VATIS UPDATE

Ozone Layer Protection

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Highlights

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United Nations
ESCAP

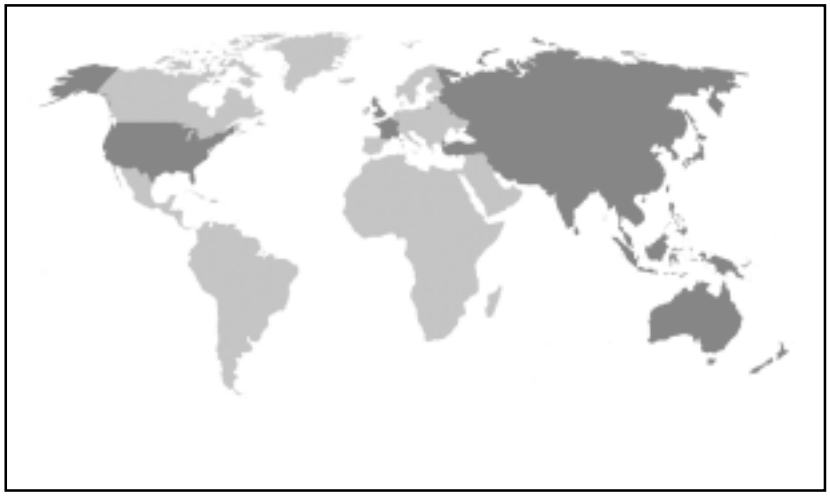
APCTT
ASIAN AND PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY

OZONE CELL
MINISTRY OF ENVIRONMENT AND FORESTS
GOVT. OF INDIA

The **Asian and Pacific Centre for Transfer of Technology (APCTT)**, a subsidiary body of ESCAP, was established on 16 July 1977 with the objectives: to assist the members and associate members of ESCAP through strengthening their capabilities to develop and manage national innovation systems; develop, transfer, adapt and apply technology; improve the terms of transfer of technology; and identify and promote the development and transfer of technologies relevant to the region.

The Centre will achieve the above objectives by undertaking such functions as:

- Research and analysis of trends, conditions and opportunities;
- Advisory services;
- Dissemination of information and good practices;
- Networking and partnership with international organizations and key stakeholders; and
- Training of national personnel, particularly national scientists and policy analysts.



The shaded areas of the map indicate ESCAP members and associate members

Cover Photo

The enEX Heat Pump that uses carbon dioxide as the refrigerant

(Credit: eCO2 Technologies Pty. Ltd., Australia)

VATIS* Update
Ozone Layer Protection
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SCIENCE OF THE OZONE LAYER

Significant ozone hole remains over Antarctica

In late September 2009, the Antarctic ozone hole, which fluctuates throughout the late winter and spring in the southern hemisphere, reached its 2009 peak circumference according to measurements by researchers at the National Oceanic and Atmospheric Administration (NOAA) of the United States. Slightly smaller than the North American continent, the ozone hole covered 9.2 million square miles, according to NOAA satellite observations. This ranks as the 10th largest since satellite measurements began in 1979. Ozone over South Pole Station, Antarctica, also reached its thinnest point of the year on 26 September. The 2009 low level of 98 DU is the seventh smallest since 1986. The record low of 89 DU was on 6 October 1993.

"The Montreal Protocol has been effective in reducing emissions of long-lived CFC gases, but high enough concentrations remain in the atmosphere to lead to significant ozone destruction in polar regions," said Mr. Bryan Johnson, project leader for the NOAA Earth System Research Laboratory Ozonesonde Group. "Monitoring ozone over Antarctica provides the essential yardstick to see whether we are on the predicted track for recovery based on the current rate of declining CFCs." Although CFCs are slowly decreasing in the atmosphere, scientists project that the ozone hole will not fully recover before 2060.

Extreme cold, ice cloud formation in the stratosphere, and a pattern of rapidly circulating air, called the polar vortex, make the ozone layer over Antarctica much more vulnerable to CFC destruction than anywhere else on the planet. (Source: 7thspace.com)

Ozone hole repair contributes to global warming, says study

In the United Kingdom, a new analysis from the Scientific Committee on Antarctic Research (SCAR), an interdisciplinary body of the International Council for Science (ICSU), has suggested that stopping ozone depletion may actually increase global warming and speed up sea level rise. This discovery pits two important environmental missions against each other.

SCAR's findings indicate that the extra radiation allowed through the atmosphere by the depleted ozone above Antarctica created wind patterns that cooled the eastern, more densely ice-covered, section of the continent. Those weather patterns partly protected Antarctic ice from the ravages of global warming. Now, as the hole in the atmosphere heals, those wind patterns will shift, fully subjecting the Antarctic ice to the effects climate change. According to SCAR, that means a rise in sea levels of up to 4.6 ft greater than earlier predictions.

The revelation by SCAR report that fixing one pressing environmental problem may accelerate another dangerous problem puts efforts to prevent rapid environmental change in a bit of a pickle. (Source: www.popsci.com)

Antarctic's optical properties

In a study for a doctoral degree by geophysicist Mr. Kai Rasmus, University of Helsinki, Finland, measurements were made during three Austral summers to study the optical properties of the Antarctic system – Antarctica, the continent, and Southern Ocean, the ocean surrounding it – and produce radiation information for additional modelling studies. The system has an important part in the global climate due to its size, its high latitude location and the negative radiation balance of its large ice sheets.

During the summer of 1997-1998, measurements of beam absorption and beam attenuation coefficients, and down-welling and up-welling irradiance were made in the Southern Ocean along S-N transect at 6°E. The attenuation of photosynthetically active radiation (PAR) was calculated and used together with hydrographic measurements to show that the phytoplankton in the investigated areas of the Southern Ocean is not light-limited.

Variabilities in the spectral and total albedo (surface reflectivity of the sun's radiation) of snow were studied at different locations in the Queen

Maud Land region during the summers of 1999-2000 and 2000-2001. The mean spectral albedo levels were found to be very close to each other. The variations in the spectral albedos were due more to differences in ambient conditions than variations in snow properties.

A Monte Carlo model was prepared to study the spectral albedo and to help in developing a novel non-destructive method to measure the diffuse attenuation coefficient of snow. The method was based on the decay of up-welling radiation moving horizontally away from a source of down-welling light. In the model, the attenuation coefficient obtained from the up-welling irradiance was higher than that obtained using vertical profiles of down-welling irradiance. The model results were compared with field measurements made on dry snow in Finnish Lapland and they correlated reasonably well.

Low-elevation (below 1000 m) blue-ice areas may experience substantial melt-freeze cycles due to absorbed solar radiation and the small heat conductivity in the ice. A two-dimensional model was developed to simulate the formation and water circulation in the sub-surface ponds. The model results show that for a physically reasonable parameter set the formation of liquid water within the ice can be reproduced. Vertical convection and a weak overturning circulation is generated stratifying the fluid and transporting warmer water downwards, thereby causing additional melting at the base of the pond. In a 50-year integration, a global warming scenario mimicked by a decadal scale increase of 3° per 100 years in air temperature, leads to a general increase in sub-surface water volume. (Source: www.sciencedaily.com)

CFCs proved to cause ozone depletion

A study by scientists in Taiwan, China, has confirmed that chlorofluorocarbon (CFC) emissions cause ozone layer depletion, a theory that was cast into doubt in the past two years. Mr. Jim Lin, an associate research fellow of Academia Sinica's Institute of Atomic and Molecular Sciences and National Chiao Tung University's Department of Applied Chemistry, was able to reach his conclusion by precisely measuring chlorine peroxide (ClOOCl) – generated when CFCs decompose – in a laboratory environment.

