



Apprise yourself with the latest technological innovations

Highlights

- Nanowire material for cooling
- Natural refrigerant cooling system
- Flux remover for vapor degreasing
- Eco-friendly fire protection technology
- Foam extrusion with solid phase CO₂
- Biofungicides as alternative fumigants



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

Researchers working at GE Appliances' labs on magnetocaloric refrigeration technology that can replace traditional compressors used in refrigerators.

(Credit: GE)

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* Value Added Technology Information Service

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Measuring nitrous oxide emissions

Researchers from the University of Eastern Finland, the University of Helsinki, Finland and the Natural Resources Institute, Finland, have applied the eddy covariance technique combined with the most-modern laser technology in the market to measure nitrous oxide emissions from a field where a bioenergy crop was cultivated (Maaninka, Eastern Finland). In the early summer, the nitrogen availability in the soil was high after the nitrogen fertilization. Nitrous oxide emissions were high during this time. The emissions, however, had significant diurnal variation. The emissions were higher during daytime than during night time.

The researchers explained these results by the variation in soil temperature and moisture. Later in the growing season when the effect of nitrogen fertilization diminished, the diurnal variation in the emissions changed surprisingly. Then the emissions were higher during night time. Excluding the diurnal variation in nitrous oxide emissions causes inaccuracies in the annual emission estimates. The results support the development of reliable measuring methods for nitrous oxide emissions and improve our understanding of the nitrous oxide emission mechanisms and their controlling factors.

Competition for soil nitrogen between plants and microbes has a crucial role for the nitrous production in the soil. When soil nitrogen availability is low, nitrous oxide emissions are higher during night-time than during daytime because plants do not consume soil nitrogen at night and more nitrogen is available for microbes and their nitrous oxide production. Stable isotope experiments with labelled nitrogen fertilizer additions confirmed the higher night

time emissions observed by the eddy covariance technique. The results have been published in the scientific journal *Scientific Reports*.

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

Ozone variability in the stratosphere

A team of researchers from Université Libre de Bruxelles (ULB), Belgium, National Center for Atmospheric Research, the United States, Sorbonne Universités, France, and Institute of Technology, Cambridge, the United States, assessed how daily ozone (O_3) measurements from the Infrared Atmospheric Sounding Interferometer (IASI) on the MetOp-A platform can contribute to the analyses of the processes driving O_3 variability in the troposphere and the stratosphere and, in the future, to the monitoring of long-term trends.

The temporal evolution of O_3 during the first 6 years of IASI (2008-2013) operation is investigated with multivariate regressions separately in four different layers, by adjusting to the daily time series averaged in 20° zonal bands, seasonal and linear trend terms along with important geophysical drivers of O_3 variation (e.g. solar flux, quasi-biennial oscillation (QBO)). The regression model is shown to perform generally very well with a strong dominance of the annual harmonic terms and significant contributions from O_3 drivers, in particular in the equatorial region where the QBO and the solar flux contribution dominate.

More particularly, despite the short period of the IASI data set available up to now, two noticeable statistically significant apparent trends are inferred from the daily IASI measurements: a positive trend in the upper stratosphere, which is consistent with other studies suggesting a turnaround for stratospheric O_3 recovery,

and a negative trend in the troposphere at the mid-latitudes and high northern latitudes, especially during summer and probably linked to the impact of decreasing ozone precursor emissions. The research findings have been published in *Atmospheric Chemistry and Physics*.

Source: <http://www.atmos-chem-phys.net>

Relative contribution of Antarctic ozone depletion

A team of researchers from East China Normal University, China, University of Central Florida and Colorado State University, the United States, carried out precipitation observations in the Southern Hemisphere which indicated an apparent moistening pattern over the extratropics during the time period 1979 to 2013. To investigate the predominant forcing factor in triggering such an observed wetting climate pattern, precipitation responses to four climatic forcing factors, including Antarctic ozone, water vapor, sea surface temperature (SST), and carbon dioxide (CO_2), were assessed quantitatively in sequence through an inductive approach.

Coupled time-space patterns between the observed austral extratropical precipitation and each climatic forcing factor were firstly diagnosed by using the maximum covariance analysis (MCA). With the derived time series from each coupled MCA modes, statistical relationships were established between extratropical precipitation variations and each climatic forcing factor by using the extreme learning machine. The research has been published in the *Journal of Geophysical Research: Atmospheres*.

Based on these established statistical relationships, sensitivity tests were conducted to estimate

precipitation responses to each climatic forcing factor quantitatively. Quantified differential contribution with respect to those climatic forcing factors may explain why the observed austral extratropical moistening pattern is primarily driven by the Antarctic ozone depletion, while mildly modulated by the cooling effect of equatorial Pacific SST and the increased greenhouse gases, respectively.

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

Impacts of stratospheric ozone depletion

A team of Chinese researchers from Lanzhou University, Nanjing University of Information Science & Technology and Beijing Normal University, used a state-of-the-art general circulation model to study the impacts of the stratospheric ozone depletion from 1980 to 2000 and the expected partial ozone recovery from 2000 to 2020 on the propagation of planetary waves in December, January, and February. In the Southern Hemisphere (SH), the stratospheric ozone depletion leads to a cooler and stronger Antarctic stratosphere, while the stratospheric ozone recovery has the opposite effects.

In the Northern Hemisphere (NH), the impacts of the stratospheric ozone depletion on polar stratospheric temperature are not opposite to that of the stratospheric ozone recovery; i.e., the stratospheric ozone depletion causes a weak cooling and the stratospheric ozone recovery causes a statistically significant cooling. The stratospheric ozone depletion leads to a weakening of the Arctic polar vortex, while the stratospheric ozone recovery leads to a strengthening of the Arctic polar vortex. The cooling of the

Arctic polar vortex is found to be dynamically induced via modulating the planetary wave activity by stratospheric ozone increases.

In the SH, the radiative cooling (warming) caused by stratospheric ozone depletion (recovery) produces a larger (smaller) meridional temperature gradient in the midlatitude upper troposphere, accompanied by larger (smaller) zonal wind vertical shear and larger (smaller) vertical gradients of buoyancy frequency. Hence, there are more (fewer) transient waves propagating into the stratosphere. The dynamical warming (cooling) caused by stratospheric ozone decreases (increases) partly offsets their radiative cooling (warming). The research findings have been appeared in the *Journal of Geophysical Research: Atmospheres*.

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

Signs of healing in the Antarctic ozone layer

Scientists at MIT in the United States and elsewhere have identified the “first fingerprints of healing” of the Antarctic ozone layer, published today in the journal *Science*. The team found that the September ozone hole has shrunk by more than 4 million square kilometers — about half the area of the contiguous United States — since 2000, when ozone depletion was at its peak. The team also showed for the first time that this recovery has slowed somewhat at times, due to the effects of volcanic eruptions from year to year. Overall, however, the ozone hole appears to be on a healing path.

