



Ozone Layer Protection

Apprise yourself with the latest technological innovations

Highlights:

- Ozone hole one of the largest on record
- Maldives to ban HCFC gas imports
- Freezer with hydrocarbon refrigerant
- Drop-in replacement for trichloroethylene
- Water mist extinguishers for spacecrafts
- Environmentally friendly chemical blowing agent
- Fumigation for postharvest pest control



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

Vortex hybrid technology for fire suppression releases water droplets of around 10 microns in size

(Credit: Victaulic Company, USA; <http://ifpmag.mdmpublishing.com>)

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Ozone hole one of the largest on record

In 2015, the south polar stratospheric vortex has been unusually large, strong and persistent with polar cap temperatures below the 1979–2014 average during most of July, August and September and with record low temperatures in October. The low temperatures, together with the size of the vortex, have led to the formation of an ozone hole that can be compared to the large ozone holes observed in 1998, 2000, 2003 and 2006.

Data on the ozone hole area from the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center showed that if averaged over the 60 worst consecutive days, 2015 has experienced the largest ozone hole ever seen. On the other hand, if one considers the amount of ozone destroyed, the so-called ozone mass deficit, the 2015 ozone hole is the fifth largest on record after 1998, 2000, 2001 and 2006.

As long as the amounts of chlorine and bromine in the atmosphere remain high, one can expect large ozone holes to occur if the stratospheric temperatures remain cold into the spring. According to the World Meteorological Organization (WMO)/United Nations Environment Programme (UNEP) Scientific Assessment of Ozone Depletion, a statistically significant decline is not expected in the size of the Antarctic ozone hole before 2025. In the meantime, large ozone holes are possible. In the long run, as chlorine and bromine decline, the annually recurring ozone holes will become increasingly smaller, eventually disappearing around 2070.

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

NASA's next ozone layer instrument

A NASA instrument to monitor aerosols, the ozone layer, and other gases in our atmosphere from space arrived on November 2015 at NASA's Kennedy Space Center in Florida, USA. The instrument began final preparations for launch to the International Space Station. The Stratospheric Aerosol and Gas Experiment III on the International Space Station, or SAGE III on ISS, was shipped to Florida from NASA's Langley Research Center in Hampton, Virginia, USA.

The SAGE III instrument, developed at NASA Langley, went through final tests before being stowed aboard a SpaceX Falcon 9 rocket as part of a NASA space station SpaceX resupply mission. The SAGE III instrument will be used primarily to study ozone, a gas found in the upper atmosphere that acts as Earth's sunscreen by blocking much of the Sun's harmful ultraviolet radiation. More than 30 years ago, scientists discovered that our planet's protective coat of ozone was thinning. Since then, NASA has orbited a series of increasingly sophisticated SAGE instruments to make accurate measurements of ozone amounts in the upper atmosphere.

The SAGE III instrument measures light intensities observed at the space station after passing through the Earth's atmosphere during sunsets, sunrises, moonsets and moonrises. As the ISS goes behind the Earth relative to the sun or moon, the instrument measures the dimming of the sunlight or moonlight caused by the Earth's atmosphere. This dimming, in turn, changes with changing at-

mospheric aerosol and ozone levels. By making these measurements, SAGE III will provide a long-term data record of key components of the Earth's atmosphere vital for improved understanding of climate change and ozone chemistry.

Source: <http://www.aero-news.net>

More intense tropical cyclones without Montreal Protocol

According to a new study published in the American Meteorological Society's *Journal of Climate*, if the Montreal Protocol had been rejected and the risks of ozone depleting substances had been ignored by the world, we would be facing even more intense tropical cyclones in the near future. Using one of the most advanced atmospheric computer models available, scientists compared our expected future with a scenario in which Ozone-Depleting Substances (ODSs) had never been regulated.

When they looked at tropical storms, they found a striking difference: By 2065, the potential intensity of tropical cyclones was nearly three times greater in the scenario of a world without the Montreal Protocol. They found that the driver of that increasing potential intensity was almost exclusively the rise in sea surface temperatures due to the greenhouse gas effect of certain ODSs. "In this study, we show that the Montreal Protocol also mitigates the strength of hurricanes, not because it protects the ozone layer but because it reduces ODSs that warm the ocean surface," said Lorenzo Polvani, at Columbia University, the United States.

In the new study, Polvani and his team, turned the question to hurricanes and tropical cyclones. They tested two scenarios: our current trajectory and the scenario of a world in which the Montreal Protocol had never existed. By using a computer model that takes into account land, ocean and sea-ice components and interactive stratospheric chemistry, the scientists could compare the changing forces behind hurricanes over several decades as ODSs increased. That finding has a bearing on research into the recent increases in tropical cyclone intensity. The study shows that even in a scenario where ozone losses are much larger than those over the past 30 years, the ozone loss did not affect tropical cyclone potential intensity.

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

Ozone hole stretches wider

According to researchers from the University of Santiago, Chile, the ozone hole over the Antarctic in the early days of December 2015 was found to be significantly wider than usual. The team, headed by Raul Cordero and Alessandro Damiani, concluded the hole stretched to over 10 million square km (3.86 million square miles), more than double the usual average for that time of the year, said a statement by the Chilean Antarctic Institute, or Inach.

The data was collected during an expedition organized by Inach to Union Glacier, beginning November 2015 with four researchers from the University and with the help of “around 600 kilos of the best possible radiometric technology,” according to the statement. The Union Glacier Joint Polar Scientific Station is located

on latitude 79° S, some 1,000 km (621.3 miles) from the South Pole.

The scientists concluded this huge annual ozone damage in the region between September and December is favored by the simultaneous occurrence of the extremely low temperatures in its stratosphere, and the “polar vortex” phenomenon, which prevents the ozone from other latitudes from filling the gap. Earlier in October 2015, the ozone hole stretched to 28 million square km (10.81 million square miles) and was concluded to be the fourth-largest ever recorded since the availability of specialized data.

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

Ozone depletion in the Arctic

According to the researchers of the Alfred Wegener Institute (AWI), Helmholtz Centre for Polar and Marine Research, Germany, in the past weeks an extreme cold spell in the Arctic stratosphere has created conditions that might cause severe ozone depletion over the Arctic in March – if the next few weeks will not bring a significant warming. “At about 20 kilometres altitude over the Arctic, the air has been as cold as minus 90 °C for weeks. Since the beginning of December, above our Arctic research station on Spitzbergen the mean temperature in the stratosphere has been 8 °C below the long-term average and 2 °C below the previous minimum. These are conditions that can result in substantial ozone depletion”, said Dr. Marion Maturilli, at AWI.

