VATIS Update Ozone Layer Protection . May-Jun 2007

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THE SCIENCE OF OZONE LAYER

Plan to restore ozone layer climate sensor

In the United States, National Aeronautics and Space Administration (NASA) and National Oceanic and Atmospheric Administration (NOAA) have announced a plan to restore a key ozone layer climate sensor to the National Polar-orbiting Operational Environmental Satellite System (NPOESS) programme. The Ozone Mapping and Profiler Suite (OMPS) Limb will be returned to NPOESS Preparatory Project (NPP) satellite set to launch in 2009. The NPOESS partners will give conditional authority to Northrop Grumman Space Technology to proceed with restoration of the instrument. The effort will be contingent on successful negotiations between the company and the government on the full cost of the effort. Northrop Grumman Space Technology is the missions main contractor.

The NPOESS is a tri-agency environmental monitoring programme directed by the Department of Commerce, the Department of Defence and NASA. Its recent restructuring had removed the OMPS Limb sensor from the NPP mission. Restoring the OMPS Limb sensor directly addresses one of the recommendations of the recently released National Research Council report Earth science applications from space: national imperatives for the next decade and beyond.

With the launch of the first spacecraft planned for 2013, NPOESS will bring improved data and imagery that will allow better weather forecasts, severe-weather monitoring and detection of climate change. The NPOESS preparatory mission will provide continuity of observations taken by NASAs earth observing system satellites Aqua and Terra. The NPP mission will also provide risk reduction for three NPOESS critical sensors, and the data processing and ground systems. The OMPS Limb will measure the vertical distribution of the ozone and complement existing NPOESS systems. NOAA and NASA will share equally the expenses to restore the OMPS Limb to the NPP spacecraft.

Website: www.bbsnews.net

Solar burp blasted ozone layer

A titanic burp of protons from the Sun in 1859 is believed to have temporarily weakened Earths ozone layer, say scientists studying ice cores from Greenland. Evidence of the massive radiation event comes from an excessive amount of ozone-related nitrates in the ice from that year. The huge September 1859 solar flare appears to have gushed 6.5 times the protons of the largest flare seen by modern science, which was in 1989.

The researchers modelled the space storm using nitrate data from the ice and compared that with the modern event also detectable in the ice. They estimated that more than three times as much ozone was destroyed by the

1859 event than in the 1989 one. The discovery hints at how nasty solar weather can get. A historic aurora light show and a geomagnetic storm followed the flare, causing telegraph lines to spark and start fires. Dr. Ron Zwickl, Deputy Director of the NOAA Space Environment Centre in Colorado, says: Most people right now think that was the largest particle event.

The new research helps confirm that and zeroes in on the effect the storm had on ozone worldwide. We are not really sure what the upper limit of the energy should be on these flares, says Assistant Professor Brian Thomas of Washburn University. The good news, adds Dr. Zwickl, is that those sorts of atmosphere-boiling solar events are not very common as a star grows older: the Sun is a middle-aged star.

Website: www.abc.net.au

CFC substitutes may inhibit ozone layer recovery

Just when the ozone layer appeared to be on the mend, scientists at the National Oceanic and Atmospheric Administration (NOAA) and the University of Colorado at Boulder have detected new growth in some ozone-depleting substances. The research team, made up of scientists from NOAAs Earth System Research Laboratory (ESRL) and the Cooperative Institute for Research in Environmental Sciences (CIRES), has been monitoring ozone-depleting halocarbons, gases like chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl bromine, and chlorinated solvents, at locations around the world.

In particular, the team is credited with first detecting the levelling off of CFCs in the atmosphere in the mid-1990s and first reporting a decrease in mean global atmospheric chlorine and bromine levels in the late-1990s. Chlorine and bromine, which are released by CFCs, HCFCs, methyl bromide, and chlorinated or brominated solvents, are the atoms responsible for depleting ozone.

In 2004 and 2005, the team also observed a decrease in the global atmospheric growth rate of most HCFCs. We believed that the most damaging ozone-depleting substances were finally declining, said Mr. Geoffrey Dutton of CIRES. But recent halocarbon measurements show a surprising turn of events: the atmospheric growth rates of three major HCFCs (HCFC-22, HCFC-141b and HCFC-142b) are again on the rise.

HCFCs have been used as a substitute for CFCs in air-conditioning, foam blowing agents and refrigeration because they have less ozone-depleting potential than CFCs. However, HCFCs like 22, 141b, and 142b are very strong greenhouse gases, more than 2,000 times as strong as carbon dioxide in the case of HCFC-142b. HCFC-22, the most abundant HCFC, has 1,700 times the global warming potential of carbon dioxide.

