



Ozone Layer Protection

Apprise yourself with the latest technological innovations

Highlights:

- Pilot plant for next-gen refrigerant gas
- Natural refrigerant system
- Solvent-based cleaning system
- Hybrid fire extinguishing system
- Field application of new foam blowing agent
- New methods reduce ham mites



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

Cascade refrigeration system utilising R450A (an HFO/HFC blend, marketed by Honeywell as Solstice N13) and CO₂

(Credit: Covirán, Spain / <http://www.coolingpost.com>)

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Study reports source of carbon tetrachloride

A new study done by scientist Lei Hu at Cooperative Institute for Research in Environmental Sciences (CIRES), the United States, and scientist Stephen Montzka, at National Oceanic and Atmospheric Administration (NOAA), the United States, has reported those rates are still 30 to 100 times higher than amounts reported to Carbon tetrachloride (CCl₄) emission inventories. The study also suggested that the source of the unexpected emissions in the U.S. appears associated with the production of chlorinated chemicals [such as those ultimately used to create things like Teflon and Polyvinyl chloride (PVC)].

Despite that phase-out, the decline of CCl₄ in the atmosphere has been unexpectedly slow. To investigate the U.S. contribution, Montzka, Hu and colleagues from NOAA, CIRES, and other scientific institutions studied observations made from NOAA's North American air sampling network. Since the late 2000s, they tracked the composition of the atmosphere from this network of 9 towers and many more regular aircraft-sampling sites across North America. "We wanted to identify where these emissions were coming from, as well as their magnitude," Hu said.

The team looked at high-density population areas to determine if the use of bleach or chemicals in laundry or swimming pools might be responsible for the emissions. They also checked into industrial sources and here they had some help. "We can't tell exactly what the sources of emissions are. It could be underreporting from known sources, it could be an

unknown source or both. It could be some other activity that's geographically tied to the production of chlorinated chemicals and products that hasn't been recognized previously," said Montzka.

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

Ozone depletion recorded in Arctic atmosphere

According to the Arctic and Antarctic Research Institute (AARI), Russia, an ozone sounding in the Arctic atmosphere carried out between January and March 2016 showed significant depletion in some areas. According to AARI, this observation was made by the Cape Baranov Ice Base research station, which carried out 12 ozone soundings. The average altitude of the ozone layer was measured at 30 km. The minimum ozone concentration in the atmosphere column from the underlying surface to an altitude of 25 km above the station was observed on February 27, 2016 (2.989 g/ sq. m., 140 Dobson units), which accounted for only 42 percent of the typical February average.

According to scientists from the Alfred Wegener Institute, Germany, the extreme development of the cyclonic stratospheric polar vortex and the resulting stratospheric cooling have been observed in the Arctic since December 2015, and could cause significant ozone layer depletion in the Arctic in the 2016 winter-spring period. Stations involved in the Stratospheric Ozone Loss Determination international program continue to perform ozone soundings. A comprehensive analysis of the data obtained will help scientists deepen their understanding of the Arctic ozone layer formation and depletion mechanisms.

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

Record thin ozone layer

While researchers are claiming that the entire ecosystem is changing, a Norwegian meteorologist has also discovered that Norway was under a record thin ozone layer. The Southern Norway basked in unseasonably warm sunshine recorded with little ice in the Arctic and reports that the Barents Sea is nearly ice-free "It's just as if there's a little hole in the ozone layer right over Scandinavia," said meteorologist Tarjei Breiteig.

Breiteig carried out calculations showing how extremely thin the ozone layer has been, based on data from National Aeronautics and Space Administration (NASA) and KNMI Climate Explorer. Researchers have been monitoring the ozone layer, part of the stratosphere that reduces the warmth of the sun, with satellites for 37 years. Never has so little ozone been measured over Scandinavia as in February. Tove Svendby, a researcher at the Norwegian Institute for Air Research, said she has full confidence in Breiteig's calculations.

The Norwegian Polar Institute also reported "extreme warmth" in the Arctic this winter, resulting in seas that no longer freeze to ice in large areas. The temperature at the North Pole was 0°C (32°F) one day this winter, at least 30 degrees higher than normal. The US' National Snow and Ice Data Center and NASA reported that the spreading of sea ice in the Arctic in February was 1.16 million square kilometers less than viewed as normal. Record small amounts of ice were recorded in January.

Source: <http://www.newsinenglish.no>

Pilot plant for next-generation refrigerant gas

The Gurgaon-based SRF Ltd, a manufacturer of intermediate chemicals and refrigerant gases, will set up a pilot plant to manufacture next generation refrigerant gas, Hydrofluoro olefin (HFO) 1234yf. As a result of this initiative, SRF will become the first technology developer outside US and Europe to manufacture HFO 1234yf, which is expected to find increasing use in car air-conditioning systems globally in future.

By venturing to develop its own process in-house R&D capabilities in refrigerant gases and high value fluorine based products, SRF Ltd has further reinforced its position in this niche domain. The in-house technology will allow SRF to manufacture, brand and sell HFO 1234yf in India and in global markets and also develop other HFO refrigerants in future. According to SRF, the capex for setting up a pilot facility for HFO 1234yf is a milestone step in SRF's journey towards becoming an R&D based chemical manufacturer at the world stage.

Significantly, the SRF announcement follows the recent agreement of Honeywell, the United States, to license its proprietary process technologies to Navin Fluorine, India, for producing the refrigerant Solstice yf (also known as HFO-1234yf) in India exclusively for Honeywell. Till date, SRF remains the only producer of Hydrofluorocarbons (HFC) 134a in India and has recently commissioned its HFC 32 plant, again with its own technology.

Source: <http://www.business-standard.com>

Bhilai Steel Plant to become CFC free

The Bhilai Steel Plant (BSP), India, has eliminated use of CFC-11 by replacing it by Li-Br based Chiller unit. Procurement of Carbon Tetra Chloride (CTC) has been stopped and use of Trichloroethylene has been started. Two projects under the aegis of United Nations Development Programme (UNDP) have been implemented in BSP for the elimination of use of CTC. Procurement of Halon based fire extinguishers have also been replaced by FM 200 based units.

All industrial package air conditioners using CFC-12 were also replaced in a phased manner by units using CFC free refrigerant. The plant has brought down the use of Ozone Depleting Substances (ODS) to 3.05 tonnes in 2014 from about 10 tonnes a decade ago. The Ozone Depleting Potential (ODP), a true measure of consumption of ODS, has also been reduced to 0.167 tonnes by BSP in 2014, which is amongst lowest in industries.

Under the ongoing expansion/modernization projects, BSP has taken due care to fully comply with the Montreal protocol in procurement and installation of, Air conditioning/ refrigeration units.

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

Honeywell partners with Indian firm

Honeywell, the United States, has entered into a supply agreement and technology license with Navin Fluorine International Limited (NFIL), India, to produce Honeywell Solstice yf, an automobile refrigerant with a global warming potential (GWP) of less than 1. Solstice yf, also known as HFO-1234yf, is a next-generation HFO refrigerant that is a near drop-

in replacement for R-134a, a hydro-fluorocarbon (HFC) with a global warming potential (GWP) of 1,300, for use in vehicle air conditioning systems globally.