Model calculations performed by AWI researchers based on the extreme cold spell in recent weeks show that the chemical conditions in the Arctic stratosphere already now exceed the ozone depletion

potential of the 2010/2011 winter. “The air masses with these unusual conditions are currently caught in a low-pressure vortex high over the Arctic. Transport of ozone into the vortex has also been low and an ozone minimum has already started to develop. By mid-February more than a quarter of the total ozone above the Arctic will have been destroyed chemically. Should the vortex persist until well into March, the formation of a deep ozone minimum over the Arctic has to be expected. However, if the vortex breaks up before then, the air masses will sufficiently mix with fresh air from lower latitudes and the Arctic will narrowly avoid a new record of ozone depletion,” explained Dr. Markus Rex, at AWI.

Source: <http://www.awi.de>

Training Manual for Customs and Enforcement Officers

The manual is intended to be used for Montreal Protocol-related customs training in developing countries in which Customs training is approved as part of their HCFC Phase-out Management Plan (HPMP) or other ODS phase-out plans. The manual focuses on identifying ODS, ODS-containing mixtures, products containing ODS and equipment whose continuous functioning relies on the use of ODS; the various smuggling schemes; and the efforts of the international community in combating illegal trade in ODS. Information on ODS substitutes is also included, because ODS are often fraudulently traded under the names of substitutes and alternative chemicals.

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Solar-powered ACs with IIT-Madras help

Leading air-conditioning firm Blue Star, India, has announced that it will work on developing solar-powered air-conditioners (ACs) and indigenising controls and other parts used in inverter ACs as part of its collaboration with IIT-Madras. Blue Star was among 25 companies that entered into memorandums of understanding (MoUs) with 25 of the top Central institutions in the country a couple of months ago. The collaboration meant for research requirements, curriculum development, faculty exchange and student internships, among others.

“We will jointly develop several products. IIT-M has an incubation centre. While we may end up using their facilities, we will also impart some training to them. In this joint development tie-up, we are focused on developing solar-powered air-conditioners in the next two years. Also, we will focus on improving the existing product line up in the air purification business,” said B. Thiagarajan, at Blue Star. The company will also look at indigenisation

of components for inverter range of ACs, a fast growing category for the company in the room AC segment.

Over the past few years, Blue Star has been boosting its R & D efforts. Some months ago, it had come up with VRF (variable refrigerant flow) IV Plus AC system, which was designed and developed in-house with the help of an international expert. A VRF system is an intelligent system that cools large multi-zone spaces with varying heating and cooling needs through smart controls.

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

Workshops on adsorption chillers

Bry-Air, India, organised a half day technical workshops on Adsorption Chillers at Delhi, Mumbai, Bangalore, Chennai and Kolkata in December 2015. More workshops are planned in January at Dubai, Dhaka, Bangkok, Kuala Lumpur, Manila and Jakarta. The workshop at Mumbai was held on December 15 at The Orchid Mumbai. It was conducted by Wes Livingston of Power Partners,

USA – the licensees of Bry-Air (Asia) for manufacture of adsorption chillers in India.

Bry-Air adsorption chillers come in the range of 70 to 1180 kW. Adsorption refrigeration was commercialised in Japan in 1986, using the silica gel-water pair. Several pairs of materials can be used, depending on the application. The technology uses low grade waste heat (50°C-100°C) that is abundantly available in India from process industries, for process cooling or air-conditioning. Adsorption is a physical process that depends on surface bonding, and involves no chemical change unlike absorption. Regeneration of the adsorbent material involves desorption by heating, which releases the bond.

In brief, silica gel adsorbs water vapour, creating a vacuum that causes cooling. In addition to the technology and application, the Workshop covered the financials viz. life cycle cost (LCC), payback and equipment selection. It was attended by about 80 delegates, mainly from the industrial refrigeration industry.

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

International Standards in Refrigeration and Air-Conditioning

An introduction to their role in the context of the HCFC phase-out in developing countries

This guide is intended to provide an introduction to standards and how they can be useful in supporting the adoption of alternatives in the context of the HCFC phase-out in developing countries. It also includes an overview of existing standards related to HCFCs and their alternatives, barriers to alternatives, the process of the adoption of international and regional standards at the national level, barriers to the adoption and how to overcome them. This booklet is intended to be a concise guide and information tool for National Ozone Units (NOU), as well as for refrigeration associations, various government departments, including those working on standardization issues (but perhaps not familiar with the specific requirements of the Montreal Protocol), and other stakeholders in the refrigeration and air-conditioning sector in Article 5 countries.

The scope of the standards covered in this document can be grouped into four main categories:

- Safety standards - for design, construction and installation of RAC products and systems
- Performance standards - for determining the efficiency and performance of RAC systems and equipment, as well as for refrigerants
- Practice standards - for identifying knowledge and guiding best practices for technicians when handling RAC systems and refrigerants
- Quality standards - these can be general and cover any industry, but can be applied to processes involving refrigerants such as production, accounting, certifying, training, etc.

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Philippines to phase-out HCFCs

The Philippines has achieved a milestone by complying with a 10% target reduction in the import of HCFCs and ODSs, this year. At the closing ceremony of the HCFC-141b Phase-out in the Foam Sector Project in the Philippines, Eva Ocfemia, at the Department of Environment and Natural Resources (DENR) said, "For 27 years, our country has been working very hard to cooperate with the international community to implement national programs for phasing out ODS to protect the ozone layer."

The DENR through the Environmental Management Bureau (EMB) has already completed the phase-out of five of the six groups of ODSs namely: chlorofluorocarbons (CFCs), halons, carbon tetrachloride (CTC), methyl chloroform and methyl bromide (non-quarantine pre-shipment or non-QPS). The remaining group of the ODS to be phased out is hydrochlorofluorocarbons or HCFCs.

The implementation of the HCFC-141b Phase-out in the Foam Sector Project is funded by the Multilateral Fund (MLF) with UNEP with technical assistance from the United Nations Industrial Development Organization (UNIDO). In the course of the project implementation, 18 companies were supported to shift their foam production from ODS-based to non-ODS-based technology. Likewise, all project beneficiaries opted for Zero-Ozone Depleting Potential (0-ODP) and Low-Global Warming Potential (low-GWP) alternatives.

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

Maldives to ban HCFC gas imports

Maldives is set to ban import of HCFC gas from June as it looks to reduce the amount of ODS used in the Maldives. President Abdulla Yameen Abdul Gayoom has ratified the Bill on Protection of the Ozone Layer, which has also been designed to promote the replacement of ODS with environmentally friendly substances. The bill has been passed by the parliament in November 2015.

