THE SCIENCE OF OZONE LAYER

Major climate shift to result from closing ozone hole

A new study led by researchers from Columbia University, the United States, has found that the closing of the ozone hole, which is projected to occur sometime in the second half of 21st century, may cause major climate change in the Southern Hemisphere, and therefore, the global climate. "Our results suggest that stratospheric ozone is important for the Southern Hemisphere climate change, and ought to be more carefully considered in the next set of IPCC model integrations," said Dr. Seok-Woo Son, lead author of the study and a research scientist at Columbia's School of Engineering and Applied Science (SEAS).

The team of 10 scientists compared results from two sets of climate models – one used by the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and the other from the Scientific Assessment of Ozone Depletion of 2006. In their prediction of future climate, many IPCC models did not consider the expected ozone recovery and its potential impacts on climate change. The chemistry-climate models used for the 2006 Ozone Assessment, however, predict that the Antarctic ozone hole will achieve full recovery in the second half of this century, and that this may have profound impacts on the surface winds and on other aspects of the Earth's climate, including surface temperatures, locations of storm tracks, extent of dry zones, amount of sea ice and ocean circulation.

"We were surprised to find that the closing of the ozone hole, which is expected to occur in the next 50 years or so, shows significant effects on the global climate," said Dr. Lorenzo M. Polvani, professor of applied physics and applied mathematics at SEAS. "This is because stratospheric ozone has not been considered a major player in the climate system." The researchers state that more research is needed to validate their results, and to fully understand how complete ozone recovery will impact the planet's changing climate. While previous studies have shown that ozone hole recovery could lead to a warming of the Antarctic, much work remains to be done. For instance, the interactions between a recovering ozone hole, increasing greenhouse gases, ocean currents, and other components of the climate system must still be explored in order to better understand how the Earth's climate will change in the future. (Source: www.sciencedaily.com)

Antarctic ozone hole update

The 2008 ozone hole season has begun. The temperature of the ozone layer is coldest over Antarctica and warmest in the circum-polar region. It is cold enough for polar stratospheric clouds to form over Antarctica, and they have been seen from the monitoring station based in Rothera on several occasions. Temperatures are slowly dropping further as winter progresses. Ozone values are above 350 DU in parts of the circum-polar regions as the circum-polar vortex builds, dropping towards 200 DU over Antarctic Peninsula. Ozone depletion is occurring as the polar vortex changes shape and the stratospheric clouds are exposed to sunlight. Ozone values are dropping at Rothera. (Source: www.antarctica.ac.uk)

Ozone-friendly replacements disastrous for global warming

The Environmental Investigation Agency (EIA) reports that the recent decision to accelerate the phase out of hydrochlorofluorocarbons (HCFCs) will in fact undermine the efforts to reduce global warming if proper precautions are not taken. The problem is that chemicals being marketed as the dominant replacements to ozone-depleting HCFCs are hydrofluorocarbons (HFCs) – extremely potent greenhouse gases, often more so than the HCFCs they are set to replace. Their use in developed and developing countries is rising quickly and emissions from HFCs are expected to reach at least 1.2 billion tonnes of carbon dioxide equivalent by 2015, which is about 10 per cent of the total Kyoto Protocol savings between its 1990 baseline and 2012 reduction targets.

The decision to bring forward the phase-out of HCFCs, made by the Montreal Protocol in last September, could reduce greenhouse gas (GHG)

emissions by up to 16 billion tonnes of carbon dioxide equivalent by 2040, with the majority of savings achieved in developing countries. "However, these enormous climate benefits stand to be lost unless decisive action is taken to ensure that climate-friendly alternatives to HCFCs are adopted" states Ms. Fionnuala Walravens, EIA's Global Environment campaigner. Many countries are finally beginning to recognise the need to limit the use of these GHGs. Last year, the European Commission issued a directive to prevent the use of high global warming potential HFCs in car air-conditioning produced from 2011. (Source: www.eia-international.org)

An eye in the sky: Keeping tabs on the ozone layer

Operating well beyond its planned lifetime of two years, Canada's SCISAT recently celebrated its fifth birthday. Since its launch in 2003, SCISAT continues to make a significant contribution to the capture and analysis of critical atmospheric data. SCISAT has proven its ability to collect long-term data on the significant gases in the atmosphere. The key to SCISAT's success lies in the performance of two instruments on-board the satellite. One is MAESTRO, developed by Environment Canada, the University of Toronto and EMS Technologies of Ottawa. The other is the Fourier-Transform Spectrometer (ACE-FTS) developed by ABB BOMEM of Quebec City. These two instruments continue to collect valuable and precise data even though they have exceeded their expected lifespan.

SCISAT provides high-precision information on the condition of the ozone layer and atmospheric changes. In 2006, data collected by SCISAT played a key role in helping scientists better understand the loss of ozone over the Northern hemisphere. SCISAT provided new evidence that the Montreal Protocol is yielding good results. Moreover, it is the only satellite capable of 3D surveillance of the gases regulated by the Montreal Protocol, which is of great importance to decision makers. The data collected by SCISAT over the past five years clearly show that levels of atmospheric CFCs, the main chemicals that destroy ozone, are falling and that the threat of overall ozone depletion is decreasing. (Source: www.marketwire.com)

ODS PHASE-OUT IN INDIA

Ozone-friendly air-conditioned coaches in the offing

The 150-year-old Railways plans to replace the existing air-conditioning systems in trains with ozone-friendly alternatives. The organization is using refrigerants based on R-12 (dichloro-diflouro methane gas), which is harmful to the ozone layer. According to an official, the alternative R-134a and MO-49 refrigerants are more eco-friendly. At present, 11 coaches equipped with conventional under-slung AC plants have been converted to use eco-friendly refrigerants. (Source: www.rediff.com)

SAIL identifies 71 projects for carbon credits

Amid the rising threat of global warming, India's leading steel producer SAIL has identified over 71 potential projects for availing of carbon credits. As part of the first phase, the company has awarded consultancy for 38 projects. With regard to other environment-friendly steps, SAIL reports that it has taken up a US$3.5 million project to stop the use of approximately 268 million tonnes of carbon tetrachloride (a cleaning solvent) for electrical machines and oxygen plants at its Bokaro, Bhilai, Durgapur, Rourkela and other steel plants. (Source: www.theindiapost.com)

CEE helps phase out ODS

The Centre for Environment Education (CEE), based in Ahmedabad, has been involved in projects aimed at phasing out ODS in the country. Two key projects are:

- Implementation plan for phase out of carbon tetrachloride (CTC) – CEE carried out a reality check on the substitution of CTC in small and medium enterprises, commissioned by the UNEP DTIE Energy and OzoneAction branch. CEE interacted with more than 300 firms, six offices of the pollution control boards and carried out 18 pilots to establish the feasibility of substitution. A

comprehensive implementation plan was also developed to help overcome barriers.