Chlorine peroxide has long been thought to trigger ozone destruction when the molecule absorbs sunlight and breaks into two chlorine atoms and an oxygen molecule, a process known as photolysis. The larger the absorption cross-section of chlorine peroxide, the faster chlorine peroxide absorbs sunlight and the faster chlorine atoms are generated, depleting the ozone layer at a rapid pace.

That fundamental theory was challenged, however, in 2007 when Mr. F.D. Pope and his co-workers from the Jet Propulsion Laboratory at the California Institute of Technology, the United States, presented contradictory data. Mr. Pope measured absorption cross sections – a method to test the photolysis rate – of ClOOCl that were about 10 times smaller than previously accepted values. That meant "it would be impossible to produce enough chlorine atoms to explain the observed ozone loss via any known chemical mechanisms."

Mr. Lin's work, the results of which were published in *Science*, proved that traditional explanations of ozone layer depletion were valid. Mr. Lin said the traditional way to test chlorine peroxide has been to test the amount of light that ClOOCl absorbs at various wavelengths using an optical spectrometer. However, Mr. Pope's results and his attempts to remove the optical method's vulnerability to impurities in the sample were not successful, Mr. Lin suspected.

To avoid the problem, Mr. Lin and his colleagues employed a mass spectrometer to measure the molecular weight of the ClOOCl shot through the spectrometer in a molecular beam, impurities included. They then determined the probability of ClOOCl being split into chlorine atoms and oxygen by light by measuring the beam intensity after it was irradiated with a laser.

The experiment allowed his team to quantify the absorption cross-section more accurately, and they obtained values consistent with previously calculated values, Mr. Lin said. By using the mass spectrometer, the scientists were able to factor out from the experiment sample impurities, which Mr. Lin said explained Mr. Pope's lower absorption readings. (Source: www.taipeitimes.com)

ODS PHASE-OUT IN INDIA

Experts advocate adoption of CFC-free inhalers

In a key development, the Ministry of Health and Family Welfare has urged asthma and chronic obstructive pulmonary disease (COPD) patients and health professionals to adopt environment-friendly inhalers. Dr. Surinder Singh, Drug Controller of India, made this appeal at a workshop on "Phase-out of CFCs in metered-dose inhalers (MDIs), transition strategy implementation and adoption of CFC-free alternatives in India" at the All India Institute of Medical Sciences (AIIMS), New Delhi.

"Environment-friendly asthma and COPD inhalers are being introduced across the country as CFC phase-out gains momentum. Soon, all asthma and COPD inhalers in India will be either dry powder or they will use a new hydrofluoroalkane propellant," said Dr. Singh.

Speaking on CFC-free alternatives, Prof. R.C. Deka, Director of AIIMS, explained, "These CFC-free inhalers provide the same medicine and the same health benefits as the old CFC-containing inhalers without damaging the ozone layer." Prof. Deka assured that the spray from the new inhaler is "just as good, or even better" at delivering the drug to where it is needed. Extensive clinical trials have been undertaken to determine the safety and effectiveness of the new MDIs. The CFC-free MDIs have been found to be as safe and effective as the CFC-containing inhalers, besides providing a number of additional benefits.

Research has shown that the HFA solutions produce very small particles, which penetrate the small airways in the lung better than the older CFC formulation of the same medicine. Some CFC-free MDIs produce particles that travel slower than those in the CFC-containing inhalers, which can make it easier for patients to inhale at the right time when activating the inhaler. Some of the new inhalers have warmer and less forceful spray, which reduces the risk of patients holding their breath. (Source: www.expresshealthcare.in)

IN THE NEWS

India, Nepal to discuss green custom drive

India and Nepal are embarking on the path to increase vigil on the common borders under the Green Customs Initiative (GCI) to check transportation of ozone depleting substances. In this regard, a bilateral dialogue was held between the two countries between 30 November 30 and 2 December 2009.

Customs and border protection officers constitute the front line of every country's defence against trans-boundary illegal trade. They are the first link in the compliance and enforcement chain, and without adequate capacity to prevent or detect illegal trade, the rest of the chain will be considerably less effective. Building the capacity of these officers, therefore, is vital.

GCI is an unprecedented partnership of international organizations, whose objective is to enhance the capacity of customs and other relevant enforcement personnel to monitor and facilitate the legal trade and to detect and prevent illegal trade in environmentally sensitive commodities covered by relevant conventions and multilateral environmental agreements. This is achieved through awareness raising on all the relevant international agreements, and provision of assistance and tools to the enforcement community. It is also complementing and enhancing existing customs training efforts under the respective agreements.

The partners of GCI comprise the secretariats of the relevant multilateral environmental agreements (Basel, Cartagena, CITES, Montreal, Rotterdam and Stockholm), Interpol, the Organization for the Prohibition of Chemical Weapons, the United Nations Environment Programme (UNEP), United Nations Office on Drugs and Crime (UNODC) and the World Customs Organization (WCO). (Source: timesofindia.indiatimes.com)

New CFC-free initiative

Sri Lanka has already achieved the 2010 target of ridding the country of CFC emissions, according to the Minister of the Environment and Natural

Resources Mr. Patali Champika Ranawaka. At the recent launch of the third stage of the National Ozone Unit's programme to create an ozone-friendly country, he said the Sri Lankan government, with the help of the Multilateral Fund of the Montreal Protocol, will fund a SL Rs 20 million project to provide CFC-free air-conditioning units to Sri Lankan businesses as well as the Military Engineering Department.

The Minister congratulated the National Ozone Unit on the exceptional design of the CFC-free air-conditioning units and for the "dedication and sacrifices they have made in designing it". He also used the ceremony to voice his concern regarding the current state of global climate change. (Source: www.dailymirror.lk)

New refrigerant gets European patent

The European Patent Office will grant a patent for a new, lower global-warming automotive air-conditioning refrigerant, HFO-1234yf, developed jointly by the multinational giants Honeywell and DuPont to help the automotive industry comply with the European Union's Mobile Air-Conditioning Directive. The measure requires refrigerants to have global warming potential (GWP) below 150 from 2011 onwards. HFO-1234yf has a GWP of 4.

Worldwide, extensive studies have found HFO-1234yf superior to other potential replacements. In addition to DuPont tests and others, the United States Environmental Protection Agency evaluated the product and proposed a rule that would approve HFO-1234yf for use in mobile air-conditioning systems in that country. DuPont is conducting lab and field tests to evaluate HFO-1234yf and other refrigerants with similar attributes as more sustainable cooling solutions for stationary air conditioning and refrigeration as well. DuPont will have access to Honeywell's patent worldwide. (Source: www.domain-b.com)

Maldives to phase out HCFCs

The Maldives is to phase out hydrochloroflurocarbons (HCFCs), which are used in cooling systems and are a thousand times more potent a greenhouse gas than carbon dioxide. The country, which is a member of the Montreal Protocol, will minimize imports of products using HCFCs by 2013, said Ms. Fathimath Reema, Ozone Officer and Assistant Director at the Environment Ministry.