The Environment ministry has warned strict penalties for anyone found importing the banned substance from the set date. The Montreal Protocol banned over 96 chemicals of which the Maldives banned importation of ODS in 2003.

The Maldives had also banned CFCs in 2008, which the Montreal Protocol had restricted from use until the year 2010. The Bill on Protection of the Ozone Layer was lobbied to facilitate government authority to minimise and stop the use and importation of ODS to the country, considering the dire need for a system of laws for the Maldives to act on ozone protection agreements the nation has signed and ratified.

Source: <http://www.haveeru.com.mv>

Afghanistan to prevent ozone depletion

Afghanistan has taken some necessary measures to protect the ozone layer. "Afghanistan had taken a big step to prevent ozone depletion," said Ghulam Mohammad Malakyar, Deputy Director at the National Environment Protection Agency (NEPA). He said they had established an office for ozone to ban the use of CFCs in refrigera-

tors and air-conditioners because the gas destroyed the layer and replaced it with HCFCs, which contained hydrogen and was comparatively less hazardous for the layer.

Malakyar said 843 employees of customs departments were trained this year to prevent the import of such gases and 15 machines for identifying the gas had been given to them. He said they also trained 380 fridge and air conditioners professionals and issued them 117 machines for the collection of the gas to them to use it in their workshops.

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

Russia set new directives for ODS production

A recent directive will help implement Russia's obligations under the Vienna Convention for the protection of the Ozone Layer and the Montreal Protocol on substances that deplete the Ozone Layer. This directive has been submitted by the Ministry of Natural Resources and Environment in order to implement Government resolution no. 228 dated 24 March 2014, on state control measures to regulate the consumption and sale of substances that deplete the Ozone Layer, hereinafter referred to as resolution No. 228.

Under resolution no. 228, the Ministry of Natural Resources and Environment calculates annual maximum allowable national ozone-depleting substances (ODS) production volumes and the share of specific ODS in maximum allowable national ODS consumption volumes, hereinafter referred to as annual calculations. Under the procedure of annual calculations, as approved by the ministry, the indicators are based on Ministry of Industry and Trade data and proposals, and in-

clude proposals by companies and private businesses that manufacture ODS substances or are planning the manufacture or import of ODS substances into Russia.

In 2015-2019, the allowable national ODS consumption volumes will total 399.69 tonnes of ozone depleting capacity. The signed directive stipulates production and consumption volumes for each ODS under the total allowable consumption volumes in 2016. The approved decisions will help implement Russia's obligations under the Vienna Convention for the protection of the Ozone Layer and the Montreal Protocol on substances that deplete the Ozone Layer.

Source: <http://www.government.ru>

Global foam blowing agents market

The global foam blowing agents market was valued at 332,690.0 metric tons in 2014, and it is expected to grow with a CAGR of 5.3% during 2015-2020. The factors driving the growth of the global market include increasing demand for polymeric foams in construction and automotive industries and high demand for foam blowing agents in the manufacturing of polyurethane foam. Polyurethane foam is the most commonly utilized polymer foam, due to its large base of end-user industries such as automotive, building and construction, electronics, flooring, furnishings, medical devices, and packaging.

In 2014, the Asia-Pacific market held the largest share in the glob-

al foam blowing agents market, in terms of value and volume. In terms of volume, Asia-Pacific foam blowing agents market is expected to witness the fastest growth (6.3% CAGR) globally, during 2015-2020. The major reasons behind the sustained growth in the region are increasing consumption of blowing agents in China and growing base of end-use industries of polymer foams.

However, the increasing international pressure of reducing the consumption of Hydrofluorocarbons (HFCs) and HCFCs would hinder the growth of the Asia-Pacific foam blowing agents market to some extent. The hydrocarbon product segment of the global foam blowing agents market is expected to witness 7.1% CAGR, in terms of volume, during 2015-2020. Based on application of foam blowing agents, the polyurethane (PU) foam segment is expected to witness 5.5% CAGR globally, in terms of volume, during 2015-2020.

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

Refrigerator of the future

A team of researcher led by Professors Stefan Seelecke and Andreas Schütze from Saarland University, Germany, are working together to develop a new method of cooling in which heat and cold are transferred using 'muscles' made from a nickel-titanium alloy. Extensive series of tests have yielded results that are now being

used to develop a prototype cooling circuit that will be used to further increase the efficiency of the process. The German Research Foundation (DFG), which has been funding the project for the last three years, has agreed to invest a further 500,000 euros. In total, the project has brought around 950,000 euros in funding to the region.

Cooling is carried out in all parts of the world. Refrigerators operate around-the-clock, air conditioning units cool offices, cooling systems help to keep computers and motors running smoothly. And the demand for cooling is being driven both by climate change and global population growth. But more cooling systems come at a price – and not just a financial one. Increased cooling means increased consumption of electrical power and therefore higher emissions of greenhouse gases into the atmosphere, driving global warming even faster.

"In our systems, Shape Memory Alloys (SMAs) are used to remove heat. Shape memory means that wires or sheets made from a nickel-titanium alloy have a certain ability to remember their original shape: If they undergo deformation, they will return to their earlier shape. So they are able to tense and flex like muscles. The fact that they absorb and release heat when they do so is something we exploit to achieve cooling," said Seelecke. *Contact: Prof. Dr. Stefan Seelecke, Saarland University, Germany. Tel: +49-681 302-71341; E-mail: stefan.seelecke@imsl.uni-saarland.de.*

Source: <http://www.uni-saarland.de>

Refrigerants, Naturally!

TAn alliance of global companies, 'Refrigerants, Naturally!' promotes a shift in point-of-sale cooling technology in the food and drink, food service and retail sectors towards alternative refrigeration technology that protects the Earth's climate and ozone layer. The alliance is taking action to combat global warming and climate change by replacing F-gases in refrigeration equipment with climate-friendly natural refrigerants. This partnership is supported by both UNEP and Greenpeace.

For more information, access:

<http://www.refrigerantsnaturally.com>

Freezer with hydrocarbon refrigerant

Developed by Panasonic, Japan, the new MDF-U5412H -40°C freezer provides a reliable freezing environment for Fresh Frozen Plasma and blood related products with outstanding stability and uniformity as well as superior efficiency through the use of hydrocarbon (HC) refrigerants. The natural refrigerants used in the Panasonic range of Biomedical Eco Series freezers minimize energy consumption, reduce environmental impact and save on running costs. A comprehensive alarm system and Class IIa Medical Device Certification ensure this freezer provides unsurpassed reliability and sample security.

