SCIENCE OF THE OZONE LAYER

Global warming fix could damage ozone layer

Pumping tiny sulphate particles into the atmosphere to create a sunshield that would keep the planet cool was first suggested as a solution to global warming by Dr. Edward Teller, a physicist best known for his involvement in the development of the hydrogen bomb, and promoted by Nobel laureate Dr. Paul Crutzen and other researchers. A new model has shown that such a "sulphate sunshade" would punch huge holes through the ozone layer above the Arctic. To make matters worse, it would also delay the full recovery of the Antarctic ozone hole by up to 70 years.

Since major volcanic eruptions temporarily thin the ozone layer in the stratosphere, Dr. Simone Tilmes and her colleagues at the National Centre for Atmospheric Research, the United States, looked into the potential impact of geo-engineering plans on ozone over the poles. Dr. Tilmes used computer models to see how a sulphate sunshade would affect the ozone layer. "Our research indicates that trying to artificially cool off the planet may be a perilous endeavour," she says. "While climate change is a major threat, this solution could create severe problems for society."

Dr. Tilmes modelled two different scenarios: one in which particles measuring 0.43 µm in diameter are used, and one where the particles are two-and-a-half times smaller. Sulphate particles catalyse the breakdown of ozone by chlorine atoms. In January 2008, researchers described how much of each type of sulphate particle would need to be injected into the stratosphere in order to compensate for a doubling in atmospheric carbon dioxide concentrations. These volumes were used in the computer models.

Dr. Tilmes found that injections of smaller particles over the next 20 years could thin the wintertime ozone layer over the Arctic by 22-76 per cent (100-230 DU). Larger particles, which would have less of a cooling effect, would still reduce Arctic ozone by 15 to 50 per cent (70-150 DU) during the winter. In the Antarctic, the injections would delay the recovery of the existing ozone hole by 30-70 years. "This study highlights another connection between global warming and ozone depletion, which had been thought of as separate problems but are now increasingly recognized to be coupled in subtle, yet profoundly important, ways," says co-author of the paper Dr. Ross Salawitch of the University of Maryland. (Sources: environment.newscientist.com, www.telegraph.co.uk and www.hindu.com)

Increase seen in atmospheric carbon dioxide

The National Oceanic and Atmospheric Administration (NOAA), the United States, has reported that despite efforts to reduce greenhouse gases, the rate of increase of carbon dioxide in the atmosphere is accelerating.

Concern has grown in recent years about such gases, with most atmospheric scientists worried that the accumulation is causing increases in the earth's temperature, potentially disrupting climate and changing patterns of rainfall, drought and storms. The Intergovernmental Panel on Climate Change has worked to detail the scientific bases of this problem and the Kyoto agreement sought to encourage countries to take steps to reduce their greenhouse emissions. Some countries, particularly in Europe, have adopted steps to reduce emissions.

However, carbon dioxide emissions – primarily from burning fossil fuels such as coal, oil and gas – have continued to increase. Since 2000, annual increases of two parts per million (ppm) or more have been common, compared with 1.5 ppm per year in the 1980s and less than one ppm per year during the 1960s, NOAA's Earth System Research Laboratory said. Last year, the increase was 2.4 ppm.

Meanwhile, another paper by researchers from Environment Canada, said human activities are at least partly responsible for the Arctic having become a wetter place over the last half century. Dr. Seung-Ki Min and colleagues studied rain and snowfall patterns in the arctic and the factors affecting them. They have concluded that human-induced greenhouse gases have contributed to

the increased precipitation rates observed in the Arctic region over the past 60 years. They have warned that this "Arctic moistening" could occur more quickly than current climate simulations indicate. (Source: ap.google.com)

Ozone hole recovery might hasten melting of polar ice

A new research by National Oceanic and Atmospheric Administration scientists has suggested that the recovery of the ozone hole above Antarctica could warm the region and cause more ice to melt in coming decades. According to the study, as the ozone hole heals, wind patterns that shield the interior of the polar region from warm air may break down, causing warming in the Antarctica, as well as warmer and drier conditions in Australia.

Despite global temperatures rising, the interior of Antarctica has experienced a unique cooling trend during its summer and autumn over the last few decades. Scientists attribute this cooling to the hole in the ozone layer, which alters atmospheric circulation patterns and strengthens the westerly winds that swirl around the continent. These winds have isolated the Antarctic interior from the warming patterns seen on the continents peninsula and throughout the rest of the world.

Most scientists agree that the ozone hole has probably reached its largest size and that ozone levels will recover by the end of the century. If the Ozone hole goes through a full recovery, the world may finally see the interior of Antarctica beginning to warm with the rest of the world.

The warming of the Antarctic may have been delayed because of the ozone hole, said atmospheric scientist Dr. Judith Perlwitz. For their research work, Dr. Perlwitz and her colleagues simulated the interaction between stratospheric ozone dynamics and atmospheric conditions between 1950 and the end of the 21st century. They concluded that as ozone levels recover, the lower part of the stratosphere above Antarctica some 10-20 km above Earth's surface will absorb more ultraviolet radiation, and rise in temperatures by as much as 9ºC, reducing the existing strong north-south temperature gradient. (Source: www.thaindian.com)

ODS PHASE-OUT IN INDIA

Navin Fluorine wins carbon credits from United Nations

Navin Fluorine International Ltd., India, has received 795,455 carbon credits from the United Nations Framework Convention on Climate Change. The company, which makes chemicals and refrigerant gases, has received the credits for its project to reduce greenhouse gas HFC23, a by-product in its refrigerant gases operation.

Current realizations for the credits are about €17 each, and at this price, the credits are worth Rs 918 million. Industries in developed countries buy carbon credits to meet their environmental obligations under the Kyoto Protocol. Each unit of carbon credit represents a reduction of one tonne in greenhouse gas emission. The company is reported to be expecting to generate 2.8 million carbon credits annually for 10 years. (Source: in.reuters.com)

Blue Star launches eco-friendly VRF AC systems

Central air-conditioning and commercial refrigeration major Blue Star has launched its Variable Refrigerant Flow (VRF) air-conditioning systems. Blue Star is the first to manufacture such eco-friendly and energy-efficient systems in India, a press release issued by the company stated. "The launch of these energy-efficient VRF systems with an eco-friendly refrigerant to prevent ozone depletion is yet another initiative of the company in the area of going green," Blue Star's Deputy Managing Director Mr. T Gouri Sankara Babu said in the release. (Source: economictimes.indiatimes.com)

National CTC Phase-out Plan

The Ozone Cell in the Indian Ministry of Environment and Forests is responsible for the overall coordination of the CTC phase-out. The project consists of investment activities and technical assistance aimed at producers and consumers of

CTC. The World Bank is the lead implementing agency for this project while UNIDO, UNDP (on behalf of the Government of Japan) and GTZ-Proklima (on behalf of the Governments of France and Germany) are the cooperating implementing agencies. Results achieved so far are:

- Implementation in 15 states with own project infrastructure till date
- All major applications for CTC usage in India identified
- For each application there have been at least two non-ozone depleting alternatives identified and assessed
- Establishment of an institutional support base for information dissemination and training has been completed in the textiles sector and is progressing fast for the metal cleaning applications.

