeholders and global industry experts in an exclusive workshop to review how environmentally preferable foam-blowing agents like Honeywell's Solstice Liquid Blowing Agent (LBA) can help the Middle East meet its Montreal Protocol commitments and also energy efficiency requirements.

Solstice LBA is non-ozone-depleting and has a GWP of 1, which is 99.9 percent lower than the HCFC and HFC blowing agents it replaces, and equal to carbon dioxide (CO₂). Solstice LBA is a critical ingredient in closed-cell foam used for spray foam, panels and appliances, allowing it to expand and providing much of its excellent insulating properties. It increases the thermal performance of con-

ventionally-processed polyurethane (PUR) and polyisocyanurate (PIR) foam in both continuous and discontinuous panel operations.

Source: <http://www.tradearabia.com>

Supercritical CO₂ foaming

In a study conducted by a team of researchers from Shanghai Institute of Applied Physics of Chinese Academy of Sciences, University of China Academy of Sciences, and ShanghaiTech University, China, radiation cross-linked isotactic polypropylene, assisted by the addition of a polyfunctional monomer (triallylisocyanurate, TAIC), was employed in the scCO₂ foaming process in order to understand the benefits of radiation cross-linking.

Due to significantly enhanced melt strength and the decreased degree of crystallinity caused by cross-linking, the scCO₂ foaming behavior of polypropylene was dramatically changed. The cell size distribution, cell diameter, cell density, volume expansion ratio, and foaming rate of radiation-cross-linked polypropylene under different foaming conditions were analyzed and compared.

It was found that radiation cross-linking favors the foamability and formation of well-defined cell structures. The optimal absorbed dose with the addition of 2 wt % TAIC was 30 kGy. Additionally, the foaming temperature window was expanded to about 8 °C, making the handling of scCO₂ foaming of isotactic polypropylene much eas-

ier. The research has been published in the journal *Molecules*.

Source: <http://www.mdpi.com/1420-3049/21/12/1660/htm>

Water-blown polyurethane foams

A team of researchers from Institute of Biomaterial Science, Helmholtz-Zentrum Geesthacht, and Institute of Chemistry and Biochemistry, Freie Universität Berlin, Germany, has shown that a reversible shape-memory effect (rSME) is achievable for polyurethane water-blown semicrystalline foams. Water-blown polyurethane (PU) foams are of enormous technological interest as they are widely applied in various fields, i.e., consumer goods, medicine, automotive or aerospace industries. The research has been published in the journal *Polymers*.

Researchers selected commercially available crystallizable poly(ϵ -caprolactone)-diols of different molecular weight for foams synthesis, followed by investigations of morphology, thermal, thermomechanical and shape-memory properties of obtained compositions. Densities of synthesized foams varied from 110 to 180 kg·m⁻³, while peak melting temperatures were composition-dependent and changed from 36 to 47 °C, while the melting temperature interval was around 15 K. All semicrystalline foams exhibited excellent one-way SME with shape-fixity ratios slightly above 100% and shape-recovery ratios from the second cycle of 99%.

Source: <http://www.mdpi.com>

Guidelines for the safe use of hydrocarbon refrigerants

This handbook provides information on precautions that can be taken to prevent any untoward accidents. It is targeted at those concerned with HC refrigerants at all levels from national policies to equipment design and manufacturing, installation, maintenance, servicing and end-of-life disposal.

For more information, contact:

GIZ Proklima
Dag-Hammarskjöld-Weg
1-5 65760 Eschborn, Germany
Tel: +49 6196 79-1022; Fax: +49 6196 79-80 1022
E-mail: proklima@giz.de

New means of controlling crop pest

Researchers at Oregon State University (OSU), the United States, have discovered a bacterium common in insects found in a plant-parasitic roundworm, opening up the possibility of a new, environmentally friendly way of controlling the crop-damaging pest. The worm, *Pratylenchus penetrans*, is one of the “lesion nematodes” – microscopic animals that deploy their mouths like syringes to extract nutrients from the roots of plants, damaging them in the process.

This particular nematode uses more than 150 species as hosts, including mint, raspberry, lily and potato. The newly discovered bacterium is a strain in the genus *Wolbachia*, one of the world’s most widespread endosymbionts – organisms that live within other organisms. *Wolbachia* is present in roughly 60 percent of the globe’s arthropods, among them insects, spiders and crustaceans, and also lives in nematodes that cause illness in humans.

Depending on the host species, *Wolbachia* can be an obligate mutualist – the bacteria and the host needs each other for survival – or a reproductive parasite that manipulates the host’s reproductive outcomes in ways that harm the host and benefit the bacteria. Parasitic *Wolbachia* can cause its host populations to heavily skew toward female. In the case of the crop-pest nematode, *Pratylenchus penetrans*, the bacteria-host relationship appears to not be one of obligate mutualism.