Solstice yf is also being used in a growing number of stationary air conditioning and commercial refrigeration applications. Honeywell will license its proprietary process technologies to produce the refrigerant to NFIL, which will manufacture Solstice yf in India exclusively for Honeywell. Small-scale production is expected to begin by the end of 2016. Honeywell and its key suppliers are investing approximately \$300 million to increase global production capacity for Solstice yf. "More than 8 million cars on the road today safely use Solstice yf," said Ken Gayer, at Honeywell.

"This agreement reflects our commitment to delivering the supply chain reliability and security that customers can rely upon as they transition to next-generation products that are safe to use, available today and capable of making a significant positive environmental impact.

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

Report of information on alternatives to ODSs

Montreal Protocol's Technology and Economic Assessment Panel (TEAP) presented report of Information on Alternatives to Ozone Depleting Substances (ODSs) during the 37th Meeting of the Open Ended Working Group (OEWG) of the Parties to the Montreal Protocol held from 4th to 8th April, 2016 at Geneva, Switzerland

During the 37th meeting of the OEWG, the TEAP of the Montreal

Protocol provided an update on new refrigerant alternatives, information on research studies on alternatives for use under High Ambient Temperature (HAT) conditions and the extension of the mitigation scenarios from the decision XXVI/9 of the 26th Meeting of the Parties (MOP) report to 2050. The salient features of the report are as follows:

- a) Data for business-as-usual and mitigation scenarios are available for the RAC sector, but limited for other sectors.
- b) Out of the 80 fluids which have either been proposed or are being tested in industry programmes, or are pending publication, or have been published in ISO 817 and ASHRAE 34 refrigerant standards since the 2014 RTOC Assessment Report, 15 fluids have been considered by the TEAP for this report and it found that majority of these are new mixtures, but traditional fluids and two new molecules are also included.
- c) There are alternative refrigerants available today with negligible ODP and lower GWP, however, for some applications it can be challenging to reach the same lifetime cost level of the conventional systems while keeping the same performance and size.
- d) Market dynamics are critical in the rate of adoption of new refrigerants. There is a limit to the number of different refrigerants that a market (customers, sales channels, service companies) can manage. Hence, companies will be selective about where they launch a product, avoiding areas which are saturated, and promoting sales where they see the greatest market potential.
- e) It is difficult to assign energy efficiency to a refrigerant, because energy efficiency of refrigeration systems is in addition to the refrigerant choice and further related to system configuration and component efficiencies. In practice the achievable energy efficiency is limited by the cost of the system, as the success in the market depends on a cost-performance trade-off.
- f) The difficulties in assessing the total warming impact related to refrigerants is discussed, including the difficulty of defining low global warming potential and assessing the energy efficiency related to the use of a refrigerant.
- g) Total climate impact related to refrigerants consists of direct and indirect contributions. The definition of the qualifiers “high”, “medium” and “low” in relation to GWP is a qualitative, non-technical choice related to what is acceptable in specific applications. The indirect contribution accounts for the kg CO₂-equivalent emissions generated during the production of the energy consumed by the refrigeration, air-conditioning, and heat pump (RAC&HP) equipment, its operating characteristics, which includes the emissions factor of the local electricity production.
- h) Results from the three projects, PRAHA, AREP-II, and ORNL, indicate a way forward in the search for efficient low-GWP alternatives for high ambient temperature conditions especially when coupled with a full system redesign.
- i) Further improvements are likely through optimizing heat exchangers circuitry for heat transfer properties and proper compressor sizing and selection.
- j) Full redesign of systems, including new components, will likely be needed to realise systems, using new alternative refrigerants, to match the performance of existing systems in both capacity as well as energy efficiency.
- k) While the commercialization process of refrigerants can take up to ten years, the commercialization of products using these alternatives will take further time.
- l) In HAT conditions, the cooling load of a conditioned space can be up to three times that for moderate climates. Due to the requirements for charge limitation according to certain safety standards, the possible product portfolio suitable for HAT conditions is more limited than for average climate conditions when using the same safety standards.
- m) Although risk assessment work on flammable refrigerants is an on-going research in some countries, there is a need for a comprehensive risk assessment for A2L & A3 alternatives at installation, servicing and decommissioning at HAT conditions.

The Co-Chairs of TEAP said that a second report would be produced for the 38th meeting of the OEWG, covering the other issues listed in decision XXVII/4 of the 27th MOP, and a third update report would be produced for the 28th MOP, which would take into account the discussions at the 37th and 38th meetings of the OEWG, and based on additional information available to the task force of the TEAP.

Regional workshop on refrigerants

A regional workshop on environmentally friendly refrigerants in room air conditioners (RAC), jointly organised by United Nations Environment Programme (UNEP), Ministry of Environmental Protection/Foreign Economic Cooperation Office (MEP/FECO) and Shenzhen Human Settlements and Environment Commission (SHEC), was held in Shenzhen, China, from 29 February – 1 March 2016. The event was attended by 100 delegates representing national ozone units, industry associations, enterprises and media from about 30 countries in Asia and the Pacific.

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

China to build R290 based AC production lines

China is the global production base for air conditioners, accounting for 75% of the global output, half of which are exported to overseas market, thus exerting significant impacts on other countries in terms of technology selection. China has chosen R290 (propane) as main alternative to phase-out HCFC in the RAC sector, and has received great support from Multilateral Fund (MLF), United Nations Environment Programme (UNEP), UNIDO and GIZ. With the support of Multilateral Funds, China has currently finished the reconstruction of 8 R290 based AC production lines, and there will be 20 lines reconstructed by the end of 2017. By far, China has achieved HPMP stage I target with a phase-out of 10,000 MT.

Source: <http://www.chinaenvironment.info>

Ozone protection in Samoa

Samoa's efforts to recover ODS have been boosted tremendously. It follows the arrival of three 499ltrs capacity refrigerant recovery cylinders. The cylinders were donated by Refrigerant Reclaim Australia Limited (RRAL), a non-profit organization established to recover, reclaim and destroy ozone depleting and synthetic greenhouse gas refrigerants. The cylinders were shipped to Samoa with the kind assistance of BOC Samoa Limited.

BOC has been a great supporter of ozone protection activities in the country and they have also imported ozone safe refrigerants as alternatives to ODS. Samoa as a Party to the Montreal Protocol on substances that deplete the Ozone Layer has been committed to phasing out ODS since 1992. ODS and contaminated refrigerants from refrigeration and air conditioning systems have been collected and recovered into 10ltrs and 20ltrs cylinders in the past years and stored by the Ministry of Natural Resources and Environment (M.N.R.E).