(Source: www.gtz.de)

Phase-out of CFCs: results and achievements

Institutional Strengthening

- The Ozone Cell, mandated to coordinate CFC phase-out, was established as per commitments under the Multilateral Environment Agreement.
- Ozone Rules and Regulations formulated.
- Capacity of concerned governmental agencies (customs officials and officials from ministries of law, commerce, and revenue) developed.
- Awareness building on the issue initiated at the industry level.

Sector Plans

- Appropriate technologies have been identified and provided to 140 small and medium units for the phase-out of CFCs in the foam sector.
- Technology identified and suitable equipment provided to 200 units in the refrigeration-manufacturing sector.
- Small equipment (e.g. vacuum charger, leak detectors) provided to refrigeration technicians under the Servicing Sector Plan; 120 technical institutes have benefited from this programme.
- Efforts to phase out the use of Carbon Tetra-Chloride (CTC) in Steel Authority of India (SAIL) plants and two private units are ongoing.
- National awareness campaign carried out by the Ozone Cell. (Source: data.undp.org.in)

IN THE NEWS

NOAA scientists win international award

The Environmental Protection Agency (EPA) of the United States has named two scientists from the Oceanic and Atmospheric Administration (NOAA) among the winners of the agency's international Ozone Layer Protection Award. Dr. David Fahey and Dr. John Daniel of NOAA's Earth System Research Laboratory in Boulder were honoured during a ceremony at the Kennedy Centre for the Performing Arts. The EPA Ozone Layer Protection Award was established in 1990 to recognize exceptional leadership, personal dedication, and technical achievements in eliminating substances that deplete ozone.

Dr. Fahey and Dr. Daniel are among the authors of a groundbreaking paper published in 2007 that calculated the benefits to the climate from citizen action and the Montreal Protocol in phasing out ozone-depleting substances that are also powerful greenhouse gases. The team of five scientists found that the direct effect of the Montreal Protocol's emission reductions has been to delay climate change by 7-12 years.

Dr. Fahey also received an individual award for his work on many aspects of stratospheric ozone depletion and the impact of aviation on ozone and climate. He has served on several international scientific assessments of ozone depletion and climate, and was the lead author of "Twenty Questions and Answers about the Ozone Layer" for both the 2002 and 2006 updates of the Montreal Protocol's Science Assessment Report. (Source: www.eurekalert.org)

Pakistan committed to Montreal Protocol

Mr. Hameedullah Jan Afridi, Pakistan's Environment Minister, recently reiterated the commitment of the government to its international obligations to thwart the threats emanating from depletion of ozone layer. Speaking at a seminar on "Montreal Protocol and Pakistan's Commitment", he said environmental problems were not confined only

to the countries that might have caused them. Underdeveloped countries, whose contribution to environment degradation was relatively less, suffered the most due to lack of resources, he said.

The Minister said NGOs and general public need to play their part to deal with environmental issues. He said it was heartening that the parties to the Montreal Protocol have collectively phased out 95 per cent production of ozone depleting substances the world over and the remaining five per cent would be ended by January 2010. He added that Pakistan, which signed the protocol in 1992, has significantly contributed in the international efforts to make the world ozone-friendly.

Ms. Shadia Yousif Bakhait, the country representative the United Nations Industrial Development Organization, said Pakistan had made notable achievements and progress by phasing out the consumption of ozone depleting substances. She said the United Nations Environment Programme had awarded Montreal Protocol certificate of recognition to the government and National Ozone Office of Pakistan for their contribution towards global efforts to protect the ozone layer. (Source: www.dailytimes.com.pk)

Illegal trade in CFCs is on the increase

A recently released a study on trans-boundary movement of ozone depleting chemicals has found that illegal trade in chlorofluorocarbons (CFCs), an ozone-depleting chemical, in the Asia-Pacific region is much larger than anyone realized. The United Nation Environment Programme (UNEP) study named Thailand as one of the key importers of illegal CFCs. Mr. Soodsakorn Putho, the director of Thai Industrial Works Department's (IWD) Treaty and International Strategy Bureau, said smuggling of CFCs has now become more intensive. The Bureau acts as Thailand's National Ozone Depletion Unit under the Montreal Protocol.

Mr. Soodsakorn said CFCs are still needed as refrigerants for the air-conditioning systems in old cars. CFCs were the original chemicals used in refrigerators, cooling systems and bottled foam spray, among other things. Under the Montreal Protocol, the international agreement established to phase out the consumption of ozone-depleting substances (ODS), the consumption of CFCs of all member countries will come to an end in 2010.

Being a member of the protocol, Thailand has tried its best to reduce the consumption of CFCs and other ozone-depleting chemicals. IWD's statistics showed that Thailand reduced the import volume of CFCs from 2,291 tonnes in 2004 to 1,364 tonnes in 2005 and 912 tonnes last year. This year, the quota is only 704 tonnes and next year only 496 tonnes can be legally imported. The figures from the Customs Department, however, show that the volume of CFCs smuggled into the country is increasing. In 2004, the department seized 6,977 kg of smuggled CFCs. The volume leaped to 88,291 kg in 2005. From 2003 to 2005, Customs reported 46 hauls of CFCs. Of this, 27 were smuggled from Lao People's Democratic Republic, accounting for 58.9 per cent, while 17.4 per cent came from Malaysia.

The UNEP study by analysing exports and imports of CFCs in 2004 between key importing countries – such as Indonesia, Malaysia, Thailand, the Philippines, Viet Nam and Iran – and key exporting countries – which include China, India and Singapore – found more than 4,000 tonnes of CFCs unaccounted for in the importing countries, meaning they do not have any record of these imports. "In some cases, these discrepancies actually correspond to the use of these goods in the market. Clearly, the problem is bigger than anyone thought before, and action had to be taken," said UNEP's OzonAction branch chief Mr. Rajendre Shende. (Source: www.nationmultimedia.com)

China phases out fumigant use in grain storage

China has phased out the use of methyl bromide as a fumigant for grain storage in a bid to protect the ozone layer, the Ministry of Environmental Protection (MEP) has stated. "Grain storage became the first to complete the phase-out among three sectors. A total of 210 tonnes of methyl bromide in 128 grain depots had been phased out by January 2007, fulfilling China's commitment to the international community," Mr. Zhu Guangyao, vice-minister of the MEP, said. The other two industries targeted to phase out methyl bromide (MB) application are the tobacco and agriculture sectors.