HCFCs replaced chlorofluorocarbons (CFCs) in the late 1980s after scientists discovered the latter was a principal contributor to ozone depletion. Although HCFCs have significant ozone depletion potential, they were considered as lesser of two evils at that time. Further, their contribution to global warming was unknown.

The government, with the help of the Montreal Protocol and the United Nations Environment Programme (UNEP), plans to conduct a survey to find out the extent to which HCFCs are used in the Maldives. Ms. Reema said the Montreal Protocol would be assisting the Maldives with finding alternative, greener technologies. (Source: www.minivannews.com)

Coca-Cola goes for HFC-free vending machines

The Coca-Cola Company and its bottling partners have announced that 100 per cent of their new vending machines and coolers will be free of hydrofluorocarbon (HFC) by 2015. Coca-Cola is committing to use its scale to aggregate demand and encourage supply as a means of accelerating the transition to HFC-free refrigeration equipment. This announcement is a result of work with Greenpeace, and a demonstration that phasing out the use of HFCs is a tangible and near-term action that corporations can take to protect the climate.

The transition to HFC-free refrigeration will reduce the equipment's direct greenhouse gas (GHG) emissions by 99 per cent. A recent peer-reviewed report by top scientists shows that HFCs will be responsible for 28-45 per cent of carbon-equivalent emissions by 2050 if society reduces carbon dioxide (CO_2) while leaving HFCs unchecked. Eliminating HFCs in the commercial refrigeration industry would be equivalent to eliminating the annual GHG emissions of Germany or Japan.

This step by Coca-Cola will help accelerate a market shift in commercial refrigeration away from HFCs. The company has invested more than US$ 50 million in research and development to advance the use of climate-friendly cooling technologies. In 2010, the company and its bottling partners will

purchase a minimum of 150,000 units of HFC-free equipment, effectively doubling the current rate of purchase to enable alignment with an interim goal to purchase 50 per cent of all new coolers and vending machines without HFCs by 2012. They together have approximately 10 million coolers and vending machines in place today around the world, comprising the largest element of the Coca-Cola system's total climate impact. As a result of the commitment to eliminate the use of HFCs in this equipment, carbon emission reductions will exceed 52.5 million tonnes over the life of the equipment – the equivalent of taking more than 11 million cars off the road for one year. Coca-Cola currently uses two HFC-free solutions. Hydrocarbon refrigeration is employed in smaller refrigeration equipment and CO_2 is used in larger equipment. CO_2 is a safe, reliable and energy-efficient alternative with positive characteristics as a refrigerant. It does not deplete the ozone layer and it is 1,430 times less damaging to the climate than a typical HFC. (Source: www.businesswire.com)

SAE International's nod to new MAC refrigerant

The Society of Automotive Engineers (SAE) International has concluded a Cooperative Research Programme (CRP) to investigate the safety and environmental performance of a new refrigerant for mobile air-conditioning (MAC) systems, determining that HFO-1234yf can be used as the global replacement in future MAC systems.

Based on evaluation and test results, sponsors of the SAE CRP1234 study concluded that HFO-1234yf can be safely accommodated through established industry standards and practices for vehicle design, engineering, manufacturing and service. The report is the third from the SAE to evaluate the new refrigerant. The recent two-year long global research programme was to determine the safety and environmental characteristics of HFO-1234yf.

SAE's research confirmed that HFO-1234yf is an environment-friendly refrigerant suitable for use in direct expansion MAC systems. It determined that HFO-1234yf is a non-ozone depleting substance with a global warming potential (GWP) of 4 compared with the current MAC refrigerant, HFC-134a, which has a GWP of 1300.

As part of the studies, SAE said the automotive industry conducted evaluations on a variety of vehicle applications. Additional tests and research were carried out at internationally recognized laboratories to verify worldwide acceptance for a common global replacement refrigerant. Extensive testing supported by multimillion dollar funding and in-kind support for SAE CRP1234 projects has been provided by several vehicle manufacturers and suppliers from Asia, Europe and the United States. (Source: www.tirebusiness.com)

New CFC-free inhaler in Bangladesh market

Another brand of non-chlorofluorocarbon (CFC) inhaler, manufactured by Beximco Pharma, hit the market in Bangladesh in an initiative that is viewed by international ozone phase-out bodies as a great private-public stride to phase out use of ozone depleting CFCs. Addressing a technical session on the inauguration of the new brand of CFC-free metered dose inhaler (MDI), the acting Director General of the Department of Environment (DOE) Dr. Fazley Rabbi said that Bangladesh is working to be fully CFC-free by the end of 2012.

Bangladesh, as a signatory to Montreal Protocol, needs to phase out the use of CFCs by end of 2009. However, the pharmaceuticals sector remains a challenge because of its essential use to produce inhaler for about three million people who suffer from asthma and chronic obstructive pulmonary disease (COPD). Bangladesh still requires about 70 tonnes of CFC annually for the essential MDI sector, despite successful removal of the gases from aerosol and refrigeration, say the officials of the Ozone Cell in DOE.

Bangladesh has so far received about US$3 million from the Montreal Protocol Multilateral Fund for conversion of CFC-based MDIs to non-CFC. The Fund's Chief Officer Ms. Maria Nolan observed that Bangladesh has made substantive delay in commencing the implementation of the project, placing the country in non-compliance with its commitment under Montreal Protocol. Ms. Nolan, however, praised the accomplishments of the country's pharmaceutical industry for taking the initiative for formulating, testing and launching MDIs with their own resources. (Source: www.dhakamirror.com)

REFRIGERATION/ AIR-CONDITIONING

HCFC-free refrigerants

Brooks Automation Inc., the United States, produces refrigerants free from hydrochlorofluorocarbons (HCFCs) that are approved by the United States Environmental Protection Agency (EPA) under its Significant New Alternative Policy (SNAP) programme as an alternative to mixed refrigerant blends that contain HCFC-22 and other increasingly regulated HCFCs.

Brooks' patented innovation in refrigerant technology eliminates HCFC-22 and other HCFCs, offering a blend with zero ozone depletion potential while providing comparable refrigeration performance. *Contact: Ms. Barbara Culhane, Corporate Marketing Manager, Brooks Automation Inc., #15 Elizabeth Drive, Chelmsford, MA 01824, United States of America. Tel: +1 (978) 262 2400; Fax: +1 (978) 262 2500. Website: www.brooks.com.* (Source: money.cnn.com)

Frictionless centrifugal chiller

The Daikin McQuay® Magnitude™ – the frictionless centrifugal chiller from McQuay International, the United States, already known for its oil-free, magnetic bearing design – is now available in models with up to 550 tonnes of cooling capacity, making it ideal for mid- to large-size buildings such as schools, universities and hospitals. With industry-leading efficiency, low sound levels and a small footprint, the Magnitude chiller reduces energy and operating costs, creates a comfortable environment, and meets requirements for sustainable design.