The Eco Series from Panasonic utilize the next generation refrigerants – naturally occurring hydrocarbons. These organic compounds boast a number of benefits when compared with traditional refrigerants. Not only do they have no effect on ozone depletion, they also have short atmospheric lifetimes and exceptionally low global warming potentials (GWP). With an increasing global focus on environmental impact and reducing carbon footprints, the new MDF-U5412H provides an ideal solution for all laboratories looking for reliable, efficient and environmentally friendly equipment.

The highly efficient hydrocarbon refrigerants used in the Panasonic Eco Series result in reduced energy consumption and therefore lower running costs. With crucial equipment operating continuously, laboratories can consume a lot of power and freezers can

contribute significantly to this expensive energy consumption. Power consumption and electrical running costs are reduced by up to 28% in the new MDF-U5412H when compared with an equivalent HFC model.

Source: <http://www.news-medical.net>

R290 compressor

Emerson Climate Technologies, the United States, has invested in an expanded propane R290 offering along with testing facilities for its customers. Emerson maintains that compared to the refrigerants it will likely be called upon to replace, such as the recently delisted high GWP refrigerant R404A, propane (R290) yields more capacity with lower power consumption. In addition, although flammable with an ASHRAE rating of A3, its GWP is only 3. Its latest lab expansion provides Emerson with both “mildly flammable” A2L and flammable A3 testing capabilities.

The company announced the introduction of R290 versions of its Copeland Scroll ZB and ZH models at Chillventa in 2014 and now says it has developed a full line of hermetic compressors compatible with R290 that are being used in walk-in and small reach-in systems where the refrigerant charge is less than 150g. This includes its Emerson AFE, low temperature, and ASE, medium temperature, hermetic compressors. According to Emerson, it has found propane capable of high-performing, efficient operation. Compared to the refrigerants it will likely replace, Emerson reported that it yields more capacity with lower wattage consumption.

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

Chiller using new R410A replacement

At the 2016 AHR Expo, Orlando, USA, Chemours, the United States, exhibited a ductless air-cooled water chiller using Opteon XL55, a lower GWP replacement for R410A. XL55, a refrigerant with an expected ASHRAE number of R452B, is seen as a competitor to R32 in the battle to replace R410A. It has been adopted by Multiaqua, the United States, a manufacturer of a range of residential and commercial air hydronic systems, in a chiller.

According to Chemours, the new gas, XL55 has a very similar GWP to R32 but with better efficiency, lower discharge temperatures and a lower flammability. In tests on a Trane chiller, XL55 is said to have exhibited better performance than both R410A and R32 when used as a drop-in. Opteon XL55 is said to be gaining significant interest from OEMs and is awaiting approval under the US Environmental Protection Agency Significant New Alternatives Policy (SNAP) programme. When replacing R410A, XL55 is said to offer improved performance, while maintaining design compatibility.

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

New refrigerant boosts energy efficiency

A research supported by the US Energy Department's Building Technologies Office has led to a major breakthrough in refrigeration systems' efficiency, and the result may yield big energy savings for supermarkets nationwide and greatly reduce greenhouse gas emissions. The department-funded Oak Ridge National

Laboratory's (ORNL's) cooperative research and development agreement with Honeywell, the United States, to develop an alternative refrigerant that minimizes the environmental footprint of supermarket refrigeration systems.

Honeywell and ORNL have developed Solstice N40, a non-toxic hydrofluoroolefin (HFO)-based refrigerant alternative for R-404A, the most common refrigerant used to cool supermarket refrigeration systems in the U.S. Sold under the trade name Solstice N40, it offers a lower-global-warming potential, energy-saving replacement for R-404A. Using Solstice N40, grocery stores will have the ability to retain their existing hardware and simply replace their current refrigerant with this option, greatly reducing the threat of environmentally harmful greenhouse gas emissions at a modest cost.

Currently, there are about 37,000 supermarket refrigeration systems in use nationwide that could benefit from this replacement for R-404A without incurring the significant cost of replacing equipment. Honeywell's refrigerant also significantly improves system performance. In fact, ORNL's research using an actual operating supermarket refrigeration system has shown Solstice N40 creates energy savings of 10 percent compared to R-404A.

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

Solar energy cooling system

Researchers at the National Autonomous University of Mexico (UNAM) have developed a solar energy system that can not only be used to cool living areas but re-

frigerate food as well. The team of researchers at UNAM's Renewable Energies Institute (IER) is led by Dr. Wilfrido Rivera Gómez Franco, who said the system can raise water temperature from 20-110 °C, or reduce it to below 0. Currently, the project's set-up includes a 60-square-meter solar array, which produces enough energy to cool or heat an 80-square-meter room. The developers are currently focusing on evaluating the system's performance under several temperature conditions and refining their control over it.

The next stage would be to install it in the real-world environment of one of the institution's laboratories. The developers are also looking for an ideal place in northern Mexico or a coastal city to install their cooling system. In those areas, the bimonthly cost of air conditioning units can run from 5,000 to 10,000 pesos (US \$290 to \$580). Those figures could be drastically reduced by using solar energy instead, as the only conventionally-generated electricity needed is to power a small pump that cycles hot water through the system.

The developers explained that although there are similar products on the international market, they cannot achieve temperatures of less than -5 °C, limiting their use to air conditioning. The system developed at UNAM can easily produce temperatures of -7 °C, expanding its application to food refrigeration. Rivera also said that their system is 50% cheaper than foreign ones, before taking into consideration import taxes that can increase the end price four-fold. A patent registration has been filed by the team of developers.

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

Cleaner and safer heat pumps

S-RAM Dynamics, the United States, has developed a heat pump that uses air; a natural refrigerant in place of environmentally-damaging HFCs. HFCs are commonly used in today's HVAC equipment, contributing to the emission of greenhouse gas emissions. S-RAM Dynamic's heat pump has the potential to slash heating and cooling costs in half. It is also unique due to its ability to operate in extreme climates, ranging from the very cold (30 degrees below zero) to the very hot (210 degrees). The system initially is manufactured as 20-ton units to be installed in low-rise commercial buildings or rooftops of commercial buildings.

Thermolift is also developing a heat pump that aims to make buildings greener and more energy efficient. It is working on a prototype that can provide heating, cooling and hot water for residential and commercial buildings by using natural gas and heat energy from the surrounding air. It is also designed to help reduce peak electricity consumption during the summer. Similar to S-Ram Dynamic's heat pump, Thermolift's design does not use HFCs. It automatically responds to environmental variables such as outdoor temperature and is set to improve efficiency in space heating by 200 percent and water heating and space cooling by 150 percent.