Phosphine gas recirculation under plastic film and fumigation using phosphine mixed with carbon dioxide have been identified as the two alternative technologies for MB, the State Administration of Grain said. Phosphine is more environmentally friendly and less likely to leave residues in foodstuffs, say experts. "All phosphine generators now used in China are made in China; and Chinese technology for grain fumigation is also being exported abroad," stated Mr. Sajjad Ajmal, China representative of the United Nations Industrial Development Organization. (Source: news.xinhua net.com)

Thai company phases out its CFC applictions

Being a major manufacturer of reciprocating compressors for refrigerators and air-conditioners, Kulthorn Kirby, Thailand, once was a main source of chlorofluorocarbons (CFCs). However, since 1997 the company, with US$5.2 million (Bt164.8 million) support from the Multilateral Fund and technical support from the United Nations Environment Programme as well a the Japan Electrical Manufacturers Association, has converted its production of compressors to use ozone-safe technology.

Because the company has more than 50 per cent share of the Thai market and 35 per cent of total production for export, the conversion of its production line has opened up the Thai compressor market to non-CFC technology, transforming the industry completely. Kulthorn Kirby's work to phase out CFCs has earned it an award from the Montreal Protocol.

Besides Kulthorn Kirby, eight other Thai companies have secured Montreal Protocol Exemplary Project Recognition awards for their participation in the Thai Building Chiller Replacement Project, in which they replaced their old building chillers using CFCs with energy-efficient, non-CFC chillers. The eight companies are Toshiba Semiconductor (Thailand), the Grand Hyatt Erawan, the Erawan Group, Venus Thread, Vibhavadee Rangsit Hotel, Thai CRT, Jong Stit and Euromill Hotel. (Source: www.nationmultimedia.com)

Engineers convicted for depleting ozone layer

In June, two refrigeration engineers have been convicted by a New Zealand court for depleting the ozone layer. The country's Ministry for Economic Development prosecuted the two men in the first ever case taken under a 1996 law protecting the ozone layer.

The pair released ozone-depleting HCFC22 into the atmosphere, as they were repairing a drinks chiller, despite a warning that it was hazardous. The Ministry said it took the case as a warning to the industry. The two were fined NZ$750 each (US$568). (Source: www.planetark.com)

Pakistan making efforts for ozone layer protection

Pakistan is making all-out efforts for the protection of ozone layer and has, so far, implemented 32 projects for phasing out ozone depleting substances (ODS). Mr. Iftikhar Ahmed, Technical Expert, United Nations Development Programme, and Ozone Cell, Ministry of Environment, said the government was providing necessary technical and financial support to the industries using ODS from the Multilateral Fund for the implementation of Montreal Protocol.

Mr. Iftikhar said that while Pakistan did not produce ODS, it imported a few chemicals like chlorofluorocarbons (CFCs), carbon tetrachloride (CTC), halons and methyl bromide (MB) for use in the foam, refrigeration, metal industry, surgical equipment, fire extinguishers and Quarantine and preshipment purposes. In collaborating with United Nations Industrial Development Organization, the Ozone Cell has implemented projects in foam and refrigeration sectors for converting ODS-based technologies into non-ODS technologies. The Cell has also trained 200 Customs officers for the purpose while over 750 technicians had been facilitated to build their capacity in retrofitting in CFCs-based refrigerators and air-conditioners.

Pakistan has introduced licensing system to regulate and monitor the import of CFCs, halons and MB while import of CTC was banned in May 2007, some two and a half year ahead of the target fixed under the Montreal Protocol, Mr. Iftikhar said. (Source: www.daily.pk)

REFRIGERATION/ AIR-CONDITIONING

Magnetic refrigeration moves on

Nanocomposites produced from metallic glasses could make promising magnetic refrigeration materials, say scientists in France. The materials are as good as the best currently available magnetic refrigerants with some added advantages. “Magnetic refrigeration is an environmentally friendly cooling technology, unlike the gas-compression refrigerators used today,” says team member Dr. Stéphane Gorsse of the Institute of Condensed Matter Chemistry of Bordeaux (ICMCB-CNRS). The technology uses no ozone-depleting, hazardous chemicals or greenhouse gases. Moreover, the energy efficiency can reach up to 60 per cent, compared with just 40 per cent for the best gas-compression refrigerators.

Current magnetic refrigerants are only efficient in a narrow temperature range of a few degrees above and below their transition temperature. The new nanocomposite material – gadolinium nanocrystallites embedded in a gadolinium-aluminium-manganese metallic glass matrix – is the first to efficiently perform in a wide temperature range of about 100ºK. Moreover, the working temperature and operating range can be tailored by tuning the composition and manipulating the microstructure. Metallic glasses are still relatively “immature” materials and have few applications, but these materials exhibit unique properties thanks to their disordered atomic structure.

Dr. Gorsse and colleagues produced their nanocomposite by rapid quenching of melt to avoid crystallization and to form a metastable disordered amorphous solid (the metallic glass). The glass was then given heat treatment, which needs to be stopped early to prevent the glass from fully crystallizing. “Our material is as good as the best currently available materials that are crystallized and which exhibit first-order transitions and strong magnetocrystalline coupling,” Dr. Gorsse adds.

The microstructure of the nanocomposite (size, volume fraction and composition of the nanocrystallites formed *in situ*), and thus the resulting magnetocaloric properties and refrigeration capacity, depends on the heat treatment temperature and time. The researchers therefore plan to study and model how the microstructure of their material evolves during heat treatment and how the glass composition affects crystallization. (Source: www.environmentalresearchweb.org)

The road to smart chillers

It is now becoming clear that demands on chillers are changing and, consequently, their design also has to change. At the heart of these changing demands is the need to offer lower life-cycle costs and to reduce the environmental impact of ac and process cooling. So the only option is to ‘revisit’ the way chillers are put together and to address every component and every aspect of their performance. This is the thinking behind the concept chiller that Lennox, the United Kingdom, exhibited recently. This concept chiller encompasses a number of technologies that are not yet ready for market but are on their way. It incorporates 30 hp scroll compressors that use the ozone-safe R410A refrigerant.