● Contributing to the success of the national programme on aspects of ozone layer protection – CEE coordinated tasks pertaining to awareness generation as part of the country programme on aspects of ozone layer protection, with reference to the country's commitments to the Montreal Protocol. The Educator's kit on protection of the ozone layer developed as part of this project was used by the media and NGOs as teaching aid materials for use across the nation. The kit, which mainly consists of a poster and a teacher's booklet with information on aspects of ozone layer depletion and its protection, has been produced for use in schools across the nation. A kit consisting of a series of transparencies, script and information supplement has also been developed, targeting information capacity building in NGOs.

Contact: Centre for Environment Education, Nehru Foundation for Development (NFD), Thaltej Tekra, Ahmedabad 380 054, Gujarat, India. Tel: +91 (79) 2685 8002; Fax: +91 (79) 2685 8010; E-mail: cee@ceeindia.org. (Source: www.ceeindia.org)

Restoring ozone layer could bring health, economic benefits

Repairing the Earth's badly-damaged ozone layer is not only to be undertaken in times of economic prosperity, United Nations Secretary-General Mr. Ban Ki-moon said recently, marking the International Day for the Preservation of the Ozone Layer. Stressing that reducing substances harmful to the layer could propel health, economic and social progress, Mr. Ban said efforts to tackle climate change are adversely affected when the global economic situation is in flux.

"As the Montreal Protocol has taught us, when we degrade our environment too far, nursing it back to health tends to be a long journey, not a quick fix," Mr. Ban said. But he pointed out that the pact also highlights how taking action in one area can lead to benefits in other areas, including efforts to achieve the Millennium Development Goals, the eight anti-poverty targets with a 2015 deadline. The Secretary-General also called for countries to reach accord on a successor pact to the Kyoto Protocol. (Source: www.un.org)

IN THE NEWS

Montreal Protocol Award for ozone protection

Nine companies from Thailand have won awards under the Montreal Protocol for their contributions towards protecting the ozone layer, which has in turn helped Thailand save on energy bills and reduce carbon emissions. According to Mr. Ian Porter, the Thailand Country Director of the World Bank, "These companies made the commendable decision to make corporate social responsibility one of their priorities. The leadership provided by their collective action will be felt beyond Thailand's borders." The Montreal Protocol Exemplary Project Recognition was given to 31 projects in Africa, Latin America, Europe and East and South Asia to mark the Protocol's 20th anniversary. All of these projects were funded by the Multilateral Fund, the financing facility set up to help developing countries acquire the needed capital to meet their obligations under the Montreal Protocol. To date, the Multilateral Fund has provided financial support to more than 5,500 ozone-protecting projects in 144 countries. (Source: www.worldbank.or.th)

Major economies promote Protocol, fast action on climate

Recently, the world's 17 major economies pledged to "continue to promote actions under the Montreal Protocol on Substances that Deplete the Ozone Layer for the benefit of the global climate system". The leaders recognized the "need for urgent action" and committed to act "without delay" to strengthen the Montreal Protocol for the benefit of the climate system. The leaders' pledge provided a powerful boost to the Montreal Protocol Parties' meeting, during which Argentina, the Federated States of Micronesia and Mauritius proposed strengthening the Protocol to address the 7.4 billion tonnes of carbon dioxide (CO_2) equivalent that will be emitted by 2015 from discarded products and equipment if these are not properly recovered and destroyed. Destruction of these substances – including CFCs and HCFCs in developed countries as well as additional CFCs in developing countries – would significantly benefit the ozone layer, saving lives

and reducing cancers and cataracts. Collectively, the major economies are responsible for 80 per cent of global climate emissions. *Contact: Ms. Alex Viets, Communications Officer, Institute for Governance and Sustainable Development, United States of America. Tel: +1 (213) 3210 911; E-mail: aviets@igsd.org; Website: www.igsd.org.* (Source: www.reuters.com)

UNEP chief supports green Olympics in Beijing

UNEP's Executive Director Mr. Achim Steiner attended the Beijing Olympic opening ceremony in China as part of UNEP's continuing support for the greening of the Games. Mr. Steiner had stated that he would take this opportunity to see first-hand some of the environmental improvements implemented for the Games. UNEP had been working with the Beijing Olympic Committee for the last three years to help make the summer Games environment-friendly. Further, the Chinese government had spent US$17 billion on a large-scale green drive ahead of the Games, including a series of long-term environmental improvements for the city. As part of this programme, tougher standards were introduced for vehicle emissions and phasing out ozone-depleting substances. (Source: www.news.xinhuanet.com)

OEWG meet: A report

The 28th meeting of the Open-ended Working Group (OEWG) of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer was held during 7-11 July 2008 at Bangkok, Thailand. The opening statements of this meeting were made by Mr. Rachada Singalavanija, on behalf of Mr. Suwit Khunkitti, Deputy Prime Minister and Minister of Industry of Thailand, and Mr. Marco Gonzalez, the Executive Secretary of the Ozone Secretariat. Some highlights of the meeting are:

- Noting the success of the Montreal Protocol since its inception, Mr. Singalavanija welcomed the commendable work of the Technology and Economic Assessment Panel and introduced the tasks ahead. With regard to phasing out HCFCs in the refrigeration and air-conditioning sector, Mr. Singalavanija called for technical and financial assistance to be made available to the Parties operating under paragraph 1 of article 5. He also referred to the funding needed to enable the Parties to comply with their HCFC reduction schedules under the Protocol and noted that various funding scenarios for the replenishment of the Multilateral Fund for Implementation of the Montreal Protocol had been prepared. In closing, he urged Parties to maintain the momentum for the successful implementation of the Protocol.
- Recalling the historic decision adopted at the previous Meeting of the Parties with regard to the accelerated implementation of control measures for HCFCs, Mr. Gonzalez noted that adjustments to the Protocol adopted at that meeting had entered into force and had become binding on all Parties on 14 May 2008. Among the challenges faced by Parties at their current meeting, Mr. Gonzalez drew attention to the replenishment of the Multilateral Fund for Implementation of the Montreal Protocol for the period 2009-2011 and urged the Parties to reach an agreement that would be of benefit to them and to the environment itself. In conclusion, he announced that the Holy See and Iraq had become Parties to the ozone treaties in 2008, bringing the Protocol closer to becoming the first multilateral environmental agreement to achieve universal ratification.