The authors used “fingerprints” of the ozone changes with season and altitude to attribute the ozone’s recovery to the continuing decline of atmospheric chlorine

originating from chlorofluorocarbons (CFCs). These chemical compounds were once emitted by dry cleaning processes, old refrigerators, and aerosols such as hairspray. In 1987, virtually every country in the world signed on to the Montreal Protocol in a concerted effort to ban the use of CFCs and repair the ozone hole.

“We can now be confident that the things we’ve done have put the planet on a path to heal,” says lead author Susan Solomon, the Ellen Swallow Richards Professor of Atmospheric Chemistry and Climate Science at MIT. “Which is pretty good for us, isn’t it? Aren’t we amazing humans, that we did something that created a situation that we decided collectively, as a world, ‘Let’s get rid of these molecules’? We got rid of them, and now we’re seeing the planet respond.”

The researchers tracked the yearly opening of the Antarctic ozone hole in the month of September, from 2000 to 2015. They analyzed ozone measurements taken from weather balloons and satellites, as well as satellite measurements of sulfur dioxide emitted by volcanoes, which can also enhance ozone depletion. And, they tracked meteorological changes, such as temperature and wind, which can shift the ozone hole back and forth. They then compared their yearly September ozone measurements with model simulations that predict ozone levels based on the amount of chlorine that scientists have estimated to be present in the atmosphere from year to year. The researchers found that the ozone hole has declined compared to its peak size in 2000, shrinking by more than 4 million square kilometers by 2015.

This research was supported, in part, by the National Science Foundation and the U.S. Department of Energy.

Source: <http://news.mit.edu>

Audit of HCFC production facilities

India is the second largest producer of HCFC-22 among the Article 5 countries in the world. There are 5 production facilities of HCFC-22 in the country. These plants are now producing only HCFC-22, since production and consumption of CFCs have already been phased-out from 1st January 2010. The country has also successfully achieved the freeze of HCFC production and consumption as on 1.1.2013 and 10% phase-out of the baseline of production and consumption of HCFCs as on 1.1.2015 in line with the accelerated phase-out schedule of the Montreal Protocol.

The phase-out of production of HCFC-22 in India is being monitored closely. It has been proposed to carry out an audit of the 5 HCFC-22 production facilities in India to analyze the pricing trends of HCFC-22. The objective of the audit is to analyze the pricing trends of domestically produced HCFC-22 for the past 5 years for all the 5 HCFC-22 production plants in the country, both for individual plant as well as for national production, taking into account the international price trend of HCFC-22.

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

Workshop on safety standards for hydrocarbons

Hydrocarbons have come up as a major contender for replacing HFCs in the current phase-down. Hydrocarbons are long-term refrigerants without any uncertainty with respect to emerging environmental regulations. These gases, in addition to having low-global warming potential (GWP), are also

freely available and have higher energy efficiency than traditional f-gases. This means that in addition to the direct emissions from HFCs, a switch to hydrocarbons will also save on indirect emissions from the high energy efficiency offered by these refrigerants.

In order to address the restrictive nature of the safety standards, the Centre for Science and Environment (CSE) organised a workshop on developing appropriate safety standards for hydrocarbon refrigerants in the RAC sector on April 26-27. The workshop brought together experts from all over the world working in the field of Refrigeration and Air-conditioning (RAC). These experts came together to articulate the specific issues that need to be addressed in order to develop an Indian standards (BIS) for use of hydrocarbons in RAC sector.

The workshop included presentations on the current state of international negotiations and the benefits from the use of hydrocarbon-based refrigerants, barriers to switching from f-gas to hydrocarbon-based RAC systems in India and the international state of standards and changes needed for wide scale implementation of hydrocarbon refrigerants in India. The presentations were followed by breakout sessions, where the changes needed in the international standards were discussed and articulated.

Source: <http://www.downtoearth.org.in>

Pilot plant for HFO refrigerant

SRF, India, has announced its intention to set up an R1234yf

production plant. SRF is in process to set up a pilot plant for the new low-global warming potential (GWP) HFO refrigerant which is the only current option to replace R134a in car air conditioning systems. The initiative will make SRF the first technology developer outside US and Europe for the manufacture of R1234yf.

SRF started producing fluorochemicals in 1989 by manufacturing refrigerants from its plant at Bhiwadi in Rajasthan, India. In the mid-90s it became the first company in India to have indigenously-developed the technology to manufacture R134a and R32. SRF remains the only producer of HFC 134a in India and has recently commissioned its HFC 32 plant, again with its own technology. Earlier, Honeywell, the United States, announced it had entered into a supply and technology license agreement with fellow Indian manufacturer Navin Fluorine International (NFIL), India, to produce R1234yf in India.

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

Trade names of chemical products containing ODS and their alternatives

This service is designed to help customs officials and National Ozone Units control imports and exports of ozone depleting substances (ODS) and prevent their illegal trade. It is a world-wide database of the commercial trade names of chemical products containing ODS controlled under the Montreal Protocol and their alternatives.

For more information, access:

<http://www.unep.org/ozonaction/InformationResources/Tradenames/>

Plans for stronger ozone protection

The 76th meeting of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol (MP) was held in Montreal, Canada from May 8-13. Together with representatives from the Foreign Economic Cooperation Office (FECO), Ministry of Environmental Protection (MEP), China Refrigeration and Air-Conditioning Industry Association (CRAA), the United Nations Development Programme (UNDP) China participated in the meeting and submitted 3 HCFC Phase-out Management Plans (HPMP) and one demonstration project proposal to the Ozone secretariat on behalf of the Chinese government.

As one of the four implementing agencies for the Multilateral Fund for the Implementation of the MP, UNDP has been assisting China to fulfill its commitment on reducing the ozone depleting substances (ODS) since 1994. Together with FECO, the main government agency in charge of MP implementation in China, UNDP projects have phased out 8450 metric tons of HCFC in the Industrial and Commercial Refrigeration and Air Conditioning (ICR) sector, and have collectively helped China reduced the HCFC consumption to 2617.7 ODS tons and reached its aimed target by 2015.

As the world biggest for HCFCs production and consumption country, China has made great commitment to comply with the Protocol and promised a big plan for the HCFCs Phase-out Stage II in terms of the phase-out volume and financial support. The newly

submitted HPMPs for the next 5 years for the over-arching sector plan, as well as the ICR sector and Solvent sector, will contribute to China's overall HCFCs Phase-out Management Plan to achieve the 35% HCFCs consumption reductions by 2020.

Source: <http://www.cn.undp.org>

New air-conditioner technology in Thailand

Saijo Denki, Thailand, in partnership with the World Bank Group and the Montreal Protocol Multilateral Fund (MLF), has launched a new technology for air conditioners that is friendly to the ozone layer and reduces greenhouse gas emissions and saves energy. The new refrigerant known as R-32 does not deplete the stratospheric ozone layer and also cuts greenhouse gas impacts in residential air conditioners by one-third. If similar air conditioning technology were widely adopted in other markets, it could help countries to significantly meet their climate goals.