With its positive pressure, oil-free design, the efficient performance of the Magnitude chiller is sustainable through its operating life because there is no oil to contaminate the refrigerant and degrade efficiency. By eliminating the high friction losses of conventional centrifugal compressors, the Magnitude chiller achieves exceptional part-load performance. Integrated part load value for the 550 t unit is 0.312 kW/t, while the full load is rated at 0.531 kW/t.

As it uses HFC-134a refrigerant, the Magnitude chiller has no ozone depletion potential. It is more compact than a traditional centrifugal chiller of similar capacity – 40 per cent smaller and 47 per cent lighter in weight. This compact size makes it ideal for retrofit projects or new installations where space or access is limited. *Contact: McQuay International, 13600 Industrial Park Blvd., Minneapolis, Minnesota 55441, United States of America. Tel: +1 (763) 553 5330; Fax: +1 (763) 553 5177.* (Source: www.earthtimes.org)

Performance of alternative refrigerant R-430A

Mr. Ki-Jung Park and Mr. Dongsoo Jung – two researchers from the Department of Mechanical Engineering, Inha University, Republic of Korea – have examined numerically and experimentally the performance of R-430A as replacement for HFC-134a used in the refrigeration system of domestic water purifiers.

Even though HFC-134a is used predominantly in such systems these days, it is to be phased out in the near future in most of the developed countries because of its high global warming potential. To solve this problem, cycle simulation and experiments are carried out with a new refrigerant mixture of 76 per cent R-152a and 24 per cent R-600a using actual water purifiers. This mixture is numbered and listed as R-430A by ASHRAE recently.

Test results show that the system performance is greatly influenced by the amount of charge due to the small internal volume of the refrigeration system in water purifiers. With the optimum amount of charge of 21-22 g, about 50 per cent of HFC-134a, the energy consumption of R-430A is 13.4 per cent lower than that of HFC-134a. The compressor dome and discharge temperatures and condenser centre temperature of R-430A are very similar to those of HFC-134a for the optimum charge. Overall, R-430A, a new long-term environmentally safe refrigerant, is a good alternative for HFC-134a in domestic water purifiers requiring no major system change. *Contact: Mr. Dongsoo Jung, Department of Mechanical Engineering, Inha University, Incheon 402-751, Republic of Korea. E-mail: dsjung@inha.ac.kr.* (Source: www.sciencedirect.com)

New absorption technology for efficient heating and cooling

Researchers at the University of Warwick in the United Kingdom have developed a new absorption technology for heat exchangers that can radically improve heating and air-conditioning efficiencies in homes and cars. Absorption technology is much more efficient than current systems but normally requires huge volumes of material. The researchers have come up with a new absorption system design that allows the devices to be small and light enough for use in both domestic heating and car air-conditioning.

The new system has thin metal sheets inserted into the active carbon in the heat exchanger, each of which contains over a hundred tiny channels. These channels, which house the refrigerant used to extract the heat, make the process much more efficient. The test system created by the Warwick researchers is up to 20 times smaller than previously possible and could lead to more efficient domestic heat pumps. The system could also be used to extract waste heat from car engines to provide cooling.

The University has set up a spin-out company, Sorption Energy, with H2O Venture Partners and is patenting the technology. *Contact: Sorption Energy Ltd., 33-35 George Street, Oxford, OX1 2AY, United Kingdom. Tel: +44 (1865) 251000; Fax: +44 (1865) 204114; Website: www.sorption energy.com.* (Source: www.energyefficiencynews.com)

Cascading CO_2 refrigeration system

In the United States, grocer Food Lion LLC and refrigeration manufacturer Kysor//Warren unveiled the grocery industry's first cascading refrigeration system with naturally occurring carbon dioxide (CO_2) to keep frozen and fresh foods cold. The new Food Lion store incorporates the use of CO_2, reducing the amount of refrigerant needed to keep products cool or frozen by more than 30 per cent.

The system is Food Lion's first "cascading" CO_2 refrigeration cycle, which uses a single system and just one condensing unit to refrigerate and freeze food. Before Kysor//Warren developed this system, grocers incorporating CO_2 refrigeration systems needed two condensing units as well as a freezer-specific system as well as a refrigeration (medium temperature)-specific system.

Food Lion was one of the first grocers to commit voluntarily to the GreenChill advanced refrigeration partnership of the United States Environmental Protection Agency (EPA), an initiative where companies pledge to go above and beyond regulatory requirements in protecting the ozone layer and reducing greenhouse gas emissions. It was also a partner of EPA's first Energy Star® and has 892 certified stores. *Contact: Mr. Christy Phillips-Brown, Food Lion LLC, 2110 Executive Drive, Salisbury, NC 28145, United States of America. Tel: +1 (704) 633 8250; E-mail: cphillips-brown @foodlion.com.* (Source: www.reuters.com)

Geothermal heat pumps

The Tranquility 20 single-stage geothermal heat pump manufactured by ClimateMaster, the United States, is equipped with EarthPure HFC-410A refrigerant and the Copeland Scroll compressor. The heat pump is included with either a permanent split capacitor, multi-speed or an electronically commutated, variable-speed fan motor. The geothermal heat pump features green technology design, which makes it eligible for extra Leadership in Energy and Environmental Design (LEED) points.

The Tranquility 20 geothermal heat pump is available in different sizes from 1.5 tonnes to 6 tonnes. It is made of galvanized steel and has powder coating. As a standard feature, the geothermal heat pump comprises a discharge muffler that delivers high-quality sound attenuation. The horizontal version of the heat pump is equipped with a discharge air arrangement that is convertible. This heat pump can be chosen for standard as well as extended range of operation.

The Tranquility 20 pump is provided with various options including the ClimaDry reheat, a method of offering modulating reheating without the need for refrigeration controls. With compressor springs and double isolation compressor mounting, this heat pump becomes capable of silent operation. The geothermal heat pump has microprocessor controls and a metering device for port expansion valve refrigerant as standard features. (Source: www.azocleantech.com)

SOLVENTS

Environment-friendly grease trap cleaner

Daimer Industries, a leading manufacturer and distributor of commercial cleaning products based in the United States, offers Eco-Green® Grease Trap Degreaser & Treatment, a plant-based grease trap cleaner that prevents nasty clogs without hazardous chemical solvents. The formulation is created for hospitality, healthcare and other industries that use grease traps.

The Eco-Green Grease Trap Degreaser & Treatment features Daimer's custom-designed Micro-Blasting® technology that employs microscopic particles, much thinner than a human hair, to pierce and liquefy grease and allow it to flow harmlessly through traps into sewers or even septic systems. The grease trap cleaner is designed to reduce the cost of pumping because the formulation helps break down waste. It can be used as a one-time treatment or even metered with a dilution pump. This solution also prevents soil and grease re-deposition.