The chiller of the future will offer optimized performance and be combined with sophisticated controls to offer a high COP at all loads – not just full load. Heat exchangers make a vital contribution to the overall performance of a chiller and we can expect to see major advances in this area. In particular, the brazed aluminium microchannel (BAM) heat exchangers have a great deal to offer. Combining compact, low-weight technology with very high heat transfer, BAM coils allow the use of much smaller condensing units to get the same system performance. As a result, refrigerant volumes can be reduced by up to 40 per cent with no compromise on performance.

In addressing the life cycle costs of chillers, it is important to look beyond the energy efficiency to take in the whole life of the plant from manufacture and installation through to end of life. Hence, manufacturing processes have to be more efficient, with as many by-products being recycled as possible. Installation also needs to be optimized through features such as ‘plug-and-play’ operation and integrated hydraulic kits that simplify installation work. The chillers themselves also need to be tough enough to withstand the

elements and eliminate the need for rooftop plant rooms, thus saving on overall construction costs. Similarly, access to all components needs to be quick and easy to facilitate both the speed and efficiency of maintenance. Last, but definitely not least, are the controls, which must be sophisticated at their core yet simple at the interface with the end user. (Source: www.acr-news.com)

Low-cost combined chiller-freezer unit

Based on years of carbon dioxide technology expertise, the Swedish manufacturer Green & Cool has developed a combined chiller-and-freezer unit for direct expansion on the evaporator side, operating either with a liquid- or air-cooled gas cooler. Designed for the natural refrigerant R744, the system offers the lowest environmental impact through significantly less direct emissions. Moreover, Crystal DX can reach a higher Coefficient of Performance (COP) compared with other refrigeration units, as no heat exchangers are involved in the system. In addition, there is no need for pumps on the secondary fluid side.

The unit is available in a wide range of capacity, from 25.2 m^3 to 50.4 m^3 swept volume on the medium temperature (MT) side and from 12.7 m^3 to 14 m^3 swept volume on the low temperature (LT) side. The units are available in different sizes to fit various applications, mainly within grocery stores and the food industry: 30-100 kW refrigeration output at -10°C for MT; and 10-30 kW refrigeration output at -37°C for LT. The "Green Control System", standard for all units, helps optimize the COP to the maximum. It is very user friendly, as it allows complete surveillance of the compressor-pack and the possibility of remote control/settings. (Source: www.r744.com)

Ozone-friendly refrigeration technology

Food Lion LLC recently unveiled the first grocery store in the United States that incorporates two ozone-friendly product refrigeration systems. Both systems reduce by more than 60 per cent the amount of refrigerants needed to keep products cool or frozen. Food Lion has been on the leading edge of companies putting in place measures and initiatives that reduce emissions of ozone-depleting refrigerants, try out new refrigeration technologies, conserve energy and support environmental sustainability.

The first system, with a medium temperature secondary coolant system, uses water and glycol to refrigerate products. The second employs a low secondary coolant temperature system featuring carbon dioxide to refrigerate low-temperature food products. Both systems were created with refrigeration partner Hill Phoenix, who is working with Food Lion to identify smarter ways to refrigerate food products using technologies that are gentler on the environment. *Contact: Ms. Karen Peterson, Corporate Communications, Food Lion LLC, 2110 Executive Drive, P.O. Box 1330, Salisbury, NC 28145-1330, United States of America. Tel: +1 (704) 633 8250, Ext. 3919; E-mail: kspeterson @foodlion.com.* (Source: www.earthtimes.org)

Alloy-based refrigerators will halve energy need

In the last 15 years, environmentalists have alerted refrigeration technology developers about the harmful side effects of employing chlorofluorocarbons (CFCs) as the refrigerant chemical. However, alternative refrigerants require a lot more energy. European scientists now claim that they have found an alternative to CFCs as well as CFC-alternatives – a solution that will halve the energy needed by a refrigerator.

The alternative that these scientists – who work on behalf of BASF, the multinational chemicals company, and a Dutch foundation called Fundamental Research on Matter (FOM) – have found makes use of electromagnetic fields. The work is pioneering a technology based on magnetocaloric materials, a new class of refrigerants that would significantly reduce the negative impact of today's cooling systems on the environment.

Magnetocaloric materials could offer highly efficient cooling technology. They are solid alloys already proven to be an alternative material to conventional refrigerants. They warm up or cool down when a magnetic field is applied or removed. Theoretical calculations have shown an energy savings potential of up to fifty per cent. (Source: www.freshnews.in)

SOLVENTS

Aqueous cleaner with biodegradable formula

The Bio-Maxx Greener Cleaner from Kimball Midwest, the United States, is a powerful all-purpose grime and grease remover. With a biodegradable formula that breaks down after use and does not contaminate environment, the product removes carbon, oil, adhesives, soot and smoke stains.

Produced from renewable natural products, the cleaner includes surfactants derived from sugar, corn and vegetable oil, and contains no heavy solvents and acidic/caustic chemicals. This unique biodegradable formula effectively breaks down after use and will not contaminate the environment. The product is not inflammable, corrosive or carcinogenic, and is VOC-compliant and free of butyl and ozone depleting chemicals. *Contact: Mr. Anchell Waks, Product Line Manager, Kimball Midwest, 4800 Roberts Road, Columbus, OH 43228, United States of America. Tel: +1 (800) 233 1294, Ext. 2502; Fax: +1 (614) 219 6101; E-mail: anchell.waks@kimballmidwest.com.* (Source: news.thomasnet.com)

Oxygen system pipe cleaning in aircrafts

Oxygen poses a substantial fire hazard and oxidation risk in aircrafts, where it is used to provide oxygen in non-pressurized cabins and to pilots. To manage this risk, the pipes and components used in the oxygen system must be cleaned to rigorous specifications. Historically, chlorofluorocarbons (CFCs) – particularly CFC-113 – were used to clean oxygen systems. However, the ozone depleting properties of CFCs have necessitated new cleaning materials and methods.

As part of the Royal Australian Air Force (RAAF) Oxygen System Replacement Project, the Defence Science and Technology Organization (DSTO) was asked to develop and trial a pipe cleaning system. The cleaning system that was developed was a multi-stage process, fully incorporated into one transportable cleaning unit. The stages involved are:

1. Initial degrease and particulate removal with recirculating HFE-71DE solvent. HFE-71DE has good solvent properties, but is not fully compatible with high-pressure oxygen.
2. Further degrease and particulate removal with recirculating HFE-7100 solvent. HFE-7100 has poor solvent properties, but is fully compatible with oxygen.
3. A final rinse with unused HFE-7100 to ensure complete oxygen compatibility.
4. A drying stage using high-purity nitrogen gas.