ODS destruction has always been an issue however with access to these massive cylinders, Samoa is heading in a positive direction to make ODS recovery easy. This initiative complements the current Hydrochlorofluorocarbons (HCFC) phase-out schedule in effect also highlighting that HCFC alternative refrigerants will be increasingly important for use in existing refrigeration and air conditioning systems. M.N.R.E will work with the Samoa Refrigeration Engineers Association (S.R.E.A) to ensure

these refrigerant recovery cylinders are put into best use.

Source: <http://www.samoabserver.ws>

Refrigerant management research report

The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) has published research project 'AHRI 8018: Review of Refrigerant Management Programs'. This project characterized refrigerant management and recycling programs implemented in key regions of the world, evaluated their effectiveness, and determined best practices as they relate to the refrigerant landscape in the United States. The report provides clarity and insights on seven primary jurisdictions: Australia, Canada, California, the European Union, Japan, the United Kingdom, and the U.S.

It also includes a high-level review of activities in China and Brazil. The focus areas of research included characterizing the current processes for original equipment manufacturers, contractors, end users, and reclaimers to handle refrigerants, how and where refrigerant recycling happens, and the amount of refrigerants ultimately destroyed. "This report marks the culmination of the largest effort ever attempted to determine the refrigerant 'lay of the land' on a global scale. The information it contains will be invaluable as the world moves closer to phasing down HFCs and replacing them over the coming decades," said Karim Amrane, at AHRI.

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



A Carrier Aquaforce chiller using R1234ze

Carrier sees future in R1234ze

Carrier, the United States, has announced that it sees the low GWP HFO refrigerant R1234ze(E) as the best long-term sustainable solution for screw chillers. Carrier joins a long list of major chiller manufacturers now offering R1234ze(E) solutions, but said that it will continue to provide HFC R134a chillers in all regions including Europe. In addition to Carrier, manufacturers already offering 1234ze chillers include Climaveneta, Airedale, Star Refrigeration, Cofely, Blue Box and Klima-Therm.

The US manufacturer considers R1234ze(E) as the long term sustainable solution for the next generation to come and the best alternative that supports the European 2030 F-Gas carbon dioxide (CO₂) equivalent reduction goals. Carrier anticipates that customer demand for very low GWP HFO-1234ze(E) chillers will grow with the evolution of European and nation-

al phase-down regulations. It also sees the introduction of high leaving water temperature screw chillers combined with very low GWP HFO 1234ze(E) as a means of extending its heat pump offer.

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

Energy gains from HFO/CO₂ cascade

Honeywell, the United States, has announced that its Solstice ze (HFO1234ze) refrigerant is being used in a new supermarket application that combines several systems to improve energy efficiency. The refrigerant is being combined with CO₂ in a new supermarket cascade system designed to deliver heating, air conditioning, and refrigeration in one comprehensive, low-carbon solution.

Refrigeration specialist Tecnologie Del Freddo (TDF), Italy, worked with Honeywell to design a cascade system capable of satisfying all of the cooling, heating and air conditioning needs for a new Unes/U2 supermarket in Italy. This solution replaces conven-

tional boiler and air conditioning units, using a heat exchanger to capture the energy generated by the refrigeration system to heat the store, provide hot water, and cool the store in the summer.

This system is expected to achieve energy savings of approximately 35 per cent per year, compared with stores with three separate refrigeration, heating and air conditioning systems. The company noted that Solstice ze is non-ozone-depleting, has a GWP of less than 1 and complies with the European F-Gas regulation. It is mildly flammable according to ASHRAE class 2L and nonflammable below 30°C.

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

Tackling climate change with HFC-free units

Global multinationals Unilever, Red Bull, the Coca-Cola Company, PepsiCo and SABMiller have announced that they have already put over 4.5 million HFC-free refrigeration units into operation worldwide. They work together under the 'Refrigerants, Naturally!' umbrella to phase-out HFCs from their refrigeration equipment as part of efforts to tackle climate change. "Our focus is replacing F-gases only with natural refrigerants, including ammonia, CO₂ and hydrocarbons. And we focus particularly on plug-in point-of-sale refrigeration equipment," said Julia.

Refrigerants, Naturally! is an initiative of international companies taking action against global warming and ozone layer depletion by replacing harmful greenhouse gases in point-of-sales cooling and freezing units with climate-friendly

natural refrigerants. The objective of the group – which sees SABMiller, Red Bull, PepsiCo, the Coca-Cola Company and Unilever join forces with supporting partners Greenpeace and United Nations Environment Programme (UNEP) – is to make natural refrigerants the preferred cooling technology in a safe, reliable and cost-effective manner.

Together, member companies, the Coca-Cola Company, Red Bull, Unilever, SABMiller and PepsiCo have placed more than 4.5 million HFC-free refrigeration units around the world – collectively avoiding more than 27 million metric tonnes of CO₂ emissions (based on the avoided HFC refrigerant emissions). So far the Coca-Cola Company has 284 CO₂ cooler, vending machine or fountain machine models certified and ready to be used. By the end of 2015, the Coca-Cola Company had deployed more than 1.8 million HFC-free units.

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

Research report on foam blowing agents

The Global Blowing Agents for Polyurethane Foam Consumption 2016 Market Research Report published by QYResearch Group, the United States, is a professional and in-depth study on the current state of the Blowing Agents for Polyurethane Foam market. First, the report provides a basic overview of the Blowing Agents for Polyurethane Foam industry including definitions, classifications, applications and industry chain structure. It also includes development policies and plans as well as manufacturing processes and cost structures.

Secondly, the report states the global Blowing Agents for

Polyurethane Foam market size (volume and value), and the segment markets by regions, types, applications and companies. Thirdly, the Blowing Agents for Polyurethane Foam market analysis is provided for major regions including USA, Europe, China and Japan, and other regions. For each region, market size and end users are analyzed as well as segment markets by types, applications and companies. The report also focuses on global major leading industry players with information such as company profiles, product picture and specifications, sales, market share and contact information.

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

China's policy promoting shift to naturals

China recently announced plans for 2016 to indicate a significant shift towards a sustainable HVAC&R industry, by issuing the list of recommended substitutes for HCFCs, finalising proposals for Stage II of the HCFC Phase-out Management Plan (HPMP) and revising national standards for natural refrigerants. Zhong Zhifeng from China's Foreign Economic Cooperation Office (FECO) released policy developments affecting natural refrigerants in China. With several policy developments in the pipeline, in 2016 China will repeatedly underline its intention to facilitate a comprehensive market shift towards natural refrigerant technology.

The draft document had already been published in June 2015, listing 12 substitutes for HCFC refrigerants, foaming agents and detergents – 10 of which are natu-

ral chemicals including CO₂, ammonia, hydrocarbons and water. Although the list is not mandatory for the industry, it clearly indicates a significant shift in mindset towards a sustainable HVAC&R industry in China, and is likely to be swiftly followed by a substantial policy evolution further promoting natural refrigerants. Since 2011, China has been implementing the first stage of its HPMP in industrial and commercial refrigeration.