(Source: www.unep.fr)

Awareness programme for tea sector stakeholders

In Sri Lanka, an awareness programme organized for tea sector stakeholders in July ended successfully. Leading tea sector stakeholders participated in this joint effort by the National Ozone Unit, Sri Lanka Tea Board, Sri Lanka Tea Research Institute and Tea Exporters. The main goal was to motivate tea exporters to promote Ceylon tea as an ozone-friendly product. In order to meet this purpose, an appropriate logo was designed and proposed. The parties agreed to urgently finalize the logo and to make arrangements to print on the packing as necessary. (Source: www.noulanka.lk)

Raising awareness through ozone-friendly competition

Sri Lanka's National Ozone Unit has planned to launch a pilot programme in Homagama Education

Zone to mark the 2008 International Ozone Day. The main objective of the school competition is to persuade students to undertake ozone-friendly activities such as:

- Form a committee to organize ozone-friendly activities in the school; and
- Conduct various activities by this committee in the school.

In order to implement the programme, the National Ozone Unit and Homagama Zonal Education Office jointly organized a briefing programme for school teachers in the zone. *Contact: National Ozone Unit, Tel/Fax: +94 (011) 2811 417; E-mail: ozone@noulanka.lk.* (Source: www.noulanka.lk)

Philippines to ban cars with ozone-depleting chemical

In the Philippines, the Land Transportation Office (LTO) will soon ban vehicles with air-conditioning units that use CFCs. Prior to the renewal of motor vehicle registrations, all vehicles that have been penalized for violating the provisions of Random Roadside Inspection (RRI) are required to present the vehicle to any Environmental Management Bureau (EMB) regional office, LTO regional office or LTO Motor Vehicle Inspection Service (MVIS) for validation service. According to LTO chief assistant secretary Ms. Anneli Lontoc, the LTO will not renew the registration of vehicles with mobile air-conditioners that contain CFCs. All vehicles manufactured from 1 January 1999 onwards should have HFC-134a or R-134a systems. Any vehicle found to have converted to R-12 will not be registered unless converted back to HFC-134a. (Source: www.davaotoday.com)

Republic of Korea acts to stop ozone-depleting chemicals

As part of the Republic of Korea's commitment to cure the stratospheric ozone layer, the government amended the Act on Control of Manufacture of Specific Substance for the Protection of the Ozone Layer. Most importantly, the amended Act required a gradual end to the production of chemicals that deplete the ozone layer by strictly complying with international agreements and by fostering the development of alternatives to ozone depleting substances. Furthermore, since 1997, the Environmental Mark has been conferred on refrigerators that do not use CFCs in an effort to motivate green consumerism. (Source: www.eiatrack.org)

Quarantine fumigant use in Fiji

The Principal Agricultural Officer at Fiji's Ministry of Agriculture, Mr. Ilaitia Boa, stated that Fiji will phase out the use of methyl bromide as a fumigant for all uses by 2009, except those classified as for quarantine and pre-shipment. Mr. Boa said methyl bromide is used for all infested imported cargoes and for all export cargoes that require treatment only to meet the importing countries' requirements. Mr. Boa pointed out that currently Fiji was free from major pest and disease, "and treatments are one of the essential components of quarantine operations. This determines the pest status of a country in market access and in trade facilitation; it also fosters tourism and economic growth". (Source: www.fijilive.com)

Zero CFC emission by 2010

In compliance with the Vienna convention for the protection of the ozone layer and the Montreal Protocol, Bhutan will have to decrease CFCs to zero per cent by 2010. Ms. Peldon Tshering, the National Ozone Officer of the National Environment Commission (NEC) secretariat, the country has already phased out 85 per cent of the baseline. Retrofitting old air-conditioners and refrigerators that use CFC with other alternatives had been effectively implemented since 2005, according to Ms. Tshering. Licensing rules do not permit import and export of products containing ODS. The rules and regulations on the control of ODS are being revised to incorporate control of HCFCs.

The UNEP regional office for Asia-Pacific and the NEC secretariat had organized a two-day train-the-trainers workshop on retrofitting of refrigeration appliances and mobile air-conditioners. Around 22 participants from vocational training institutes (VTIs) and the college of science and technology (CST), and technicians from the armed forces attended the retrofitting workshop. Furthermore, training programmes on retrofitting refrigeration and mobile air-conditioning are expected to be introduced for students of VTIs and CST, said Ms. Tshering. (Source: www.kuenselonline.com)

REFRIGERATION/ AIR-CONDITIONING

LX series air-conditioners

York® LX series of air-conditioners and heat pumps from Johnson Controls Inc. provide dealers of heating, ventilation and air-conditioning with a new product offering that increases their selling options. With the smallest 13 SEER footprint in the industry, LX series units are a perfect fit in multi-family applications or wherever cooling is essential but space is limited. This series features a MicroChannel coil with enhanced heat transfer characteristics, enabling the units to achieve the desired performance levels with less coil surface area than competitive condensers and up to 50 per cent less refrigerant. The units are available with environmentally friendly R-410a and R-22.

The 14.5 SEER LX series air-conditioners use a compressor blanket and swept-wing fan blade for quieter operation. 15+ SEER can be achieved when the air-conditioner is matched with a variable-speed air handler or gas furnace. A fully louvered steel coil guard, corner posts and a polymer mesh protect the condensing coils from damage. The unit's heavy-duty cabinet is made of powder-coated steel that resists corrosion and rust creep. In addition, the MicroChannel coil offers better galvanic corrosion resistance than conventional coils. In tests, the coil withstood 7,000 h of salt spray with a higher success rate than conventional coils at just 1,000 h, making the units suitable for seacoast applications. *Contact: Johnson Controls Inc., 5757 N. Green Bay Avenue, P.O. Box 591, Milwaukee, WI 53201, United States of America. Tel: +1 (414) 524 1200* (Source: www.prdomain.com)

Powerful yet compact commercial split system

Sanyo Air-conditioners Europe (SAE) has launched its Big PACi range of high-performance commercial split air-conditioning systems. The new models offer powerful heating and cooling in a reduced footprint. Lightweight and compact, the Big PACi is available in two models, C706VH8 and C906VH8 8-10 HP (20-25 kW), with improved performance and lower power consumption for large commercial applications. Capable of offering both heating and cooling (down to -15ºC), the Big PACi is a flexible and space-saving alternative to two separate climate solutions.

Ideally suited for large retail applications, the Big PACi's lightweight and compact design enables easy installation in any commercial space. The use of newly designed front discharge fans saves valuable footprint and installation space when compared with traditional 20 kW and 25 kW units that use vertical discharge fans. Featuring Sanyo's DC Inverter technology, Big PACi's outstanding heating and cooling power is the result of variable compressor rotation speed. This ensures quicker control of room temperature than conventional air-conditioners, ensuring both energy efficiency and a comfortable environment. Each unit utilizes the latest Sanyo twin rotary compressor, in which perfectly balanced dual rotors revolve smoothly and efficiently to provide powerful, quiet and vibration-free performance with sound levels from 57 dB.