"We welcome the initiative of the Thai private sector in turning the challenges of protecting the global environment into business opportunities. The success of re-designed R-32 air conditioners is testament to the strong policy and leadership of the Thai Government to protect the environment and strengthen private sector innovation. Countries such as Thailand can consider adopting a procurement policy that demands or favors the use of ozone and climate friendly products, in order to promote the further development and use of such products," said Ulrich Zachau,

World Bank Country Director for Thailand.

According to Saijo Denki, re-designed R-32 air-conditioners are 5 to 10 percent more energy efficient and have a cooling capacity that is 10 percent higher than older models. With this technology breakthrough, the Thai company is in a good position to develop higher energy efficient and cost competitive products, while consumers will benefit from reduced energy costs when using these new products. Most importantly, the new models do not consume ozone depleting substances and do not adversely affect the climate.

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

Multilateral fund for Pakistan

The Multilateral Fund of the Montreal Protocol has approved US\$5.68 million for the conversion of foam manufacturing industries to cleaner technologies in Pakistan. The funding was approved by the fund's executive committee. It will help Pakistan reduce its consumption of hydro chlorofluorocarbons (HCFC) by 50 per cent in 2020, and with full implementation of the plan, it will prevent the emissions equivalent of 685,000 tonnes of carbon dioxide (CO₂).

Pakistan has successfully reduced use of various Ozone Depleting Substances (ODS), including chlorofluorocarbons (CFC) and carbon tetrachloride (CTC). The Ministry of Climate Change (MoCC) has been working on the second phase-out programme of HCFCs since 2011. The phasing-out of HCFCs from Pakistan is ascertained through Hydro chlorofluorocarbon Phase-out Management Plan

(HPMP). In the first phase of the plan, the five foam manufacturing industries were converted to ozone friendly technology by 2015.

According to the Ministry, alternative technologies had been carefully selected to carry out the HCFC phase-out and to maximize the climate benefit. After successful completion of the first phase last year, Ministry of Climate Change prepared the phase two document in consultation with stakeholders. The plan will be implemented by the government in collaboration with the United Nations Industrial Development Organisation (UNIDO) and the United Nations Environment Programme (UNEP).

Source: <http://www.tribune.com.pk>

Partnership to produce 1234yf

Honeywell, the United States, has entered into a supply agreement with Juhua Corp., China, to produce Honeywell Solstice® yf (HFO-1234yf), further extending its global supply base for this low-global warming potential (GWP) hydrofluoroolefin refrigerant. Under a multi-year agreement, Juhua Corp. will manufacture Solstice yf in China for Honeywell, and Honeywell will market and sell the product to customers in the United States and Europe. Production is expected to begin by the end of 2016.

According to Honeywell, in addition to helping to meet worldwide demand, production in China can help support the future adoption of Solstice yf in the region. The additional production will complement capacity currently being built by Honeywell in the U.S. Honeywell says Solstice yf, with a GWP of less than 1, is a near drop-in replacement for R-134a, a hydro-

fluorocarbon (HFC) with a GWP of 1,300. R-134a has been widely used as a refrigerant in automobiles and mobile applications, but Honeywell said Solstice yf is also being used in a growing number of stationary air conditioning and commercial refrigeration applications.

Honeywell said the agreement is in line with the company's commitment to meet growing demand through a robust and diversified global supply infrastructure. According to Honeywell, the company and its suppliers are investing approximately \$300 million to increase global production capacity for Solstice yf, including the construction of a new, world-scale manufacturing plant using new process technology at the company's existing Geismar, the United States, refrigerants manufacturing site.

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

RAC industry expo in China

At a global exhibition held in China, the latest refrigeration and air-conditioning (RAC) technologies were displayed. The Asia-Pacific RAC industry also reviewed challenges it faces as it moves beyond phasing out ozone-depleting substances towards new generation climate-friendly and energy-efficient alternatives. It also engaged industry decision-makers in discussions on the availability, affordability and need for alternative technologies, especially the readiness of the servicing sector for such technologies and refrigerants.

Organised by the China RAC Industry Association with support from the United Nations Environment Programme (UNEP) OzonAction, the 13th Ozone2Climate event was visited by more than 40,000 people from around the world. For the

first time, the Roadshow also showcased achievements of the RAC servicing sector. Six Chinese vocational schools offering RAC training participated in the Roadshow.

Participants in the 13th Ozone2Climate event reviewed progress in the RAC industry's contribution to implementing the Montreal Protocol and the relevant policies, regulations and standards for alternative refrigerants. They also learned about China's progress in implementing its HCFCs phase-out management plan. The Ozone2Climate event was the 13th to be held since the inaugural event held in May 2011 in Male, Maldives and was supported by the UNEP OzonAction Compliance Assistance Programme.

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

ODS awareness programme in Pakistan

The UNEP conducted the Customs/Enforcement officers training programme in Pakistan to create awareness about Ozone layer and ozone depleting substances (ODS) and measures to protect the Ozone layer. Trends in illegal trend of ODS, importance of Ozone layer and exchange of information, Do's and Don'ts in this regard were discussed at these sessions. The awareness campaign comprised of three seminars of which one was already held in Karachi, second in Lahore on April 27, 2016 and in Islamabad on April 29, 2016. Customs, Coastguards and Police officers attended these sessions and a total of 90 officers attended each seminar.

Source: <http://www.customnews.pk>

US EPA SNAP lists R123 alternatives

The US Environmental Protection Agency (EPA) has Significant New Alternatives Policy (SNAP)-listed two new R123 alternatives and expanded the acceptable uses of R513A and CO₂ in air conditioning and refrigeration. A determination of acceptability, listed in Federal Register, has expanded the list of acceptable substitutes under the EPA's SNAP programme. Already listed as acceptable as a foam blowing agent, the HFO 1336mzz(Z) is determined to be acceptable in centrifugal chillers, positive displacement chillers and industrial process air conditioning.

This is in new equipment specifically designed for use of 1336mzz(Z) and not as a retrofit. It is, however, deemed acceptable for use in new and as a retrofit gas in non-mechanical heat transfer applications. Developed by Chemours, the United States, HFO 1336mzz(Z) has been seen as a potential replacement for R123. It has a 100-year GWP of about nine. HFO1336mzz(Z) is also to be found in another new Chemours blend deemed acceptable under the SNAP regulations.

XP30, proposed for ASHRAE designation as R514A, blends 1336mzz(Z) with trans-1,2-dichloroethene, a gas not previously used in refrigerants. Another potential replacement for R123 in centrifugal and positive-displacement chillers, R514A is deemed acceptable as a retrofit gas as well as in new equipment. The EPA has also extended the acceptability of R513A as a substitute for R134a in both new and retrofit retail food refrigeration, refrigerated food processing and dispensing equipment. Marketed by Chemours as Opteon XP10, R513A was previously SNAP-listed for use in chillers.

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

Complete phase-out of ozone-depleting CFCs

Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer will achieve the final phase-out of ozone-depleting chlorofluorocarbons (CFCs) this year with the phase-out of CFCs used in metered-dose inhalers (MDIs).

More than 98% of the CFCs used in MDIs have already been phased out, and will disappear completely in 2016, a significant milestone following 30 years of concerted global action to protect the ozone layer. Affordable CFC-free alternatives for all inhaled treatments have been developed over the last 20 years, and are now available worldwide.

