THE SCIENCE OF OZONE LAYER

Antarctic ozone update

As of 21 December 2007, although a small area of ozone-depleted air (with ozone values below 250 DU and depletions approaching 30 per cent) remained over East Antarctica, the ozone hole of 2007 had cleared up. The temperature of the ozone layer was too warm for PSCs to exist. Over Antarctica ozone values were higher than 250 DU, with values up to 350 DU over the Southern Ocean. A spring warming took place over the Pacific coast of Antarctica and the Antarctic Peninsula in late October; however, this subsided as the ozone hole became more symmetric again. A second major warming took place towards the end of November, but subsided in early December. The summer circulation is now established.

In general, the vortex was more disturbed in 2007 than it was in 2006; however, there have also been periods of stability. Early August saw the largest ozone hole recorded for that time of the year, although at the same time very high ozone levels existed over the northern Antarctic Peninsula. The vortex was more circular in mid-September, the ozone hole area reached a maximum of just over 24 million square kilometres but returned to an elliptical shape and initially warmed slowly. (Source: www.antarctica.ac.uk)

First ozone observatory in Tibet starts operation

The first ozone measurement observatory in Tibet Autonomous Region, has become operational on the world's highest plateau. At an elevation of 3,648.9 m in Lhasa, which is located in the low-level ozone layer region on western China's Qinghai-Tibet Plateau, the US$208,000 observatory is equipped with the cutting-edge Brewer Ozone Spectrophotometer that alone costs US$192,000.

According to Mr. Zhang Yong, a senior engineer with Lhasa Meteorological Bureau, Qinghai-Tibet Plateau is a hot spot area for international climate change observation. Comparisons of ozone data in Tibet with those in the baseline observatory in Qinghai Province will accurately reflect changes in the ozone layer over the plateau. The Lhasa observatory will provide precise information on the total ozone amount and ultraviolet-B radiation. The sophisticated instruments will regularly send data to Chinese meteorological departments for analysis, which will be forwarded to the World Ozone and Ultraviolet Radiation Data Centre based in Canada. (Source: www.news.xinhuanet.com)

Getting to the heart of Antarctic ozone

A team comprising researchers from the United Kingdom and the United States has modelled the effects of ozone depletion at different levels in the stratosphere and found that ozone loss in the lower stratosphere (near the tropopause region) has no significant effect on tropospheric temperatures. Hitherto, scientists believed that the troposphere might be more sensitive to depletion of ozone lower down in the stratosphere, which peaks in December-January, because ozone depletion in the stratosphere above the Antarctic generally peaks in October/November whereas tropospheric cooling tends to lag behind, reaching a maximum in December-January. The research team included scientists from the United Kingdom's University of East Anglia and the University of Leeds, and the United States' Colorado State University and NOAA Earth System Research Laboratory.

Ms. Sarah Keeley of the University of East Anglia states that lower stratospheric ozone changes are not the driver for tropospheric response in Antarctica and this is contrary to the suggestion made in the World Meteorological Organization Scientific Assessment of Ozone Depletion: 2006. The team used the Hadley Centre Atmospheric model HadSM3-L64 to conduct their investigations. They performed a control experiment with ozone concentrations comparable to those in the 1970s and three perturbation experiments at the level separating the lower and middle stratosphere. According to Ms. Keeley, the team's findings have implications for understanding the mechanisms of stratosphere-troposphere coupling and the drivers of atmospheric circulation change in the southern hemisphere. (Source: www.environmentalresearchweb.org)

ODS PHASE-OUT IN INDIA

Status of ODS phase-out

India is in the process of phasing out ODS in both the production and end use consumption sectors. Altogether, 296 projects have been approved and funded by the Multilateral Fund (MLF). A total amount of US$229,655,884 has been approved by the Executive Committee of the MLF Secretariat to phase out 46,381 ODP tonnes. Sector-wise break-up of the funds approved by the MLF for ODS phase-out projects in India are as follows:

- Aerosol: US$3,227,739 for 27 projects to phase out 689 ODP tonnes;
- Foam: US$34,785,641 for 159 projects to phase out 4,373 ODP tonnes;
- Halon: US$2,458,701 for 18 projects to phase out 2,162 ODP tonnes;
- RAC: US$32,254,823 for 49 projects to phase out 3,203 ODP tonnes;
- Solvent: US$66,178,980 for 41 projects to phase out 12,966 ODP tonnes; and
- Production sector: US$90,750,000 for two projects to phase out 22,988 ODP tonnes.

Foam sector phase-out project: In 1991, the foam sector used 1,580 t of CFCs (predominantly CFC-11), which amounted to about 31 per cent of India's total CFC consumption at that time. It was estimated that the demand for foam products would grow at 15-20 per cent annually until 2010. The foam sector was therefore identified as a priority sector for initiating phase-out activities. A survey of the foam sector carried out at the time of the original country programme, identified about 235 manufacturers of foamed plastics utilizing CFCs as blowing agents. About 20 per cent of the enterprises were large/medium-sized, while the rest were small and medium enterprises (SMEs) in the unorganized and informal sectors. At its 37th meeting in 2002, the Executive Committee of the Montreal Protocol approved the foam sector phase-out plan at a total funding of US$5,424,577 to phase out 612 ODP tonnes of CFC-11 by 31 December 2006. UNDP was responsible for the implementation of this project. A total of 122 foam manufacturing enterprises under this sector plan has phased out CFCs from their processes. The substitute technologies identified for phasing out ODS at the time of preparation of the country programme include:

- Flexible moulded polyurethane (PU) foam: Water-based technologies for both interim and permanent solutions;
- Integral skin PU foam: HCFCs as the interim solution, water and HFCs as permanent solution;
- Rigid PU foam: HCFCs as interim solution, hydrocarbons and water as permanent solution;
- Phenolic foams: Hydrocarbons as both interim and permanent solutions; and
- Thermoplastic foams: Hydrocarbons as both interim and permanent solutions.

It was considered strategically important to support the conversion of manufacturing facilities of the polyol system producers on a priority basis, to enable them to customize non-CFC formulations and thus facilitate more economical ODS phase-out for the downstream foam manufacturers. Also, ODS phase-out in the large number of SMEs operating in this sector, many of which were not identified at the time of the country programme preparation, was considered to be a challenge.

Commercial refrigeration sector: At its 38th meeting held in November 2002, the Executive Committee of the Montreal Protocol approved the commercial refrigeration sector (manufacturing) phase-out plan at a total funding of US$3,609,186 to phase out 535 ODP tonnes of CFC-11 by 31 December 2006. UNDP was responsible for the implementation of the commercial refrigeration component, while UNIDO was responsible for implementation of the transport refrigeration sub-sector under this sector plan.