Offering end-users increased flexibility, the Big PACi can be matched with a single ducted unit or up to four indoor units of the same type on multi-split systems. There are eight different styles of indoor units now available for use with the Big PACi, including wall-mounted, ceiling-mounted, cassette and ducted units. New additions to the indoor range of units include the XM Mini Cassette and the ultra-slim US ducted unit. All indoor units feature high performance and are designed with the needs of the installer as well as the end-user in mind, making installation and maintenance a breeze. Meanwhile, piping length has been raised to 100 m, further aiding installation flexibility. (Source: www.wnibi.com)

Solar powered air-conditioning

A research team led by Prof. Marcelo Izquierdo of the Universidad Carlos III, Spain, is aiming to utilize absorption chilling technology into homes with a little help from the sun. Absorption chilling differs from standard mechanical air-conditioning in that it does not use an active force, such as a compressor, to condense the coolant chemical but rather uses heat to drive a circulatory system. Many absorption chillers are used in areas where adequate waste heat is available (turbine power

or water heating systems are common sources). This allows them to make use of waste heat for a secondary purpose, thereby making the entire system more efficient and cost-effective.

Prof. Izquierdo's team built an absorption chiller unit that closely resembles a typical exterior air-conditioning unit, and it works by capturing solar energy and residual heat to provide the impetus for the system's circulation. The device uses a refined lithium bromide-based coolant process (most absorption chillers use either an ammonia + hydrogen + water or a lithium bromide solution + water system) and is capable of cooling water to a temperature of 7º to 18º C at an ambient temperature of 33º to 43º C. The machine can produce adequate chilled water to cool a 120 m^3 area by means of a water-to-air heat exchanger. Neither the lithium-bromide solution nor the more common ammonia + hydrogen systems will deplete ozone. This makes them a viable alternative to the HCFC refrigerants used in modern compression units. (Source: www.dailytech.com)

Central cooling plants have pre-engineered, modular design

McQuay International, the United States, offers modular central plants that are pre-engineered and pre-assembled for simplified on-site installation. The factory-assembled units cost less per tonne to build compared with traditional site-built plants, while the energy-efficient design helps reduce operating costs. Competitive installed and operating costs make McQuay modular central plants ideal for new construction and expansion projects where criteria include fast-track completion schedules and minimal interruption to cooling.

The modular central plants combine a McQuay water-cooled chiller with pumps, cooling tower and interconnected piping. Chiller models are screw, scroll, centrifugal or magnetic bearing compressors, depending on requirements. The cooling tower includes a VFD as standard for optimized performance. Options include redundant water pumps, redundant cooling towers, a water-side economizer, a boiler module and a chilled water secondary pump module. Single-source OEM supply helps in reducing site assembly and commissioning time, while factory fabrication and assembly help increase reliability. High-quality construction features galvanized finish on all the structural steel and condenser water piping. The chillers use HFC-134a refrigerant, which has no ozone depletion potential or phase-out schedule. The modular central plants are available in a wide selection of sizes, from 100 t to 600 t, allowing factory fabricated central plants up to 2,400 t. The spacious interior provides easy access to control panel and other interior components. *Contact: McQuay International, P.O. Drawer 1551, Minneapolis, MN 55440, United States of America. Tel: +1 (763) 5535 330; Fax: +1 (763) 5535 177.* (Source: www.news.thomasnet.com)

R-410a for green chiller-boiler

Hydronika Inc., the United States, has standardized on R-410a for its 'green' chiller-boiler units for zero ozone depletion. Hydronika chiller-boiler is designed around HVAC green building standards. This reflects the continuing commitment of the company to deliver hydronic chiller-boiler units that do not make any compromise on environmental obligations.

Hydronika chiller-boiler systems are the heart of a hydronic heating and cooling system delivering chillers, boilers, pumps and controls in a single package. Hydronic systems are inherently more efficient than traditional forced-air systems and the basis of design for green building systems. The chiller-boilers are proven systems designed from the ground up to impress installers, owners and contractors with their intelligent design and high-quality components like R-410a. *Contact: Mr. Michael Scharing, Hydronika Inc., United States of America. Tel: +1 (760) 4843 368; Website: www.hydronika.com.* (Source: www.pr-usa.net)

Eco-friendly car air-conditioning

The European Union-funded B-COOL project, set to end in 2008, is developing a new, high-efficiency, low-cost air-conditioning system for small, A and B segment cars, using carbon dioxide (CO_2) as a refrigerant. Once the replacement of choice for ozone-harmful CFCs in refrigeration and air-conditioning systems, HFCs do not have any known effects on the ozone layer but contribute to global warming. Presently, HFCs are a specific target of the Kyoto Protocol. Under the European Union's Sixth Research Framework

Programme, a specific call for proposals was published on "…highly efficient air-conditioning systems with near zero greenhouse gas emissions and elimination of hydrofluorocarbons...".

According to B-COOL project coordinator Mr. Carloandrea Malvicino of Italy's Centro Ricerche Fiat, "We have developed new testing procedures to assess both fuel consumption and thermal performance of CO_2 air-conditioning technologies, and we have created and tested two vehicle demonstrators using a Fiat Panda and a Ford Ka." The B-COOL project's new cooling system is based on the use of R-744 (liquid CO_2) as a working fluid. R-744's physical properties, which include a high volumetric cooling capacity, make it favourable for cooling, refrigeration and heating applications. (Source: www.environmental-expert.com)

Effective recovery of propellants during refrigerator recycling

Air Products Malaysia Sdn. Bhd. offers Cryo-Condap® systems to safely reclaim R-11, R-12 and cyclopentane propellants that are released during the recycling of refrigerators. The reliability and efficiency of these systems are coupled with world-class cryogenic and engineering support. The Cryo-Condap system uses liquid nitrogen in a patented low-temperature heat exchanger to cool down and capture the ODS that are released when the refrigerators/freezers are crushed. Even minute remnants of R-11, R-12 and cyclopentane are then caught using molsieve adsorption. The exhaust gas now conforms to EC regulations and can be discharged into the atmosphere. Benefits of the system include:

- With virtually 100 per cent ODS recovery, the emissions conform to the toughest environmental legislation at present (2037/2000) and in the future;
- World-class cryogenics and engineering teams provide expert support and consultation; and
- Cryo-Condap is a zero added waste system, and hence creates no additional problems.