FECO has been undertaking a series of activities including investing in the conversion of production lines to natural refrigerants, conducting studies on alternative technologies, revising standards, and providing training and workshops for natural refrigerant technology. While implementing the first stage, the Chinese government has been also working on its proposal for the Stage II HPMP. The proposal may be discussed for about a year before it gets final approval from the Executive Committee. Although the proposal might be modified during the process, Zhifeng claimed that its focus will remain on natural refrigerant technologies.

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

Natural Refrigerants Market– Global Industry Perspective, Comprehensive Analysis and Forecast, 2014 – 2020 report

The report covers detailed competitive outlook including company profiles of the key participants operating in the global market. The detailed description of players includes parameters such as company overview, financial overview, business strategies and recent developments of the company.

For more information, access:

<http://www.syndicatemarketresearch.com>

New low-GWP refrigerants

AGC Asahi Glass (AGC), Japan, has developed a new type of refrigerant for centrifugal chillers and binary cycle generators. The refrigerant is HFO-1224yd, which AGC gave the brand name AMOLEA yd as part of its AMOLEA series. It is non-flammable, has low GWP, and offers excellent theoretical efficiency. The company positions this refrigerant as a low-pressure next-generation refrigerant alternative to HFC-245fa.

While R134a is the mainstream high-pressure refrigerant and R123 is the mainstream low-pressure refrigerant for centrifugal chillers, HFC-245fa is also used. R134a is adopted in car air conditioners, but its use in new car air conditioners is already banned in Europe in regulations to phase-down HFC consumption. In the United States, use of R134a in chillers is likely to be banned from 2025.

The phase-out of R123 (HCFC) is already set for the end of 2019 in developed countries based on the Montreal Protocol. Like HFO-1233zd(E) and HFO-1336mzz proposed by other manufacturers, HFO-1224yd is non-flammable and has low toxicity, excellent thermal stability, and high theoretical capacity. Other companies are also proposing high-pressure refrigerants such as HFO-1234ze(E) as next-generation refrigerants. All of these refrigerants, however, are mildly flammable.

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

Natural refrigerant system

In developing the HEOS Sistema, CAREL, Italy, has come up with an environmentally friendly refrigeration system for supermarkets. The system, which is being launched in the US this year, consists of condensing units that reside on top of freezer or refrigerated cabinets. Each unit is fitted with a variable-speed BLDC compressor that operates efficiently by adapting to load conditions.

CAREL's controller supplies inverters and electronic expansion valves with continuous modulation for optimal management of the compressors. The heat of condensation is carried outside the store via a water loop that is cooled by an outdoor cooling device or chiller. At present, the HEOS operates with R410A. However, "we're seeking a natural refrigerant solution," said Alessandro Greggio, at CAREL.

"In Europe, where the HEOS system was introduced, the majority of installations are in medium-small supermarkets with about 40 cases. But the system can be applied to larger stores with 120 cabinets. Typically each cabinet uses one condensing unit but it depends on the size of the cabinet," said Greggio.

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

New compressor series unveiled

At the Mostra Convegno Expocomfort (MCE) held from 15-18 March 2016 in Italy, process technology manufacturer GEA

presented a new compressor series designed for use with hydrocarbons – the HG44e – alongside its subcritical and transcritical CO₂ compressors. With the HG44e, "the complete platform is optimised from the efficiency side," said Manuel Fröschle, at GEA. Furthering the current trend towards developing new natural refrigerant-based technologies, the HG44e features optimised engine components and special oil filling in order to maximise performance.

With four model sizes, the HG44e hydrocarbons series covers the range of maximum displacements from 41.3 m³/h to 67,0 m³/h. For hydrocarbons, high solubility poses particular challenges in terms of compressor design. With the HG44e series, "the motor protection tool is located outside, not inside the box. And the drive gear is optimised to handle hydrocarbons," said Fröschle. GEA also demonstrated compressor model EX-HG88e – the largest GEA compressor that is suitable for use in hazardous environments.

GEA is the first and only European manufacturer to offer semi-hermetic compressors for zone 1 and 2 ATEX – and recently also IECEx-certified. The compressors therefore conform to international standards. "Over the past three years, we have improved the efficiency and reliability of our complete CO₂ range, as well as improving their running behaviour and extending their operating limits with an increase of condensing and evaporating temperatures in the subcritical CO₂ compressors," said Fröschle.

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

Hydrocarbon systems unveiled

Compressor maker Embraco, Brazil, has launched three hydrocarbon products. The EM3 compressor, delivering up to 1,400 BTUs of capacity, is designed for the light commercial market. "It offers a 30% energy efficient improvement over current solutions," said Michel Moreira, at Embraco. The Fullmotion variable speed condenser, a best-seller in Europe, is new to the North American market. Offering dual voltage capability and up to 4,000 BTUs of capacity, it is up to 9% more energy efficient than similar solutions, said Moreira.

Finally, Embraco's Plug n' Cool propane condensing unit is a pre-charged, sealed, top-mounted system cooled by a water loop, and used mainly with reach-in cabinets. It dispenses with the need for a machine room. All three units help end users like food retailers and food service establishments comply with the U.S. Department of Energy's new energy efficiency regulations starting in 2017, as well as the Environmental Protection Agency's planned delisting of R134A and R404A.

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

R450A increases efficiency in CO₂ cascade

Honeywell, the United States, is having further success in deploying lower GWP HFO refrigerant blend R450A in combination with CO₂ in cascade refrigeration systems. The latest installation is at a 12,000m² refrigerated distribution centre operated by food cooperative Covirán, Spanish. Covirán is made up of

more than 2,800 small and medium-sized independent retailers and is the second largest in Spain in terms of sales, and number three in Portugal.

Covirán in collaboration with Systemfrost, Spain, developed a solution that would combine best-in-class performance with sustainability. Systemfrost designed a cascade system utilising R450A – an HFO/HFC blend with a GWP of 601, marketed by Honeywell as Solstice N13 – and CO₂. It was designed to meet key criteria around energy efficiency, emissions reduction and refrigeration performance. A blend of 42% R134a and 58% HFO1234ze(E), R450A has a GWP of around 601, less than half that of R134a. The total charge of R450A in the Covirán system is 1,020kg.

The new refrigeration installation designed by Systemfrost includes three freezer rooms, one dual-temperature room and a large, chilled dispatch area. The system is expected to reduce annual energy consumption by more than 3% and achieve lower direct CO₂ emissions of 60% annual compared to a similar system using R134a, the traditional refrigerant used in such applications.

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

New line of small hydrocarbon compressors

Tecumseh Products, the United States, has unveiled a new range of small compressors, the TC series, designed for hydrocarbons R290 (propane) and R600a (isobutane). With a capacity range of 300-1,500 BTU/h, the smaller TC compressors "have all of the U.S. Department of Energy efficiency regulations covered," said Tony Carstensen, at Tecumseh. The

compressors, which will be in production by the end of 2016, would typically be used in self-contained/stand-alone beverage coolers, reach-in refrigerators and freezers, and vending machines.