HCFCs are not regulated as greenhouse gases under the Kyoto Protocol; but under the Montreal Protocol, industrialized nations were required to begin phasing out production of HCFCs by 2004, working towards a total phase out by 2020. In contrast, the Protocol allows developing countries to increase production of HCFCs until 2016 and continue production at 2015 levels until 2040.

Website: www.cires.colorado.edu

ODS PHASE-OUT IN INDIA

Solvent sector: conversion of carbon tetrachloride (CTC)

The following are among the projects implemented in the solvents sector by the United Nations Industrial Development Organization (UNIDO):

Chiplun Fine Chemicals, Ratnagiri, Maharashtra:
The project, with a budget of US$155,815, will phase out the use of 15.2 MT of CTC at Chiplun Fine Chemicals, Ratnagiri, Maharashtra. CTC is used as process solvent in the manufacture of ibuprofen and will be replaced with ethylene dichloride. The major cost items are US$45,100 for two glass-lined reactors, US$8,370 for one PP reactor, US$3,000 for new storage tank, US$ 17,190 for brine chilling plant and US$34,770 for high-vacuum distillation system. The incremental operating costs are US$8,305. The project will eliminate 16.72 tonnes of CTC consumption from the solvent sector, which constitutes 0.42 per cent of the CTC consumption in the country.

GRD Chemicals Ltd., Indore, Madhya Pradesh:
The project will phase out the use of 16.30 MT of CTC at GRD Chemicals Ltd., Indore, Madhya Pradesh. CTC is used as process solvent in the manufacture of bromhexine hydrochloride. Under a budget of US$127,598, the major cost item is US$69,000 for one GL reactor, one SS centrifuge, one vacuum pump, distillation unit and one fixed fire-fighting unit. Incremental annual operating cost is US$9,917. Country studies and the country programme prepared during 1992 have identified the sector as a high priority area. The project will eliminate 17.93 ODP tonnes of CTC consumption from the solvent sector, which constitutes 0.48 per cent of the CTC consumption in the country.

FDC Ltd., Roha, Maharashtra:Another project, with a budget of US$238,372, will phase out the use of 31 MT of CTC at FDC Ltd., Roha, Maharashtra. CTC is used as process solvent in the manufacture of bromhexine. The major cost item is US$129,220 (for three new glass-lined reactors, one centrifuge, one vacuum system, one brine chilling plant and fixed fire-fighting system). Incremental operating cost is US$23,088. The project will eliminate 34.1 ODP tonnes of CTC consumption from the solvent sector, which constitutes 0.92 per cent of the CTC consumption in the country.

Benzo Chemical Industries, Tarapore, Maharashtra:The project will phase out 20.92 MT of CTC, which is used as process solvent in the manufacture of bromhexine. The project has a total budget of US$132,881, with the major cost item being US$71,000 for one glass-lined reactor, one distillation reactor, one vacuum pump, one centrifuge and one fixed sprinkler type fire fighting equipment. Incremental operating cost is US$ 10,786. The project will eliminate 23 ODP tonnes of CTC consumption from the solvent sector, which constitutes 0.57 per cent of the CTC consumption in India.

Pradeep Shetye Ltd., Alibagh, Maharashtra:The project will phase out the use of 121.7 MT of CTC at a total budget of US$278,992 at Pradeep Shetye Ltd. Here too, CTC is used as process solvent in the manufacture of bromhexine. The major cost item is US$ 140,500 comprising of one glass-lined reactor, two new SS reactors, one distillation set-up, chilling plant, storage tank, vacuum pump and nutsch filter. Incremental operating cost is US$32,018. The project will eliminate 133.87 ODP tonnes of CTC consumption from the sector, which constitutes 3.6 per cent of Indias CTC consumption.

Sapna Engineering, Mazgaon, Maharashtra:
This project will phase out the use of 13.15 MT of CTC at Sapna Engineering, Mazgaon, Maharashtra. The firm uses CTC as cleaning solvent in the manufacture of coils and condensers for refrigeration and air-conditioning equipment. The major cost item of the US$240,292 project is US$ 160,000 for one ultrasonic degreaser and one ultrasonic cleaning system that uses trichloroethylene as solvent. Incremental annual operating cost is US$8,555. The project will eliminate 14.47 ODP tonnes of CTC consumption from the solvent sector, which constitutes 0.36 per cent of the ODS solvent consumption in the country.