In 1996, when CFC-based aerosols were phased out in developed countries, CFC-free replacement inhalers were not available for the hundreds of millions of patients with asthma/chronic obstructive pulmonary disease worldwide who relied on them, and so a temporary exemption was allowed.

The safe phase-out of CFC MDIs is an impressive achievement that has required two decades of coordinated activity involving the pharmaceutical industry, healthcare regulators and providers, and patients. The introduction of CFC-free alternatives has had benefits for patient health, thus generating a double-dividend gain. The extensive educational campaign associated with this transition has had a positive impact on the health of patients by increasing the awareness of the benefits of CFC-free alternative therapy.

While inhaled therapy doubled in the last 20 years to meet the health needs of patients, CFC MDIs were safely phased out to

help meet the needs of the global environment.

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

Energy-efficient refrigeration

As European supermarkets become increasingly acquainted with energy-efficient refrigeration technology, simultaneous progress is being made in developing newer and simpler ways of smoothing the path for the transition to this climate-friendly new equipment. The recently launched SuperSmart project is one such initiative seeking to facilitate this adoption. SuperSmart aims to achieve both decisive environmental benefits through a fast implementation of efficient heating and cooling solutions, as well as significant economic benefits through reduced energy use in the supermarket sector all across Europe.

The three-year project seeks to remove non-technological barriers to the uptake of these solutions by helping to raise the level of expertise among technical and non-technical staff, as well as supporting the introduction of a new European Ecolabel for supermarkets by drafting possible criteria.

The project is led by leading Norwegian research institute SINTEF in coordination with eight other organisations, including shecco, the Construction Technologies Institute – National Research Council, the German Federal Environment Agency (UBA), the Royal Institute of Technology (KTH), University of Braunschweig, the Research Centre for Energy Resources and Consumption (CIRCE), DPTU Energija, and the International Institute of Refrigeration (IIR).

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

Nanowire material for cooling

A team of researchers at Pennsylvania State University (Penn State), the United States, led by Qing Wang, professor of materials science and engineering, has created nanowire material that could cool with an electric field that is safe for humans. Such nanoarrays are lightweight and flexible enough to be embedded in firefighter gears, athlete garments and for other uses.

The nanoarrays are made up of ferroelectric barium strontium titanate, which can cool to about 5.5 degree Fahrenheit using 36 volts. Ferroelectric polymers used earlier by others require an electric field that's not within the safety limits for human beings. The researchers state that just a 500-gram battery can power the nanoarrays for two hours, which is sufficient for people who do moderate exercise. An important advancement with this wearable technology is that it does not require regeneration of coolants and hence avoids ozone depletion.

The U.S. National Science Foundation research at Penn State showcases further advancements in the field of wearable textiles. The wearable textiles field is getting considerable attention in the United States with the recent creation of \$317 million in public-private partnership funding through a consortium at Cambridge, Mass-based Massachusetts Institute of Technology (MIT), the United States.

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

R32 air-conditioner launched

Toshiba, the United Kingdom, has launched new air condition-

ers using lower global warming potential (GWP) refrigerant R32. The new refrigerant will be used in Toshiba's new Mirai premium range of residential wall-mounted air conditioning split units. They will be available in capacities from 1.5 to 4.5kW. "Many end users are looking to adopt greener, lower GWP technology. When combined with the advanced features of Mirai, R32 is an attractive option that is more environmentally friendly while delivering superb comfort," said David Dunn, at Toshiba.

Toshiba has been producing R32 units for the Japanese market since 2014. To date, some 225,000 units have been installed, without incident, the company says. Across all manufacturers, there are more than 5 million R32 units installed in Japan alone. Toshiba's new Mirai range features a number of technical advances, including dustless operation due to a special coating on the cooling coil, a larger heating capacity, and exceptionally quiet operation due to a 13% increase in fan size.

Units are designed to eliminate potential sources of ignition, and are equipped with brushless motors and a power relay instead of a contactor. To reduce flame propagation, both indoor and outdoor units have fireproof steel enclosures surrounding the electrical systems. Toshiba warns that for installers and service engineers working with R32, the refrigerant is classified as flammable and needs to be handled accordingly. It points to the correct procedures explained in the Hydrocarbon Safe Handling course, which is a top up on the standard F-gas qualification.

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

New R404A replacement

Chemours, the United States, is preparing to launch a new A2L refrigerant replacement for R404A in commercial hermetic refrigeration units. Formerly known as DR-3, and now to be marketed as XL20, the new refrigerant is a blend of R1234yf (78.5%) and R32 (21.5%). Its GWP of 148, based on IPCC 4, brings it just below the 150 limit demanded by the European F-gas regulations for commercial hermetically sealed systems from January 1, 2022. It has been submitted for ASHRAE approval and provisionally assigned the number R454C.

The HFO R1234yf provides the low GWP element of the blend with the R32 being added to increase its cooling capacity and provide a performance close to R404A. Though XL20 is a "mildly flammable" A2L, Chemours maintains that the small charge sizes found in single condensing unit systems and stand-alone coolers and freezers are able to accommodate refrigerants with some degree of flammability.

XL20 is said to exhibit slightly lower pressures and capacity than R404A, but the thermodynamic cycle efficiency is 7% higher than R404A. It does, however, have a moderate 5K temperature glide. Compressor discharge temperatures are also about 12K higher than R404A, but well below temperatures which would normally require liquid or vapour injection. The drop-in performance of XL20 has been evaluated in a 1.5m³ capacity double-door reach-in freezer originally designed for R404A and with a with a refrigerant charge of 1.05kg.

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

Lower GWP refrigerant for flooded systems

Developed by Honeywell, the United States, a new non-flammable, lower global warming potential (GWP) refrigerant could have applications in flooded chillers. Honeywell has submitted the refrigerant for addition to ANSI/ASHRAE Standard 34-2013, Designation and Safety Classification of Refrigerants as R515A.

Also offering a non-flammable alternative to R134a in domestic refrigerators in the USA, R515A comprise the HFO 1234ze(E) with 12% of the fire suppressant HFC227ea (heptafluoropropane). R515A has a GWP of around 400 and is expected to be compatible with Solstice ze approved compressors. As an azeotrope, it could also be used in flooded chillers, an application where, until now, there have been no non-flammable, lower GWP alternatives.

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

R1233zd(E) chiller

Carrier, the United States, has become the latest chiller company to design a machine using low global warming potential (GWP) refrigerant R1233zd(E). The new AquaEdge 19DV two-stage, variable-speed centrifugal chiller is featured on the Carrier. Produced by Honeywell as Solstice zd, R1233zd(E) is a single component, non-flammable A1, fourth generation HFO refrigerant. It was originally developed for use as a blowing agent but has also been found to be a high efficiency alternative to R123.

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

Window air-conditioning using sustainable refrigerant

Friedrich, the United States, a leading air conditioning manufacturer, has introduced new units for residential and light commercial customers that use a more environmentally sustainable refrigerant called R32. Friedrich claims to be the first in U.S. to unveil units that use R32. Benefits of R32 include significantly reduced global warming potential (GWP) and zero ozone depletion potential (ODP). R32 also helps increase energy efficiency.