Daimer's Eco-Green green chemicals line, which includes about 100 formulations, comprise mainly plant and vegetable components without ozone-depleting substances or dangerous volatile organic compounds (VOCs). Eco-Green solutions biodegrade around 50 per cent faster than most competitors. *Contact: Daimer Industries Inc., 16 Tower Office Park, Woburn, MA 01801, United States of America. Tel: +1 (781) 3934 900; Website: www.daimer.com.* (Source: news.thomasnet.com)

Degreasing/drying solvent

Solvokane™ S – from Solvay Advanced Functional Minerals, Italy – is an azeotropic, non-flammable mixture of Solkane® 365mfc (1,1,1,3,3-pentafluorobutane) and 1,2-dichloroethylene, with an added specialty surfactant. It is designed for drying applications and typically operates in a three-stage vapour degreasing/drying unit, with Solvokane™ in the final rinse.

Solvokane™ S offers product characteristics that are very close to HCFC-141b and CFC-113, with a Kauri butanol (Kb) value of 25. The solvency power versus common contaminants is stronger than what the Kb value would suggest.

Solvokane™ S is a new generation, environmentally compatible solvent. A volatile, colourless liquid without any ozone depletion potential, it has a relatively low global warming potential, as well as other properties that make it a superior CFC/HCFC replacement. Other features include: fast drying with no-residue; low temperature with a boiling point 36°C; excellent toxicity characteristics; drop-in replacement for high cost HFC/HFE solvents; and cleaning similar to R141b and R113. (Source: www.solvaychemicals.com)

Bi-solvent-based cleaning of precision components

Crest Ultrasonics Corp., the United States, has patented a system for the bi-solvent-based cleaning of precision components. The method uses two solvents, both free of any volatile organic compound (VOC), for cleaning precision components utilizing also a solvent reclamation process to reduce the discharge of solvent while recovering it for reuse and/or disposal.

The operation typically comprises a cleaning of the precision component in a one solvent tank to remove any soil, particulate matter, grease or other contaminant, followed by rinsing of the clean component in a second solvent tank to remove any film left on it. Both cleaning and rinsing steps comprise subjecting the component to oscillation and ultrasonically induced cavitation within the solvent to assist with the processes.

The solvent recovery mode comprises separating the first solvent, removed as part of the rinsing step, from the second solvent. In one embodiment, the second solvent can be more expensive than the first solvent such that the second solvent is recovered and reclaimed for reuse while the first solvent, along with the removed contaminants, is properly disposed of.

In one preferred embodiment, the second solvent can have a Kauri butanol value between 10 and 150; for example, Novec™ Engineered Fluid HFE-7200, which has a boiling point of 61°C and a wide liquid range from -135° to 61° C, making it suitable for vapour degreasing applications. HFE-

7200 is non-ozone depleting, has very low global warming potential, offers reduced greenhouse gas emissions, is not a VOC, and is approved without restrictions under the United States Environmental Protection Agency's Significant New Alternatives Policy (SNAP) programme. (Source: www.freepatentsonline.com)

Plastic-safe universal cleaner

Techspray, the United States, has engineered solvent cleaners that offer exciting new options for precision cleaning. Precision-V Plastic-Safe formula is engineered for use on sensitive plastic components, packaging and enclosures. It is claimed to be ideal for optics cleaning, critical electronics and other sensitive surfaces. Universal formula is an effective defluxer, degreaser and contact cleaner, which is safe on sensitive plastics like ABS, Plexiglas and Lexan.

Precision-V cleaners leave no residue, evaporate extremely fast, and are non-inflammable with no flash-point. Electronics, optics and metal parts are cleaned quickly and thoroughly, eliminating the need for further rinsing. Precision-V cleaners are non-ozone depleting, being ideal replacements for cleaners containing Freon, HCFC-141b and AK225. They remove oils, greases, silicones and other common industrial contaminants, and cleans R, RA, RMA and SA type flux residues after high-temperature reflow, wave and hand-soldering. Suitable for both lead and lead-free processes, the main components of the Precision-V solvents are 1,2-transdichloroethylene, methyl nonafluorobutyl ether, methyl nonafluoroisobutyl ether, n-heptane, methanol, ethanol, and 1,1,1,2-tetrafluoroethane and carbon dioxide in aerosol. (Source: www.techspray.com)

Video on Ozone Layer Preservation

The UNEP DTIE OzonAction Programme has produced a short news video about the interlinkages between ozone layer protection and climate change in the context of the HCFC phase-out and growing interest in HFCs.

For more information, contact:

UNEP DTIE OzonAction Branch
15 rue Milan, 75441 Paris Cedex 09, France
Tel: +33 (1) 4437 1450; Fax: +33 (1) 4437 1474
Email: ozonaction@unep.fr
Website: www.uneptie.org

HALONS

Halon replacement anti-fire products

In the United States, Megola Inc., in collaboration with Vulcan Technologies and Innovative Green Solutions, has successfully demonstrated the Hartindo™ line of anti-fire products at the Fort Eustis United States Military base. Demonstrations included use of Hartindo AF31 to extinguish small tray diesel fuel fires and similar trays with car tyres set on fire. These were extinguished using portable extinguishers. Hartindo AF31 – a clean, non-toxic, non-corrosive, electrically non-conductive and biodegradable product – can extinguish A, B, C, D and F/K class fires. Water-based Hartindo AF21 total fire inhibitor was sprayed on clothing and demonstrated against untreated materials. AF21 is non-toxic and non-corrosive, offering permanent protection from fire.

The effectiveness of Hartindo AF11E as a 1:1 Halon replacement (direct replacement for both Halon 1301 and 1211) was presented in a closed chamber simulating a total flooding system and was compared against DuPont's FM200 product. In portable form, Hartindo AF11E equals the performance of Halon 1211. *Contact: Megola Inc., 704 Mara Street, Suite 111, Point Edward, ON, Canada, N7V 1X4. Tel: +1 (519) 336 0628; Fax: +1 (519) 336 0625; E-mail: megola@megola.com.* (Source: www.foxbusiness.com)

Clean agent fire suppression

Chemetron engineered systems – manufactured by Chemetron Fire Systems, the United States – safeguard lives and assets using environment-friendly solutions. Chemetron systems employ 3M™ Novec™ 1230 Fire Protection Fluid to work together with state-of-the-art controls and detection components to detect and extinguish fires long before substantial fire damage can occur.

Novec 1230 Fire Protection Fluid is an environmentally acceptable, people-compatible, clean agent for vital facilities with a wide range of fire hazards. It suppresses fire by removing the heat energy and interrupting the combustion process. With extinguishment capability of 10 seconds or

less, the product extinguishes fires rapidly and effectively. Its key features include: a very low global warming potential of 1; atmospheric life time of just about 5 days; zero ozone depleting potential; no post-fire residue; and electrical non-conductivity.

Novec 1230 Fire Protection Fluid is recognized by all the top independent listing and approval agencies, including by the United States Environmental Protection Agency's Significant New Alternatives Policy (SNAP). *Contact: Chemetron Fire Systems, 4801 Southwick Drive, 3rd Floor, Matteson, IL 60443-2254, Illinois, United States of America. Tel: +1 (800) 748 1503; Fax: +1 (708) 748 2847.* (Source: www.chemetron.com)

Hybrid fire suppression system

Victaulic Vortex 1500 fire suppression system – from Victaulic, the United States – is a hybrid system incorporating liquid (water) and inert gas (nitrogen) extinguishants discharged together from a single emitter. Using a supersonic technology, the system atomizes the water to less than 10 micron size, forming a dense homogeneous suspension of nitrogen and water. In this manner, two extinguishment mechanisms are occurring simultaneously: cooling and oxygen reduction.