Results of tests with RAAF oxygen system pipes in the size range 1/8 inch to 1/2 inch, in stainless steel, copper and aluminium showed that the above cleaning system meets RAAF oxygen system cleanliness specifications for both non-volatile residue and particulate contamination. The recommended final cleaning procedures comprise a five minute flush in both directions for both HFE-71DE and HFE-7100 at flow rates above the onset of turbulence, calculated using a Reynolds No. of 4000; followed by a final rinse with 600 ml of clean HFE-7100 at one litre/min. The pipes were dried with high-purity nitrogen until a refrigerant leak detector no longer signalled the presence of any HFE solvents. (Source: www.dsto.defence.gov.au)

Precision cleaning with recirculating supercritical fluid

Previously, Freon and trichloromethane were the solvents of choice for cleaning of precision gyro and accelerometer parts used in inertial navigation systems. Supercritical carbon dioxide (CO_2) is now emerging as one of the ecologically correct, non-ozone depleting cleaning substitutes. Litton Systems Inc., the United States, has been assigned patent on a supercritical fluid recirculating system for a precision parts cleaner.

The invention comprises high-pressure, high-volume recirculating flow system for a supercritical fluid. The system includes a precision parts chamber that receives the fluid, a high-pressure piston pump for recirculating the fluid, and a pneumatic cylinder with a piston driven from an air supply source. Supercritical CO_2 flows into the chamber across the parts to be cleaned. Several one-way valves in the system ensure that the fluid pumped flows in only one direction.

The preferred fluid pressure in the system is about 3,000 psi, but the system may be capable of 4,000-5,000 psi. Nozzles may be employed in the chamber to provide thorough cleaning of all contaminants, even if deposited in tiny cracks at these pressures. The system further includes a heater on the downside of the chamber fluid flow to maintain the fluid in supercritical condition. A flow metering valve intentionally introduces a pressure drop just before the extractor to turn the fluid to gas and cause separation out of the contaminants and solvents. The gas is then exhausted. (Source: www.freepatentsonline.com)

Active solvent with stabilizer

Bromothane S from MicroCare, the United States, is a powerful replacement for most ozone depleting solvents and most chlorinated solvents in metal finishing and precision cleaning applications. This cleaner delivers speedy cleaning and easy handling as an economical precision cleaner. Bromothane S is a mixture of normal propyl bromide (nPB) and a unique stabilizer package.

As a versatile high-temperature solvent, Bromothane S offers superior cleaning of hydraulic oils, lubricating oils, cutting oils, penetrating oils and even heavy greases. It is a replacement for 1,1,1-trichloroethane (TCA), trichloroethylene, perchloroethylene and HCFC-141b in many applications. Its chemical and physical properties closely mirror TCA. The solvent is easily recovered in the vapour degreaser using a common industrial procedure. This means Bromothane S is ideal to be recycled and reused in a vapour degreaser, reducing solvent consumption and minimizing waste.

Bromothane S is safe on most components, substrates, ceramics, metals and other materials, except acrylics, Buna N, natural rubber, ABS and polycarbonate. The cleaner is non-inflammable and non-carcinogenic. The use of the solvent as a cold cleaner or in manual cleaning operations is not approved except in an engineered system. Bench top dipping and brushing applications are not approved due to the risk of worker exposures. Although Bromothane S has a slight ozone depletion potential, it is not listed as a Class II ozone-depleting substance in the Montreal Protocol. It also has a low global warming potential but is 100 per cent a volatile organic material. *Contact: Micro Care Marketing Services, MicroCare Corp., 595 John Downey Drive, New Britain, CT 06051, United States of America. Tel: +1 (860) 827 0626; Fax: +1 (860) 827 8105; E-mail: techsupport@bromothane.com.* (Source: www.bromothane.com)

Precision degreasing solvent

The 292 Precision Degreasing Solvent from A.W. Chesterton, the United States, is a fast-acting, industrial strength solvent blend. It is designed to clean and flush away oily and greasy sludge, wax, tar grit and grime in a single application leaving virtually no residue and requiring no rinsing. The 292 Precision Degreasing Solvent can be used on bearings, pulleys, valves and fittings, chains, cables and electro-mechanical assemblies. It cleans lathes, presses, production tools, moulds and finished parts.

The low-odour, low-residue solvent evaporates rapidly and has a flash point of 41ºC. It is ozone-safe (no ozone depleting potential) and safe for all metals as well as most plastics. *Contact: A.W. Chesterton Co., 500 Unicorn Park Drive, Woburn, MA 01801-3345, United States of America. Tel: +1 (781) 438 7000; Fax: +1 (781) 438 6443.* (Source: www.chesterton.com)

Vapour degreasers with minimum solvent emission

Liquid vapour degreasing with solvent has been an accepted method of precision part cleaning for over 50 years. It incorporates washing, rinsing, drying, and solvent reclamation in compact, cost-effective unit. The vapour degreasers from Sonicor, the United States, are designed to minimize solvent emissions and assure full compliance with environmental regulations. Equipment designs and operating processes have been totally re-engineered to reduce solvent losses to near zero.

All Sonicor solvent degreasers meet NESHAP regulations, the United States Environmental Protection Agency directives, and other applicable regulations. The key advantages of using Sonicor degreasers are:

- No process chemistry to mix or maintain;
- Most of the solvent is reclaimed automatically in the unit;

- Few process variables to be managed;
- Very easy and cost-effective to operate and automate; and
- Typically smaller footprint.

Sonicor's full line of precision ultrasonic vapour degreasers have been designed to operate with a broad range of commercially available solvents. This includes many of the traditional materials like methylene chloride, trichloroethylene and perchloroethylene. They are also suitable for use with newer solvents like HCFC, HFC, HFE, n-propyl bromide and AK225. *Contact: Sonicor, 14 Connor Lane, Deer Park, NY 11729, United States of America. Tel: +1 (631) 586 0107; Fax: +1 (631) 586 0146; E-mail: sonicor@sonicor.com.* (Source: www.sonicor.com)

Non-hazardous blends of propionates

Rossi Technology Corporation, the United States, has patented a non-hazardous and non-toxic cleaning solvent made of blends of propionate esters. Propionate esters selected from the group methyl, butyl and propyl propionates and higher homologues are blended with esters selected from the group methyl hydroxypropionate, ethyl hydroxypropionate and higher homologues. The mixtures are particularly useful in electronic parts cleaning and defluxing, and for degreasing.