Website: www.unido.org

IN THE NEWS

Asia-Pacific nations pledge to cut ozone depleting chemicals

Worried over the fast shrinking ozone layer, the Asia-Pacific nations have agreed to phase out critical uses of chlorofluorocarbons (CFCs) and other ozone depleting substances by 2008, two years ahead of their committed deadline. This was decided in a key meeting that was held in the Bhutanese capital Thimpu in April. The meeting brought together a region that is home to 60 per cent of the world population and accounts for nearly 75 per cent of the total production and consumption of CFCs.

Senior United Nations Environment Programme (UNEP) officials, who attended the three-day long meet, discussed the future of Montreal Protocol, which completes 20 years this year. Terming the Montreal Protocol as a quiet revolution as compared with high-profile but little achieving Kyoto Protocol, Mr. Rajendra Shende, head of the OzonAction Unit of the UNEP, said that the former had managed to achieve a lot without attracting attention to itself. The Protocols features included a precautionary approach, polluters pay principle and multilateral cooperation based on transparency, trust and consensus, he remarked.

Mr. Shinde said that time-bound actions have resulted in successful management and reduced consumption and production of nearly 100 ozone depleting chemicals. He described as even more startling, the unintended benefits of the Montreal Protocols policies. For instance, the protocol had led to a reduction of 8 gigatonnes equivalent of carbon emissions, while Kyotos own target was only 2 gigatonnes. The meeting also discussed critical issues relating to the reduction of hydrochlorofluorocarbons (HCFCs), as well as ODS uses in military applications and metered dose inhalers use.

Website: www.financialexpress.com

Bhutan exceeds ODS reduction target

Bhutan has exceeded its target to reduce annual import of ozone depleting substances (ODS) from 170 kg to 63 kg. In compliance with the Montreal Protocol, Bhutan was supposed to decrease its annual ODS import by 50 per cent, to 85 kg. But it reduced imports by 72 per cent a year.

According Mr. Ritu Raj, the head of Ozone Unit of the National Environment Commission (NEC), such results were possible after they imposed a complete ban on ODS-based equipment like deep-freezers, refrigerators, fire extinguishers and air coolers. He said that Bhutan was successful in framing the licensing rule, which outlines what ODS-containing products importers can and cannot import or export.

The nationwide survey conducted earlier by NEC had found that ODS in use in Bhutan was about 2,500 kg of which about 450 kg were used by nine major industries. Worldwide, Bhutan is in the low volume consumption category, meaning it consumed less than 30 tonnes of ODS a year. Actual ODS consumption in Bhutan is estimated to be less than 0.1 tonne a year according to NEC.

As many as 60 participants from about 24 countries were in Thimphu from 10 to 14 April to mark the 20th Anniversary of signing of Montreal Protocol on Substances that Deplete the Ozone Layer. In his opening address, the Minister for Trade and Industry, Mr. Lyonpo Yeshey Zimba, said that the theme of the Anniversary, Montreal Protocol and Inter-generational Equity was in consonance with the environment chapter of the countrys draft constitution, which holds every Bhutanese as a trustee of the countrys natural resources and environment for the benefit of the present and future generations.

Website: www.kuenselonline.com

CFC smugglers favour India as a destination

After gold, silver and electronics in the 1970s and 1980s, India has emerged as a favoured destination for yet another form of smuggled products in the current decade chloroflourocarbons (CFCs) slotted for a phase-out in less than three years from now. According to the United Nations Environment Programme (UNEP), which organized an international ozone conference in Thimphu, Bhutan, India is facing a smuggling problem due to the high prices for CFCs. The international price for CFCs is about US$2 per kg, while in India it is US$6 or US$7. This provides enough incentive for the smugglers to target India, say well-informed sources.

The situation is bizarre, since India is one of the bigger manufacturers and exporters of CFCs. India produces nearly 6,000 tonnes of CFCs, while the domestic demand is only 1,000 tonnes. The balance is exported to countries in South Asia, Latin America and Africa. But as there are only four manufacturers of CFCs in India, there are fears that they have formed a cartel to keep the prices unnaturally high within India and as a result make it a smugglers haven.

UNEP fears that what is happening in India may be replicated elsewhere especially as the deadline for the phasing out of CFCs approaches. Now, the international community is gearing up to face this new challenge, not quite envisioned in the Montreal Protocol. To counter this rather unexpected development, the OzonAction Unit of UNEP has launched a counter-smuggling project called Project Skyhole Patching. It involves 20 customs and environmental authorities from 18 countries, including Australia, Bangladesh, China, India, Japan, Republic of Korea, New Zealand, Sri Lanka, Thailand and Viet Nam.