Victaulic Vortex 1500 fire suppression system can effectively be applied in total flooding fire suppression applications. It incorporates an open architecture design. It is fully compatible with automatic hazard detection systems and adaptable for remote manual activation. Since the system only discharges pure nitrogen and potable or de-ionized water, there are no environmental or life-safety risks because of system discharge. The United States Environmental Protection Agency recognizes Victaulic Vortex homogenous suspension discharge as a suitable replacement for Halon 1301.

The basic system consists of stored nitrogen and either potable or captive water supply, or de-ionized water piping along with single or multiple zone control boxes and system emitters in the hazard area. *Contact: Victaulic Asia Pacific, Unit 06-10, 3A/F, A Mansion, No. 291 Fumin Road, Shanghai, China, 200031. Tel: +86 (21) 6170 1222; Fax: +86 (21) 6170 1221; E-mail: vicap @victaulic.com.* (Source: www.victaulic.com)

FOAMS

Thermal insulation solutions

Germany-based Bayer MaterialScience AG, one of the world's largest producers of polymers and high-performance plastics, has recently presented a series of thermal insulation solutions based on rigid polyurethane foam (PUF). It is used to insulate buildings, warehouses and pipe networks, as well as refrigeration equipment.

BaySystems Pearl, a joint venture between Bayer MaterialScience and Pearl Insulation Materials Industries, Dubai, is working intensively on new systems that use environment-friendly blowing agents to produce rigid PUF. On the one hand, this reflects a general trend towards more eco-friendly construction. On the other hand, it is another step towards the phase-out of halogenated blowing agent HCFC-141b (dichlorofluoroethane).

Systems for spray foam and refrigeration equipment that are based on the blowing agent HFC-245fa have already been tested and approved by customers. Compared with HCFC-141b, the introduction of HFC-245fa constitutes an advance in environmental terms and is a major step towards halogen-free blowing agents such as pentane.

The use of pentane is the most cost-effective way for manufacturers of PUF sandwich panels and refrigerating appliances to produce effective insulation in an environment-friendly way. This blowing agent meets the same high application standards as HCFC-141b. BaySystems supplies special systems for several sandwich panel production plants that use pentane. (Source: www.azom.com)

Avoiding HFC-134a emissions in PUF manufacture

Acme Tele Power Ltd. (ATPL), India, has started a greenfield project for the large-scale, continuous manufacture of rigid polyurethane foam (PUF) panels. HFC-134a and pentane were found to be the most economical and commercially viable as blowing agents compared with the others like HFC-245fa and HFC-365mfc1. HFC-152a is not used in the foam blowing industry for the manufacture of continuous PUF panels.

Pentane, being inflammable in nature, requires substantial additional investment to ensure safer operations. Despite this, ATPL opted for pentane as the blowing agent to avoid greenhouse gas emissions, which would have occurred if HFC-134a were to be used as the blowing agent. *Contact: Mr. Sandeep Kashyap, Associate Vice President, Acme Tele Power Ltd., DLF Cyber City, 9th Floor, Building C, DLF Infinity Tower, Gurgaon, Haryana 122022, India. Tel: +91 (124) 456 1812; Fax: +91 (124) 414 7188; E-mail: sandeep.kashyap@acme.in; Website: www.acme.in.* (Source: indscanblog.com)

Production of "green" polyols

Industrial Urethanes, South Africa, following its development of an environment-friendly rigid polyurethane (PU) foam blowing agent, has set its sights on the production of "green polyols" derived from natural unsaturated oil sources such as palm, soya, sunflower, rapeseed and Jatropha. It plans to convert up to 50 per cent of its PU production from using petroleum-based polyether and polyester to polyols derived from natural sources that have zero ozone depletion potential, zero global warming potential and zero volatile organic content, explained the Technical Director of the company, Dr. Peter Groome.

"By modifying natural oils in certain ways we can arrive at polyols that ensure there is no reactive product to dispose of. Reaction times are also significantly reduced, and a third benefit is the fact that natural oils give off significantly lower odour levels when polyols are extracted," Dr. Groome said. The company is also examining the recycling of PET bottles, which can be granulated and chemically broken down into "green" polyols that can then be used to manufacture PU, producing propylene oxide rather than glycerine, and ultimately PU compounds that have exceptional fire retardant properties, he added.

Major international motor vehicle manufacturer Ford has already specified its requirements for natural-base PU products and Dr. Groome says others are bound to follow suit because both rigid and flexible PU have many uses in motor vehicles from seats to air filters. In the United States, commercial quantities of natural oil-based polyols have been available over the past two years, initially from soybean oil but currently many other natural oil options are also being investigated. *Contact: Industrial Urethanes, P.O. Box 411, Edenvale 1610, South Africa. Tel: +27 (11) 922 1900; Fax: +27 (11) 976 0872; E-mail: indur@indur.co.za; Website: www.indur.co.za.* (Source: www.pu2pu.com)

Blowing agents for polymeric foams

Honeywell International Inc., based in the United States, has filed for patent on foam blowing agents comprising one or more chlorofluoroolefins selected from 1,2-dichloro-1,2-difluoroethene, 3,3-dichloro-3-fluoropropene, 2-chloro-1,1,1,3,4,4,4-heptafluoro-2-butene, and 2-chloro-1,1,1,4,4,4-hexafluoro-2-butene, as well as on foams produced using these. The invention is meant to provide new, environmentally safer, alternative blowing agents that are effective and possess or impart properties to the foams that are at least comparable to those associated with the most widely used blowing agents. Such desirable properties include vapour phase thermal conductivity (low k-factor), non-inflammability (as per to ASTM standard E-681), and low- or no-toxicity.

Applicants have found that the above-mentioned gases have a low or near-zero ozone depletion potential and a low global warming potential, show a low or no-toxicity, and are soluble in polyols. Thus, these compounds are desirable alternatives to be used as blowing agents. Further, their use does not require any major engineering changes to conventional systems used in foam preparation and formation. (Source: www.faqs.org)

Avoidance of GHG emissions in rigid PUF manufacture

Lloyd Insulations (India) Ltd. (LIL) – engaged in the business of design, fabrication, supply and installation of advanced insulation and allied system – is implementing a greenfield project for manufacturing of various types of insulated panels using rigid polyurethane foam (PUF) as the core material sandwiched between two rigid steel facings. The panels will have a variety of uses such as in industrial building panels, cold storage and food preservation, and clean rooms.

The blowing agent used in rigid PUF manufacture needs to achieve the raw density required and a fine cellular character along with low heat conductivity. Some amount of this blowing agent escapes at the time of manufacture, during usage and ultimately at the time of decommissioning/ disposal of the PUF. Hence, the blowing agent needs to be environmentally harmless.