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

iPIC (Informal Prior Informed Consent) online

<http://www.unep.org/ozonaction/ipic>

Bio-based cleaner

Developed by Soysolv, the United States, the Soysolv® Graffiti Remover has been recognized in a recent independent study conducted by the non-profit Center for a New American Dream. Soysolv® Graffiti Remover is a safer alternative made from American farm-grown soybeans and corn and replaces traditional toxic chemicals with a patented formulation. It revealed that some graffiti cleaning products are significantly less hazardous and clean just as well as their more toxic counterparts.

Soysolv® ranked Best in Class and showed excellent efficacy at removing graffiti from smooth, non-porous painted and un-painted surfaces. The Center for a New American Dream examined product ingredient information, and existing lists of known carcinogens, reproductive toxins, and other human health hazards compiled by the U.S. Environmental Protection Agency and others. The products were then tested throughout Portland, Oregon, to measure the products' effectiveness removing different types of graffiti from a variety of surfaces.

"We are proud that our product performed well in this independent testing removing graffiti. We are even more proud to know our product was recognized as environmentally friendly because of its all natural ingredients," said Steve Smith, at Soysolv®. Soysolv® uses 100% bio-based ingredients derived from plants in its patented formulation. The product contains no hazardous air pollutants, no ozone-depleting chemicals and no suspected carcinogens. Soysolv® Graffiti Remover is non-flammable and 100% bio-degradable. *Contact: Soysolv®, USA. Tel: +1-877-769-7658.*

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

Drop-in replacement for trichloroethylene

Developed by Enviro Tech International, the United States, the 'EnSolv' consists of stabilized n-propyl bromide solvent with KB value of 130, which can be used in existing vapor degreasing equipment with only minor alterations to programs and temperature settings. Non-flammable product offers mid-range temperature operation, low GWP, and biodegrades readily in environment. Available as replacement for HCFC-225, EnSolv NEXT high-trans, fluorinated solvents feature KB value of 91, zero ODP, and low GWP.

EnSolv is a direct, drop-in replacement solvent for TCE that can be used in existing vapor degreasing equipment with only minor alterations to programs and temperature settings. EnSolv is a stabilized n-propyl bromide solvent with a superior KB value of 130, which is very comparable to TCE (129). In most cases, EnSolv will clean parts as well or better than TCE, making the transition to EnSolv virtually seamless.

Enviro Tech has addressed these customers directly by introducing the EnSolv NEXT line of high-trans, fluorinated solvents. EnSolv NEXT has a number of benefits over similar high-trans fluorinated solvents like DuPont Vertrel, 3M Novec and others, in addition to being a viable alternative to chlorinated solvents or nPB solvents. EnSolv NEXT has one of the highest solvency ratings of all of the high-trans fluorinated alternative solvents. *Contact: Enviro Tech International, Inc., 1800 N. 25th Ave., Melrose Park, IL, 60160, USA.*

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

Bio-based solvent technology

WC Vision LLC and Amyris, Inc., the United States, has announced a new relationship whereby Amyris's high-performance cleaning brand, Muck Daddy™ has been named the official hand cleaner of the PWC racing series. Muck Daddy, developed by Amyris's biochemists for more than decade, is a breakthrough line of high-performance cleaning products based on Amyris's proprietary Myralene™ 10 solvent, a revolutionary ingredient positioned to replace harsh petroleum- and limonene-based solvents.

Muck Daddy's first release, the High Performance Hand Cleaner, is USDA Certified Biobased and formulated with industrial workers' needs and wellness in mind. Muck Daddy's Scrubbing Wipes, another innovative product in the brand's line, can be used to clean oily, greasy dirt off hands as well as tools, parts and surfaces. Muck Daddy hand cleaners also contain Amyris's premium skincare ingredient, Neossance® squalane, to moisturize and improve the condition of hands. *Contact: Amyris, Inc., 5885 Hollis Street, Ste. 100, Emeryville, CA 94608, USA. Tel: +1-510-450-0761; Fax: +1-510-225-2645.*

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

VOC-compliant alternative solvent

TBF Environmental Technology Inc., Canada, a world leader in the development of environmentally-friendly industrial solvents, has announced that BerdeSol™ – the company's latest Volatile Organic Content (VOC)-compliant alternative – is now commercially available. This is the third of three major

announcements from TBF in recent months, who late last year, also released two other industry-changing VOC-compliant alternatives ShiraSol™ and KradaSol™.

BerdeSol can replace slow-evaporating conventional solvents like Heptane, Aromatic 100, Cyclohexane, Methyl Amyl Ketone (MAK), Perchloroethylene, and Butyl Acetate. Not only does BerdeSol perform similarly to these solvents, it also eliminates the emission of VOCs and other toxic pollutants. In its continuing efforts to improve Southern Californian air quality, the South Coast Air Quality Management District (SCAQMD) has created a new class of Clean Air Solvents (CAS) for solvents which, among other criteria, contain no more than 25 grams of VOC per liter of material.

SCAQMD has certified BerdeSol as a Clean Air Solvent. In addition, independent ASTM 313-91 testing has confirmed BerdeSol is VOC-compliant throughout the United States and Canada. TBF solvents do not contribute to ozone creation or depletion. All TBF solvents reduce the risk to the health and safety of workers by replacing conventional toxic solvents. *Contact: TBF Environmental Technology Inc., 12255 King George Boulevard, Surrey, British Columbia, Canada V3V 3K2, Tel: +1 604-580-1575; E-mail: info@tbfenvironmental.com.*

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

Solvent recycling systems

CBG Technologies, the United States, has introduced the PW Series Solvent Recycling Systems, specifically designed for precision parts cleaning. The PW series offers full integration with new and

existing vapor degreasers, parts washers and ultrasonic cleaning systems. This integration produces consistently-fresh solvent through continuous recycling and recovers 100% of the solvent for reuse.

Precision parts manufacturers benefit from this progressive and environmentally-friendly equipment line, which streamlines the production process. Using consistently clean solvents eliminates repeat runs caused by rejected parts. The PW Series also reduces production costs by virtually eliminating the expense related to the purchase of new solvents and waste disposal.

Available in 15 and 30-gallon sizes, the PW Series delivers a recycled solvent that will meet specification requirements. All models are UL 2208 and CSA certified. The PW Series is fully-automated and features all-metal construction with a dual wall 304 stainless steel processing tank. *Contact: Nancy Isom, CBG Technologies, 2211 Lake Club Drive, Columbus, Ohio 43232, USA. Tel: +1-800-941-9484; E-mail: pwseries@cbgtechnologies.com.*

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



PW series solvent recycling system

Bio-based organic cleaner

Corrosion Technologies Corporation, the United States, claims to have developed a fast-acting bio-based degreaser with no ODSs. The N'Viro Solve is an organic cleaner made from various plant and fruit derivatives. This naturally occurring degreaser removes baked-on oil deposits, as well as heavy grease, from painted and unpainted surfaces. The cleaner takes the place of the flammable and carcinogenic cleaners that are often used to remove oil/grease based belly grime and stains from aircraft surfaces. The product features following characteristics:

- Dissolves oily buildup that other types of degreasers can't touch;
- Dilutes with, and rinses easily with, water; and
- Contains no chlorinated or petroleum-based solvents.