Since the project began, customs in Hong Kong, India and Thailand have played an active role in sharing information on ozone depleting substances (ODS), say UNEP officials. In less than six months from the project launch, it has already borne fruits, with over 10 seizures of nearly 65 tonnes of ODS across the Asia-Pacific region. According to Mr. Atul Bagai of UNEPs Bangkok office, the main seizures have taken place in China, India and Thailand.

Website: www.earthtimes.org

Honeywells R410A certified vendor programme

On 4 April 2007, Honeywell announced that three Chinese air-conditioner manufacturers Haier, Changhong and Midea are using R-410A refrigerant purchased from licensed suppliers and have met the criteria of its R410A Certified Vendor Programme (CVP). Honeywell created the CVP specifically for Chinese air-conditioner manufacturers who use R410A refrigerant purchased from licensed suppliers. The announcement was made at the 18th Annual China Refrigeration Show, held from 4 to 6 April 2007, in Guangzhou, China.

Under the programme, all participating companies agree to be periodically audited by third parties to ensure that they are using R410A refrigerant purchased from licensed suppliers. Honeywell has retained the SGS Group to conduct audits according to a strict protocol. Companies receive a certification letter from SGS Group on the basis of the audit results. As part of the programme, Honeywell will identify certified Chinese manufacturers of air-conditioners for key buyers in Europe. Those certified companies can also gain other strategic benefits and advantages such as co-marketing opportunities with Honeywell brands in global markets.

Website: www.jarn.co.jp

Hydrofluoroalkane effective, but costlier as MDI propellant

A common asthma inhaler powered by a new propellant is safe and effective, but could come at nearly triple the cost to consumers until a generic version hits the market, according to a review in New England Journal of Medicine. The review, conducted by two university professors and a director for the Food and Drug Administration (FDA), examines the consequences of switching to hydrofluoroalkane (HFA), which is replacing chlorofluorocarbon (CFC), as a key ingredient in albuterol inhalers designed to relieve asthma. The FDA has banned sale of CFC albuterol inhalers in the United States after 2008.

Albuterol, one of the medicines that relieve asthma attacks, is the seventh most commonly prescribed drug in the United States. As it is so widely used, the report predicts that Americans will spend an additional US$1.2 billion a year on three patented inhaler brands containing the new propellant until generic versions reach pharmacies, probably after 2012. Patients who pay for their own medications will probably be hit hardest by new costs, paying on average US$ 312 more per year.

While the new inhalers are just as effective as their traditional CFC counterparts, a few differences have been reported. One brand, for example, comes sealed in a protective pouch. After that pouch is opened, the drug carries a shelf life of just two months, while most inhalers can typically be stored for 15-24 months, said Dr. Leslie Hendeles, the University of Florida professor of pharmacy and pediatrics, who spearheaded the review. Two brands of HFA inhalers contain ethanol, while some HFA inhalers tend to clog more easily.

Dr. Hendeles noted that CFC inhalers release negligible amounts of the propellant, and do not pose a threat to ozone depletion. However, more than 185 other countries signed the Montreal Protocol, an international treaty requiring complete withdrawal of all CFC products. As the inhaler is deemed medically necessary, it is exempt until new market replacements using HFA become available.

Website: www.medicalnewstoday.com

DuPont, Honeywell to develop car air-conditioning refrigerant

DuPont entered a joint development agreement with Honeywell International Inc. to work on creating next-generation refrigerants for automotive air-conditioning. According to DuPont, under the agreement both companies will jointly identify, develop, test and qualify new low-global warming potential refrigerants. The companies will work with the automotive industry to qualify a refrigerant by mid-2007. The new refrigerants

would let automakers meet new European regulations that require the use of such refrigerants in mobile air-conditioning applications. The regulations take effect for new model automobiles beginning 2011.

Website: www.marketwatch.com

Lack of alternatives makes CFC phase-out difficult

Chlorofluorocarbons (CFCs) have been banned in many countries around the world, a lead that the Jakarta administration is yet to follow, despite Jakartas usage of CFCs making up 60 per cent that of the Indonesian level, an official said. Mr. Daniel Abbas, the Deputy Chairman of the administrations team on ozone protection, said that his office was facing difficulties in forcing businesses to stop using CFCs due to a lack of alternatives. The State Ministry of the Environment informs us that Jakarta is the main user of ozone depleting substances. But we cant force businesses to stop it unless there are alternative substances, he said.