The PUF industry has thus been searching for substances with zero ozone depletion potential (ODP) that meet the performance (insulation, fire resistance, etc.) and economic criteria. Several such blowing agents have been developed, such as hydrofluorocarbons and hydrocarbons. LIL will be using one of these zero-ODP blowing agents. *Contact: Lloyd Insulations (India) Limited, Kalkaji Industrial Area, New Delhi 110 019. Tel: +91 (11) 3088 2900-906; Fax: +91 (11) 3088 2894, 3088 2895; E-mail: lloyd@dataone.in; Website: www.lloydinsulation.com.* (Source: indscanblog.com)

Methods of using a foam blowing agent

Solvay S.A. of Belgium, jointly with several inventors, has patented an invention that relates to methods utilizing environmentally advantageous compounds or compositions – for example, fluoroethers, fluoroalkanes, fluoroketones, and sulphur-, nitrogen- and phosphorous-substituted fluorides – for applications such as foam blowing, solvent cleaning, refrigeration, semiconductor etching, heat transfer, fire extinguishing and production of aerosols. The invention also relates to specific azeotropes that can be applied in at least one of these processes. These compositions would be alternatives to halofluorocarbons in view of their low ozone depletion and greenhouse gas potential.

The invention covers a method using compounds or compositions for useful applications, comprising a step wherein at least one compound applied is selected from the groups consisting of fluoro-substituted ethers, nitrogen-containing compounds, fluoro-substituted alkenes and alkyne, alkanes and iodoalkanes, fluorinated compounds with a keto group, fluorinated alcohols, fluorinated silanes, and fluorinated phosphorous and sulphur compounds, which have low/zero ozone depletion potential and zero global warming potential. (Source: www.wipo.int)

FUMIGANTS

Solar power to kill weeds

Soil solarization – preparing planting beds by covering them with clear plastic sheets for several weeks during the summer to trap heat – destroys weeds, nematodes and fungi – says an expert from the University of Florida (UF), the United States. The study published in the *International Journal of Pest Management* showed solarization effectively prepared planting beds for snapdragons, in some cases as well as the soil fumigant methyl bromide.

Solarization has some advantages over fumigants, says Dr. Bob McSorley, a nematology professor with the UF Institute of Food and Agricultural Sciences. It is inexpensive and environment-friendly, though the sheeting requires disposal. The downside is that solarization requires intense sun exposure, and hence can be used only during summer, to prepare beds and fields for fall-grown crops. Three to four months after solarization, harmful organisms start to return. Solarization has “tremendous potential” for Florida floriculture and vegetable farms, when used as part of an integrated pest management approach, says the United States Department of Agriculture plant pathologist Dr. Dan Chellemi. (Source: news.ufl.edu)

Evaluation of anaerobic soil disinfestation

In the United States, researchers from the Horticultural Research Laboratory of the United States Department of Agriculture Agricultural Research Service (ARS) and the University of California Santa Cruz have evaluated anaerobic soil disinfestation (ASD) as alternative to methyl bromide (MeBr) fumigation in a bell pepper-eggplant double crop system. ASD combines brief periods of soil saturation with soil solarization, allowing reducing conditions to develop in concert with increased soil temperatures. This technology is being widely investigated as an alternative to chemical soil fumigation for control of soil-borne pathogens, plant-pathogenic nematodes and weeds in response to the global phase-out of MeBr, and as an option for organic and transitional growers.

A complete factorial field experiment with three levels of initial irrigation (10, 5, 0 cm), two levels of poultry litter (amended and unamended) and two levels of molasses (amended and unamended), in combination with solarization was established to optimize ASD for Florida vegetable production. Untreated (UTC) and MeBr controls were included. As indicated by redox potential (Eh), strong to moderate anaerobic conditions (-300 to 200 mV) developed in treatments amended with poultry litter and/or molasses.

As anaerobic conditions are essential for pathogen control, soil amendment is necessary for ASD applications in coarse-textured, low-organic-matter soils. ASD treatment greatly affected pH and nutrient availability, which must be considered when adapting ASD technology. Weed biomass from plant holes at bell pepper (*Capsicum annuum*) harvest was equivalent to MeBr in all treatments with soil amendments, regardless of initial irrigation. Control of yellow nutsedge (*Cyperus esculentus*) emerging through plastic was inconsistent for each factorial treatment, although generally intermediate between MeBr and UTC. Marketable pepper yields were greater than UTC and equal to harvest from MeBr for all but three treatments. Although more research is needed to determine optimal soil amendments (including cover crops), irrigation and tarps for soil disinfestation, ASD is a promising alternative to chemical fumigation. (Source: acs.confex.com)

Research on sulphuryl fluoride

In the United States, Dow AgroSciences and its commercial partners – Cardinal Professional Products and Fumigation Service & Supply – are conducting research on the performance of ProFume® (sulphuryl fluoride) as an methyl bromide (MeBr) alternative. In a paper on "Control of carob moth in fresh dates fumigated with ProFume gas fumigant", Mr. Bob Williams, senior research biologist with Dow AgroSciences, provided an update on the use of ProFume' in commercial fumigation chambers with fresh dates. A research, conducted jointly with the California Date Commission, evaluates the efficacy of dosages of ProFume lower than earlier tested for carob moth control.

Since it received registration in California in May 2005, ProFume has become a proven replacement for MeBr as a post-harvest fumigant over a wide variety of commodities. Mr. Ed Hosoda of Cardinal Professional Products presented how ProFume is successfully being used for the eradication of various post-harvest pests, and addressed potential future uses for the fumigant.

A paper from Mr. John Mueller of Fumigation Service & Supply discussed his experience working with ProFume over the past 12 years. He covered background experience, market growth, objective benefits, successful adjustments, dialling into effective dosage rates and advancements in the product. The penetration capability of sulphuryl fluoride over that of MeBr also was addressed. In both research and commercial fumigations, ProFume has demonstrated it is an economically and technically viable alternative to MeBr, reports Dow AgroSciences. (Source: www.pctonline.com)

MeBr alternatives in forest tree seedling nurseries

Scientists at the Southern Forest Nursery Management Cooperative, Auburn University School of Forestry and Wildlife Sciences, the United States, have conducted studies as part of the Area-wide Pest Management Project for Methyl Bromide Alternatives in South Atlantic Region. This is the third year of a five-year project with each trial a two-year, large-scale demonstration of methyl bromide (MeBr) alternatives managed under standard nursery practices. In the 2009/2010 growing season, 6 weeks of post-sowing, seedling counts (trees/ft^2) at two nurseries in Alabama indicate no significant difference between the soil fumigants tested.

Soil analysis indicates no significant difference in *Trichoderma* spp. fungi levels among the soil fumigants applied. Of the two iodomethane products tested, the Midas™ 50/50 had significantly higher levels of fungi than the Midas™ 98/2. This difference is attributed to the amount of chloropicrin in each product, as previous Nursery Cooperative research showed 100 per cent iodomethane inhibited *Trichoderma* spp. growth compared with MeBr. When the fungi levels were examined at one site, soils treated with DMDS + Chlor had significantly higher levels than chloropicrin. MeBr treated soil fell among the two extremes. Nematodes were not detected in any fumigant treatment at six weeks post-sowing. (Source: mbao.org)

RECENT PUBLICATIONS

Ozone Depletion, Chemistry and Impacts

This new book presents the latest research on the ozone layer from around the globe. The topics covered by noted scientists include: new problems in ozone precursor monitoring and solutions; ozone decomposition by catalysts and its application in water treatment; ozone in phenols and xenobiotics degradation; ozone history and ecosystems; catalytic ozonization; a model-based warning system for air pollution monitoring; quasi-biennial oscillations in the equatorial stratosphere; etc.