Tecumseh also announced that for self-contained/stand-alone commercial refrigeration equipment with capacities of less than 0.5 HP, Tecumseh continues to support propane as the refrigerant of choice, within the charge limitations (150g) and safety requirements mandated for A3 refrigerants. "R290 offers 25% energy savings. It's the best option where you can use 150 grams and 0.5 horsepower or less," said Carstensen.

Tecumseh sees the OEM marketplace for its compressors divided into two camps, one that embraces hydrocarbons and one that avoids them. The first group "likes the efficiency R290 gives them and are concerned about SNAP and DOE regulations," said Carstensen. In May 2015 Tecumseh was acquired by Mueller Industries and Atlas Holdings, which each own a 50% share of the company.

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

CO₂ refrigeration

Hillphoenix, the United States, has introduced its new AdvansorFlex CO₂ refrigeration system, which delivers all the benefits of CO₂ refrigeration in a compact and scalable format for small and medium-sized retailers. As part of its Advansor CO₂ platform, AdvansorFlex is an environmentally sustainable HFC-free system that uses the natural refrigerant CO₂. Both Advansor CO₂ and AdvansorFlex CO₂ are part of Hillphoenix's Second Nature®

line of alternative refrigeration systems and have a GWP of 1.

“AdvansorFlex is ideal for smaller retailers who want the environmental benefits and energy savings of CO₂ refrigeration but don’t have the square footage for a full-sized system. Multiple AdvansorFlex units can also be grouped together in a distributed system, so it’s good for larger stores as well,” said Dustan Atkinson, at Hillphoenix. A single AdvansorFlex unit can serve as a centralized refrigeration system in smaller stores such as convenience stores, pharmacies, and smaller format grocery stores.

The unit’s weatherproof enclosure allows for both inside and outdoor placement, and its compact footprint takes up less floor space in back rooms, equipment rooms, mezzanines, and rooftops. The system also provides straightforward installation, ease of maintenance, and reliable, cost-saving, day-to-day operation. *Contact: Hillphoenix, 2016 Gees Mill Road, Conyers, GA 30013, USA. Tel: +1-770-285-3264; Fax: +1-770-285-3080; E-mail: info@hillphoenix.com.*

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

Low GWP R134a alternatives

Bitzer, Germany, has announced the approval of the HFO refrigerants R1234yf and R1234ze(E) and blends R513A and R450A for use in its CSH and CSW screw compressors. Bitzer points out that the two HFO alternatives to R134a have global warming potential (GWP) of under ten, and the non-flammable HFO/HFC blends GWPs of about 600. The volumetric refrigerating capacity and pressure levels of R1234yf are described as comparable with those of R134a, while the capacity figures and pressure

levels of R1234ze(E) are around 20 to 25% lower.

According to Bitzer, it subjected R1234yf and R1234ze(E) to intensive testing, and the compressors performed well with both in all of the tests and laboratory experiments. The tested compressors achieved nearly identical isentropic efficiency values with R1234yf and R1234ze(E) as with R134a. Due to differences in the thermodynamic properties, the COP measurement results are in some cases slightly lower.

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

New R1234yf chiller

Climavenet, Italy, has introduced a screw chiller operating on R1234yf to its Integra range of 4-pipe air source products. Offering cooling capacities from 200 to 1100kW, the new i-FX-Q2 family employs inverter driven screw compressors and EC motor fans. They are said to be the first multi-purpose units adopting the new generation HFO1234yf low GWP refrigerant, which is now being widely adopted for use car air conditioning systems.

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

Magneto-caloric cooling

The Ames Laboratory in the United States will be leading a major effort to develop a commercial application for caloric cooling, said to be more efficient and quieter than conventional cooling. The technology is called magneto-caloric cooling, in which certain solid materials heat up when placed in a magnetic field and cool down when they are removed from the field.

Magneto-caloric cooling is the most developed form of what is called caloric cooling, a process that was

discovered in the 1800s and also includes mechano-caloric cooling and electro-caloric cooling. The technology has undergone development over the decades, but not to the point of commercialisation. However, starting 1 July, the Ames Laboratory at Iowa State will be leading an effort called CaloriCool to develop a commercial application for magneto-caloric cooling and other forms of caloric cooling. The Ames Laboratory, which operates under the United States Department of Energy, has previously done important research into magneto-caloric cooling.

The Ames Laboratory will be collaborating with eight other national labs in the CaloriCool programme. “This is truly a major effort – a multimillion-dollar programme to develop caloric cooling to the point of commercial application,” said Dr. Joseph Sebranek, distinguished professor of animal science at Iowa State University, at a ‘Scientists Speak’ session at the IARW-WFLO Convention, held on 16-19 April in Las Vegas.

Some progress has already been made towards the commercialisation of magneto-caloric cooling. Materials capable of producing the magneto-caloric effect (heating and cooling) include an alloy of lanthanum, iron and silicon (Calorivac, from Vacuumschmelze in Germany), and an alloy of manganese, iron, phosphorus and silicon (Quice, from BASF in Germany). BASF, Haier and the Astronautics Corp. of America displayed a wine cooler using a magneto-caloric heat pump at the Consumer Electronics Show in 2015, while Cooltech showcased a medical fridge employing magnetic refrigeration at the MEDICA show last November.

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

Solvent-based cleaning system

Dürr Ecoclean, Germany, has developed an innovative solvent-based cleaning system for heat-treating contractors, metalforming shops and companies from the automotive and aircraft industries. The large-chamber EcoCDuty is designed for loads measuring up to 1250 x 840 x 970 mm and weighing up to 1 tonne. Operating with hydrocarbons or modified alcohols, it provides high cleaning quality and process reliability at fast cycle times. Additional benefits of this modular unit include its exceptional ease of operation and attractive design.

The large-chamber cleaning machine uses hydrocarbons or polar solvents (modified alcohols) and operates under full vacuum. Its modular design ensures adaptability to individual user needs. Configured as a steam degreaser in its standard version, the system is additionally available with one or two stainless steel flood tanks – e.g., for a process comprising steam degreasing and injection flood washing or steam degreasing, injection flood washing plus a preserving step. Vacuum drying is standard on all three versions.

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

New critical cleaning solvent

Developed by EnviroTech Surface Technologies, United Kingdom, the 'ProSolv' is a new, less expensive fluorinated solvent formulation for all precision cleaning applications. The solvent has been developed as a "drop in" cost effective alternative which

is less expensive than the current fluorocarbon formulations. It offers future proof cleaning systems giving long term savings without compromising quality. Substitution is simple with no changes to equipment or control settings needed.

ProSolv is friendly to the environment it has zero ODP and a very low impact on global warming. In addition, it is a non-flammable stable azeotrope needing no testing for acid acceptance or stabilising additives, easy to use and maintain and safer for employees and the workplace. ProSolv like many other fluorinated solvent azeotropes is extremely effective for precision cleaning in hightech industries such as aerospace, aviation, electronics and medical due to the use of an additive trans 1,2-dichloroethylene.