Source: <https://www.sciencedaily.com>

Researchers evaluate sulfuryl fluoride

A team of researchers from USDA ARS Southeastern Fruit and Tree

Nut Research, Kansas State University, and Douglas Products, the United States, evaluated the efficacy of sulfuryl fluoride (SF, 99.8% purity) for the control of fourth instar pecan weevil, *Curculio caryae* (Horn) at 25 °C for a 24 hour exposure. Weevil larvae were collected as they naturally emerged from pecans harvested in late September, 2015.

Larvae were maintained on moistened toweling in an environment chamber at 7.2 °C and no light before processing. To infest a pecan, a weevil was placed inside a microcentrifuge tube containing 4% agar gel and capped with a dental wick. The tube was placed through the cut end of a previously prepared, empty pecan shell. A glass microscope cover slip was glued to the pecan shell opening to seal it.

For each replicate, at least 30 infested pecans in a burlap bag were fumigated with SF in a modified 3.8 L glass fumigation container. Each treatment was replicated four times. The SF concentration in each fumigation container was analyzed using GC/MS at 30 min. after SF introduction and prior to termination of the fumigation at 24 h. For the dose-response trial there were five target SF dosage treatments, ranging from 150-750 g-h/m³, and non-fumigated controls.

Source: <https://www.mbao.org>

Sulfuryl fluoride fumigation with heat

A team of researchers from Kansas State University (KSU), the United States, and Mississippi State University (MSU), the United States, the application of Sulfuryl fluoride (SF) under high temperatures to determine the highest temperature, shortest exposure time, and lowest concentration by time product, the CTP, of SF that can control all life

stages of *T. putrescentiae*. Mobile stages of mites and eggs were prepared in separate ventilated glass vials. Mites were exposed to SF at 1400 gh.m⁻³ and four high temperature treatments for two days.

Results showed that complete control of ham mites was achieved at 40oC, which was the highest tested temperature. Mites were then exposed to at 1400 gh.m⁻³ of SF at 40oC for different lengths of time and results indicated that more than one day exposure was required to kill mobile stages and eggs. When mites were exposed to 300 and 1000 gh.m⁻³ CTP of SF for various exposure times at 40oC, results indicated that mobile stages were 100% killed after 36 h or longer at 300 gh.m⁻³ and the same result was achieved at 3 h or longer at 1000 gh.m⁻³.

Egg mortality at 300 gh.m⁻³ was recorded as 98.9% after 96 h and was 97.8% after 48 h when exposed to 1000 gh.m⁻³. This study showed that utilizing heat while applying SF at a concentration near the maximum allowable rate to control ham mites will increase the efficacy of fumigant against the most tolerant life stage, the egg. However, when the target CTP of SF was either 300 gh.m⁻³ or 1000 gh.m⁻³ at longer exposure times, mortality did not reach the same level found with 1400 gh.m⁻³.

Source: <https://www.mbao.org>

Researchers study phytosanitary treatment

Researchers from Chapman University, the United States, have carried out a study to determine whether irradiation could serve as a suitable phytosanitary treatment alternative to methyl bromide (MB) fumigation for blueberries and sweet cherry and also to determine the effect of phytosanitary

irradiation treatment on survival of *Salmonella* spp. and *Listeria monocytogenes* on these fruit.

'Bluecrop' blueberries (*Vaccinium corymbosum*) and 'Sweetheart' cherries (*Prunus avium*) were irradiated at 0.4 kGy or fumigated with methyl bromide and evaluated for quality attributes during storage. Irradiation caused an immediate decrease in firmness of both fruit without further significant change during storage. Fumigated fruit, in contrast, softened by 11-14% during storage.

Irradiation did not adversely affect blueberry and cherry shelf-life. MB fumigation did not impact blueberry and cherry quality attributes initially; however, fumigated fruit exhibited greater damage and mold growth than the control and irradiated samples during storage. Irradiation at 400 Gy resulted in a ~1 log CFU g⁻¹ reduction in *Salmonella* spp. and *Listeria monocytogenes* counts, indicating that this treatment cannot significantly enhance safety.

Source: <http://www.onlinelibrary.wiley.com>

Methyl bromide emissions control

Flagler Global Logistics, the United States, has been operating a permitted commercial scale methyl bromide emissions control system since February 2014 to support its fumigation system used for the imports of produce from South America. The system fumigation system employs Flaglers patented adsorption system for recovering methyl bromide from fumigation chambers in sequence with Value Recovery's patented technology that chemically destroys methyl bromide using a thiosulfate solution. *Contact: Peter J. Joyce President Value Recovery, Inc. 510 Heron Drive,*

Suite 301 Bridgeport, NJ 08014, USA. Tel: 856-982-5553.

Source: <https://www.mbao.org>

Researchers test efficacy of methyl bromide

Researchers from North Carolina State University (NCSU), the United States, and Texas A&M Agrilife Extension Service, the United States, have been testing the efficacy of treatment regimens for bermudagrass control that could be used as alternatives to methyl bromide. In the research locations in North Carolina and Texas, applying fluazifop + glyphosate before dazomet was required for acceptable bermudagrass control.