Website: www.thejakartapost.com

UNEP calls on media to focus on ozone layer

Journalists in the Asia-Pacific region have been called on by the United Nations Environment Programme (UNEP) to play a greater part in focusing public attention on the need for protecting the ozone layer. UNEP recently organized a media and climate change workshop in Singapore for journalists from 10 countries in the region.

Mr. Jim Curlin of UNEP said the United Nations was calling on journalists in the region to help get key messages out on climate change issues, particularly as this year marks both the 20th anniversary of the signing of the Montreal Protocol and the 10th anniversary of the signing of the Kyoto Protocol. Ozone depletion and climate change are two topics with real human, economic and social impacts, he said. At the two-day workshop for media in the region on ozone protection and linkages with climate changes, 15 participants from the region got the opportunity to learn about new developments in global ozone protection and learn about upcoming challenges.

Website: www.vietnamnews.vnagency.com.vn

Philippines mulls regional ODS info centres

With global warming becoming an international issue that pushes nations across the world to contribute to local actions against the use of ozone depleting substances (ODS), the Philippine Government plans to put up Regional Information Centres and Networks (RICN) nationwide for an aggressive information campaign against ODS.

RICN is seen as one of the most cost-effective methods of delivering the ozone protection messages with the use of identified multipliers, one of the target audience of the information education campaign against ODS. These multipliers such as journalists, teachers, NGOs, etc. are the direct recipients of the message who will re-echo the message to other targets. Putting up RICN nationwide is one of the planned targets of the Philippine Ozone Desk based on the nations Country Programme for ODS.

The governments strategy to ensure the smooth phase-out of ODS in the country is striking a balance between

the supply and demand of ODS. The supply is being controlled by the Department of Environment and Natural Resources (DENR) through strict implementation of its ODS licensing system for the dealers, resellers and retailers of ODS. The DENR is also currently working on reducing the demand for ODS, specifically chloroflourocarbons and to prevent the development of a black market of the controlled and banned chemicals.

Website: www.pia.gov.ph

Montreal Protocol: hard journey for Bangladesh

Bangladesh has been making its maximum efforts to comply with the Montreal Protocol, but some practical reasons are now compelling the country to be non-compliant, particularly for the essential use of chlorofluorocarbon (CFC), an ozone depleting substance (ODS), in producing the metered dose inhaler (MDI) for patients.

Although Bangladesh, as a signatory to the Protocol, is set to phase out CFCs by 2010, it is very difficult for the country to phase out this very effective and widely used ODS as per schedule. At a recent media workshop held in Singapore, the UNEP officials cautioned that some medium level consumer countries, including Bangladesh, are now nearing a non-compliance situation. Mr. Thanavat Junchaya, the Regional Network Coordinator of UNEP, said that the Asia-Pacific region accounts for more than 80 per cent of the global production and consumption of ODS. It includes the largest producers and consumers like India, and China, and also the smallest countries like the Pacific Island nations.

With its annual baseline use of 581.6 tonnes of ODS, Bangladesh is a medium category user along with Afghanistan, Pakistan, Malaysia, Sri Lanka and Viet Nam. The countrys actual ODS consumption is, however, more than the baseline accounts, as its use in the essential sector has not been calculated during the baseline survey. Now this additional need of ODS has created a non-compliance situation. Although Bangladesh framed the Ozone Depleting Substances Control Rules in 2004 and import of ODS is controlled under it, the use of CFCs for producing essential drugs by four private pharmaceutical companies cannot be contained.

Website: www.nation.ittefaq.com

REFRIGRATION/AIR-CONDITIONING

Use of R744 in supermarket refrigeration

The natural refrigerant carbon dioxide (CO2) in the form of R744 being future proof in terms of energy and cost efficiency, environmental performance, and safety offers a long-term solution for commercial refrigeration. This is the key message from a study presented before the Institute of Refrigeration by Mr. Andy Campbell, Head of Refrigeration of Tesco, the retail chain major.

Tests with one sub-critical cascade and one trans-critical system working under real-life conditions in frozen food cabinets demonstrated that both systems have been working efficiently without any failure over the one year test period. Sub-critical cascade systems using R744 in combination with other primary refrigerants lead not only to energy savings of up to 15 per cent compared with conventional R404a cooling cycles, but also reduced the total global warming impact by nearly 60 per cent.

The study has reported the following advantages for R744 systems when compared with systems running with hydrofluorocarbons (HFCs) such as R404a:

Energy efficiency: Higher Coefficient of Performance (COP) that will also significantly reduce indirect global warming emissions due to improved heat transfer within the heat exchanger and reduced system pressure drop.