Six window room air conditioner models in Friedrich's Chill line and five through-the-wall air conditioner models in Friedrich's Uni-Fit line using R32 are now available and meet the most recent ENERGY STAR-qualified standards. R32 has just one-third of the GWP of R410A. Other advantages include higher operating efficiencies, meaning units that use R32 refrigerant consume less power as compared to similar units with R410A.

Also, units using R32 require significantly less refrigerant volume in the system, reducing the total amount of refrigerant needed another strong environmental advantage. Known for innovation and rigorous testing, including an extensive onsite lab facility where product research, performance, stress and safety measurements are done, Friedrich has conducted additional R32 tests for the last few years.

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

Natural refrigerant cooling system

Mayekawa Manufacturing Company Ltd., Japan, is planning to launch four new models of its highly efficient natural refrigerant-based cooling system, the NewTon, on the 21st of July 2016. The four new models comprise the NewTon R-3000 and R-6000 for cold storage, and F-300 and F-600 for frozen storage and all four will feature reduced refrigerant charge, system size and weight compared to previous models. Mayekawa have disclosed that they have upgraded the technology used in the previous models and so, while still maintaining high energy efficiency.

The new models are set to offer minimised refrigerant charge and improved maintenance in a bid to ease any potential anxiety users may have regarding the everyday operation of the system. Mayekawa claims that the new models' more compact size and weight should help reduce the impact of facility renovation, which is expected to increase as Japan's 2020 deadline for completely phasing out of ozone-depleting HCFCs under the Montreal Protocol draws nearer.

Source: <http://www.hvac-intelligence.co.uk>

Manual for Servicing HFC Based Domestic and Commercial Refrigeration Appliances

For more information, contact:

INFRAS - Consulting Group for Policy
Analysis and Implementation
Gerechtigkeitgasse 20,
Postfach CH-8039
Zurich, Switzerland
Tel +41 1 205 9595; Fax +41 1 205 9599
E-mail: info@infras.ch
Web: www.infras.ch

Acoustic technology based ultrasonic cleaner

Developed by Sonix IV Corporation, the United States, the 'Sonix 4' ultrasonic cleaner product line offers a completely green technology that uses sonication to process fluids making industrial processing more efficient and sustainable. This acoustic technology utilizes the phenomenon of cavitation to breakdown cellular structures, emulsify and homogenize fluids for better stability, remove bioburden and debris, and makes the filtration processing more efficient.

This technology is used for processing in the oil and gas industries, the food and beverage industries, medical and dental industries, and countless other industrial applications. The physical phenomena of imploding cavitation bubbles yielding pressures upwards of 60,000 psi and temperatures above 5500 K (9,440°F) allows the microscopic shearing of cohesion and adhesion forces as well as the breakdown of cellular membrane walls affectively killing microscopic organisms and disinfecting processed items as well as the bath water.

Essentially in addition to cleaning precision parts and surgical instruments we can make the dirty make up water clean again without the use of chemicals for reuse applications to conserve water and for waste treatment applications for the sustainability of our environment. Sonix 4 ultrasonic cleaning systems reduce operating costs while increasing production. *Contact: Sonix IV Corporation, 4301 Dorchester Road, Charleston, SC 29405,*

USA. Tel: +1-843-554-0239; Fax: +1-843-554-4136; E-mail: tomray-sonix@gmail.com.

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

Non-ODS electronic grade coating

The '3M™ Novec™ 2704 Electronic Grade Coating' from 3M, the United States, is a fluorinated polymer diluted in 3M™ Novec™ 7200 Engineered Fluid, a segregated hydrofluoroether solvent, providing a low viscosity, low surface tension coating solution. Designed for moisture and corrosion protection of printed circuit boards and electronic components, it dries to an ultrathin, transparent coating with excellent hydrophobic and oleophobic properties.

It does not need curing and is easy to apply. A yellow-orange dye is incorporated into the fluorinated polymer backbone that will fluoresce under ultraviolet (UV) light, thus aiding inspection and detection in the quality control process. Novec 2704 coating is non-flammable, non ozone-depleting, low in toxicity, low in GWP, RoHS compliant and low in VOC content. *Contact: 3M, Electronics Materials Solutions Division, 3M Center, Building 224-3N-11 St. Paul, MN 55144-1000, USA. Tel: +1-800-810-8513.*

Source: <http://www.multimedia.3m.com>

Flux remover for vapor degreasing

Cleaning experts MicroCare, the United States, have introduced a radical new flux remover. Designed for cleaning circuit boards in automated vapor degreasing systems, this innovation

uses a unique, patent-pending formulation to help companies clean PCBs faster, better and at lower cost while meeting ever-more stringent European regulations. The MicroCare® Tergo™ High Performance Flux Remover is a non-flammable, low-temperature cleaning fluid that features a non-volatile additive specifically engineered to clean challenging solder pastes and flux residues.

It also can remove stubborn white residues. It is a versatile cleaner that is effective even on water-soluble (OA) fluxes. It has secondary applications as a degreaser and can even remove slight oxidation and tarnish from finished surfaces. The Tergo™ High Performance Flux Remover is compatible with traditional vapor degreasing procedures and no hardware modifications normally are required. This makes the Tergo™ High Performance Flux Remover a drop-in replacement for many older vapor degreasing chemistries that are being phased-out under environmental, health, safety or economic pressures.

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

ECO-MAC PROJECT

UNEP DTIE in cooperation with USEPA is developing and testing the energy efficiency of an improved HFC-134a MAC system ("I-MAC") on small vehicles that already achieve the highest fuel efficiency, and compare the test results with a CO2 MAC system ("B-Cool") vehicle which is being developed under funding from the European Commission and European vehicle manufacturers and suppliers.

For more information, access: <http://www.unep.org/ozonaction/>

New fire suppression innovation

Tyco Fire Protection Products, the Netherlands, has introduced its latest innovation in engineered fire suppression, 'iFlow', a unique delivery system for inert gas clean agent. The state-of-the-art components provide regulated and effective discharge pressure, eliminating the potential for peak pressure and flow spikes. This controlled flow enables the use of smaller diameter, low pressure piping and reduced pressure relief venting requirements, minimising complexity in piping, and reducing the costs associated with providing pressure venting.

iFlow combines the proven fire extinguishing properties and environmental benefits of the inert gases with technology to help design engineers overcome challenges in pipe size, venting design and overall installation. The system incorporates three innovative components working together: the iFlow valve, the iFlow horizontal check valve and the matrix container racking system. The iFLOW valve regulates flow at nominal pressures of 60 bar (in a 300 bar system) and 40 bar (in a 200 bar system).

VdS approved, the iFlow valve also limits the output pressure, even in the event of a discharge occurring against a closed selector valve. The iFlow check valve connects multiple containers and can eliminate the need for a discharge manifold on certain systems, to help minimise installation time. The matrix container provides architects and design engineers with more choice when systems have to be installed in tight spaces. When compared with traditional

bracketing systems, the matrix design enables containers to be positioned in conventional rows or even arranged around columns to fully utilise available space.