A total of 157 firms in the commercial refrigeration sub-sector and 39 enterprises in the transport refrigeration sub-sector have phased out CFC-11 and CFC-12, respectively. As a component of non-investment activity, technical workshops were organized on 26 May 2006 in Chandigarh and on 3 June 2006 in Chennai in order to create awareness and disseminating information about the existing and future alternative technologies in the commercial refrigeration sector. (The Montreal Protocol: India's Success Story 2007)

IN THE NEWS

Montreal protocol's success lessons on climate change

Argentina, Mauritius, Micronesia and the United States announced at the United Nations climate conference in Indonesia that they would continue to work together to maximize the climate benefits of the world's ozone treaty – the Montreal Protocol on Substances that Deplete the Ozone Layer. The United States' Deputy Assistant Secretary for Environment Mr. Daniel Reifsnyder said that the United States was interested in finding ways to reduce emissions of "banks" of ozone-depleting chemicals currently contained in refrigerators and air-conditioners that otherwise will be emitted into the atmosphere at the end of life of these equipment. Stating his country's consent, Argentina's Minister of Environment Mr. Romina Picolotti said, "Argentina agrees that we should continue the successful cooperation with the Parties to the Protocol. The cooperation under the ozone treaty is an example of developed and developing countries working together to implement solutions to a worldwide environmental problem. In terms of the banks of old CFCs and HCFCs, they are damaging to the climate as well as the ozone layer. We have it in our means to solve this problem, and we should move quickly to do so."

Recovering and destroying the banks of CFCs and HCFCs currently contained in refrigerators and air-conditioners could avoid at least a portion of the expected 7.4 billion tonnes of carbon dioxide equivalent in emissions between 2002 and 2015, with the possibility of even greater emissions beyond 2015, as per estimates by the Protocol's Technology and Economic Assessment Panel. By comparison, the Kyoto Protocol mandates a reduction of 5 billion tonnes below 1990 emissions from 2008 to 2012, assuming full compliance from industrialized countries (Kyoto's reductions will be 10 billion tonnes, once the 5 billion tonnes of growth above 1990 levels is added in). Eliminating CFC and HCFC banks will also prevent destruction of the ozone layer, which shields the earth from harmful ultraviolet radiation that cause skin cancer and cataracts, a weakened immune system, and damaged ecosystems and agricultural productivity. *Contact: Mr. Durwood Zaelke. E-mail: zaelke@igsd.org.* (Source: www.unep.fr)

World's first CO_2 refrigeration interactive course

In the United Kingdom, 'elearning-training.com' has introduced a new and pioneering e-learning course on the use of carbon dioxide (CO_2) in refrigeration systems. CIBSE and the Construction CPD Service have accredited this highly instructive course, which provides a broad introduction to the fundamental knowledge required to work on CO_2 systems and also helps prepare the student for further studies on advanced CO_2 refrigeration systems. The course covers design, installation and maintenance considerations, including benefits in using CO_2 and functionality of the different refrigeration systems – volatile secondary, volatile secondary with DX, volatile secondary/cascade, trans-critical and direct expansion.

Experienced engineers from Star Refrigeration have developed this course. Star Refrigeration has been working on the development of CO_2 technologies and solutions that reduce users' environmental impact and running costs for more than 15 years. The information about the use of CO_2 in refrigeration systems was collected from many sources around the world and put together into a superior two-module course, including CO_2 fundamentals and CO_2 refrigeration system basics. Danfoss has also contributed to the development of the CO_2 course by providing valuable learning material. Students achieving 80 per cent or more in the final test will receive a diploma certified by CIBSE and the Construction CPD International Service. *Contact: Elearning-training, Thornliebank IE, Glasgow G46 8JW, United Kingdom. Tel: +44 (141) 6387 916; Website: www.elearning-training.com.* (Source: www.processingtalk.com)

Consumption and production of ODSs in developing countries

Compliance with the approaching 2010 targets for phasing out the consumption and production of CFCs and halons is the major challenge facing countries operating under Article 5 of the Montreal Protocol. At the same time, developing countries must also prepare themselves to comply with the

accelerated HCFC phase-out schedule, decided recently by the Parties on the occasion of the 20th anniversary of the Montreal Protocol, starting with a freeze in production and consumption by 2013. the deadline for the complete phase out of methyl bromide is 2015. Decision makers in developing countries need information that easily conveys where their countries stand in relation to these targets. The trends analysis service from the United Nations Environment Programme-Division of Technology, Industry and Economics (UNEP-DTIE) is designed to provide such a visual tool.

By means of consumption and production data officially reported by their governments, countries must demonstrate that they fully meet the specific legal obligations (control measures) of the protocol as per the agreed timetables. Countries must permanently reduce their dependency on ODS in a step-wise manner and ultimately end it altogether. During the compliance phase, the phase-out process is country-driven in terms of both needs and responsibilities. This means that government commitment and ownership is crucial for success. Nevertheless, as implementation of the Montreal Protocol is not performed in isolation, partnership and cooperation continues to be essential in this period. The Multilateral Fund and its implementing agencies, bilateral agencies, NGOs and other nations continue to help countries identify and overcome compliance challenges. *Contact: Mr. R. Shende, Head, Ozonaction Branch, UNEP-DTIE, 15, rue de Milan, 75441 Paris Cedex 09, France. Tel: +33 (1) 4437 1459; Fax: +33 (1) 4437 1474; E-mail: ozonaction@unep.fr.* (Source: www.unep.fr)

Indian ports become transit points for illegal ODS

Even as India moves closer to completely phasing out the use of ODS in the next two years to comply with the Montreal Protocol, intelligence agencies are concerned about fresh reports of ODSs being smuggled into the nation through ports in Gujarat. A recent intelligence input with the Directorate of Revenue Intelligence states that some importers are using fraudulent declarations for illegal trade of CFCs and other ODSs through inland container depots (ICD) and ports across the state.

As India started phasing out the production of ODSs, illegal traders are exploiting this excellent business opportunity and have started smuggling ODSs into the country. There have been reports of several illegal ODS imports being seized in the recent past, apart from several illegal consignments confiscated in several cities across the country. The easy availability of ODSs in some nations, which produce them legally or illegally, facilitates this illegal trade. (Source: www.expressindia.com)

Insulating China's National Olympic Stadium

Honeywell has announced that closed-cell polyurethane foam insulation using its Enovate® blowing agent is helping to insulate China's National Olympic Stadium, the first such use for a major public building in the region. The insulating technology will help meet strict energy efficiency and environmental guidelines required by government construction authorities and international Olympics construction guidelines regarding environmental protection. The energy-efficient material is used to insulate walls for seating areas in the National Stadium, commonly called the Bird's Nest. The stadium will be the venue for the opening ceremony of the 29th Summer Olympic Games in Beijing, which begin in August 2008. The nearly 2.8 million square feet facility will hold more than 90,000 spectators.