The blends are effective replacements for ozone depleting solvents such as chlorofluorocarbons, trichloroethane and carbon tetrachloride. They were developed specially for use in the cleaning of screens and substrates in the thick film process. The accuracy needed in the thick film process enhances the need for frequent cleaning of the wire screens. Misprints onto substrates also require frequent washing with solvent. The solvent blends of this invention have been shown to be effective removers of the pastes used in the thick film process. The rapid drying characteristics are also ideal for this application.

The addition of ethyl hydroxy propionate greatly reduces the off-odour of n-butyl propionate, which has the greater solvent power and enhances the potency of the propionate mixture. The blends are non-inflammable and have a flash point of 41ºC. (Source: www.freepatentsonline.com)

HALONS

New fire-fighting foam

The key feature of Baum's Novacool Universal Extinguishing Foam (UEF) products is their ability to dramatically and quickly lower fire site temperature. Fire-fighters report a cooling shield that precedes them when fires are fought with Novacool products. In addition, they report 70 per cent faster extinguishment as compared with any Class A or B agent. Besides extinguishing A, B, D and K fires and 3D fires, it cools, blankets and emulsifies surfaces, and also eliminates possibility of re-ignition.

Novacool UEF provides a highly effective and environmentally responsible alternative for fire-fighting. It is effective at about one-seventh the concentration of conventional fire-fighting chemicals. Its selective use of rapidly biodegradable substances dramatically enhances the effectiveness of water (mixed at 0.4 per cent). Novacool UEF works by combining with water and reducing waters surface tension, which allows the water to develop a high surface area relevant to the mass it is hitting. This high surface area to mass allows for a very rapid and efficient heat transfer from the object to the water. This transfer results in quick extinguishment and rapid cooling. Cooling helps to prevent fire re-ignition.

Baum's Novacool UEF is produced by Baum's Castorine Co., the United States, and distributed through its partner company Poland & Sons LLC. It replaces aqueous film-forming foams and ozone-depleting halon gases. Novacool UEF does not contain the fluorochemical surfactants, perfluorooctyl sulphates and perfluorooctylbetaines, or glycol ether. *Contact: Poland & Sons LLC., P.O. Box 6772, 525 W. Grand Ronde, Kennewick, WA 99336, United States of America. Tel: +1 (509) 586-2158; Fax: +1 (509) 586 0244.* (Source: www.novacoolfire.com)

Portable fire extinguisher

Ningbo Ever-Flourish Co., China, offers Dissolvable Tiny-foamed Extinguisher (DTE) type portable fire extinguishers as halon substitutes. The Fire Buster model MSJ460 has a cylinder (aluminium)

volume of 460 ml and a gross weight of 560 g. The jet nozzle has an angle of 15º and can spray out the liquid from any angle. The extinguishant, made from natural plant materials, is claimed to also have cooling and fire-retarding properties.

Fire Buster is applicable in fire types Class A, B and C and in starting fires. It can spray up to a distance of 5 m and the jet at one spray would last a minimum of 10 s. The extinguisher will function in temperatures in the range of 0-80ºC. The resistant pressure is 1.8 MPa. Fire Buster MSJ460 is an aerosol type fire extinguisher, which can control a starting fire very efficiently. *Contact: Ningbo Ever-Flourish Co. Ltd., No. 10, Lane 311, Jiangdong South Road, Ningbo, China. Tel: +86 (574) 8789 5533; Fax: +86 (574) 8789 5522.* (Source: www.asianproducts.com)

Compact inert gas fire extinguishing system

Traditional pure inert gases, such as nitrogen or carbon dioxide, used by themselves cannot inert and extinguish fires at concentrations that allow humans to function. Recent discoveries, however, have shown that blended compositions of such gases can be formulated to support human function while extinguishing fires.

One particular composition, labelled IG-541, has achieved such capability by blending a mixture of nitrogen, argon and carbon dioxide in a ratio of 52:40:8 per cent to extinguish fires, yet support human activity by increasing the human respiration rate with the addition of carbon dioxide, so that sufficient oxygen can be inhaled in necessary quantities. This concept has withstood extensive tests and medical review. A major drawback is that the large storage spaces needed for the compressed gas tanks may require almost ten times the space of halogenated fluorocarbon systems. This greatly limits its use and curtails retrofit into existing installations. Other inert gas compositions too suffer from the same limitations.

N2 Towers Inc., Canada, has secured a European patent on a compact, fixed fire extinguishing system that delivers an inert gas composition suitable for use in occupied spaces by means of a combination of stored gas containers and solid propellant inert gas generators. The device comprises a container, which holds IG-541, but without nitrogen, such that the container is correspondingly 52 per cent (volume of nitrogen) smaller in volume than a typical IG-541 container. A solid propellant gas generator is fixed to the container. The solid propellant designed to generate nitrogen gas when the burning of the propellant is initiated by an electric squib. It comprises a mixture of sodium azide and sulphur that is universally used in automotive airbag gas inflators. (Source: www.freepatentsonline.com)

Fire extinguishing composition and process

E.I. Du Pont de Nemours & Co., the United States, has secured a European patent on a process for extinguishing, preventing and controlling fires using a composition containing trifluoromethane (CHF_3). CHF_3 can be used in volume percentages with air as high as 80 per cent without adversely affecting mammalian habitation, with no effect on the ozone in the stratosphere and with little effect on the global warming process.

The invention includes a process for preventing, controlling and extinguishing fire in an enclosed, habitable air-containing area, which contains combustible materials of the non-self-sustaining type. The process comprises introducing into the air in the enclosed area an amount of a gaseous composition comprising CHF_3, sufficient to suppress combustion of the combustible materials in the enclosed area. Preferably, the amount of CHF_3 is maintained at a level of 14-80 volume per cent. CHF_3 may be used in the process in conjunction with as little as 1 per cent of at least one halogenated hydrocarbon co-extinguishant. (Source: www.freepatentsonline.com)

Filler

FOAMS

Low-emission polyurethane foam insulation

BioBased™ 1701s from BioBased Insulation, the United States, has become the first spray polyurethane foam insulation to meet the stringent Greenguard certification guidelines for indoor air quality. The soy-based, water-blown, closed cell insulation product earned both the Greenguard Certification and the Greenguard Certification for Children & Schools. The Greenguard Certification Process tests products for emissions of formaldehyde, volatile organic compounds (VOCs), aldehydes, respirable particles, ozone and other pollutants.