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

Eco-friendly fire protection technology

Brassbell, Sweden, has developed an environmentally engineered, human safe, fast extinguishing gas in the fire suppression systems. The Clean Agent FS49C2 is thermal extinguishing gas that extinguishes fire without removing the oxygen from the air. This makes it possible to extinguish a fire with people in the room surviving.

Extensive research led to development of a clean gaseous fire extinguishing agent FS49C2, physical properties of which are similar to those of Halon 1301, yet the agent causes considerably less damage to the environment. The main component of FS 49 C2 is the most widely used replacement gas for refrigeration systems, characterised by zero ozone depletion potential (ODP) factor.

Due to its quick action and favourable weight-volume ratio, FS 49 C2 may also be used in existing Halon 1301 fire suppression systems, thus allowing to significantly limit investments into fire protection. Replacement of Halon 1301 with FS 49 C2 only requires some minor adjustments in quantity of the agent and functioning of the system.

Source: <http://www.bfp-g.com>

Inert gas fire system components

Rotarex Firetec, Luxembourg, has announced that it released complete set of components for inert gas fire protection that, when configured into a complete system, are certified by Underwriters Laboratories (UL). Called INEREX®, the components for 200-300 bar inert gas total flooding fire systems are easy to configure and install. Rotarex Firetec has done all the necessary compatibility and performance testing, and there is no need for additional certification when the components are configured into a system and installed according to NFPA 2001 standards.

INEREX component systems use a constant flow pressure regulator that modulates discharge pressure to a constant 40-60 bar. This helps save time and money, since low pressure (schedule 40) manifolds can be used, plus venting and pipework requirements are simpler – lowering costs and enabling easier installation. It also delivers better safety by preventing freeze up and explosive discharge force. The systems are easy to maintain, as no reconditioning is necessary after a system discharge – plus functional tests are possible while the system is armed.

Compatible with all inert gas types, INEREX is comprised of high quality components and designed using proven technology. Now, with UL approval, fire protection system designers, engineers and installers can be confident that INEREX inert gas installations will deliver optimal performance when required. Contact: Rotarex Firetec. Charles

Strobel. E-mail: strobel.charles@rotarex.com

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

Fire extinguishing system with HFC-227ea

Minimax, the Netherlands, has developed the MX 200 fire extinguishing system with the fire extinguishing agent HFC-227ea. It is characterised by its highly effective and fast extinguishing action (< 10 seconds). The extinguishing agent itself is toxicologically harmless; it extinguishes without leaving any residue and gets along with a small storage volume. The extinguishing agent acts both physically and chemically.

The fire extinguishing agent treated in the ISO 14520-9 under the designation HFC-227ea is widely used throughout the world. The MX 200 fire extinguishing system can be individually adapted to suit nearly every area. Nozzle holes and container fill volumes are the result of object specific design calculations and characterise a system optimised down to the smallest detail. The charging pressures of up to 50 bar mean that multi-zone systems and longer pipeworks can be designed.

HFC-227ea is suitable for class A and class B fire and is used as total flooding agent. The gas pressure of 3.91 bar at 20 °C favours a rapid vaporisation at the nozzles and speedy distribution throughout the room. HFC-227ea is neither corrosive nor electrically conductive and therefore causes no damage through short circuits or through residues left on sensitive components. It is colourless and almost odourless

and is in gaseous form at room temperature.

Source: <http://www.minimax.nl>

Automatic light hazard water mist nozzles

Securiplex, the United Kingdom, has announced the completion of fire testing for its automatic light hazard water mist nozzles in accordance with test protocols of FM Approvals and the International Maritime Organization (IMO). While Securiplex already has a wide variety of water mist approvals in place, the addition of the automatic light hazard nozzle approval will allow Securiplex to satisfy customer needs for an even wider range of applications such as accommodation spaces on marine vessels, museums, hotels and retrofit of historic buildings.

Water mist systems utilizing automatic nozzles function similarly to a conventional sprinkler system but offer several advantages such as much smaller piping/tubing requirements, scrubbing of smoke and toxic gases, significant and rapid temperature reduction and 80-90% less water consumption compared to conventional sprinkler systems. These advantages provide tremendous benefits to the customer including ease of installation, personnel safety and dramatic reduction in collateral damage to the facility and equipment.

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

Clean agent FE 36 fire extinguishers

Kanex, India, has introduced the modular type Clean Agent FE

36 Automatic fire extinguishers which keeps guard and extinguishes fire quickly and efficiently. In the event of a fire, Kanex Modular type Fire extinguishers activate automatically, spraying the extinguishing agent with maximum force, ensuring that the fire is brought under control rapidly and efficiently.

Kanex Clean Agent extinguishers contain FE36 (HFC 236fa), the cleanest, most powerful and ECO friendly extinguishing agent with zero ozone depletion potential (ODP) and are the obvious choice of concerned corporate worldwide. UL Listed and FM Approved FE 36 (HFC 236fa) gas is Compliant with ASTM -D6541-11 also approved by US EPA (Environmental Protection Agency), Listing under USA Signification New Alternative Policy (SNAP).

FE – 36 does not contain d-limonene, which is flammable non-volatile residue. Extinguishing agents containing d-limonene may leave a coating of d-limonene. In FE-36 variation between atmospheric temperature and boiling point is less, hence it does not leaves any condensed moisture as in case of CO₂ FE 36 is not scheduled for phase-out as HCFC like Halotron I, which contains Chlorine.

Source: <http://www.kanexfire.com/clean-agent-fe-36-modulars.php>

International Standards in Refrigeration and Air-Conditioning

This guide provides an introduction and overview of the issues related to international standards in the refrigeration and air-conditioning sector.

For more information, access:

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

Open-cell PP/POE elastomer blend foams

In an experimental study, a team of researchers from Ningbo Institute of Materials Technology and Engineering, China, and Ningbo University, China, prepared open-cell polypropylene/polyolefin elastomer (PP/POE) blend foams for fabrication of reusable sorbents for oil sorption. The foams were prepared via continuous-extrusion foaming using supercritical carbon dioxide as the blowing agent.

The interconnected open-cell structure was characterized by scanning electron microscopy. The hydrophobicity and lipophilicity of PP/POE open-cell foams were revealed by tests of contact-angle measurement, water and cyclohexane sorption on the foam surface, CCl₄ and cyclohexane sorption in water, and oil/water separation. Further, the sorption tests indicated that PP/POE blend foams showed larger oil-up-take capacities than pure PP foams.

In addition, cyclic compression tests showed that PP/POE open-cell foams had excellent ductility and significantly improved recoverability compared to pure PP foams. In cyclic sorption-desorption tests, the sorption kinetics was studied in terms of capacity and saturation time, showing that PP/POE foams kept larger sorption capacities for 10 cycles, with larger sorption rates and good reusability.