Closed-cell spray foam insulation using Enovate has been proven to provide exceptional energy benefits and environmental performance than other insulation materials. Honeywell's Enovate blowing agent – a non-inflammable, zero ozone-depleting hydrofluorocarbon (HFC) liquid – allows insulating foam to expand and helps provide many of the foam's key performance characteristics. Yantai Polyurethane Co. Ltd. supplied the polyurethane insulation materials, while Harbin Tianshuo Building Materials Industry Co. Ltd. is responsible for overall spraying construction. Earlier to this, closed-cell polyurethane using Enovate served as a roofing material to repair the Louisiana Superdome in New Orleans, the United States, following Hurricane Katrina in 2006. (Source: www.money.cnn.com)

Fluorocarbons destruction facility in Indonesia

The phase-out of the production and consumption of CFCs has been implemented successfully in

accordance with the Montreal Protocol. Nevertheless, challenges still remain, including the disposal of unwanted CFCs and other types of ODS in developing nations. The Ministry of Environment (MoE), Japan, has been working to promote the control of emissions of fluorocarbons (HCFCs, HFCs and CFCs) at the international level and, as part of international cooperation, has also provided technical assistance and consultations to the Asian region, resulting in the establishment of a fluorocarbons destruction facility in Indonesia. The MoE intends to continue its efforts to make the proper destruction of fluorocarbons more widely available to other developing countries based upon the experience gained from this project, and thereby contribute to global ozone layer protection and climate change prevention. (Source: www. env.go.jp)

China explores ways to protect its grain crops

China is exploring more ecological and effective ways to manage its grain storage in a bid to ensure safe resources for consumption and production. As part of a United Nations Industrial Development Organization (UNIDO) project, China has stopped using bromomethane as a pesticide in its grain storage facilities. Phosphine fumigation is now being used to control pests at storage depots – especially those in southern China which are most prone to damage by pests. Phosphine is more environmentally friendly and less likely to leave residues in foodstuffs, experts opine. According to official figures, the proportion of grain lost at storage depots is about 0.2 per cent. However, this figure can be as high as 5-10 per cent for individual grain producers due to pests and mildew.

Meanwhile, authorities are experimenting with other physical methods to control pests in grain depots, including using special inert dust and simulating low-voltage oxygen environments in which the pests cannot survive. However, these methods are yet to be implemented in grain depots. Finding effective ways to reduce the amount of grain lost by producers and establishing greener storage methods are two of the six areas that authorities want to address with the aid of international co-operation. The other areas include development of modern grain logistics, enhancing the refined production of grain and edible oils, setting up a modern information system for grain circulation, and building quality control and rapid examination systems. (Source: www.chinadaily.com.cn)

Meeting environment protection and recycling objectives

The treatment of cooling appliances raises several issues; in particular, the hazardous material they contain is a serious concern. Existing treatment practices have been reviewed in order to assess their environmental performance and highlight the associated CFC and volatile organic compound (VOC) releases into the environment. In Austria, the ordinance on waste prevention, collection and treatment of Waste Electrical and Electronic Equipment stipulates a minimum recycling and reuse rate of 75 per cent for cooling appliances such as refrigerators and freezers.

Two recycling techniques are presently employed in Austria – maximum material recycling (MM) and material recycling with thermal recovery (TM). Austrian researchers recently studied whether the current recycling and reuse target is compatible with optimal treatment practices for the cooling appliances with respect to resource conservation and environmental protection. To this end, they classified end-of-life refrigerators and freezers into two categories. The first category includes CFC-containing appliances, which are expected to disappear due to the Montreal Protocol's ban on CFCs. Appliances that contain VOCs form the second category. The team quantified the material conservation and emissions generated by both the MM and TM methods. The results are as follows:

- Resource conservation is more than 40 per cent higher when using the MM recycling technique compared with the TM method. However, resource conservation can be increased for the TM process. This difference is because of a better recycling of metals using the MM technique.
- The ozone depletion potential caused by the treatment of CFC-containing cooling appliances is much higher under the MM technique than under the TM technique.
- The treatment of CFC-containing appliances has a higher acidification potential when using the MM technique whereas the reverse pattern is observed for equipment containing VOCs.

- For both categories of appliances, the reduction of the global warming potential is higher under the MM technique than the TM technique.
- The MM technique generates significantly less solid residuals than the TM technique.

The researchers conclude that these results do not make it possible to identify the best recycling technology. However, they show that for CFC-containing cooling appliances, CFC emissions, which are responsible for ozone depletion, are the most important environmental impacts and should be minimized. In this regard, they suggest that the TM technique is the most suitable method to recycle equipment containing CFCs. For VOC-containing equipment, they suggest that the MM technique could be adopted, from an environmental point of view. (Source: www.fona.de)

Russia to produce Freon

Russia has received permission from the Ozone Secretariat to produce 140 t of Freon-113 used in space technology. Delegations from the Ministry of Natural Resources and Roskosmos, Russia's space agency, managed to reach an agreement for exclusive production of the substance in Russia. At present, there is no ozone-friendly equivalent for Freon-113. Ozone Secretariat is mainly responsible for protecting the ozone layer according to agreements signed in the mid-1980s banning the manufacture, use, transportation and handling of ODS. (Source: www.en.rian.ru)

Greenchill refrigeration partners help cool the planet

In the United States, several large supermarket chains, refrigeration equipment firms and chemical refrigerant companies launched the new Greenchill Advanced Refrigeration Partnership with the Environmental Protection Agency (EPA). Greenchill is a voluntary programme aimed at promoting green refrigeration technologies, strategies and practices that protect the stratospheric ozone layer, reducing greenhouse gases and saving on money. To counteract the depletion of stratospheric ozone, which protects earth's residents from the sun's ultraviolet radiation, the Greenchill partners guarantee to use only ozone-friendly alternatives and advanced refrigeration technologies in all new and remodelled stores. EPA believes that the partners' adoption of advanced refrigeration methods will lead to increased energy efficiency and reduce operating expenses to the industry by over US$12 million annually. The 10 Greenchill founding partners include the Whole Foods Market, Publix Super Markets Inc., Giant Eagle, Hannaford Bros., Harris Teeter, Food Lion LLC, Hill Phoenix, Kysor/Warren, Honeywell International and DuPont.

Existing partners, and those in the future, must pledge to go above and beyond regulatory needs by establishing an inventory of current refrigerant emissions that may affect climate change and the stratospheric ozone layer, and then setting reduction targets for these emissions. Greenchill partners will take part in a joint industry-government research initiative to assess the performance of green technologies in terms of energy efficiency, reduction of ozone-depleting refrigerant charges and minimization of refrigerant leaks. The EPA estimates that widespread adoption of advanced refrigeration technologies, best practices and improved equipment design and service could reduce refrigerant emissions by one million tonnes of carbon equivalent per year, the equivalent of taking 800,000 automobiles off the road every year. (Source: www.ens-newswire.com)

Green profit for chemical plant

3F, one of China's top chemical firms, produces ingredients for everything from aerosols to fire extinguishers. However, the financial harvest the company is reaping from a small, shiny unit at its Changshu plant comes from destroying a chemical. The unit rakes in millions of euros, most of which the plant utilizes to clean up its environmental standards, under a US$5 billion scheme created by the Kyoto Protocol on global warming.