This produces a powerful fluorinated cleaning solvent with a very low surfaces tension which cleans blind holes and the smallest gaps more effectively at a lower cost. With these wide range of properties ProSolv is particularly effective used with ultrasonics. It can usually be used in existing degreasers or sprayed from an aerosol container. Contact: *EnviroTech (Europe) Ltd, 100a High Street, Hampton, Middlesex, UK, TW12 2ST. Tel: +44-20-8281-6370.*

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

Aqueous stencil cleaner

KYZEN, the United States, has been awarded with 2016 NPI Award in the category of Cleaning Materials for its AQUANOX® A8820 Advanced

Aqueous Stencil Cleaner, during the IPC APEX EXPO at Las Vegas. AQUANOX® A8820 is an engineered Micro Cell Technology (MCT™) cleaning fluid designed to remove wet solder paste and uncured chip bonder adhesive from stencils used in surface mount printing processes. It effectively removes common solder pastes and fluxes, and demonstrates a favorable compatibility profile with stencil cleaning systems.

A8820 works well with spray-in-air and select ultrasonic cleaning machines, and is effective on uncured adhesives. Additionally, the no-foaming property of A8820 is compatible with all materials commonly used in electronic assembly manufacturing and cleaning processes. KYZEN's AQUANOX® A8820 has been designed from the ground up for the tough challenges of cleaning no-clean, lead-free residue from small, 1005 apertures while being compatible with modern nano-coatings as well as with all of the modern offline cleaning equipment that is popular in the industry.

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

Natural Refrigerants New eDocs+

This new application launched by OzonAction on February 12, includes publications, videos, fact sheets and other awareness materials to help National Ozone Units (NOUs) and other stakeholders to build their capacity to implement the Montreal Protocol in a sustainable manner and at the same time to derive climate benefits. It is now available in the Android Play Store and Apple Store/iTunes.

For more information, access:

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

New water mist technology

Alpha Fire Services (Pvt) Ltd, Sri Lanka, has launched the Proano Kitchen Water Mist Fire Suppression Systems, which are rapid and effective on kitchen (F/K class) of fires. Water Mist is nebulised fresh water distributed through a network of Proano's specially designed Mist Nozzles under low pressure. "This system is known to suppress F/K class fires rapidly and bring the temperature down quickly. Unlike traditional chemical systems, when a Water Mist Fire Suppression System is used there's no need to disrupt or shut down operations which leads to little to no downtime," said Mr. Frank Anthony Ryde, at Alpha Fire Services.

Proano's LPCB certified Commercial Kitchen Product is the first certified Water Mist product to protect industrial and commercial kitchens used around the world in many 5 star hotels and food courts. Ryde added that the benefits of Water Mist technology are many, as once water droplets are nebulised into millions of nano-sized particles, they work on 2 sides of the Fire Tetrahedron, cooling down the heat, and suffocation of the fire from oxygen by the chemical reaction of mist being converted into steam. This proves safe for people in occupied areas due to it working in low pressure and using low water volumes, resulting in minimal damage.

Source: <http://www.island.lk>

Hybrid fire extinguishing system

Victaulic, the United States, has developed Victaulic Vortex™, the

world's first FM Approved hybrid fire suppression system using both water and inert gas. "When extinguishing fire, the existing systems put a lot of water out, but only a small portion ends up on the fire itself. The rest of the water needs to be cleaned up afterward," said Larry Carmen, at Victaulic. The Victaulic Vortex system uses nitrogen to help break water droplets into a fine mist, which results in minimal wetting of the protected area, eliminating the need for extensive cleanup.

The water mist provides cooling and helps block the radiative heat transfer to other objects in the room. Also, oxygen near the flame zone is displaced by the steam produced when the water mist droplets are vaporized by the heat from the fire. Victaulic Vortex can be used just about anywhere, but Victaulic recommends it in particular for facilities with a lot of machinery, and also for data centers. Traditional sprinklers can cause damage to machinery like combustion turbines and generators, but the Victaulic Vortex system doesn't present the same water damage risk.

The advantage in data centers, Carmen said, is that it's "green," and safe for the occupants working there. They recommend everyone leave the room before the system is discharged, but the discharged inert gas and water mist will not be harmful to someone inadvertently left behind during the relatively short period of time they will need to then exit the room. Contact: Victaulic Company, 4901 Kesslersville Road Easton, PA 18040, USA. Tel: +1-610-559-3300.

Source: <http://www.hgi-fire.com>

New alternative for fire suppression solution

The new water mist systems developed by Flamefast Fire Systems Ltd., the United Kingdom, offers an alternative firefighting solution for hotels, office blocks as well as factory machinery, museums, and telecommunication applications. Extensively tested and using the very latest technology, water mist systems are installed in the same way as sprinkler system. By rapidly converting energy to steam the water mist starves the fire of the oxygen it needs to burn. This not only results in a much faster rate at which the water absorbs the heat, but also minimises the damage cause to the surroundings.

VID Model OH-L2 is an automatic low pressure water mist nozzle for automatic fire protection of locations with LR fire hazards such as hotel rooms, small offices, restaurant seating areas and other locations with ceiling heights up to 5.0 m having similar fire hazards. Its automatic low pressure water mist nozzle is a modern mean of providing fire protection with water mist. It combines the advantages of the fire sprinkler technology with the advantages of the water mist technology providing the reliability, low water pressure and enhanced fire fighting performances from sprinklers and combining it with the low water requirements from water mist nozzles.

Fire-Kill Model OH-SW is an automatic Low Pressure Water Mist Nozzle for automatic fire protection of locations such as hotel rooms, hospital rooms, offices, homes and other locations with up to 3m ceiling height having similar fire hazards.

Source: <http://www.flamefast-fire-suppression.co.uk>

Field application of new foam blowing agent

The Chemours Company, the United States, a global chemical company with leading market positions in titanium technologies, fluoroproducts and chemical solutions, has announced that Opteon™ 1100 foam blowing agent and BASF SPRAYTITE® foam insulation have successfully been applied in the first ever in-field spray foam application in a residential home. These products work together to offer homeowners excellent thermal insulation performance while reducing energy consumption, environmental footprint, and greenhouse gas emissions.

Opteon 1100 (formerly Formacel™ 1100) foam blowing agent will help meet the long-term needs of polyurethane foam customers for non-flammable, high efficiency, low global warming potential (GWP) solutions. Opteon 1100 offers extremely low GWP, zero ozone depletion potential (ODP), excellent thermal insulation performance and improved R-value. In addition, the increased shelf-life of Opteon 1100 lets formulators and installers spray insulation without worrying about yield losses, poor reactivity, or the cost and disposal of unused foam kits.

BASF SPRAYTITE foam insulation is a closed-cell spray polyurethane foam insulation that creates a seamless insulation air barrier to improve the energy efficiency, comfort and durability of homes and buildings. When formulated with Opteon 1100, the system gives polyurethane foam customers a non-flammable, high efficiency, low GWP solution. SPRAYTITE technology improves air leakage control, insulation performance,

indoor environment, moisture resistance and structural strength.