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

Foaming with CO₂ and water as co-blowing agents

A team of researchers from Zhengzhou University, China, and

University of Toronto, Canada, studied the foaming behavior of poly(vinyl alcohol) (PVOH) and microfibrillated cellulose (MFC) composites in a batch process using supercritical carbon dioxide (scCO₂) and water as co-blowing agents. In PVOH/MFC composites, water is an economical plasticizer. It not only suppressed the potential thermal degradation of PVOH but also extends the processing window. A uniform cell structure and a high cell density were achieved in the PVOH/MFC foams.

The results showed that cell density was increased by increased water content. Further, the MFC contained both micro- and nano-sized fibers. These created numerous heterogeneous nucleation sites and caused local pressure variations. However, cell density decreased when the MFC was overdosed. Due to the high crystallinity that then developed around the MFC, the gas content was too low, and the stiffness was too high.

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

Foam extrusion with solid phase CO₂

In a study conducted by researchers from Institute of Plastics Processing (IKV), RWTH Aachen University, Germany, low density polyethylene (LDPE) was foamed in the extrusion process using dry ice as physical blowing agent. The blowing agent was metered in form of pellets over the hopper. To determine relevant process parameters and improve the understanding of the process a melting model is applied. The influence of the formation of a melt film and melt pool on the dissolution of the blowing agent is discussed.

The theoretical considerations are validated in a design of experiment study. As a result, the efficiency of

the process is especially affected by the throughput rate, granules temperature, and blowing agent concentration. Further varied parameters are the barrel temperature in the melting zone and diameter of the dry ice pellets. Fast melting and pressure build-up were shown to reduce blowing agent losses. *Contact: Sven Hendriks, Institute of Plastics Processing (IKV), RWTH Aachen University, Aachen, Germany. E-mail: sven.hendriks@ikv.rwth-aachen.de.*

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

New chemical blowing agent

Clariant International Ltd, the United States, has introduced new HYDROCEROL chemical blowing agents. The blowing agent used in the production of plastic interior parts when its appearance and performance were not adversely affected. Early chemical blowing agents will affect the surface finish of plastic car parts, but its application is limited. Clariant HYDROCEROL products enable automotive interior parts having highly consistent cell structure, down to 60 microns in diameter, and 7% of material weight.

The application of chemical blowing agents remove proprietary technology, can reduce the effect of water, carbon dioxide (CO₂) and acid etching to reduce its injection mold, molded parts to reduce surface defects. Seven Trust Plastic Co., Ltd. is specialized in the development and production of plastic profiles of enterprises, production of material PVC foam profile, PVC wpc door, wpc foam profile, PP, PE wpc profile, color, soft and hard, steel-plastic coextrusion profiles.

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

Biofungicides as alternative fumigants

In the 2013 production season, Mark Bolda, a Farm Advisor in Strawberries and Caneberries with University of California Cooperative Extension, the United States, tested 14 different biofungicide materials in a series of strawberry trials. Bolda saw clear plant response with a few of the products, including *Bacillus amyloliquefaciens* (Double Nickle, Certis), *Trichoderma virens* (SoilGard, Certis), *Bacillus subtilis* (Serenade, Bayer), and *Streptomyces lydicus* (Actinovate, Monsanto).

Bolda followed that up in 2014 by testing this smaller list of products in soil that had been treated with anaerobic soil disinfestation, which is flooding with the addition of a carbon source. In 2015, Bolda narrowed testing down to one product which had shown the best results in his '14 trials, an application of *Streptomyces lydicus* (Actinovate), following an application of a chemical fumigant called allyl isothiocyanate (Dominus, Isagro USA). "It helped us close the gap between what we would achieve with Dominus alone and what we normally see with methyl bromide," said Bolda.

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

Controlled release of pesticides from plastic mulches

Imaflex Inc., the United States, has developed a plastic mulch film, ADVASEAL® HSM, that releases a selective herbicide to control certain broadleaf weeds and nut-sedge. The herbicide, Halosulfuron-Methyl* (HSM), is continuously and completely delivered over three to

four days leading to better efficacy, higher crop yields and lower application costs. ADVASEAL® HSM is the first controlled release plastic mulch that ever has received a pesticide registration worldwide.

US-EPA registered it as new herbicide formulation for approved crop uses on asparagus, cucumbers, cantaloupes, melons, pumpkins, squash and tomatoes. ADVASEAL® HSM is currently already commercial available in the Southeast of the US, where most states have completed registration. ADVASEAL® HSM delivers a combination of efficacy, simplicity, and safety for the control of noxious weeds and in addition controls emission of fumigants (required for a transition period for soil borne pathogen control).

Data are reviewed across trials for efficacy, crop safety, fumigant containment, and agronomic suitability of ADVASEAL® HSM for selected crop production systems. These characteristics of ADVASEAL® HSM are discussed in light of its suitability to release in addition selective nematicides and fungicides to provide in combination with herbicides a sufficient broad band activity to replace soil fumigants in pre-plant soil sanitation.

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

Soil disinfestation with steam

A team of researchers from University of California Davis, Reiter Affiliated Companies, Ramco Norcal and Driscoll's Strawberry Assoc. Inc., the United States, have reported weed and pathogen control results with steam as well as fruit yields over four strawberry production seasons (2011/12, 2012/13, 2013/14 and 2014/15). Steam was applied by a proto-type tractor towed steam ma-

chine with a Clayton steam generator. Steam controls weeds and soil borne pests and strawberry yields usually increase with steam up to 20% compared to common non-chemical pre plant soil disinfestation treatments in California.

The results suggest that these steam induced benefits are due to combined effects of extra nutrient release and reduction of pathogen pressure. The team is currently separating those effects in controlled experiments. Furthermore researchers investigate steam induced changes in soil microbial community and the utilization of steam in combination with allyl isothiocyanate (AITC) and cover crops as management tool. A commercial flat field steam applicator is being manufactured in cooperation with industry.

Previous and current investigations have shown that steam has to be considered as alternative soil disinfestation method for California strawberry production. Depending on field conditions, steam shows similar or better pest and weed control efficacy than common chemical and non-chemical soil disinfestation methods. However, it is critical that constant soil temperatures are achieved throughout the treatment.

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

Reductive soil disinfestation

In a study conducted by a team of researchers from Nanjing Normal University, China, Reductive soil disinfestation (RSD) with incorporation of various organic matters under flooding conditions combined with plastic mulching were applied to suppress FOC and prevent banana Fusarium wilt disease. The biological properties of the soil during the RSD process were investigated using quantitative real-time PCR and

denaturing gradient gel electrophoresis. Besides, high performance liquid chromatography was used for investigating the role of organic acids in the mechanisms of RSD.

The results showed that the values of soil redox potential significantly decreased by >800 mV in the RSD treatments incorporated with rice straw and bagasse under flooding conditions compared with untreated soil. The lowest soil pH (5.36) and a significant decline in the *F. oxysporum* population to 2.79% of untreated soil were obtained in flooded soil with the highest amount (1.2%, w/w) of rice straw (C/N, 46.0). Incorporation of bagasse (C/N, 129.6), pig manure (C/N, 12.8), and lime also significantly decreased the populations of *F. oxysporum*, but were less effective than rice straw.