The cleaner has many applications in several industries such as agriculture, aviation, concrete, construction, marine and mining. Some key applications include:

- Cleaning and degreasing engines;
- Removing belly grime and stains from aircraft;
- Cleaning and maintaining ground equipment; and
- Cleaning and degreasing tractors, spray rigs and earth moving equipment.

Contact: Corrosion Technologies Corporation, P.O. Box 551625, Dallas, TX 75355-1625, USA. Tel: +1-972 271 7361; Fax: +1-972 278 9721; E-mail: info@corrosionx.com

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

Water mist extinguishers for spacecrafts

The International Water Mist Association's supporting member The Colorado School of Mines, the United States, along with ADA technologies, the United States, have developed water mist Portable Fire Extinguishers (PFEs) for spacecraft applications. In December 2015 two of nine units were sent to the International Space Station (ISS). "The water mist fire extinguishers will replace the carbon-dioxide units which had been on board so far. There will be three more launches in spring to carry the other seven units to the ISS," said Dr. Angel Abbud-Madrid, at Center for Space Resources.

Dr. Angel Abbud-Madrid is planning to come to the 16th International Water Mist Conference in Vienna, Austria, on 21st and 22nd September 2016 to give a presentation on the mentioned portable fire extinguishers. The payload consists of the first two (out of a total of nine) water-mist PFEs, which will replace carbon-dioxide extinguishers currently on the International Space Station. Three additional missions in the spring will launch the remaining PFEs, including two missions with SpaceX and one more with Orbital ATK.

After several years of research, testing, and conducting experiments on a variety of NASA flight facilities (including drop towers, low-gravity aircraft, and a Space Shuttle experiment in 2003), the Mines researchers and their students found water-mist fire suppression technology to be more efficient and suitable for putting

out spacecraft fires than any other suppression agent.

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

Water mist firefighting systems

Advanced Firefighting Technology (AFT), Germany, has applied advanced aerodynamics technology from flow engineering applications involving liquid/gas mixtures to create AFT water mist firefighting systems. The AFT technology creates a narrow distribution of ultra-fine water mist, foam or CAFS using speciality nozzles. The droplets create an enlarged surface area (almost 50 times) as compared to a conventional water tender. This results in rapid cooling due to extensive heat absorption and the resultant steam generated expands 1640 times in volume thus inserting the atmosphere around the fire. The combined effect of cooling and blanketing results in effective rapid extinguishing.

Using the atomization technology, the water mist is developed by using the kinetic energy of compressed air and mixed with the liquid in specially designed multiple nozzle systems. Atomisation works with compressed air to pressurise the system, propell the liquid and mix it with the liquid for creating mist. Atomisation creates water mist in the range between 100-150 μm which results in 40 times more cooling as compared to conventional water spray of diameter 5000 μm . Contact: *Advanced Firefighting Technology GmbH, Heggenkamp 15, D-49163 Bohmte, Germany. Tel: +49-5471-97307-0; Fax: +49-5471-97307-20; E-mail:*

info@aftgmbh.com.

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

Targeted fire-fighting mist jet

Tech firm Plumis, the United Kingdom, has developed Automist Smartscan system to target fire-fighting water mist jet on areas where fire is present. As a result, the system reportedly uses 90 percent less water, causing much less water damage while offering the same fire-fighting performance as ceiling systems.

First of all, a single ceiling-mounted device senses when there's excessive heat in the room. This activates the wall unit, causing it to scan the room with its infrared pyrometer. When it detects the hottest point in the room, it shoots a stream of water mist at that location, continuing to do so until the heat signature lessens to the point that it no longer poses a threat.

The wall unit can apparently be installed much more easily than a ceiling sprinkler system. It doesn't require its own water tank or additional piping, instead just running off the existing water system via a 3/4-inch hose attachment. Additionally, it's only 50 mm (2 in) deep, so not much behind-the-wall room is necessary.

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

Twin-fluid hybrid fire suppression

Research has showed that combining cooling and oxygen dilution could be even more effective than either one alone. Victaulic Company, the United States, has achieved this com-

bination with the use of nitrogen gas to atomize the water and act as a particle carrier to penetrate fire plumes. The Victaulic team focused on a method of injecting the atomized droplets into a nitrogen "down-blast" to penetrate into fire plumes to get to the root of the fire for more efficient cooling using smaller than typical droplets, which collectively present a greater surface area.

The larger the surface area, the faster that heat may be absorbed. A high rate of heat absorption reduces the risk of fire propagation by reducing convective and radiative heat transfers. The Victaulic Vortex Fire Suppression System was the first to be approved in this FM category and because it uses a blend of inert clean agent gas and water mist, it is suitable for special hazard machinery spaces, turbine enclosures and flammable liquids. The Victaulic Vortex system uses a supersonic jet stream of nitrogen to atomize a low-pressure stream of water into sub-10-micron water droplets.

The droplets are as little as one 30th the size of water particles delivered by traditional water mist systems and provide as much as 50 percent more heat absorp-

tion and total extinguishing. As the water droplets are atomized, they are evenly mixed with the nitrogen molecules and discharged into the hazard space in homogeneous suspension. Typically, in other twin-fluid technologies, nitrogen is a propellant of another suppressing agent like water mist, but the Victaulic Vortex system uses the water mist and nitrogen as complimentary extinguishing agents. *Contact: Victaulic Company, 4901 Kesslersville Road Easton, PA 18040, USA. Tel: +1-610-559-3300.*

Source: <http://www.ifpmag.mdmpublishing.com>

Oxygen reduction to extinguish fire

Most research related to the aircraft fire safety is aimed at developing improved fire-resistant materials for aircraft interiors. Meanwhile, there is no efficient method in place to directly prevent, suppress or extinguish fire within a pressurized cabin. However Flame Guard USA has introduced FirePASS® which can be implemented in passenger aircraft in four modifications. FirePASS® technology is already being used for fuel tank fire & explosion prevention. FirePASS® can work as a sup-

pression system for installation on current airplanes that pressurize at altitudes above 1500 m, as a preventative measure for future aircrafts that will be pressurized on the ground or as a combination of both.