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

Liquid-type nucleating agent

Researchers at School of Chemical and Biological Engineering, Seoul National University and Korea University, Republic of Korea, investigated the effects of liquid-type additives on the morphology, thermal conductivity, and mechanical strength of polyurethane (PUR) foams. The PUR foams synthesized with perfluoroalkane showed a smaller average cell diameter and a lower thermal conductivity than PUR foams prepared with propylenecarbonate or acetone.

The average cell diameter of the PUR foams decreased from 228 to 155 μm and the thermal conductivity decreased from 0.0227 to 0.0196 kcal/mh °C when the perfluoroalkane content was 0.0 to 2.0 php (parts per hundred polyol by weight). The perfluoroalkane likely acted as a nucleating agent during the formation of the PUR foams. The addition of perfluoroalkane induced the smaller cells size of the PUR foams probably due to lower surface tension of the polyol and perfluoroalkane mixture, resulting in high nucleation rate.

The smaller cell size appears to be the main reason for the improvement in the thermal insulating and the mechanical properties of these PUR foams. The compressive strength of the PUR foams prepared with perfluoroalkane was higher than the PUR foams prepared with the propylenecarbonate and acetone. Based on the morphology, thermal conductivity, and compressive strength, researchers suggested that the perfluoroalkane is an efficient

liquid-type additive for the improving the thermal insulation of PUR foams.

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

Injection of physical blowing agents

Researchers at Institut für Kunststoffverarbeitung (IKV), Germany, studied a new injection technique for introducing physical blowing agents into molten polymer for its application in foam extrusion. Therefore, a special injection device was mounted on a standard laboratory scale single screw extruder. By means of this device, CO₂ was injected into PS melt. A polystyrene (PS) of BASF, PS158K, was used in this study.

The density of this resin is 1.05 g/cm³ and its melt volume rate is 3 cm³/10 min. CO₂ from Linde AG, Germany with a purity of 99.7% was used as the physical blowing agent. A 20 wt% masterbatch of a sodium bicarbonate/citric acid system in PS (Hydrocerol CF 20 S, Clariant Masterbatches GmbH, Germany) was used as nucleating agent. The foam extrusion tests were conducted on a 25 mm single-screw extruder (Collin, Germany) with a length of 25 D.

The blowing agent was introduced into the melt by means of an Optifoam® 22 system (Sulzer Chemtech AG, Switzerland) which is based on the fluid injection nozzle invented at the IKV. A static mixer (SMK 22, Sulzer Chemtech) with 22 mm in diameter is integrated in this system. The blowing agent was provided by a dosing unit (LEWA, Germany) featuring two high pressure membrane pumps. The foams produced with this new technique exhibit a cell size in the range of 100 microns.

Source: <http://www.citeseerx.ist.psu.edu>

New methods reduce ham mites

Tom Phillips, an entomologist at Kansas State University (KSU), the United States, has helped develop new methods to keep mites away from dry-cured hams while also meeting international requirements to protect the ozone layer. Phillips, was part of a research team led by food scientists at Mississippi State University, the United States, that was successful in using the food-safe compound propylene glycol to protect from ham mites. Their work has been published in the *Journal of Meat Science*.

For many years, ham mites were controlled with methyl bromide, a fumigant that is safe to food. But in 1989, it was one of several substances listed in the Montreal Protocol, an international treaty to phase-out the use and production of substances responsible for ozone depletion. "Methyl bromide has been important as a fumigant for controlling pests of different kinds. Seventy to 80 percent of all bromide use was for sterilizing soil in very high-value places like California and Florida, where they grow strawberries and fresh vegetables," said Phillips.

Phillips and colleagues developed food-grade coatings with propylene glycol, a common food preservative, which they applied to hams before the aging process begins. Whole dry-cured hams, also known as country hams, are considered a specialty product and often take three months to two years to fully cure. They differ from wet-cured hams, which are the refrigerated products consumers most often buy at grocery stores.

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

New technology for pest-free grain

Recently the board of the Plant Biosecurity Cooperative Research Centre (PBCRC), Australia, visited grain growing properties in the Mingenew region of Western Australia to see PBCRC stored grain research in action, as part of regular visits with CRC Participants. "We have been working with the Plant Biosecurity CRC on new ways to manage insect pests in stored grain for several years now. New, chemical-free methods of controlling pests in grain storage silos are vital for growers' livelihoods," said Sheila Charlesworth, at Mingenew-Irwin Group, Australia.

"PBCRC researchers are developing several approaches to stored grain protection. Working with growers and industry gives us the opportunity to test them in the real world," said Dr Michael Robinson, CEO of PBCRC. Annual PBCRC surveys have been monitoring the number of insects Australia-wide with resistance to phosphine, the industry standard fumigant. The results have driven research into alternative control methods.

One of the alternatives is nitrogen technology, which gives growers the ability to control pests in grain silos with low oxygen environments, a technique proving to be both cost-effective and chemical-free. Aeration of grain silos is another useful tool for growers, as lower temperatures slow insect growth and give them a chance to get on top of potential infestations, while also reducing insect resistance and increasing seed viability.

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

Weed control in tomato with alternative fumigants

Researchers at University of Florida, the United States, conducted experiments at the Gulf Coast Research Education Center in Florida, to evaluate nutsedge and broadleaf weed control with combinations of dimethyl disulfide, chloropicrin, 1,3-dichloropropene, and metam potassium in tomato. No fumigant, 131 kg ha⁻¹ 1,3-dichloropropene + 200 kg ha⁻¹ chloropicrin (1,3-D+Pic), 392 kg ha⁻¹ of dimethyl disulfide (DMDS), or 340 kg ha⁻¹ of DMDS + 90 kg ha⁻¹ of chloropicrin (DMDS+Pic) were applied with three shanks at 20 cm in a raised bed.

Within each fumigation treatment no metam potassium, or metam potassium at 195 kg/ha was applied at 30 cm using a Yetter rig prior to the initial bed shape, at 10 cm at the top of the bed with six shanks, or at both depths. All beds were covered with TIF plastic immediately after fumigation. The experiment was set up as a factorial with four blocks and conducted in the spring 2014, fall 2014, and spring 2015 crop.

In two of the three seasons, metam potassium applied at 10 cm significantly reduced nutsedge density compared to the nontreated control. Applications at 30 cm appeared to provide no added benefit. Though not always significant, metam potassium alone tended not to provide the level of control achieved when combined with other fumigants at 20 cm. In two of the three seasons, DMDS alone reduced nutsedge density compared to the nontreated control and in all three seasons DMDS combined with metam potassium at 10 cm enhanced the level of control achieved.

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

Anaerobic soil disinfestation

Researchers at University of California, the United States, has found that *Prunus Replant Disease (PRD)* is a soilborne complex that suppresses growth and productivity of replanted almond and stone fruit orchards, even in the absence of plant parasitic nematodes.