The United Nations-led scheme allows chemical plants to earn credits when they destroy HFC-23, a waste product from the manufacture of the refrigerant HCFC-22 and a powerful greenhouse gas (GHG). The emission reduction offsets can be sold to rich nations that have overshot domestic GHG quotas. Critics are concerned that the scheme is so lucrative that it has discouraged companies from cutting emissions of the GHG waste product – by giving them incentives first to produce it and then destroy it. One issue for debate is whether

companies should be allowed to earn carbon offsets for destroying extra HFCs produced above 2000-2004 levels, the limit imposed under the present treaty. However, there is no likely end to the production of HFC-23 because manufacturing of HCFC-22 will continue even when its use as an ozone-depleting refrigerant is phased out by a 2040 deadline. (Source: www.uk.reuters.com)

China eliminates Freon from tobacco industry

The tobacco industry in China reports to have eliminated the use of Freon from its production process. This step meets an important target of the Montreal Protocol, according to which China has to phase out the use of Freon in tobacco production by the end of 2009. To meet the target, the industry has spent seven years upgrading facilities and introducing new technologies. Freon is a chemical gas that depletes the ozone layer. (Source: www.cctv.com)

Eurammon awards for natural refrigeration

Students from around the world competed for this year's Natural Refrigeration award given away by eurammon, a joint European initiative set up in 1996 by companies, institutions and individuals advocating an increased use of natural refrigerants. The Natural Refrigeration award recognizes the best scientific dissertation or thesis on the topic of natural refrigerants. By awarding this prize, the European initiative for natural refrigerants hopes to encourage young scientists to work on sustainable refrigeration and air-conditioning solutions. The winners presented their work to eurammon's international members and accepted their awards, with prize money totalling 5,000 euros.

Mr. Jorg Nickl wrote his thesis on "Development of an expander/compressor for the trans-critical refrigeration process with CO_2 as refrigerant" at the Technical University of Dresden to bag the first place. The coefficient of performance (COP) of trans-critical refrigeration circuits with CO_2 can be improved by 20 per cent by replacing the throttle valve with an expander. Mr. Nickl designed a low-frequency, three-stage expander that is directly connected to a compressor. In practical trials, the doctoral student was able to demonstrate the increased efficiency of this design. The second place went to Ms. Christine Junior from the Technical University Carolo-Wilhelmina, Brunswick, for her diploma thesis on "Energetic evaluation of different R-744 loop concepts". Mr. Arash Soleimani Karimabad, who obtained his M.Sc. at the Royal Institute of Technology, Stockholm, came in third with his thesis "Experimental investigations of an ammonia/carbon dioxide cascade system for supermarket refrigeration". *Contact: Dr. Karin Jahn, eurammon, Lyoner Strasse 18, D-60528 Frankfurt, Germany. Tel: +49 (69) 6603 1277; Fax: +49 (69) 6603 2276; E-mail: karin.jahn@ eurammon.com; Website: www.eurammon.com.* (Source: www.verivox.de)

Readiness for 2010 phase-out of R-22 equipment surveyed

Emerson Climate Technologies, the United States, has announced results from its recent contractor and distributor survey regarding R-22 equipment phase-out by 2010. All of those surveyed said they are aware of the phase-out of R-22 equipment. However, only 13 per cent reported that they are exclusively quoting R-410A and 69 per cent reported that they currently quote both R-410A and R-22, while 11 per cent are not even offering R-410A. One of the most dramatic points from the survey results is that 40 per cent plan to wait until 2010 to convert their sales to R-410A equipment. The survey results also indicate higher costs for R-410A systems as the primary reason. Furthermore, over half of the contractors reported that their technicians and staff were trained to support R-410A, and the vast majority stated that they could easily find R-410A equipment. Also, 11 per cent of those surveyed said their customers were specifically asking for R-410A equipment. (Source: www.csemag.com)

Filler

REFRIGERATION/ AIR-CONDITIONING

New air-conditioning models

In Malaysia, AEC Air-Conditioning Engineering Sdn. Bhd. has introduced two new Panasonic air-conditioners – Envio 12 Inverter with the technology capable of saving energy and Envio P2 with an air-purifying system. These two models will help reduce power usage by half for cost-savings and use R-410A gas to help reduce ozone depletion. The air-conditioners cool rooms 1.5 times faster and their cooling mechanism adjusts cooling power according to changes in the room temperature. Envio 12 and P2 air-conditioners come with an improved version of the advanced e-ion air purifying system, with built-in intelligent patrol sensor that changes colour, indicating the pollutant levels in the air. (Source: www.brudirect.com)

Combined CO_2 heat pump and solar heating system

In Denmark, at the Institut für Thermodynamik, Technical University of Braunschweig, researchers have developed a new heating system based on a carbon dioxide (CO_2) heat pump connected with a solar storage tank. The heating capacity of the heat pump is about 2 kW and the Braunschweig University reports that it promises to be more energy-efficient than conventional appliances that are based on combustion. Energy demand for hot water supply is gaining more importance as the heating of buildings requires little energy, especially in houses with high insulation standards. This makes it possible to raise the operating point of the heat pump to temperatures of approximately 55ºC-60°C, at which CO_2 is highly efficient as a refrigerant. (Source: www.iifiir.org)

Energy-efficient water cooling and heating

Aqua Products Co. Inc., the United States, reports that utilizing York® air source heat pump and R-410A refrigerant, the RCS Green Reverse Cycle Chiller™ (RCC) can heat water to 46°C and cool water to 4°C. The system can be sized to meet the heating requirements of homes. Available in 2-3 t and 4-5 t capacity models, the chiller has optional APCHPL16 Aqua solar heat pipe hot water collectors that feature 16 glass vacuum tubes with high-intensity film and heat pipe to absorb solar energy.

The RCS uses electric compressor technology to produce low-cost hot water. The amount of useful hot water delivered by the RCS is greater than the amount of energy it takes to create it. The hot water coefficient of performance (COP) of the RCS is the ratio of useful hot water output (Btuh) compared with the total kilowatt (1 kW = 3,413 Btuh) it takes to produce it. The COP range of the RCS is from 2 to as high as 6 when operating under favourable conditions. The maximum COPs of gas, oil or electric resistance heating is 1.