At both locations, this pretreatment followed by tillage-incorporated dazomet at 525 pounds/acre – the maximum labeled rate for soil-incorporation on golf course fairways – resulted in < 10% bermudagrass cover at the final evaluation date. Tarping after tillage did not improve efficacy and, consequently, is not recommended for common bermudagrass renovations in order to save management resources and reduce potential worker exposure to dazomet.

Three fluazifop + glyphosate applications resulted in < 5% cover at the final evaluation date and should be considered for renovations where effective dazomet treatment regimens are not feasible. Overall, results from this research suggest golf course superintendents have a difficult yet fairly straightforward decision to make when choosing a bermudagrass control approach. Ultimately, established common bermudagrass can be controlled cheaply or quickly, but not both.

Source: <http://www.gcsaa.org>

Brassic as biofumigants

Phasing out of methyl bromide has resulted in the need for alternative strategies for the management of soilborne pests and diseases. Among several bioactive molecules, glucosinolates from Brassicaceae and their enzymatic degradation products, especially isothiocyanates formed by myrosinase enzyme, stand out as a promising alternative biofumigants.

A team of researchers from G.B. Pant University of Agriculture & Technology, India, studied the effectiveness of biocidal compounds released from brassica species {*Sinapis alba* L. (syn. *Brassica alba* L.), *B. nigra* L., *B. napus* L., *B. rapa* L., *B. juncea* L. and *B. carinata*} tissue degradation on *Fusarium oxysporum* f. sp. *ciceris* (Padwick) Matuo & K.Sato (F.o.c; causal agent of chickpea wilt) growth *in vitro*, propagule attrition in soil and incidence of chickpea wilt in the field. *Brassica alba* L. was found to be the most toxic as it resulted in maximum percent mycelial growth inhibition of the pathogen followed by *B. nigra* L. and *B. juncea* L. tissues. Lowest wilt severity under field conditions was observed in *B. juncea* L. tissues while greatest grain yield was produced in *B. alba* L. amended plots. The study showed that the soil amendment with brassicas might be a feasible non-chemical approach to manage fusarium wilt of chickpea.

The research is published in *Legume Research*.

Contact: Pramod Prasad, Department of Plant Pathology, G.B. Pant University of Agriculture & Technology, Pantnagar-263 145, India. E-mail: pramoddewli@gmail.com

Source: <http://www.arccjournals.com>

Refrigeration – Solved Examples

The book provides a summary of useful formulae for practicing engineers. It is designed to serve as a useful supplementary reading to students at various academic levels, lecturers and research workers, the book contains completed and commonly accepted formulae and thermophysical data. SI units are adopted throughout, but there is a table for conversion between SI and IP units.

Contact: ASHRAE Bookstore, 6300 Interfirst Drive, Ann Arbor, MI 48108, USA. Tel: +1-734-780-8000; Fax: +1-734-780-2046

NASRC Transcritical CO₂ Installation Specification

The new online guide to transcritical CO₂ refrigeration systems has been published by the North American Sustainable Retail Council (NASRC), which advocates CO₂ as a sustainable and easy-to-use refrigerant. The specifications part of the guide gives advice on which pipe fittings, valves and oils to use in “the installation of a complete and operational CO₂ refrigeration system”.

Contact: North American Sustainable Retail Council (NASRC). Tel: +1-650-867-7533; E-mail: Info@Nasrc.Org

Handbook of Polymer Foams

The book reviews the chemistry, manufacturing methods, properties & applications of the synthetic polymer foams used in most applications. It details the fundamental principles, which apply to all polymer foams. This book will be of interest to those just embarking upon an exploration of the subject of foams, whether in industry or academia. But this will be equally useful to those already working in the field, who need to know about different types of foam.

Contact: Smithers Rapra, Shrewsbury Laboratory, Shawbury, Shrewsbury, Shropshire, UK, SY4 4NR. Tel: +44-0-1939-250-383

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ACREX India 2017

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Web: <http://www.acrex.in>

12-14 Apr

Beijing,
China

China Refrigeration Expo 2017

Contact: Beijing International
Exhibition Center of CCPIT-Beijing
Beijing, China
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Fax: +86-10-5856-6000

15-18 May

Rotterdam,
The Netherlands

12th Heat Pump Conference

Contact: Conference Secretariat Congress
P.O. Box 77
3480 DB Harmelen
Tel: +31-88-089-8101
E-mail: heatpump@congressbydesign.com
Web: <http://www.hpc2017.org>

13-15 Jun

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RAHV VIET NAM 2017

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Fax: +852-2851-8637

6 Sep

Bangkok,
Thailand

ATMOsphere Asia 2017

Contact: ATMOsphere
Tel: +32-2-230-3700
E-mail: info@ATMO.org
Web: <http://www.atmo.org>

20-21 Sep

Rome,
Italy

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Contact: International Water Mist
Association
Poststraße 33 (im HBC)
20354 Hamburg, Germany
Tel: +49-0-40-35085-215
Fax: +49-0-40-35085-80
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USA

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Contact: Conference Secretariat
E-mail: mbao_admin@mbao.org

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