Application of rice straw under flooding conditions significantly decreased fungal diversity and increased soil bacterial diversity, and the increased bacteria, such as *Clostridium* spp. regarded as organic acids producers, were considered to have an antagonistic effect on *F. oxysporum*. In a field experiment, a wilt disease control efficiency of 82.3% was obtained in flooded soil incorporated with 0.5% (w/w) rice straw compared with untreated soil. Besides, four kinds of toxic organic acids to *F. oxysporum* were detected in soil solutions of RSD treatments. Acetic acid and butyric acid were the primary organic acids, followed by small amounts of isovaleric acid and propionic acid.

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

Anaerobic soil disinfestation to suppress pathogens

Researchers from USDA-ARS Crops Pathology and Genetics

Research Unit, University of California, Davis, the United States, investigated the potential of ASD to manage soilborne populations of *Agrobacterium tumefaciens* and *Pythium ultimum* under walnut nursery conditions. Anaerobic soil disinfestation (ASD) is a fumigation-independent strategy for controlling soilborne pathogens. While ASD has been shown to suppress soilborne pathogens for several vegetable crops, it has not been examined for tree-crop diseases.

The following experiment was performed in the late summer of 2013 and 2015: rice bran at 20 metric tons/ha was applied to ASD plots, irrigated for 24 h (13 cm of water, 1 drip emitter per 930 cm²), and covered by TIF plastic for 6 weeks. Mesh bags of sterile soil infested with either *A. tumefaciens* or *P. ultimum* were buried at 15 cm (both trials), 30 cm (first trial), 45 cm (second trial), and 76 cm (second trial) depths prior to ASD treatments. Anaerobic conditions were generated down to 76 cm depth within 1 week and maintained for 6 weeks.

To serve as a comparison, mesh inoculum bags of *A. tumefaciens* and *P. ultimum* were buried at the same depths as in ASD trials in adjacent fields that were fumigated with Telone C-35 at the maximum allowable rate. In both field trials, ASD exhibited pathogen suppression similar to traditional chemical fumigation. *A. tumefaciens* and *P. ultimum* populations were reduced below detection limits during both chemical fumigations. In the ASD treatments, 30% of the samples had *A. tumefaciens* populations below detection limits, while the remaining replicates had populations that were significantly lower than the no treatment control populations.

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

New fumigant tackles charcoal rot in strawberries

Gas company BOC, in conjunction with the CSIRO and LZD Czech Republic, has developed a new soil fumigant that has shown efficacy comparable to the formerly used methyl bromide. The CSIRO, DPI Victoria and BOC's field studies with EDN Fumigas (Ethanedinitrile) have shown it to be effective on soil pathogens and weeds. The Australian Pesticide and Veterinary Medicine Authority (APVMA) is expected to approve registration shortly.

EDN Fumigas is a broad spectrum fumigant that is highly toxic to insects, weeds, nematodes and soil-borne pathogen. An efficacy soil fumigation study under APVMA trial permit was conducted by BOC at a customer site growing strawberry fruit crop in Palmview, Queensland. This site had been experiencing severe charcoal rot disease. Six beds, with a sandy soil type, measuring 90m long and 0.65m width were selected for the study. Three beds were applied with EDN Fumigas at the rate of 50g/m² at 5cm depth using drip application method and another three beds were used as a control.

Prior to application all the soil beds were covered with low density polyethylene plastic sheet. Soil samples were collected from both the trial and control beds before application of the EDN Fumigas and 14 days after application using standard procedure. The samples were then sent to SARDI, Urrbrae, South Australia for analysis. Fourteen days after fumigant application, no colony forming units of the target soil borne pathogen was found in the EDN Fumigas applied beds while it was found in the control beds.

Source: <http://www.goodfruitandvegetables.com.au>

Asia-Pacific Refrigerant Market – Forecast to 2021

According to this report, the Asia-Pacific refrigerants market is expected to grow at a CAGR of 6.0% between 2016 and 2021. In terms of volume, the fluorocarbon refrigerants segment dominated the Asia-Pacific refrigerants market. Increasing population and increasing demand of refrigerants in automobile and food industries, along with initiatives for new technologies and products are projected to make this region ideal for the refrigerant market to grow. The growing construction, automobile, and packaged food industries are fueling the demand for refrigerants in Asia-Pacific.

Contact: Research and Markets. Tel: +1-800-526-8630; Fax: +353-1-481-1716; E-mail: press@researchandmarkets.com

Handbook of Research on Advances and Applications in Refrigeration Systems and Technologies

The Handbook gathers state-of-the-art research related to thermal performance and energy-efficiency. Covering a diverse array of subjects, this publication provides a broad insight into the optimization of cold-supply chains and serves as an essential reference text for undergraduate students, practicing engineers, researchers, educators, and policymakers.

Contact: IGI Global, 701 E. Chocolate Ave., Hershey, PA 17033, USA. Tel: +717-533-8845; Fax: +717-533-8661; E-mail: cust@igi-global.com

Two-Phase Flow in Refrigeration Systems

This book covers advanced mass and heat transfer and vapor compression refrigeration systems and shows how the performance of an automotive air-conditioning system is affected through results obtained experimentally and theoretically, specifically with consideration of two-phase flow and oil concentration. The book is ideal for university postgraduate students as a textbook, researchers and professors as an academic reference book, and by engineers and designers as handbook.

Contact: Springer India Private Ltd. Tel: +91-8527-8027-70; E-mail: Naveen.taneja@springer.com

2016

11-14 Sep
Turin,
Italy

7th International Conference on Magnetic Refrigeration at Room Temperature, Thermag VII

Contact: Congress Secretariat
E-mail: registrationthermag2016@axeacongress.com
Web: <http://www.thermag2016.com>

11-13 Oct
Nuremberg,
Germany

Chillventa 2016

Contact: NürnbergMesse GmbH
VisitorService
Messezentrum
90471 Nürnberg, Germany
Tel: +49-911-8606-4906
Fax: +49-911-8606-4907
Web: <https://www.chillventa.de>

16-18 Nov
Shanghai,
China

14th International Auto Air-conditioning & Transport Refrigeration Exhibition (CIAAR 2016)

Contact: Secretariat
Tel: +86-21-6775-9095
E-mail: ciaar.int1.com@autocoolexpo.com
Web: <http://www.autocoolexpo.com>

20-21 Nov
Kobe,
Japan

International Symposium on New Refrigerants and Environmental Technology

Contact: Japan Refrigeration and Air Conditioning Industry Association (JRAIA)
Kikai Shinko Bldg. 201, 5-8, Shibakoen 3-chome,
Minato-ku, Tokyo 105-0011, Japan
Tel: +81-3-3432-1671
Fax: +81-3-3438-0308
E-mail: jraia2016.gbm@or.knt.co.jp
Web: <http://www.jraia.or.jp>

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Contact: Mr. Tony Giometti (ASHRAE, Manager of Conference Programs)
E-mail: giometti@ashrae.org

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