Contact: Air Products Malaysia Sdn Bhd., Level 2, Bangunan TH Uptown 3, No. 3, Jalan SS21/ 39, 47400 Petaling Jaya, Selangor Darul Ehsan, Malaysia. Tel: +60 (3) 7727 1836; Fax: +60 (3) 7726 1832; E-mail: spoc@apci.com. (Source: www.airproducts.com.my)

SOLVENTS

High-performance degreaser

CRC Industries Inc., the United States, has introduced a high-performance degreaser that uses less volatile organic compounds (VOCs). The T-Force degreaser offers the performance of trichloroethylene, perchloroethylene and n-propyl bromide without the associated risks. It does not contain Class I or II ozone-depleting chemicals. It is non-conductive, non-corrosive, non-staining and has no flashpoint or fire point. The product, with a dielectric strength of 33,300 V, dissolves grease, oil, sludge and corrosion. It evaporates quickly without leaving any residue, and can be used on air tools, mechanical brakes, clutches, chains, motors, dies, moulds, bearings, compressors, etc. (Source: www.factorymaintenance.com.au)

Non-inflammable, VOC-compliant contact cleaner

Krylon Products Group, the United States, offers Sprayon® Electro Wizard™ contact precision cleaner that instantly removes, dissolves and rinses away foreign contaminants from sensitive equipment and precision instruments. Available with a dielectric strength of 12,500 V, the VOC-compliant Electro Wizard evaporates instantly, eliminating trapping of airborne contaminants and allowing parts to be handled immediately. The non-inflammable cleaner, which is based on a new patent-pending formula, is safe on plastics and suits a wide range of applications, including printed circuits, relays and switches, meters and timing devices, X-ray equipment, radar, hydraulic and missile fuel systems, office machines, electronic games, computer systems and memory devices, satellite communication equipment, TV-video equipment, and cameras. Electro Wizard is an alternative to HCFC-141b, a Class II ozone-depleting substance that will be phased out by the Environmental Protection Agency by 2010.

Krylon offers a comprehensive line of commercial products to meet specific and dynamic application needs of the industrial and contractor end-user market. Under its Krylon® Industrial, Sprayon®, Tri-Flow®, White Lightning®, and Rubberset® brand

names, the company manufactures and supplies premium paints, applicators, lubricants, electronic cleaners, degreasers, adhesives, etc. for use in various industries. *Contact: Krylon Products Group, 101 W Prospect Avenue, Cleveland, OH 44115, United States of America. Website: www.kpg-industrial.com.* (Source: www.news.thomasnet.com)

Foaming detergent cleans evaporator and condenser coils

CRC Industries Inc., the United States, offers a high-performance, heavy-duty foaming alkaline detergent blend that cuts through dirt, grease, oil and other types of residue. Foaming Coil Cleaner is a low-odour product that does not require any rinsing and can be sprayed from any position, even upside down. Designed to clean evaporator and condenser coils of refrigeration and air-conditioning systems, this foaming detergent is registered under NSF C1 and A1 for use in meat and poultry plants. Free from Class I or Class II ODSs or chlorinated solvents, it has no flash-point or fire point. The product is available in 20 oz aerosol cans. *Contact: Ms. Carol Brown, CRC Industries Inc., 885 Louis Drive, Warminster, PA 18974, United States of America. Fax: +1 (215) 6742 196; E-mail: cbrown@crcindustries.com.* (Source: www.ws. thomasnet.com)

Cleaning machined components and assemblies

No single process, as previously enjoyed with the ozone-depleting chemicals, has surfaced as the dominant replacement technique to reduce the reliance of the manufacturing industry on ODS. Solvent cleaning has achieved the stigma of being environmentally non-compliant and many users have rejected this option.

High-performance cleaning without ODS or water cleaning involves lowering the soiled parts into a boil chamber holding the co-solvent. Here, a mixture of solvating and rinsing agents – continuously heated and agitated – dissolves and removes contaminants while providing a drying vapour blanket. For immersion rinse, the parts are then cycled from the boil chamber to an adjacent rinse chamber filled with clean rinsing agent, which removes the remaining solvating agent and the dissolved contaminants. Residual particulates, if any, are displaced by mechanical agitation or ultrasonics. Following the immersion rinse, the parts are raised out of the rinse chamber into a vapour zone for a final condensation rinse. Thereafter, the parts are removed from the fluoro-inerted equipment – dry and clean. The vapour zone is formed by vapours rising from the boil chamber mixture, filling the area above the boil and rinse chambers. Condensing coils keep the vapour at a pre-determined level. The distillate generated flows by gravity into the rinse chamber through a separator. The rinse chamber overflows to the boil chamber, completing the cycle. Soil concentration allows for separation and disposal by reduction of solvent to soil-only component. Waste stream is very low and limited to soil removed during cleaning operation. *Contact: Mr. Don Adams, Novaline Engineering Pty Ltd., Australia. E-mail: Info@novaline.com.au; Website: www.novaline.com.au.* (Source: www.hotfrog.com.au)

New composition for degreasing and defluxing

Purac Biochem NV, the Netherlands, has obtained an European patent for a non-ozone-depleting cleaning composition for degreasing and defluxing purposes. The composition contains at least one C6-12 alkyl lactate ester, preferably 2-ethylhexyl lactate, in an amount of 70-99 per cent by weight and at least one emulsifier, preferably n-octanol, in an amount of 1-30 per cent by weight. A key advantage of the present cleaning composition is based on the fact that in the rinsing step with water for removing the cleaning composition from the treated surface an emulsion is formed, which on the one hand is stable enough for having proper rinsing ability and on the other hand, after the rinsing step, will separate quickly into an oil and a water phase. (Source: www.freepatentsonline.com)

Aqueous fibre optic cleaner

An aqueous fibre optic cleaner developed by Illinois Tool Works Inc. has been awarded a United States patent. The fibre optic connector end faces are effectively cleaned by exposing them to a predominantly aqueous solution and thereafter wiping them dry. The predominantly water-based cleaning solution contains water, water-soluble organic solvents, propylene glycol ethers and isopropanol.

The formula of the cleaning solution, by weight, is 4 per cent propylene glycol n-butyl ether, 2 per cent propylene glycol methyl ether, 1.2 per cent tripropylene glycol methyl ether, 1.5 per cent isopropanol and 91.3 per cent deionized water. The components other than water are all 100 per cent volatile, producing vapours readily under room temperature and normal atmospheric pressure. (Source: www.freepatentsonline.com)

Cleaning solvent for aircraft hydraulic fluid

In the United States, Boeing Company is patenting a cleaning solvent that removes commercial aircraft hydraulic fluid. The environment-compliant solvent comprises: about 25-35 volume per cent perfluorocarbon (PFC) with about 4 to 8 carbons in the alkyl chain; about 25-35 volume per cent HCFC with about 2 to 5 carbons in the alkyl chain; and the balance petroleum distillates with from about 5 to 9 carbons in the alkyl chain.