BioBased 1701s is bio-based, uses water instead of ozone-depleting chemicals as the blowing agent, and has a nominal density of 27.23 kg/m^3. The two-component foam has a tensile strength of 131 kPa and a compressive strength of 159 kPa. When spray-applied, the foam expands 30:1, filling crevices, gaps and cavities on building walls. It is claimed to reduce energy consumption in climate control by providing thermal resistance, and to reduce the risk of moisture accumulation. (Source: www.biobased.net)

Solvent slurry process for high-solids fluoropolymers

3M Innovative Properties Company, the United States, has applied for a joint patent, together with four inventors, on a process for producing fluoropolymers by solvent slurry polymerization of at least one fluorinated monomer in a reactor containing a hydrofluorocarbon (HFC) solvent and water. The amount of fluoropolymer solids produced in the polymerization is greater than 10 per cent by weight based on the amount of water and fluorinated liquids.

The applicants have found that higher concentrations of fluoropolymers, than has so far been achieved by other processes, may be attained by using improved agitation systems, such as a double planetary mixer and a coaxial turbine agitator or double helical ribbon mixer. A flow field is developed in the reactor using a mixer that imparts both a tangential and an axial flow component. The amount of fluoropolymer solids produced in the polymerization is greater than 20 per cent or even greater than 30 per cent by weight based on the amount of water and fluorinated liquid.

The fluoropolymer slurry may be thixotropic or shear thinning. The process may include separating the fluoropolymer and water from the HFC solvent (such as hydrofluoroether), agglomerating the fluoropolymer, drying it and reusing the solvent for another process of the claimed invention. (Source: www.wipo.int)

Process for the production of synthetic resin foams

Daikin Industries Ltd., Japan, has been assigned a European patent on a process for producing synthetic resin foam. The process comprises reacting a polyol with a polyisocyanate compound in the presence of a low-boiling organic blowing agent to provide polyurethane or polycyanurate foam. A mixture of 5-95 weight per cent of 1,1,1,3,3-pentafluoropropane (HFC-245fa) and 95-5 weight per cent of a hydrocarbon (preferably cyclopentane) with boiling point between 20ºC and 70ºC is used as the organic blowing agent.

The blowing agent used is not harmful to the ozone layer and has a low global warming potential. It is non-inflammable and fully compatible with the resin formulation. The synthetic resin foam produced by the process has high heat insulation and mechanical strength. The hydrocarbon can be a single species or a combination. As the chosen hydrocarbons have lower molecular weights than HFC-245fa, they cause foaming with higher efficiency. Moreover, because their boiling points are higher than that of HFC-245fa, they are not easily evaporated even when the ambient temperature is high.

Although hydrocarbons are generally considered to be poorly compatible with polyols, there are cases in which the compatibility of those hydrocarbons with polyols is synergistically improved when they are used in admixture with HFC-245fa, thus broadening the range of compatible polyols. A preferred blowing agent composition is a mixture of 50-95 weight per cent of HFC-245fa and

5-50 weight per cent of cyclopentane. The polyol that can be used in this invention includes the polyether polyols and polyester polyols.

A foam stabilizer, for example a silicone series stabilizer or a fluorine-containing surfactant, could be used among the other additives for the production of polyurethane foam. The production equipment can be of any type that allows even admixing of the ingredients. Thus, using a mixer or a foaming machine, for instance, the polyol, polyisocyanate compound, blowing agent, catalyst and other additives are thoroughly mixed and moulded to give the foam. (Source: www.freepatents online.com)

Foams blown with hydrofluorocarbons and carbon dioxide

Bayer MaterialScience LLC, the United States, has obtained a European patent on a process for the production of rigid polyurethane (PU) foams in which a hydrofluorocarbon (HFC) in combination with water and carbon dioxide is used as the blowing agent. The rigid PU foams thus produced are useful in the production of refrigeration units.

The process involves reacting an organic polyisocyanate with an amine-initiated polyether polyol, with an average molecular weight of at least about 149, in the presence of a hydrogen-containing fluorocarbon (up to 20 per cent), a quantity of water (less than 5 per cent), carbon dioxide (up to 5 per cent), surfactant and a catalyst. Isocyanate-reactive compounds that are not amine-initiated may optionally be included in the reaction mixture, up to 70 per cent by weight, based on the total amount of isocyanate-reactive materials.

Any of the known organic isocyanates, modified isocyanates or isocyanate-terminated pre-polymers made from any of the known organic isocyanates may be used in the process. The most preferred polyisocyanates are methylene-bridged polyphenyl polyisocyanates and pre-polymers of methylene-bridged polyphenyl polyisocyanates. The polyisocyanate is generally used in an amount such that the isocyanate index (the ratio of equivalents of isocyanate groups to equivalents of isocyanate-reactive groups) is from about 0.9 to about 3.0, preferably from about 1.0 to about 1.5. (Source: www.freepatentsonline.com)

FUMIGANTS

New grape rootstocks fight pests naturally

Five new pest-resistant grape rootstocks recently released by University of California Davis are environment-friendly alternatives to chemical fumigants. The new rootstocks are resistant to nematodes (tiny worms) and phylloxera (aphids), two of the most damaging vineyard pests.

The hardy new rootstocks mark the culmination of 15 years of research by Dr. Andrew Walker, a plant geneticist and breeder, and Dr. Howard Ferris, a nematologist. The rootstocks include the root and trunk of a grape plant, onto which many different grape vine varieties can be grafted. The new rootstocks, developed using conventional breeding methods, are designed to be planted without fumigation. *Contact: Dr. Andrew Walker, Department of Viticulture and Enology, University of California Davis, One Shields Avenue, Davis, CA 95616, United States of America. Tel: +1 (530) 752 0902; E-mail: awalker@ucdavis.edu.* (Source: www.news.ucdavis.edu)

Fumigation and recapture systems

Nordiko Quarantine Systems, Australia, has won the prestigious Climate and Stratospheric Ozone Award for 2008 of the United States Environmental Protection Agency. Nordiko has been recognized for its efforts in reducing the release of ozone-depleting gases, using its range of Australian-developed fumigation and recapture systems, which trap ozone depleting gases. Besides its environmental benefits, the Nordiko technology has significant occupational health and safety advantages, as it prevents hazardous and toxic gases from escaping into the workplace.

The fumigation/recapture chamber is configured to treat 20 ft and 40 ft container cargoes as well as fresh produce – with a dechilling function prior to treatment. Temperature control minimizes gas usage and recapture virtually eliminates residual gas emissions. Using a Nordiko system offers the following advantages:

- Significant reduction in the release of toxic fumigant gases;
- Streamlined fumigation process;
- No need for fumigation at both the load and discharge ports;
- Reduced fumigation time; and
- Addresses occupational health, safety as well as environmental issues.