The advantage of using water with an air source heat pump provides the unique ability of adding multiple single-phase power RCS modules for larger loads like 10, 15 and 20 tonnes. Staging is accomplished with a simple adjustment of the built-in water temperature controller standard in each RCS. *Contact: Mr. John W. Seppamaki, Aqua Products Co. Inc., 14301 C.R. Koon Hwy., Newberry, SC 29108, United States of America. Fax: +1 (803) 3211 980; E-mail: j.seppamaki@aquaproducts.us; Website: www.aquaproducts.us.* (Source: www.news.thomasnet.com)

Infrared gas sensor products

Edinburgh Instruments, the United Kingdom, is offering Chillcard II and Guardian FR monitors that enable high-accuracy detection and measurement of R-125, R-134a, R-123, R-11, R-12 and R-22 refrigerant gas at levels between 0 and 1,000 ppm. The reliability, accuracy and long-term stability of the monitors, combined with low-maintenance requirements, can be attributed to proprietary dual-wavelength infrared sensor technology and more than 30 years of sensor design and manufacturing experience. The Chillcard II instruments include a range of useful optionals and accessories, such as four-digit LCDs, DC pumps and RS232 interface adapters for advanced output signal processing. Suitable for a wide variety of applications, these gas sensors can detect gases from up to 30 m away using the optional sampling pump.

The Guardian range of infrared gas displaying monitor systems ensures near-analyser quality continuous sampling, measurement and display of target gas concentrations at an attractive price. The Guardian FR monitors feature a four-digit LCD and alarm set-point controls housed in a tough plastic enclosure that has an IP54 rating against the ingress of particulates and water. *Contact: Edinburgh Instruments, 2 Bain Square, Kirkton Campus, Livingston, West Lothian EH54 7DQ, United Kingdom. Tel: +44 (1506) 425 300.* (Source: www.processingtalk.com)

Refrigeration system with reciprocating compressor

LG Electronics Inc., the Republic of Korea, has patented a refrigeration system that includes an evaporator that cools as a refrigerant is evaporated; a reciprocating compressor for compressing the refrigerant discharged from the evaporator; a condenser for changing the refrigerant compressed in the reciprocating compressor into a liquid refrigerant; and a capillary tube to decompress the refrigerant discharged from the condenser and transfer it to the evaporator. The reciprocating compressor is claimed to be capable of improving lubrication performance and performance of the refrigeration system by using a hydrofluorocarbon (HFC), such as HFC-134a, as refrigerant and a refrigerant oil well harmonized with the HFC refrigerant. The ester-based lubricant contains an additive, like a stabilizer or anti-oxidant. (Source: www.freepatentsonline.com)

Non-ozone depleting mobile heat pump

Air Force Research Laboratory (AFRL), the United States, has developed an efficient, lightweight and air-transportable heat pump for Air Force base heat pump units. The non-ozone depleting mobile heat pump (NODMHP) employs single-phase gaseous refrigerants such as helium, a gas that does not deplete ozone or contribute to global warming, in place of existing fluorocarbon-based refrigerants such as R-22. AFRL built and tested a 1 tonne single-phase pulse-tube prototype for heat cycle efficiency and capacity, and compared the results with current Air Force R-22 systems and off-the-shelf alternatives. Test results reveal that the prototype unit is a good adiabatic heat provider for efficient space heating of deployable shelters and meets the unit size reduction goals.

As the helium working fluid is inexpensive, easy to use, and has a significantly longer service life, NODMHP is a good candidate for both Department of Defence and commercial industry applications. This technology provides a good heating capability for extreme cold location applications. *Contact: Programme Manager, Pollution Prevention, ESTCP Programme Office, #901, North Stuart Street, Suite 303, Arlington, Virginia 22203, United States of America. Tel: +1 (703) 6962 128; Fax: +1 (703) 6962 114; E-mail: P2@estcp.org.* (Source: www.estcp.org)

Eco-friendly thermal separation and recycling of refrigerants

In Germany, a cooperation effort between Solvay Fluor & Derivate GmbH and RCN Chemie GmbH has resulted in the development of eco-friendly techniques for the separation and recycling of refrigerants. Two different processes have been developed to recycle used refrigerants.

The primary recycling process for single-substance refrigerants on a large technical scale involves processing the used refrigerant back to its original quality. Primary recycling when integrated into the production method for new materials conserves valuable raw materials and energies. One essential prerequisite is that the refrigerant types are not mixed. In most cases, it is not possible to apply the primary recycling process to blends of different refrigerants. The quality of the processed materials is monitored by analyses. Also, the quality of the processed refrigerant depends to a great extent on the type of equipment used and also how this is operated. If the processed refrigerant does not comply with the stringent quality requirements of the respective international standards (e.g. ARI 700), its use can, under certain conditions, result in an increased risk of system failure.

In secondary recycling, secondary raw materials are extracted from the product that is to be disposed of. The refrigerants are decomposed in a high-temperature separation plant. The decomposed products are recovered as hydrofluoric acid and hydrochloric acid. (Source: www.solvayfluorides.com)

FOAMS

A green alternative in foam insulation

FoamXperts, the United States, is introducing tripolymer foam insulation as a more energy-efficient and earth-friendly product. The non-toxic product is water-based, with a high resin content derived from tree sap. Also, it is mould- and fire-resistant, and provides a higher level of insulating properties because it expands before hardening to conform to the shape of any space. It is not harmful if breathed, is free of petroleum or formaldehyde, and is installed with a foaming agent that does not require the use of CFCs or HCFCs that harm the earth's ozone layer. Tripolymer foam insulation, made by C.P. Chemical Co., was developed about 50 years ago for military use and refined in the late 1970s and early 1980s for commercial and residential use. The foam product saves energy because it provides a typical R factor of 15 to 18, about five points higher than fibreglass rolls (batts) the most common form of insulation. (Source: www.indystar.com)

Blowing agent blends

Arkema Inc., the United States, has secured a European patent on foam blowing agent blends of HFC-134a and a pentane selected from n-pentane, i-pentane and i-pentane/cyclopentane, as well as polyol premixes and polyurethane foam compositions containing such blends. These blends of pentanes with HFC-134a reduce or avoid deficiencies associated with the use of either alone. Moreover, the addition of relatively small amounts of HFC-134a has been observed to lower the k-factor (and thus enhance the thermal insulating properties) of foams made with such blends relative to the use of the pentanes alone, especially at low temperatures, while still taking advantage of the low global warming potential properties of the pentanes. Other advantages include good/improved solubility in raw materials such as polyester polyols (especially for i-pentane) and less VOC content than pure hydrocarbon as HFC-134a is not a VOC. *Contact: Arkema Inc., 2000, Market St., Philadelphia, PA, United States of America.* (Source: www.freepatentsonline.com)