The main advantage of PFC over trichlorotrifluoroethane is it does not catalyse ozone depletion reactions in the upper atmosphere. It is also negligibly reactive in the lower atmosphere and hence does not contribute to the formation of photochemical smog. HCFC's advantage over fully halogenated trichlorotrifluoroethane is that it reduces the ozone depletion potential by more than 95 per cent. Key features of this solvent blend include the desired properties of cleaning capability, acceptable environmental properties regarding ozone depletion and volatile organic compound vapour pressure, rapid evaporation and relatively low toxicity. A low dielectric constant allows use of the blend even when an aeroplane's electrical systems are operating. The blend is stable at practical operating temperatures and can be stored outdoors. (Source: www.freepatentsonline.com)

Poznan, Poland

The 14th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC)

To set an overall framework for intergovernmental efforts to tackle the challenge posed by climate change

1-12 December 2008

FOAMS

Azeotropic compositions in foams production

Bayer Corporation, the United States, has patented an azeotropic composition made up of about 58 per cent to 77 per cent by weight of dimethoxymethane and about 23 per cent to 42 per cent by weight of cyclopentane for use as a blowing agent in a process for the production of polyurethane foams. Among others, the key objectives of the present invention are:

- To provide an azeotropic composition that does not contain chlorine or any other halogen and therefore has zero ozone depletion potential;
- To provide a process for producing urethane foams in which no chlorine-containing blowing agent or other halogen-containing blowing agent is employed; and
- To provide polyurethane foams having good physical properties and produced without the use of a blowing agent that contains chlorine or any other halogen.

(Source: www.freepatentsonline.com)

Foam production using dissolved CO_2 under pressure

Denmark-based Bayer Aktiengesellschaft and Hennecke GmbH have obtained a United States patent on a process for the continuous production of polyurethane block foam using carbon dioxide (CO_2) as a foaming agent. The main object of the present invention is to improve the foam qualities of multi-component foamed materials, using CO_2 physically dissolved under pressure, by producing a very uniform bubble seed structure. It has been found that the pressure in the mixing chamber can be varied within wide limits, in the interest of effecting mass flow control of the components, if air or nitrogen is first dissolved as a nucleating agent in one of the (main) components and then CO_2 is secondly dissolved in the other (main) component, and if the component containing the nucleating agent is injected under high pressure into the component containing CO_2. (Source: www.freepatentsonline.com)

New blowing agent

Enovate® 3000 (1,1,1,3,3-pentafluoropropane, HFC-245fa) is a liquid HFC that was developed as a blowing agent for rigid insulating foams by Honeywell Inc., the United States. The product is a replacement for HCFC-141b and other fluorocarbon and non-fluorocarbon blowing agents. It is a non-inflammable liquid with a boiling point slightly below room temperature. Enovate 3000 is technically suitable for nearly all rigid foam applications. It has zero ozone depletion potential and a low global warming potential. In addition, it is not considered a volatile organic compound in the United States. Key features of Enovate 3000 are:

- Liquid blowing agent;
- Boiling point – 15.3ºC;
- Non-inflammable; and
- Produces foam with the highest R-value.

(Source: www.sprayfoam.com)

Green acoustic panels

Auralex Acoustics Inc., the United States, has introduced its first green acoustic panel. The environmentally friendly Eco-Tech brand acoustic panels are manufactured utilizing a proprietary formulation of 100 per cent recycled polyester fibres. The Eco-Tech family of products are designed with the environment in mind, yet retain the longevity and acoustic properties for which Auralex is known. Eco-Tech is manufactured without harmful CFCs. Earlier this year, the company announced the first green acoustic foam product on the market, eco-friendly StudioFoam.

The new Eco-Tech acoustic panels are available in the same great colour choices and cuts as the company's original acoustic panels. There is no increase in cost to either the dealer or consumer. The new offering meets and exceeds the quality of product and testing data (acoustic and fire) that the professional consumer demands. Mr. Dave Paxton, Director of Operations at Auralex Acoustics said, "The introduction of Auralex's Eco-Tech is the next step in our ongoing initiative to become a more earth-conscious company by refining our products and practices." *Contact: Auralex Acoustics Inc., #6853 Hillsdale Court, Indianapolis, IN 46250, United States of America. Tel: +1 (317) 842 2600; Fax: +1 (317) 842 2760; E-mail: auralexinfo@auralex.com*. (Source: www.news.ecoustics.com)

Light-coloured foam for use in marine applications

In the United States, Huntsman Petrochemical Corporation has patented a light-coloured foam for use in marine applications. The new foam includes a white colour, which is suitable for use in marine flotation devices. The foam includes a methylene diphenyl diisocyanate (MDI) and polymethylene diphenyl diisocyanate (pMDI). In some embodiments, the foam also includes a polyol, surfactant, catalyst and blowing agent.

It has been discovered that through the use of MDI, pMDI or MDI prepolymers or modified MDI such as carbodiimide modified or uretonimine modified MDI, a white polyurethane (PUR)/polyisocyanurate (PIR) foam may be produced. Without being limited by theory, such foam may be acceptable to the surfboard industry. Further, without being limited by theory, such foam may not scorch or discolour during the manufacturing process. (Source: www.freepatentsonline.com)

Dichloroethylene and CO_2 blowing agent blend

Arkema Inc., the United States, has reported an invention relating to a method of producing foam such as a closed cell, rigid polyurethane foam which employs CO_2 as the predominant blowing agent and incorporates dichloroethylene. The CO_2 is preferably produced *in situ* via the reaction of water, in part B, and isocyanate, in part A. The water and the dichloroethylene are preferably incorporated into the polyol or B part. It was found that including a dichloroethylene in the polyol or B part reduced the viscosity of the B part and provided for a better flow of the B part in the production/mixing equipment. It also provides for better mixing of the B part and the A part which results in a more uniform foam. The inclusion of a dichloroethylene in the B part also enhances certain properties of the resulting foam such as brittleness and adhesion. *Contact: Arkema Inc., 2000 Market Street, Philadelphia, PA 19103, United States of America.* (Source: www.wipo.int)