Cost efficiency: No significant difference in system cost once serial production has started; a further reduction of running costs if inspections under the upcoming F-gases regulation in the European Union could be avoided by using R744.

Material reduction: It is 6-8 times smaller than R22 systems because of its higher cooling capacity in a given volume compressors; more compact pipe works, valves and heat exchangers also reduce the material use.

Emissions reduction: Higher energy efficiency use of the low global warming refrigerant R744, lead to a total reduction of 774.2 tonnes of CO2 emissions within just one year.

Safety: Excellent safety properties make it suitable for even customer areas.

Website: www.r744.com

ODS-free refrigerant

Hanyoung GreenCool Co. Ltd. is a leading hydrocarbon refrigerant manufacturer, also involved in research and development of alternative refrigerants for ozone depleting substances. It has developed various pure and mixed hydrocarbon refrigerants as replacements for CFCs and HFCs, heat transfer fluids for heat pipes, etc. These refrigerant replacements include the following:

Os12a for CFC R-12 and HFC R-134a.

Os22a for CFC R-22.

Os502a for CFC r-502.

Contact: Mr. James Ryu, CEO, Hanyoung Green Cool Company Ltd., 20-6, Angang-eup Sabang-ri, Gyeongju-si, Gyeongsangbuk-do, 780-803, Republic of Korea. Tel: +82 (19) 2532980; Fax: +82 (2) 26451603.

Website: www.greencool.co.kr

Simple, compact CO2 compressor

OBRIST Engineering GmbH of Austria, a leading developer of carbon dioxide refrigerant (R744) technology components, has introduced its latest compressor featuring swash ring technology. The new variable displacement compressor, named C99, offers better performance in a more simple and compact design.

Compared with conventional swash plate compressors, the C99 compressor has the following key advantages:

Reduced number of parts;

Improved weight, noise, vibration and harshness parameters;

Very low hysteresis controlling mechanism; and

Integrated oil management for reduced oil circulation rate.

The new compressor is sized for cooling capacity requirements of up to 17kW and could help original equipment manufacturers to achieve better performance of R744 systems in a cost-effective way.

Website: www.r744.com

Fuel savings with R744

Visteon Corporation, a leading multinational automotive supplier, has identified substantial fuel savings for compact cars that use R744 refrigerant in their cooling system. This will put an end to the question whether R744 is efficient in small vehicles. Extensive testing on a small Toyota car equipped with a 1.0 litre petrol engine has found that R744 outperforms the refrigerant HFC-134a not only in environmental aspects, but also in cooling performance.

According to Visteon, the natural refrigerant will not only reduce direct emissions from mobile air-conditioning systems but also lead to a reduction of tailpipe emissions by 7 g/km. That is, more than a 10 per cent vehicle emissions reduction can be achieved by using R744 instead of HFC-134a. The testing results showed that R744 systems can reduce fuel consumption by 0.3 litre/100 km (R134a 6.65 litres/100 km vs. R744 6.33 litres/100 km) at 25C ambient temperature, and by 0.5 litre/100 km (R134a 7.38 litres/100 km vs. R744 6.82 litres/100 km) at 35C ambient temperature.

Website: www.r744.com

Water chiller systems

Matsu Chilling Systems, Australia, is offering water chiller systems that are more environmentally sustainable than comparable imported systems. Matsu water chiller systems feature increased chiller life, high efficiency of refrigeration compressors and eco-friendly refrigerants as the core of the sustainable approach.
Colder water allows concrete companies to mix batches for longer, which allows good flexibility in the delivery schedule, and to deliver higher quality concrete by increasing and controlling the setting time. Summit Matsu Chilling Systems has used some specific features in recent chiller deliveries to concrete batch plants to increase the sustainability of chillers:

Direct heat exchange between refrigeration system and water, eliminating intermediate heat exchanger and glycol system. This reduces overall parts used, environmental impact and the cost of the system.

Heat exchanger capable of using recycled or reclaimed water. Reduces the impact of batch plants on potable water supplies.

Use of 407C and 134a refrigerants, which do not deplete the ozone layer.

Use of efficient refrigeration compressors for less greenhouse gas emission.

High-quality steel frames designed for long (20+ years) outdoor use.

High-quality aluminium for finned (12 fins/inch) heat exchangers.

Epoxy coating on condenser fins for less fin corrosion.

Customized options such as marine grade aluminium casings, aluminium sound attenuators, or copper/copper-finned coils are available for chiller durability in harsh environments.