Zero-ODP Styrofoam insulation

Dow Building Solutions has developed a next-generation foaming agent technology that will allow it to manufacture Styrofoam™ R5/inch insulation with a zero ODP and halve its greenhouse gas emissions for North America. The proprietary formulation substitutes HCFC-142b, an ozone-depleting compound that the United States and Canadian regulations under the Montreal Protocol require to be phased out by 1 January 2010 in North America. The foaming agent enables Dow's North American customers to continue receiving Styrofoam insulation without compromising product performance and cost-leadership position. Dow has started conversion to the next-generation foaming agent at its North American Styrofoam production facilities, investing in new technology, new capacity and optimizing its overall grid for sustainability. (Source: www.azom.com)

Foamed articles

ICI Plc, the United Kingdom, has obtained patent on a foamed article having a closed cell structure formed from a polymer blend, comprising at least 80 per cent by weight of a styrenic polymer and up to 20 per cent by weight of an acrylic polymer, with gaseous CO_2 as blowing agent. ICI's process for preparation of polystyrene foam by extrusion is already patented in the United Kingdom as well as Europe. These patents detail the preparation of polystyrene foam having a density from 32 to 160 kg/m^3 using an extrusion process with liquid CO_2 as a blowing agent. The United States patent discloses the preparation of a polystyrene foam by re-expansion of an extruded foam.

The foams have lower initial thermal conductivities and retain gaseous CO_2 blowing agent over longer periods, thereby maintaining beneficial thermal properties. Additional benefits may also include the reduced emission of gaseous blowing agents to the environment and the ability to prepare foams without the need for the inclusion of fire retardants or plasticisers within the foam. Styrenic polymer may be a homopolymer or a copolymer of at least one of styrene, methyl styrene and acrylonitrile. Suitably, the styrenic polymer has an average molecular weight (number average) from 180,000 to 250,000 and preferably 180,000 to 230,000. (Source: www.freepatentsonline.com)

HALONS

New fire suppression systems

Sea-Fire Marine, the United States, reports that its FD and FG Series FM-200 pre-engineered automatic fire suppression systems have been certified by Transport Canada, a government regulatory agency, as meeting Canada's strict standards for safety and reliability. The existing H series' approval and a growing list of global certifications enable Sea-Fire to offer builders and owners a variety of fire protection options. As with the H series, the FM-200 FD and FG series are approved for installation aboard Canadian registered vessels in machinery spaces, cargo pump rooms and other enclosed spaces where inflammable and combustible liquids pose a hazard.

Sea-Fire's FD and FG series offer fire protection for spaces from 25 to 1,500 ft^3 and feature FM-200 extinguishing agent, an EPA-approved alternative to halon. Leaving behind no residue, the clean, gaseous chemical extinguishing agent is safe for people, environment and equipment. By releasing the entire amount of FM-200 agent in seconds, the FD and FG series minimize the risk of injury and equipment damage. Sea-Fire FM-200 fire suppression systems also bear Factory Mutual, RINA, Lloyds Register, MCA and USCG approvals and are CE certified. *Contact: Sea-Fire Marine, 9331-A, Philadelphia Rd., Baltimore, MD 21237, United States of America. Website: www.sea-fire.com.* (Source: www.the-triton.com)

Fluorocarbon compositions for fire suppression

DuPont Co., the United States, has developed and patented fire suppression compositions comprising fluorocarbons or HFCs. These compositions can be used for flame suppression, reduction, extinguishment or inertion. One aspect provides a flame suppression composition comprising at least one fluorocarbon or HFC selected from the group consisting of a HFC having the formula E- or Z-$R^1CH=CHR^2$ – R^1 and R^2 are, independently, C_1 to C_6 perfluoroalkyl groups and a fluorocarbon or HFC. The compositions also preferably have an ozone depletion potential not greater than 0.05 (preferably less than 0.02, even zero). *Contact: E. I. Du Pont de Nemours and Co., 1007, Market Street, Wilmington, DE 19898, United States of America.* (Source: www.wipo.int)

Fire and explosion suppression substances

Graviner Ltd., the United Kingdom, has received a European patent on a fire extinguishing and explosion suppression agent comprising perfluorohexane (C_6F_{14}) discharged in atomized form, for example, by means of a pressurizing gas that may, for instance, be nitrogen at least partially dissolved in the perfluorohexane. Another agent comprises a mixture of trifluoromethane dissolved in perfluorohexane. The agents have zero ODP and low toxicity. The fire/explosion suppression agent, comprising a non-inflammable partially or fully fluorinated hydrocarbon having a boiling point above 0ºC, is provided together with discharge means for discharging it in atomized form.

The boiling point of perfluorohexane is 58ºC. It is known for use as a fire suppression agent in the form of a streamed liquid. However, standard lab tests of its fire suppression capability when used in this way, against a two-dimensional or surface-type fire, have shown that to produce the same fire suppression capability as a given quantity of halon-1301, three times as much perfluorohexane is required (when measured in mass or volume terms). It has been found that, when applied in atomized form, perfluorohexane is particularly effective against three-dimensional fires – rapidly developing fires and explosions. The droplets of perfluorohexane in the atomized discharge have a distribution size of 20-200 µm. Such droplets are large enough to have sufficient momentum to reach the seat of the fire or the developing fire ball in as short a time as possible (typically a few tens of milliseconds). However, they are still small enough to evaporate in the flame so as to absorb its heat. (Source: www.freepatentsonline.com)

Fluorinated esters in fire extinguishants

Ansul Inc., the United States, has patented a set of perfluorinated ester compounds that can be utilized alone and in combination with one another

or with other known extinguishing agents to fight fires. Although perfluorinated esters are generally known to be very unstable and weak nucleophiles, it has been found that relatively small amounts of hydrogen greatly increase the inflammability of these compounds. Ansul has discovered that there are particular perfluorinated esters that are non-inflammable and fulfil all or most of the desirable characteristics for clean extinguishing agents. These esters are volatile and capable of fire suppression by both air exclusion and cooling. Also, they are highly inert to oxidation, stable in storage and yet rapidly hydrolyse in the atmosphere to form water-soluble fragments. Additionally, this group of esters covers a broad range of different boiling points, i.e. 30ºC to 100ºC, so as to enable specific applications as either flooding agents or streaming agents. These novel fire retarding esters have the formula $R^1COOCR^2(CF_3)_2$ wherein R^1 = H, CF_3, C_2F_5, C_3F_7 or CF_3CO_5 and R^2 = H or CF_3. *Contact: Ansul Inc., 1 Stanton Street, Marinette, WI 54143, Wisconsin, United States of America.* (Source: www.wipo.int)

Fire protection systems

Levitt Safety Ltd., Canada, can assist any organization to make the transition from halon to an alternative non-ozone-depleting alternative fire suppression agent. It has the knowledge and experience in all stages of the transition including:

- Develop specifications for a replacement system that targets all potential fire risks;
- Design new alarm, control and ventilation systems, as needed;
- Produce a budget and project plan;
- Supervise the new installation; and
- Assist in securing the existing halon stocks.