A fire onboard of an aircraft is easily extinguishable using a specially developed FirePASS-SC agent, which provides a safe environment inside aircraft. This system can store and release hypoxic fire suppression agent FirePASS-SC that will instantly suppress any fire without affecting passengers' ability to breathe. Upon its release, the agent floods the passenger cabin creating a human-breathable fire-extinguishing atmosphere. Aboard an aircraft pressurized at 2000 meters such an emergency atmosphere would correspond to an altitude of 4000 meters, which is absolutely safe for the time needed to localize the fire source and eliminate the possibility of a secondary ignition.

FirePASS® in prevention mode is designed for installation in future aircraft and space vehicles pressurized on the ground. The system creates an artificial atmosphere with fire-extinguishing properties that is maintained and constantly regenerated by an on-board air-regeneration or life-support system. This atmosphere contains 16% of oxygen, which corresponds in partial pressure to an altitude of 2200 m. and is absolutely safe for anyone. *Contact: Flame Guard USA, 4 Hillview Drive Units A&B, Lake Barrington, IL USA 60010. Tel: +1-855-377-2100; Fax: +1-847-387-3824; E-mail: info@flameguardusa.com.*

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



Vortex hybrid technology

Environmentally friendly chemical blowing agent

Scientists from Zibo Zhenghua Foam Materials and Shandong University of Technology, China, have jointly researched and developed a new type of chemical blowing agent of polyurethane rigid foam 'CFA-A8', which might help to replace the prevailing physical blowing agents that contain ODS and super greenhouse gases.

Already in February of last year at a technology evaluation meeting in Beijing, was the new organic compound reviewed by Chinese academicians. At that time Shu Xingtian, an academic at the Sinopec Research Institute of Petroleum Processing (RIPP), said that the sugar-based chemical produced no ODS and had a much lower GWP=1 than existing physical blowing agent.

The project received 1.8 million yuan funding support from the Multilateral Fund. This fund was established by the UNEP in 1991 to assist developing countries meet their Montreal Protocol commitments. In total, the company and the involved university have spent about 10 million yuan on research and promotion of the technology, including a joint research center.

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

New foam expansion agents

The Chemours Company, the United States, a global chemical company with leading market positions in titanium technologies, fluoroproducts and chemical solutions, has announced that, along with its partner Changshu 3F Zhonghao,

China, it has broken ground on the world's first full-scale production facility for HFO-1336mzz in China. This site, expected to begin production mid-year 2017, will provide increased capacity of low GWP foam expansion agents and refrigerants.

Foam expansion agents based on HFO-1336mzz, sold by Chemours as Formacel™ 1100, offer excellent environmental properties across a variety of applications, including appliances, spray foam and board stock. Formacel™ 1100 offers a range of benefits to help Chemours customers meet their long-term environmental needs. Formacel™ 1100 also offers superior stability compared to other olefin-based blowing agents, and its shelf life of up to 12 months allows customers to use the product with confidence over an extended period.

HFO-1336mzz is a preferred technology for many Opteon™ refrigerants due to its unique attributes of having low GWP, non-flammability, high efficiency and thermal stability. Chemours is actively developing several new refrigerant fluids based on HFO-1336mzz technology for a variety of applications, including traditional chiller systems and the emerging arena of waste heat recovery using technologies such as high temperature heat pumps. *Contact: Janet Smith, The Chemours Company, Global Communications Leader, USA. Tel: +1-302-773-4508; E-mail: janet.e.smith@chemours.com.*

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

Liquid foam blowing agent

Bayer Pearl, Dubai, has started using Honeywell's Solstice liq-

uid blowing agent (LBA) technology in its new polyurethane spray foam insulation to offer homeowners in the Middle East excellent thermal insulation performance and reduced energy consumption with lower global-warming impact. Honeywell, the United States, and Bayer Pearl have developed the new polyurethane spray foam system using the new blowing agent to be the most economical and competitive when assessed by performance and overall cost effectiveness.

Insulation made with Solstice LBA has been shown to provide 10 per cent better thermal insulation performance than hydrocarbon blowing agents and four per cent better performance than HFC-based insulation foam. Foam made with Solstice LBA meets the sustainability requirement of GWP less than five, as mandated under Estidama, a mandatory programme in Abu Dhabi which aims at constructing and operating buildings and communities more sustainably.

Blowing agents from Honeywell are being rapidly adopted in a wide range of applications, including spray foam insulation, household refrigerators and freezers, insulated architectural panels, and refrigerated shipping containers. Solstice LBA, which is based on HFO technology, has an ultra-low GWP of One, which is 99.9 per cent lower than blowing agents it replaces and equal to carbon dioxide. It is non-ozone-depleting and non-flammable. Solstice LBA has received Environmental Protection Agency (EPA) approval under the SNAP programme.

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

Irradiation preserves blueberry, grape quality

A study done by researchers at Chapman University, the United States, and published in the American Society for Horticultural Science reveals that irradiation can also be effective for treating blueberries and grapes for export without compromising fruit quality. 'Star', 'Jewel', and 'Snowchaser' blueberries and 'Sugraone' and 'Crimson Seedless' grapes were irradiated at a target dose of 400 Gy (range of 400-590 Gy for blueberries and 400-500 Gy for grapes) and stored for 3 and 18 days under refrigeration, plus 3 days at ambient temperatures. "This experiment was designed to simulate the time of ground transport (from California) to Mexico and sea transport from California to Asia," the scientists explained.

The fruit was then evaluated for soluble solids concentration, titratable acidity, and weight loss. With respect to these quality attributes, the results showed differences among fruit varieties, but the researchers found treatment effects to be "not significant." The study also involved sensory tests in which consumers evaluated the fruit on appearance, flavor, texture, and overall "liking." Firmness was the primary attribute affected by irradiation for both varieties of grapes, but sensory testing showed that consumers did not have a preference for control or irradiated fruit.

"However, sensory scores for flavor were higher for the irradiated berries than the control berries after storage, suggesting a decline in quality of the control blueberries with time," the scientists not-

ed. The authors said the research showed that (in terms of quality) irradiation at 400 Gy can maintain blueberry and table grape quality sufficiently to meet transportation, distribution, and storage needs for overseas markets. "Our results show that both blueberries and grapes have a high tolerance for phytosanitary irradiation and that storage affects their quality more than irradiation treatment," they concluded.