HALONS

Cleanest fire extinguishers

Luzon Buying Office Inc., the Philippines, offers Bestfriend brand fire extinguishers that use FE-36 and HCFC-123 chemicals. The chemicals, manufactured by the United States-based chemical multinational DuPont, are claimed to be the most advanced and cleanest pre-engineered agent. HCFC-123 has been a viable replacement for Halon-1211. It is a multi-purpose vapour type of fire extinguisher that has a low ozone depleting potential and low toxicity levels. However, FE-36 is regarded as the perfected version of HCFC-123. It is non-toxic and has zero ozone depleting potential. *Contact: Mr. Almond Yatco, Luzon Buying Office Inc., 340, Dr. J. Fernandez Street, Mandaluyong, Metro Manila, The Philippines. Tel: +63 (2) 5313 850; Fax: +63 (2) 7184 695.* (Source: www.alibaba.com)

Sodium azide-based suppression of fires

In Canada, N2 Towers Inc. has patented a fire suppression system based on sodium azide. This equipment includes: a housing disposed within the space; at least one generator disposed within the housing and containing pre-packed sodium azide-based propellant; an ignition device for igniting said sodium azide-based propellant and thereby generating a low-moisture fire suppressing gas; and an opening in the housing for directing the fire suppressing gas mixture into said space. (Source: www.wipo.int)

Redesigned clean agent fire suppression systems

In the United States, Fike's clean agent fire-fighting system offering will include the use of DuPont FM-200 clean agent. The use of FM-200 (HFC-227ea) will not require engineering changes to Fike's product offering nor will it require technical or installation changes for Fike's distributors. FM-200 has identical performance characteristics as FE-227 (HFC-227ea), which Fike had previously used. Fike's fire suppression systems with FM-200 will still meet UL and FM approvals. *Contact: Fike, 704 SW, 10th Street, Blue Springs, MO 64015, United States of America. Tel: +1 (816) 2293 405; E-mail: fpssales@fike.com; Website: www.fike.com.* (Source: www.chemicalprocessing.com)

Novec 1230 for crew compartment protection

In Canada, the Department of National Defence, Aerojet and 3M Canada have jointly evaluated the effectiveness of Novec™ 1230 as a "drop-in" replacement for halon in existing crew compartment fire protection systems. Novec 1230 has been considered as the most cost-effective solution, but because its boiling point is much higher than that of other halocarbons, conventional nozzles may not fully vaporize it, thereby reducing its effectiveness. Further work is needed to find the means to deliver Novec 1230 as a vapour and to test the effectiveness of this solution in a crew compartment fire. *Contact: Dr. Andrew K. Kim, Institute for Research in Construction, National Research Council, Canada. Tel: +1 (613) 9939 555; E-mail: Andrew.Kim@nrc-cnrc.gc.ca.* (Source: www.irc.nrc-cnrc.gc.ca)

Seeking a miracle fire-fighter

Researchers at the National Institute of Standards and Technology, the United States, are screening 12 chemicals on behalf of the United States Air Force, to identify one with at least some of the desirable properties of Halon-1301. Dr. William Grosshandler, Director of the institute's Building and Fire Research Lab, states that all the possible substitutes for halons have drawbacks. One of the candidates, perfluorobutane, has four carbon atoms linked to 10 fluorine atoms and is quite effective as an extinguisher. However, it is a strong greenhouse gas; its presence in the atmosphere would trap the heat of sunlight and could contribute to global warming. Halon-1211, another common halon, is packaged in hand-held fire extinguishers of the kind used on airport flight lines and is stored aboard aircraft for putting out engine fires. Known as a "streaming" extinguisher, it is a liquid rather than a gas. "We simply have to learn to live without halons, for the sake of the global environment," states Dr. Grosshandler. (Source: www.query.nytimes.com)

FUMIGANTS

Removal of anthrax clean-up agent

Researchers in the United States report to have discovered a fast and efficient method for removing methyl bromide used in the sterilization of buildings and equipment following anthrax attacks. The new chemical "scrubber" removes 99 per cent of the pesticide following fumigation and could pave the way for its broader use in anthrax clean-up efforts. Mr. Roman Bielski and Mr. Peter J. Joyce have documented the effectiveness of their removal method in experiments with an empty office trailer filled with air containing methyl bromide. They treated air exhausted from the trailer with a solution of sodium sulphide combined with a powerful catalyst. This chemical "scrubber" removed over 99 per cent of the methyl bromide from the air. (Source: www.sciencedaily.com)

Disinfecting with radio frequencies

In the United States, RF Biocidics is developing a new approach using radio frequency (RF) heating to clean up food and agriculture products. Mr. Marc Eichenberger, COO of Allied Minds (a pre-seed investment company that established RF Biocidics, a University of California-Davis spin-out company), said that the system can eliminate pathogens and insects without the use of chemicals or radiation. RF heating can deliver lethal energy to insects and microbes without disturbing or damaging the host material or leaving behind any molecules. "Wood is a big problem," said Mr. Eichenberger. "If you think about all the pallets and containers made of wood, they carry pests around the world as things are shipped."

RF Biocidics' said that its RF heating system is based on the difference in electrical conductivity between arthropod pests, which is high, and the host commodity, which is low. It has demonstrated the advantages of lower frequencies in terms of the type and efficiency of RF interactions with different materials. The system can uniformly go through products such as nuts or grains and disinfect and disinfest. "The whole objective is that you kill the parasites, whether they are insects or things such as *E. coli*, *Salmonella*, other types of bacteria or fungi, while leaving the host material as untouched as possible," Mr. Eichenberger said. This system avoids the types of problems caused by using thermal heat to clean food, which can change the colour and texture of the product. The technology could also have applications in other markets, including as an anti-bioterrorism measure, an alternative to pasteurization and more. (Source: www.media.cleantech.com)

Trial system to capture and neutralize gas

Genera, a fumigation company, is testing a system to recapture and neutralize methyl bromide used for some container fumigations at Port Nelson, New Zealand. Following positive signals from the Australian quarantine service on whether it accepts phosphine as an alternative to methyl bromide, a larger, separate recapture system for fumigations of large stacks of timber would be installed.

Genera is leasing the portable recapture equipment for containers from Australian company Nordiko, to help it comply with strict new rules on methyl bromide in the Nelson City Council's air quality plan. The recapture system would be used on all container loads where more than 3 kg of methyl bromide was used and on all containers containing logs for export. An application had been submitted to the Australian Quarantine by Biosecurity New Zealand to use phosphine en route as a fumigant instead of methyl bromide. If successful, large-scale fumigations of stacked timber at Port Nelson would not be necessary. (Source: www.stuff.co.nz)

Alternative pesticides studied

In response to the need for safe and effective alternatives to methyl bromide, researchers at the Instituto Tecnologico Agrario de Castilla y Leon in Valladolid, Spain, undertook a three-year project to study new methods of weed control in strawberry nurseries. In the study, methyl bromide alternatives were evaluated for weed control and plant yields at strawberry nurseries participating in Spain's Methyl Bromide Alternatives Project. Replicated experiments and commercial-scale field demonstrations were both carried out.