Contact: Nova Science Publishers Inc., 400 Oser Avenue, Suite 1600, Hauppauge, NY 11788-3619, United States of America. Tel: +1 (631) 231 7269; Fax: +1 (631) 231 8175; E-mail: Main@novapublishers.com; Website: www.novapublishers.com.

Handbook for the Vienna Convention for the Protection of the Ozone Layer

The eighth edition of the Handbook for the Vienna Convention has been published. It contains the full text of the Vienna Convention for the Protection of the Ozone Layer (1985) in Section 1. Section 2 updates the text of the decisions of the Conferences of the Parties by incorporating the decisions adopted at the Eighth Conference of the Parties in Doha, Qatar, in November 2008. The decisions are presented in sub-sections relating to each article of the Convention. The Handbook has continued to be a useful reference guide and will continue to be updated as necessary. For the first time, it is being published only in electronic form to take advantage of the improved communication technology and to save the environment by being economical on paper usage.

Contact: Earthprint Ltd., P.O. Box 119, Stevenage, Hertfordshire, SG1 4TP, England, United Kingdom. Tel: +44 (1438) 748 111; Fax: +44 (1438) 748 844; E-mail: customerservices@earthprint.com.

TECH EVENTS

07-09 Apr
Beijing
China

CHINA REFRIGERATION EXPO 2010
Contact: Mr. Zhou Jinglong,
Beijing International Exhibition Centre (BIEC), Suite 601, Floor 6, Henghua International Mansion, 26, Yuetanbeijie, Xicheng District, Beijing 100045, China.
Tel: +86 (10) 58565888;
Fax: +86 (10) 58566000;
E-mail: jinglong@biec.com.cn.

05-08 May
Istanbul
Turkey

ISK/SODEX Istanbul 2010 International HVAC & Refrigeration Exhibition
Contact: Hannover-Messe Sodeks Fuarcilik A.S.,
Beybi Giz Plaza,
Dereboyu Cad. Meydan Sok.,
No. 28, Kat. 2, Daire. 3-4,
Maslak - Istanbul, Turkey.
Tel: +90 (212) 290 3333;
Fax: +90 (212) 290 3331-32;
E-mail: info@sodex.com.tr.

19-20 May
Cologne
Germany

Blowing Agents & Foaming Processes 2010
Contact: iSmithers,
Shawbury, Shrewsbury,
Shropshire SY4 4NR,
United Kingdom.
Tel: +44 (1939) 252 421;
E-mail: conferences@ismithers.net.

7-9 Jun
Tokyo
Japan

ACRA 2010 – 5th Asian Conference on Refrigeration and Air-conditioning
Contact: Prof. Masafumi Katsuta,
Japan Society for Refrigeration and Air-conditioning Engineers,
San-ei Bldg., 8 San-ei-cho,
Shinjuku-ku, Tokyo 160-0008, Japan.
E-mail: acra2010@jsrae.or.jp;
Website: www.jsrae.or.jp

15-18 Jun
Kuala Lumpur
Malaysia

REVAC 2010
Contact: AMB Exhibitions Sdn. Bhd.,
1701, 17th Floor, Plaza Permata (IGB), 6, Jalan Kampar,
Off Jalan Tun Razak,
50400 Kuala Lumpur, Malaysia.
Tel: +60 (3) 4045 4993;
Fax: +60 (3) 4045 4989;
E-mail: support@ambexpo.com.

01-03 Sep
Singapore

REFRIGERATION ASIA 2010
Contact: IIR Exhibitions Pte. Ltd.,
205 Henderson Road,
#03-01 Henderson Industraial Park,
Singapore 159549.
Tel: +65 6319 2668;
Fax: +65 6319 2669;
E-mail: sharon.lim@iirx.com.sg.

PUBLICATIONS from APCTT

PERIODICALS

(Free access at www.techmonitor.net)

- ❑ Asia Pacific Tech Monitor (6 issues/year) — (e-version)
- ❑ VATIS Update (6 issues/year)
  - ❍ Biotechnology — (e-version)
  - ❍ Non-conventional Energy — (e-version)
  - ❍ Food Processing — (e-version)
  - ❍ Ozone Layer Protection [#] — (e-version)
  - ❍ Waste Management — (e-version)

BOOKS

	Indian Rupees* (India, Bhutan and Nepal)	US Dollars*
❑ Managing Innovation for the New Economy: Training Manual, 2002 Volume 1: How to Guide & Quick reference materials Volume 2: Articles & Lectures	1,000.00	50.00
❑ Regional Capacity-building for the Adoption of ISO-14000 and Transfer of Environmentally Sound Technology: Training Manual, 2000	600.00	30.00
❑ Small Rural Industries in the Asia Pacific Region: Enhancement of Competitiveness of Small Rural Industries in a Liberalized Economic Environment and the Impact of Poverty Alleviation, 2000	600.00	30.00
❑ Technology Transfer and Technological Capacity-building in Asia and the Pacific		
❍ Volume 1: Big Countries and Developed Economies, 1999	600.00	30.00
❍ Volume 2: ASEAN, NIEs, SAARC and the Islamic Republic of Iran, 1999	600.00	30.00
❍ Volume 3: Least Developed and Pacific Island Countries and Economies in Transition, 1999	600.00	30.00
❍ Volume 4: Emerging Issues in Regional Technological Capability-building and Technology Transfer, 1999	600.00	30.00
❑ Rural Industrialization as a Means of Poverty Alleviation: Report of the Regional Seminar on the Enhancement of Partnerships among Governmental, Non-governmental and Private Sector Entities for the Promotion of Rural Industrialization for Poverty Alleviation, 1999	600.00	30.00
❑ Institutional Development for Investment Promotion and Technology Transfer, 1999	500.00	25.00
❑ Ozone Depletion Substances Phase-out Technologies: Problems & Issues on Technology Transfer, Absorption and Generation, 1998	300.00	15.00
❑ Development and Utilization of S&T Indicators: Emerging Issues in Developing Countries of the ESCAP Region, 1998	300.00	15.00
❑ ODS Phase-out: A Guide for Industry, 1998	500.00	25.00
❑ Proceedings of the Consultative Meeting on Technology Management Education and Training for Developing Countries, 1997	800.00	40.00

Notes: Amount less than Rs 500 should be sent through a demand draft only. Otherwise, payment should be made by cheque/ demand draft/UNESCO coupon in favour of the Asian & Pacific Centre for Transfer of Technology, payable at New Delhi.

[#] Print version supported by the Ozone Cell, Ministry of Environment & Forests, Government of India, for distribution to a select target group.

** Amount to be sent to APCTT with the order for covering costs and handling charges.*