The alternatives on offer include:

- Water-based systems such as roof-mounted sprinklers;
- Carbon dioxide Systems;
- Water mist systems; and
- Inert gas systems.

Contact: Levitt Safety Ltd., 2872 Bristol Circle, Oakville, ON L6H 5T5, Canada. Tel: +1 (905) 829 3668; Fax: +1 (905) 829 5988; E-mail: systems @levitt-safety.com.

SOLVENTS

Carcinogen eliminated from degreasing process

Nakanishi Manufacturing Corp. now no longer uses trichloroethylene (TCE), a cancer-causing chemical, in its eastside bearings factory. The company began the TCE phase-out in summer 2006, replacing one of two degreasing processes with a new one that does not use TCE. The new degreasing process uses a degreaser with a trademarked name, Isopar L, produced by ExxonMobil Chemical. Tests have shown the new method works well enough for the firm to make the change permanent. The new vacuum degreasing process allows Nakanishi to reuse the Isopar L in a closed system, rather than venting it into the outside air. In the past, the company released as much as 45,350 kg/y of TCE into the air around the Voyles Road plant. A 2006 study showed the air in the vicinity of the plant could have the highest level of TCE found in any community in the whole of the United States. (Source: www.onlineathens.com)

All-purpose metal cleaner

Kyzen Corp., the United States-based provider of environmentally responsible precision cleaning chemicals, offers a new, heavy-duty aqueous high-alkaline all-purpose cleaner for metals. Metalnox M6319 is an aqueous blend of detergents, alkalinity builders, conditioners, and organic and inorganic inhibitors designed for heavy-duty cleaning of oils, waxes, grease, drawing oils, machining oils, fingerprints, hydraulic fluids, road dirt, carbonized oils, petrolatum and shop dirt. The cleaner is relatively safe to use on most alloys.

M6319 is diluted with water as needed to remove the soils involved. Besides, 1-3 per cent of M6319 or an inhibitor may be added to all rinse stages to prevent flash rusting of ferrous parts. The metal cleaner is low-foaming, non-phosphated and safe on magnesium, as well as ferrous and copper alloys. It features trace silicates, prevents flash rust and has no HAPs, CFCs or SARA 313s. Additionally, M6319 features low-use cost and low VOC. It can be used in both spray and immersion systems. M6319 is multi-metal safe for use on

yellow metals, including copper, bronze and brass, some aluminium alloys, iron, steel and composites in addition to most precious metals, plastics and rubbers. *Contact: Kyzen Corporation, 430, Harding Industrial Drive, Nashville, TN 37211, United States of America. Tel: +1 (615) 8310 888; Fax: +1 (615) 831 0889.* (Source: www.americanmachinist.com)

Coating system ensures low environmental impact

Infratrol Manufacturing Corp., the United States, offers an all-electric ecoflex system that has been designed for powder coating of small parts. This system does not require drains, and does not generate sludge/hazardous waste, hazardous air pollutants or ozone-depleting substances.

The compact, energy-efficient powder coating system has a low environmental impact, and is available in four standard sizes, with the smallest requiring only 700 ft^2 of floor space. A complete ecoflex powder coating system is operational at the firm's facility in New Berlin, Wisconsin, to demonstrate the powder coating system's abilities. *Contact: Mr. Hank Hemphill, Vice President of Sales, Infratrol Manufacturing Corp., 2500 S., 162nd Street, New Berlin, WI 53151, United States of America. Tel: +1 (262) 7978 140; Fax: +1 (262) 7978 141.* (Source: www.news.thomasnet.com)

Replacements for chlorinated solvents

Envirotech (Europe) Ltd., the United Kingdom, is offering Ensolv as the industry-standard substitute for HCFC-141b, other chlorinated solvents and trichloroethylene. A patented azeotropic stabilization and solvent enhancement formulation ensures that Ensolv conforms to relevant ASTM and aerospace cleaning standards.

In order to meet specific industry needs, a range of Ensolv precision cleaning solvents have been developed, based on a unique patented inhibitor package to neutralize acid, inhibit rust, prevent corrosion of metals and enhance solvency in soil lifting performance. The complete range of Ensolv solvents contains no chlorine, is non-inflammable, azeotropic, environmentally friendly, and has excellent solvency and soil loading capacity.

Ensolv is a general-purpose solvent employed for vapour degreasing and ultrasonic cleaning, while Ensolv CW is formulated for general cold and hand wiping applications but exhibits the versatile performance of Ensolv. Ensolv CWA addresses the specific requirements for cold wipe and hand wipe cleaning of electronics, and it exhibits the same characteristics and cleaning performances as Ensolv. Ensolv A is specifically formulated for vapour degreasing and ultrasonic cleaning of electronic assemblies and components. A product line of solvents that offers variable rates of solvency and evaporation to meet the specific needs of these industries is available for adhesives, ink blends and coatings.

Ensolv is used and approved by major aerospace, electronics and engineering companies in Europe, the United States and Asia. The solvent cleaner, manufactured by Envirotech International Inc. in the United States and the United Kingdom to ISO 9002 standards, is available through distributors in Europe, the United States and Asia. *Contact: Envirotech Ltd., Bermuda House, 45 High Street, Hampton Wick, Kingston upon Thames, Surrey KT1 4EH, United Kingdom. Tel: +44 (20) 8281 6370; E-mail: info@ensolv-europe.com.* (Source: www.ensolv-europe.com)

Cleaning processes at AT&T

In the late 1980s, AT&T endeavoured to eliminate CFCs by redesigning its cleaning processes, which resulted in a reduction in the cost of cleaning circuit boards from US$0.25 to US$0.15 per square feet and an overall annual savings of US$3 million. Some of the process changes that have been developed at AT&T to reduce hazardous wastes include a low-solids flux and application equipment that eliminates the need to remove the residue with CFCs or other solvents after soldering. This product is now being marketed commercially, due to its success.

In addition to the new flux equipment, terpene cleaning systems were developed to replace CFCs and other solvents in the process. Terpene, a citrus-based cleaner, provides excellent removal of both organic and ionic compounds. In addition, terpene rinse baths may be used from six months to a year before they are disposed of through fuel blending. (Source: www.future500.org)

FUMIGANTS

Radio waves for pest control

In the United States, Dr. Juming Tang and Dr. Shaojin Wang at Washington State University (WSU), along with colleagues at the University of California-Davis and USDA's Agricultural Research Service, have developed a way to harness electromagnetic energy at radio frequency (RF) to get rid of insect pests. RF heating traits were first applied to walnuts, owing to the heat sensitivity of this low-moisture commodity. Using a WSU heating block system, thermal death kinetic models were developed for targeted insects, including codling moth (*Cydia pomonella*), Indianmeal moth (*Plodia interpunctella*), red flour beetle (*Tribolium castaneum*) and navel orangeworm (*Amyelois transitella*). RF energy generates heat by agitating bound water molecules in dry agricultural products such as walnuts. This process also generates heat through ionic conduction and agitation of free water molecules in the insects. More thermal energy is converted in insects than in walnuts, thus providing pest control in low-moisture foods.