In the replicated trials eight fumigant treatments were tested each year, including the non-fumigated control and commercial standard methyl bromide plus chloropicrin mixture. The other treatments evaluated include dazomet, chloropicrin alone, metam sodium plus chloropicrin, chloropropene: chloropicrin, DMDS plus chloropicrin and propylene oxide. The best alternative treatments from the replicated experiments were then tested in the demonstration phase of the project. The team discovered that several of the chemical alternatives they evaluated controlled weeds as consistently as methyl bromide, but all the alternatives studied were less consistent than methyl bromide in terms of plant yields. They also found that the use of some types of barrier films increased performance and consistency of alternative pesticides and that environmental factors such as weather, soils and rotational crops contributed to inconsistencies in weed control and runner yields at high-elevation nurseries. (Source: www.chemie.de)

Methyl bromide monitor approved by Cal/EPA

Effective 25 June 2008, the Department of Pesticide Regulation of the California Environmental Protection Agency (Cal/EPA), the United States, has added a real-time remote sensor monitor for the detection of methyl bromide, in addition to colorimetric detector tubes. The Air Check Advantage Continuous Methyl Bromide Monitor, from PureAire Monitoring Systems, can now be used to monitor enclosed areas, including greenhouse soil fumigation and commodity fumigation.

The new methyl bromide monitor is capable of low 0.3 ppm detection and includes a local digital display, 4-20 mA analogue output, user-settable high- and low-concentration alarm relays and a fail-safe system fault relay. Designed to monitor fumigation chamber clearing and storage areas, it is suitable for providing worker protection at orchards, growers, international airports and seaports where commodities are fumigated before shipping. The heart of the Air Check Advantage is a highly reliable and substance-specific detection system, which converts methyl bromide into a gas more easily and selectively detected by a renewable electrochemical sensor. Annual maintenance costs are estimated at approximately US$75 per year and could save an average orchard up to US$16,000 per year in colorimetric tubes. (Source: www.environmental-expert.com)

Mustard – hot stuff for natural pest control

Researchers, growers and industry specialists from 22 countries are sharing the latest research into the use of *Brassica* species, such as mustard, radish or rapeseed, to manage soil-borne pests and weeds – a technique known as biofumigation. "*Brassica* plants naturally release compounds that suppress pests and pathogens, principally isothiocyanates (ITCs), which most people would recognise as the hot flavour in mustard or horseradish," says CSIRO's Dr. John Kirkegaard. When ITCs are released in soil by green manuring, soil-borne pests and pathogens can be suppressed and the yields of solanaceous vegetables such as potatoes, tomatoes and eggplants can easily be increased by up to 40 per cent in some cases. According to Dr. Kirkegaard, "The technique is relevant to developed nations seeking alternatives to banned synthetic pesticides like methyl bromide, as well as poor farmers in developing countries who often have few alternatives to control serious diseases in their crops." (Source: www.hindu.com)

RECENT PUBLICATIONS

Networking Counts: Combating Illegal Trade in ODS

This book explains the creation and implementation of an enforcement network bringing together ozone and customs officers in South Asia and South-East Asia and the Pacific to discuss ways to improve control of transboundary movements of ozone-depleting substances and preventing illegal trade.

Illegal Trade in ODS: Asia and Pacific Region

This report is an assessment on illegal trade in ODS in the Asia and Pacific region. It analyses the smuggling reasons, routes and trends of ODS and also presents the outcome of a desk study on trans-boundary movement of ODS in the region. It could assist customs officers, ozone officers and other enforcement officers in their work to control trade in ODS.

For the above two publications, *contact: UNEP DTIE OzonAction Branch, 15 rue Milan, 75441 Paris Cedex 09, France. Tel/Fax: +33 (1) 4437 1450/1474; E-mail: ozonaction@unep.fr.*

Natural Refrigerants: Sustainable Ozone- and Climate-Friendly Alternatives to HCFCs

This collection of articles was compiled to highlight the benefits of natural refrigerants and to guide those involved in implementing the HCFC phase-out in developing countries: policy stakeholders, manufacturers of refrigeration and air-conditioning equipment, and end-users of R22. The edited volume contains 31 articles by individual authors representing government entities, academia and industry.

Contact: Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH, Postfach 5180, 65726 Eschborn, Germany. Tel: +49 6196 79-0; Fax: +49 6196 791 115; E-mail: info@gtz.de.

TECH EVENTS

6-8 Nov
Manila
Philippines

Refrigeration Philippines 2008
Contact: Global-Link Inc.,
Unit 1003, Antel 2000 Corporate Centre, 121 Valero Street,
Salcedo Village, Makati City,
The Philippines.
Tel: +63 (2) 7508 588;
Fax: +63 (2) 7508 585;
E-mail: jing@globallinkph.com.

11-14 Nov
Florida
United States

2008 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions
Contact: Methyl Bromide Alternatives Outreach, 6556 N. Dolores Avenue,
Fresno, California, CA 93711,
United States of America.
Tel: +1 (559) 4499 035;
Fax: +1 (559) 4499 037;
Website: www.mbao.org.

20-21 Nov
Kobe
Japan

International Symposium on New Refrigerants and Environmental Technology 2008
Contact: Japan Refrigeration and Air-Conditioning Industry Association (JRAIA), Kikai Shinko Bldg. 201,
5-8, Shibakoen 3-chome, Minato-ku,
Tokyo 105-0011,
Japan.
Tel: +81 (3) 3432 1671;
Fax: +81 (3) 3438 0308;
Website: www.jraia.or.jp

23-25 Nov
Shanghai
China

China International Exhibition for Auto Air-conditioning and Transportation Refrigeration
Contact: Shanghai Gehua Exhibition Service Co. Limited,
Rm. 1403, Shengli Building,
No. 9120 Humin Road,
Shanghai, 200235,
China.
E-mail: gehua@autocoolexpo.com;
Website: www.gehuaexpo.com.

2009

18-21 March
Koyang City
Rep. of Korea

Heating, Air-Conditioning, Refrigeration and Fluid Exhibition
Contact: Korea Refrigeration and Air-Conditioning Industry Association (KRAIA), HARFKO Secretariat, Kraia,
161-7, Samsung-dong, Kangnam-gu,
Seoul, 135-090,
Republic of Korea.
Tel: +82 (2) 5582 541;
Fax: +82 (2) 3697 515;
E-mail: yhk@ref.or.kr.