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

Fumigation for postharvest pest control

Researchers at U.S. Department of Agriculture (USDA), Agricultural Research Service (ARS), have found that nitric oxide fumigation is effective against all arthropod pests at various life stages tested. Nine insect pests at various life stages and bulb mites were subjected to nitric oxide fumigation treatments under ultralow oxygen conditions of

≤ 50 ppm O_2 in 1.9L glass jars as fumigation chambers. The insect species are codling moth, confused flour beetle, Indian meal moth, lettuce aphid, light brown apple moth, long-tailed mealybug, spotted wing drosophila, and western flower thrips. The nine insect species represent different body sizes, taxonomical groups, host materials (fresh plants vs stored products), and feeding habits (external vs internal) of the pests.

Nitric oxide concentrations, treatment times, and temperatures varied by species and life stages due to variations among different pest species and life stages in susceptibility to nitric oxide fumigation. Complete control of all pest species at various life stages was achieved. In general, smaller soft body insects such as aphid and thrips are more susceptible to nitric oxide fumigation than larger insects such as lepidopteran larvae and hard body insects such as beetle and weevil. Eggs are more tolerant to nitric oxide fumigation than other life



Blueberries ready to enter the x-ray unit at the irradiation facility
(Credit: Anuradha Prakash)

stages. The efficacy of nitric oxide fumigation increases with CxT (Concentration x Time) product increases and is also positively related to temperature.

The treatment for small soft body insects can be as short as 2 h at low temperatures for cold storage of fresh products. Longer treatments of 24-48 h may be needed for eggs of stored product insects depending on nitric oxide concentration and temperature. Data suggests that nitric oxide fumigation has the potential to control most insect pests and mites at various life stages. Nitric oxide fumigation was also found to improve postharvest quality of strawberries in comparison with controls. This can bring important benefits to some delicate fresh products with short shelf-life. Results suggest that nitric oxide fumigation has potential to be an effective and safe alternative treatment for postharvest pest control on fresh commodities.

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

Sulfuryl fluoride to control insects

Researchers at Oklahoma State University (OSU), the United States, conducted a field experiment in eight 13.6-MT steel bins containing 6.8 MT each of wheat to assess efficacy of sulfuryl fluoride (SF) control phosphine-resistant and susceptible *Rhyzopertha dominica* (F.) and *Tribolium castaneum* (Herbst). Approximately 400 adults of each type of beetle were added to each bin. Additionally, muslin bags containing immature stages and adults, with their respective diets, were also placed in bins. Four bins were fumigated with SF and four bins were untreated con-

trols. The SF dosages in treated bins ranged from 1,196–1,467 mg-h/liter. Mortality of adults in each bag was assessed 5 d post-fumigation. Diet minus adults from each bag were incubated in a jar, and number of adults counted after 8 wk.

Insect Damaged Kernels (IDK) were assessed pre-fumigation and up to 6 wk post-fumigation. No significant change occurred in number of IDK of wheat in SF-treated bins. A significant increase in IDK occurred in wheat in untreated bins. In trier samples from SF-treated bins, *R. dominica* numbers declined from 24 pre-fumigation to 0 at 3 and 6 wk post-fumigation; *T. castaneum* numbers were very low and were unchanged. In the trier samples for untreated bins, *R. dominica* numbers were not significantly different for the three sampling periods and *T. castaneum* numbers increased significantly 3 and 6 wk postfumigation.

In WBII traps from SF-treated bins, numbers *R. dominica* and *T. castaneum* declined from 25 and 33, respectively, pre-fumigation to 0 or near 0 at 3 and 6 wk postfumigation. In WBII traps from untreated bins, the mean numbers of *R. dominica* and *T. castaneum* increased significantly from 1 wk pre-fumigation to 3 wk and 6 wk post-fumigation. Mortality of adults in each muslin bag was assessed 5 d post-fumigation. Diet minus adults from each bag were incubated in a jar, and number of adults counted after 8 wk. Results show SF is effective against all life stages of highly phosphine-resistant *R. dominica* and *T. castaneum*, and can be used for phosphine resistance management.

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

Researchers study integration of biofumigation

In a study done by researchers at Institute of Agricultural Resource and Environment, Jiangsu Academy of Agricultural Sciences, China, soil biofumigation with brassica plant residues suppresses soilborne plant pathogens. However, few studies reported the impact of biofumigation, especially combining biofumigation with antagonistic microbes, on disease incidence of Phytophthora blight of pepper and soil bacterial community structure. Biofumigation (BF) and combining biofumigation with antagonistic bacillus amyloliquefaciens strain BS211 (BF+BS211) were tested to control the pepper disease caused by Phytophthora capsici at 0, 15 and 20 days after biofumigation (DAB) under controlled conditions. BF+BS211 treatment showed the lowest disease incidence among these treatments.

Real-time PCR and denaturing gradient gel electrophoresis (DGGE) were used to investigate the microbial effects, and the results indicated that the BF and BF+BS211 treatments affected certain microbial populations and increased soil bacterial diversity, which might play significant roles in the suppression of Phytophthora blight of pepper. There was a negative correlation between soil bacterial diversity and disease incidence. Cloning of the bacterial community showed that the bacterial community structures were altered by BF and BF+BS211 treatments. These findings suggested that disease control could be improved by this integrated approach.

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

National Certification Schemes for RAC Servicing Technicians

This publication aims to provide introductory information for institutions in developing countries to better understand the issue of certification in the field of refrigeration and air conditioning, to assist in the creation of such certification and training schemes and to demonstrate to service technicians and enterprises why it is in their interest to participate. The publication can be of interest to the general public to better understand the importance of certification in ensuring the installation of safe and reliable equipment and provision of quality services through adherence to applicable standards.

Informal Prior-Informed Consent (iPIC) – Supporting Compliance through Prevention of Illegal and Unwanted Trade in ODS

This short booklet briefly describes how the iPIC system works and its advantages, it provides some information on results and successes from iPIC in 2014 and encourages countries which are not yet members to join and to begin to reap the benefits of this initiative. This initiative was developed in order to better manage trade in ozone depleting substances (ODS) that are controlled under the Protocol.

For the above two books, contact: UNEP DTIE OzonAction, 15 rue de Milan, 75441 Paris CEDEX 09, France. Tel: +331-4437-1450; Fax: +331-4437-1474; E-mail: ozonaction@unep.org

Polymeric Foams: Innovations in Processes, Technologies, and Products

This book offers the latest in processes, technologies, and products related to polymeric foams. It covers business development trends, novel processes, new and environmentally friendly blowing agents, and the development and usage of various types of foams (bead and polycarbonate, polypropylene, polyetherimide microcellular, and nanocellular). It also covers flame-retardant foams, rigid foam composites and foam sandwich composites.

Contact: Bookpoint, 130 Milton Park, Abingdon, Oxon OX14 4SB, UK. Tel: +44-1235-400-400; Fax: +44-1235-400-401; E-mail: book.orders@tandf.co.uk

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