Contact: Nordiko Quarantine Systems, Level 2, 403 Pacific Highway, Artarmon, New South Wales, NSW 2064 Australia. Tel: +61 (2) 9906 5552; Fax: +61 (2) 9906 1874; E-mail: info@nordiko.com.au. (Source: www.nordiko.com.au)

Soil fumigation with gasiform pesticide

Church & Dwight Co., the United States, has patented a soil fumigation process that involves dispersing a particulate ammonium carboxylate (such as ammonium bicarbonate) on or below the ground surface, followed by covering of the treated ground area with a tarpaulin to seal the ground surface from contact with the atmosphere. The tarpaulin covering is maintained for a sufficient time period to allow decomposition of the ammonium bicarbonate into a mixture of ammonia and carbon dioxide gases, and to effect fumigation of the covered plot with the generated gas mixture. (Source: www.freepatentsonline.com)

Drip-applied soil fumigation for Freesia production

Fumigants such as iodomethane (IM – Midas), 1,3-dichloropropene (DP – InLine), metam sodium (MS – Vapam HL) and furfural (FF – Multiguard) are possible alternatives to methyl bromide (MB) for flower growers to control weeds and diseases for continual production. These fumigants can be delivered in drip irrigation systems, permitting better distribution through the soil.

In the United States, the Agricultural Research Service conducted three trials on two sites to test the efficacy of these alternative fumigants for the control of weeds and disease for the production of the cut flower, Freesia. It was found that Midas preformed as well as a combination treatment of MB and chloropicrin (CP). DP performed as well as IM, but FF required the addition of MS to perform as well as DP and IM. The study shows that Freesia can be produced following fumigation with these fumigants.

One trial compared rates of DP together with CP; the second trial compared IM together with CP, DP:CP, and FF with and without MS; and the third trial compared rates and formulations of IM:CP to the standard MB:CP treatments. Most treatments reduced populations of *Pythium* spp. and controlled weeds compared to the untreated controls. Formulations of IM:CP reduced the incidence of disease caused by *Fusarium oxysporum*. IM:CP treatments performed as well as MB:CP, and treatments of DP:CP performed as well as IM:CP. Presently only the DP, CP and MS formulations are registered for use on ornamental crops. *Contact: Agricultural Research Service (ARS), Jamie L. Whitten Building, 1400 Independence Avenue, S.W., Washington DC, 20250, United States of America.* (Source: www.ars.usda.gov)

Lumber kiln helps control pests

In a joint project with Nippon Express Philippines Corp., the Philippine Department of Science and Technology's Forest Products Research and Development Institute (FPRDI) has found that heat treatment (HT) using the Institute's 1,000 board feet capacity furnace-type lumber dryer (FTLD) is a technically and commercially feasible way to eliminate insect pests and diseases that infest wooden pallets – although reinfestation could occur under favourable conditions. According to Mr. Robert A. Natividad at the FPRDI, HT requires that the pallet's wood core be treated at 56ºC for 30 minutes. Studies have shown that the optimum HT time is 5 hours and average operation cost is 46 per cent cheaper than fumigation using methyl bromide.

Presently, six of the country's biggest producers of wooden pallets use the technology. HT provides the pallet industry with a safe and cheap method to get the International Plant Protection Convention (IPPC) mark, which indicates that the risk of pest spread has been addressed, on its products, something any exporter who relies on wooden packaging materials cannot afford not to have. (Source: www.pia.gov.ph)

RECENT PUBLICATIONS

The Montreal Protocol: Celebrating 20 Years of Environmental Progress

The Montreal Protocol, having phased out 95 per cent of the ozone-depleting substances covered in the treaty, has not only allowed the ozone hole to begin the healing process, but as scientists have recently discovered, the treaty has also been an incredibly effective measure in mitigating climate change. This book aims to take a comprehensive look at the Montreal Protocol from its very beginnings to the present, looking towards the future. The authors speak of a proposed adjustment to the treaty: an accelerated phase-out of HCFCs that would bring enormous climate benefits much more than the emissions reductions expected from the first commitment period of the Kyoto Protocol.

Contact: Cameron May Ltd., International Law Publishers, No. 7 Cornwall Crescent, Notting Hill, London W11 1PH, United Kingdom. Tel: +44 (20) 7792 1055; Fax: +44 (20) 7222 8517; E-mail: info@cameronmay.com.

Ozzy Ozone: Defender of our Planet – Ozzy Goes Island Hopping

The fourth issue of the "Ozzy Ozone: Defender of our Planet" comic book series, entitled "Ozzy Goes Island Hopping" features ozone depletion and climate change with a special focus on hydrochlorofluorocarbons (HCFCs). In this story Ozzy and Zoe Ozone travel from the stratosphere to visit their friends to learn about the effects of climate change in small islands and low-lying coastal states, and about the importance of phasing out HCFCs.

Contact: United Nations Environment Programme, 15 rue de Milan, 75441 Paris Cedex 09, France. Tel: +33 (1) 4437 1450; Fax: +33 (1) 4437 1474; E-mail: ozzy@unep.fr.

TECH EVENTS

7-10 Sep
Copenhagen
Denmark

8th IIF/IIR Gustav Lorentzen Conference on Natural Working Fluids Refrigeration and Energy
Contact: Ms. Hanne Christoffersen, Conference Secretary, IIR Gustav Lorentzen Conference 08, Kongsvang Allé 29, DK-8000 Aarhus, Denmark.
E-mail: secretariat@iir-gl-conference-2008.dkT.

08-11 Sep
North Carolina
United States

Sixth International Conference on Foam Processing & Technology
Contact: Mr. Vipin Kumar, Conference Chair, Dept. of Mechanical Engineering, University of Washington, Box 352600, Seattle, WA 98195, United States of America.
Tel: +1 (206) 543 5535;
E-mail: vkumar@u.washington.edu

21-26 Sep
Chengdu
China

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

25-28 Sep
Xian
China

6th International Conference on Compressors and Refrigeration '08
Contact: ICCR Organizing Committee, Xian Jiaotong University, China.
Tel: +86 (29) 8266 3785;
Fax: +86 (29) 8266 8724;
E-mail: sec@iccr2008.org;
Website: www.iccr2008.org.

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 & Emissions Reductions
Contact: Methyl Bromide Alternatives Outreach, 6556 N. Dolores Avenue, Fresno, California, CA 93711, United States of America.
Tel: +1 (559) 449 9035;
Fax: +1 (559) 449 9037.