Contact: Matsu Chilling Systems, 3 Hiles Street, Alexandria, NSW 2015, Australia. Tel: +61 (2) 9698 4666; Fax: +61 (2) 9698 4688

Website: www.matsu.com.au

Website: www.ferret.com.au

CO2 compressor family on R744

Ixetic GmbH, Germany, has developed innovative and cost-efficient compressors for carbon dioxide refrigerant in mobile air-conditioning (MAC). Ixetics R744 compressor family will increase the efficiency of MAC systems substantially by combining excellent control behaviour with the capability to run at suction temperatures of up to 40C without any restrictions in driving mode. The new components have high accuracy in torque management without additional sensors in the system.

The low-weight and reliable R744 compressors will reduce parasitic horsepower consumption by 50 per cent compared with current systems working with the refrigerant HFC-134a. In addition, they are highly cost-efficient, as they use simple low cost switch and make pressure relief valves inside the compressor or the system unnecessary. The compressor family is suitable for all possible vehicle classes, ranging from compact cars to luxury class models. Other important features and advantages of Ixetics R744 compressor family are:

Modular housing concept, allowing for maximum flexibility for mounting devices.

No temperature compensation for the solenoid needed.

Low leakage rate 15 g/year.

Complete displacement range between 15 cc and 31 cc.

Website: www.r744.com

Non-ozone depleting vapocoolants

Dr. Ajaz S. Hussain and Dr. Rakesh Govind from the University of Cincinnati, the United States, have invented vapocoolant chemical compositions that can be used as skin refrigerants or topical anesthetics. These compositions are non-ozone depleting, non-toxic, non-carcinogenic and less inflammable than ethyl chloride. They match the skin temperature vs. time profile needed in the management of myofascial pain syndromes, for effectively freezing skin prior to minor skin surgery and painless injections.

The new liquid chemical compositions are reported to be effective in replacing the presently used chlorofluorocarbon-based vapocoolants. Their composition, by total weight, is 40-55 per cent hydrofluorocarbon and 60-45 per cent of ethyl alcohol. They are capable of cooling a desired area to at least 5C upon spraying for less than 5 seconds.

Website: www.freepatentsonline.com

AEROSOLS

New blowing agent for one-component foam

Honeywell International has announced that it has developed a blowing agent that would replace R-134a, a hydrofluorocarbon (HFC) used to make one-component foam expand, and would meet European Union regulatory requirements for zero ozone-depletion potential and reducing the use of high global warming potential (GWP) substances. The one-component foam is easily dispensed from a can and requires no mixing. This energy-saving foam is commonly used to seal gaps around windows and doors. Honeywells new developmental product has a very low GWP. According to Mr. Ian Shankland, technology leader for Honeywells low-GWP initiative, results from the initial overall performance testing are very favourable. The results have shown that the new technology can be used as a direct replacement for R-134a with very minimal process modifications.

Website: www.honeywell.com

Energy-saving foam products

Homeowners can save energy, and costs and reduce carbon dioxide emissions by choosing the right thermal insulation and using innovative building materials. BASF, the worlds leading chemical company, has brought out several innovative products that make these energy savings possible.

Neopor is a foamable plastic in granule form that BASF uses to make thermal insulation panels for walls and roofs. The granules contain a special graphite that reflects heat radiation like a mirror and thus prevents heat loss. Neopor achieves the same insulation level as the EPS Styropor using much less material.

StyrodurC is a rigid polystyrene foam, which is resistant to compression and moisture, for insulating basements against cold, moisture or pressure from the soil. It is free of ozone-depleting chemicals and is foamed with carbon dioxide. ElastoporH spray foam system is used for sealing and insulating roofs. The polyurethane-based rigid foam, produced by mixing two initially liquid components, provides reliable thermal insulation for roofs for decades.

Insulating materials in buildings ensure that as little heat as possible gets lost during winter heating; MicronalPCM phase-change materials in the model buildings interior walls ensure additional temperature control: the latent heat storers microscopically small plastic capsules contain a wax storage medium at their core. If the room temperature rises, the wax inside the microcapsules melts and absorbs the excess heat. If it falls, the wax becomes solid and the capsules release their heat again, helping to absorb temperature peaks.

Website: www.prdomain.com

Polystyrene foam made with CO2 as a blowing agent

The Dow Chemical Company, the United States, has patented a thermoplastic foam, made from styrenic polymer blown with solely carbon dioxide (CO2), and a process for making that polystyrene foam. Foam sheet made by this process has tensile elongation values greater than or equal to five per cent over an extended period of time under ambient conditions in both machine and cross direction. The thermoplastic foam and process are especially suited to make thermoplastic foam sheet for thermoforming purposes.