Earlier in 2014 they reported that anaerobic soil disinfestation (ASD) implemented in 2013 with rice bran (20 metric tons/ treated ha; in strips covering 50% plot area) was as effective as soil fumigation (Telone C35, 600 kg/treated ha; 50% plot area) for preplant control of *Pythium ultimum* (a PRD contributor) and early stimulation of replanted almond orchard growth, but cost of the ASD was more than double that of soil fumigation.

The researchers reported that full-season orchard responses to 2013 ASD treatments and early responses to new 2014

treatments designed to reduce ASD costs. All 2014 ASD treatments (100, 60, and 36%) were as effective as soil fumigation in reducing *P. ultimum* inoculum density (to 0 to 95 cfu/g soil), compared to controls (2008 to 3663 cfu/g). To date, ASD has provided tree growth stimulation equal to that of soil fumigation. Further research is needed to optimize ASD substrates and application methods for replant problems of almonds and stone fruits.

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

Soil disinfestation in strawberry production

In a study, researchers from University of California, the United States, Reiter Affiliated Companies, the United States, Ramco Norcal, the United States, Driscoll's Strawberry Assoc. Inc., the United States, reported weed and pathogen control results with steam as well as fruit yields over four strawberry production sea-

sons (2011/12, 2012/13, 2013/14 and 2014/15).

They studied the efficacy of steam compared to chemical and non-chemical soil disinfestation methods in California. 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 CA.

Furthermore they investigated 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 show that steam has to be considered as alternative soil disinfestation method for California strawberry production. However, it is critical that constant soil temperatures are achieved throughout the treatment.

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

Agricultural Fumigants Market - Global Forecast to 2021

Research and Markets has announced the addition of the "Agricultural Fumigants Market - Global Forecast to 2021" report to their offering. According to the report, the agricultural fumigants market is projected to reach USD 1.74 billion by 2021 at a CAGR of 4.6% from 2016 to 2021. The market is driven by factors such as global economic growth, rising agricultural production, better storage technology, and modern agricultural practices. The high growth potential in emerging markets and untapped regions provides new opportunities for market players. The report covers major Companies such as Adama Agricultural Solutions Ltd., Basf Se, Degesch America Inc. (Dai), E.I. Dupont De Nemours And Company, Fmc Corporation, Ikeda Kogyo Co. Ltd., Reddick Fumigants, Syngenta Ag, Dow Chemical Company, and United Phosphorus Ltd. (Upl).

The phosphine agricultural fumigant type is projected to grow with the highest CAGR from 2016 to 2021. Phosphine is mostly used to treat grain stored in various structures, as it is one of the most effective way to kill internal insects or insects deep within the grain mass. Phosphine fumigants are mostly used in the North American and European regions as it is found to be the most effective alternative of methyl bromide, which has led the market to grow at the highest rate.

On the basis of form, the agricultural fumigants market is led by the liquid fumigants followed by the gaseous form. The gaseous form is projected to grow at the highest CAGR from 2016 to 2021. The importance of gaseous form is increasing as it is the most effective manner to reach insects in stored grains and on crops or soil in their most remote places. Liquid fumigants, such as methyl bromide, chloropicrin, metam sodium, and others (including rest of the fumigants in that particular form) are used mostly in many regions due to its safe application and usage for bulk grains and agricultural commodities.

For more information, access:

<http://www.researchandmarkets.com/research/mfwqxf/agricultural>

ICR2015: Advances in magnetic refrigeration industrialisation

Based on the papers presented and workshops organized during the 24th IIR International Congress of Refrigeration, the author has summarized recent progress and advances achieved regarding magnetic refrigeration.

The author has also assessed the potential for future industrialisation of magnetic refrigeration systems in the future.

Handbook on indirect refrigeration and heat pump systems

Indirect systems have come into focus because of requirements governing tighter constructions in order to minimize refrigerant leakage from plants as well as changing legislation implemented in order to achieve the phasing out of various types of CFC, HCFC and high-GWP refrigerants.

The Handbook on indirect systems was published in Swedish in 2010 in cooperation with over twenty companies and experts and an English translation has been prepared by the IIR. An expectation of all involved in producing the Handbook is that it will help to better understand and work with indirect systems.

CO₂ as a refrigerant

This book highlights the application of carbon dioxide in supermarkets, industrial freezers, refrigerated transport, and cold stores as well as ice rinks, chillers, air conditioning systems, data centers and heat pumps.

This guide is for design and development engineers needing instruction and inspiration as well as non-technical experts seeking background information on a specific topic.

For the above three publications, contact: International Institute of Refrigeration, 177, boulevard Malesherbes, 75017 Paris, France. Tel: +33-1-4227-3235; Fax: +33-1-4763-1798

2016

14-16 Jun

Ho chi Minh, Viet Nam

RAHV VIET NAM 2016

Contact: Top Repute Co., Ltd.
Unit 2802, Shun Tak Centre West Tower,
168-200, Connaught Road,
Hong Kong
Tel: +852-2851-8603
Fax: +852-2851-8637
E-mail: topreput@top-repute.com

11-14 Jul

West Lafayette, USA

Purdue Compressor, Refrigeration and High Performance Buildings Conferences

Contact: Kim Stockment
Conference Coordinator, Purdue University,
177 S. Russell Drive, West Lafayette,
IN 47907-2099, USA
Tel: +1-765-494-6078
Fax: +1-765-494-0787
E-mail: hlconf16@purdue.edu
Web: <https://www.engineering.purdue.edu>

11-13 Oct

Nuremberg, Germany

Chillventa 2016

Contact: Alexander Stein
(Exhibition Director)
Tel: +49-0-911-8606-8386
Web: <https://www.chillventa.de>

16-18 Nov

Shanghai, China

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

Contact: Shanghai Gehua Exhibition Service Co., Ltd. Room 901, 34 Building, Caohejing Hi-Tech Park, No.258, Xinzhuan Rd., Songjiang District, Shanghai, China
Tel: +86-21-6775-9095
Fax: +86-21-6451-6467
E-mail: ciaar.int1.com@autocoolexpo.com
Web: <http://www.autocoolexpo.com>

8-10 Nov

Orlando, USA

2016 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions

Contact: Conference Secretariat
E-mail: mbao_admin@mbao.org
Web: <https://www.mbao.org>

20-21 Nov

Kobe, Japan

International Symposium on New Refrigerants and Environmental Technology

Contact: JRAIA Kikai Shinko Bldg. 201, 5-8, Shibakoen 3-chome, Minato-ku, Tokyo 105-0011, Japan
Web: <http://www.10times.com>

23-25 Nov

Jakarta, Indonesia

The 45th International Exposition on Heating, Ventilation, Air-conditioning, Air-Filtration & Purification and Refrigeration Systems in Indonesia (HVACR Indonesia 2016)

Contact: informa exhibitions 111 Somerset Road #10-05, TripleOne Somerset, Singapore 238164
Tel: +65-6411-7777
E-mail: hvacrpsindonesia@informa.com
Web: <http://www.hvacrseries.com>

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