RF treatments effectively control insect pests at life stages present in in-shell walnuts without negatively affecting walnut quality or storability. This process is technically feasible for large-scale commercial applications. RF treatments may serve as a non-chemical alternative to chemical fumigants for post-harvest pest control in similar commodities (e.g. almonds, pistachios, pecans, lentils, peas and soybeans), reducing the long-term impact on the environment, human health and competitiveness of agricultural industries. (Source: www.csrees.usda.gov)

New technology for Israeli date crops

Researchers in Israel are applying a new process to disinfect Medjoul dates. Thermal disinfestation replaces the need to employ methyl bromide on Medjoul date varieties exported from Israel, and is environmentally sound and sustainable. It is estimated that nearly 9,000 t of dates were treated by thermal disinfestation, but the technology has not yet been applied to other Israeli date varieties. The ministry for environment protection is supporting a project to study the suitability of this technology for other date varieties, dried fruits and stored food products. (Source: www.freshinfo.com)

Biofumigant from weed

In the United States, researchers at the National Centre for Agricultural Utilization Research in Illinois believe they have found the answer to the food versus fuel debate and high commodity prices that challenge the biodiesel industry. They report that pennycress (*Thlaspi arvense*) can be turned into a biodiesel feedstock. "It is off season from corn and soybeans, has high seed yield and high oil", points out lead researcher Dr. Terry Isbell. However, a colleague, Dr. Steve Vaughn, found promise in the glucosinolate portion as a potential soil fumigant.

The glucosinolates in pennycress meal restrict its use as an animal feed, but also contain the chemical sinigrin, which in the presence of water disintegrates into allyisothiocyante, a bio-fumigant. A bio-fumigant could provide an eco-friendly alternative to methyl bromide, Dr. Vaughn states. Apart from killing weed seeds in the soil prior to planting high-value crops, pennycress meal would have value as a fertilizer, Dr. Vaughn adds. (Source: www.biodieselmagazine.com)

Cold treatment for fruit fly

In Australia, researchers at the NSW Department of Primary Industries (DPI) have proved that cold storage at temperatures of 2°C or 3°C effectively kills Queensland fruit fly (QFF) in citrus fruits. Cold treatment at these temperatures for 14-16 days provides greater market flexibility and reduces problems associated with cold chilling, such as internal fruit and skin damage. This treatment mode is the Australian citrus industry's preferred method and Japan formally accepted it after the federal government advised them of the results of extensive replicated trials conducted at Gosford and Western Australia. At Gosford, post-harvest researchers examined the effect of cold treatment on QFF, while scientists from the Department of Agriculture examined the impact of the same treatment on the Mediterranean fruit fly (MFF). Trials show that QFF were killed after 14-16 days storage and MFF after 16-20 days. (Source: www.sciencedaily.com)

RECENT PUBLICATIONS

Thermophysical Properties of Refrigerants for Applications in Vapour-Compression Systems

This booklet provides the most important thermophysical property data for different refrigerants with applications to vapour-compression systems in an easily accessible form. Tables are used to illustrate the basic cycles at various evaporating and condensing temperatures, and also provide information on pressure ratio, volumetric capacity and isentropic compression work. The coefficients of performance (COPs) of cycles with isentropic compression are given, as is the thermodynamic efficiency of each cycle (with the Carnot cycle used as reference). Data are provided for the following refrigerants: R-32, R-125, R-134a, R-152a, R-290 (propane), R-404A, R-407C, R-410A, R-507, R-508A, R-600a (isobutane), R-717 (ammonia), R-744 (carbon dioxide, including transcritical cycles and R-1270 (propylene).

Saving Energy in Refrigeration, Air-Conditioning and Heat Pump Technology

This guide presents, in a concise and didactic manner, all solutions that make it possible to cut the energy consumption of refrigeration and air-conditioning systems, including heat pumps. This is a vital issue as these systems consume about 15 per cent of worldwide electricity. The solutions apply to the design, operation and maintenance of various systems (compressors, condensers, expansion devices, evaporators, etc.) and take refrigerant selection into account. While several practical cases of highly energy-efficient systems are presented, the guide includes an extensive bibliography and an overview of the main applicable regulations and standards.

For the above publications, *contact: International Institute of Refrigeration, 177, Blvd. Malesherbes, 75017 Paris, France. Tel: +33 (1) 4227 3235; Fax: +33 (1) 4763 1798.*

TECH EVENTS

9-11 Apr
Shanghai
China

China Refrigeration Expo
Contact: Mr. Zhou Jinglong/
Ms. Peng Lu, Beijing International Exhibition Centre (BIEC), Suite 601, Floor 6, Henghua International Mansion, 26, Yuetanbeijie, Xicheng District, Beijing 100045, China.
Tel: +86 (10) 5856 5888, ext. 605/610;
Fax: +86 (10) 5856 6000/6551;
E-mail: jinglong@biec.com.cn.

20-21 May
Berlin
Germany

The 10th International Conference on Blowing Agents and Foaming Processes 2008
Contact: Sharon Garrington, Conference Organiser, Conference Department, Rapra Technology Ltd., The United Kingdom.
Tel: +44 (1939) 250 383;
Fax: +44 (1939) 252 416;
E-mail: sgarrington@rapra.net.

2-4 Jul
Singapore

HVAC Asia 2008
Contact: HQ Link Pte Ltd., 205, Henderson Road, #03-01, Henderson Industrial Park, Singapore 159549.
Tel: +65 6534 3588;
Fax: +65 6534 2330;
E-mail : hqlink@singnet.com.sg;
Website: www.hvacrseries.com.

12-17 Jul
West Lafayette
United States

Purdue Compressor Engineering and Refrigeration and Air-Conditioning Conferences
Contact: Mrs. Virginia D. Freeman, Program Secretariat for
The Ray W. Herrick Laboratories, Purdue University,
140 S. Martin Jischke Drive,
West Lafayette, IN 47907-2031,
United States of America.
Tel: +1 (765) 494 6078;
Fax: +1 (765) 494 0787;
Email: herlconf@ecn.purdue.edu;
Website: www.ecn.purdue.edu.

21-26 Sep
Chengdu
China

8th International Conference on Controlled Atmosphere and Fumigation in Stored Products
Contact: Ms. Li Yue,
Chengdu Grain Storage Research Institute, State Administration of Grain Reserves,
No. 95, Huapaifang Street,
Chengdu 610031,
China.
Tel: +86 (28) 8766 0408;
Fax: +86 (28) 8766 1523;
E-mail: caf20088th@yahoo.com.cn.