The thermoplastic foaming process (and the foamable mixture) involves melting a styrenic polymer, introducing a blowing agent consisting essentially of carbon dioxide directly and continuously into the melted styrenic polymer, thoroughly mixing the two, and then extruding and foaming the mixture at a die temperature below 150C into a region of lower pressure to form thermoplastic foam.

Website: www.freepatentsonline.com

Process for preparing rigid urethane foamed plastics

Bayer Aktiengesellschaft, the multinational chemical company has obtained a United States patent on a process for the production of rigid foamed plastics containing urethane groups, by use of a blowing-agent mixture containing 5 to 50 parts by weight of C3 and/or C4 alkanes and 50 to 95 parts by weight of cyclopentane. The rigid foamed plastics thus produced can be used as composite components or for foam filling of cavities in refrigerator construction.

The invention provides cyclopentane-containing blowing agent mixtures that retain the good thermal insulation property of cyclopentane even at low temperatures. Cyclopentane condenses at low temperatures owing to its relatively high boiling point. This occurs normally when polyurethane rigid foamed plastic is used for insulating domestic refrigerators. It has been found that by adding small proportions of low-boiling alkanes in the C3 and C4 series, the advantageous thermal conductivity of cyclopentane foam can be retained and also the pressure inside the cells can be greatly increased, especially at low temperatures.

An important feature of blowing-agent mixtures is that they are liquid at room temperature and the normally gaseous alkane components do not increase the vapour pressure of the total mixture above 1 bar. Further, the

impairment of insulation effect is surprisingly small. Cyclopentane easily dissolves in most polyols used in rigid polyurethane foam. However, solubility of the blowing agent is reduced by adding low-boiling aliphatic alkanes. The invention thus provides an advantageous method of producing rigid foamed plastics containing urethane and optionally containing isocyanurate groups, by reaction of polyisocyanates, polyols, blowing agents and optional foam auxiliary substances.

Website: www.freepatentsonline.com

Extrusion of low-density foam using water blowing agent

Amesbury Group Inc., the United States, has patented a process for extruding a low-density foam. The invention provides a method that uses an environmentally safe blowing agent to produce a high-quality, soft, low-density elastomeric foam having thermoplastic properties and good compression set resistance.

A foamable thermoplastic elastomer, such as a thermoplastic rubber, is fed into a heated extruder barrel where it is compressed and melted by the action of a screw. A blowing agent consisting of water is introduced into the melted thermoplastic elastomer. The melted thermoplastic elastomer and the water are thoroughly mixed and then cooled to a uniform, pre-determined temperature. The mixture is then forced through a die to form an extruded foam profile.

Website: www.freepatentsonline.com

Process for rigid polyurethane foaming

Samsung Electronics Co. of the Republic of Korea has secured a United States patent on a process for producing a rigid polyurethane foam having a closed-cell size of about 80-130 m and thus, improved heat insulating properties. The process comprises reacting a polyol component and a polyisocyanate component in a reaction medium containing a blowing agent. The blowing agent used is cyclopentane or HFCs, while the polyol component has at least one polyaromatic polyol selected from the group of polyols based on toluene diamine, methylene diphenyldiamine and bisphenol-A, with an average OH value of 200-650.

If one of the polyaromatic polyols is used alone, it is used in an amount of 5-70 parts by weight per 100 parts by weight of total polyols. The heat insulating performance of the solids in the cells of the rigid polyurethane foam is improved by using a large amount of aromatic components and thus, the thermal conductivity index may be lowered. If two or more polyaromatic polyols are used in combination, the amount of mixture is preferably 40-70 parts by weight per 100 parts by weight of total polyols. The reaction medium comprises a blowing agent (cyclopentane or HFCs), water, a reaction catalyst and a foam stabilizer, which are conventionally used in production of rigid polyurethane foam. may be used as a blowing agent.

Website: www.freepatentsonline.com

HCFC-141b foaming agent

Ningbo Synkemi Import & Export Company, China, offers HCFC-141b (1,1-dichloro-1-fluoroethane) foaming agent. HCFC 141b can also be used as a cleaning agent alternative for CFC-11 and CFC-113. The product has a boiling point of 32.05C at 1 atm pressure. Its density at 25C is 1.227 g/cm3 while the vapour pressure at the same temperature is 0.079 MPa. The foaming agent has an ozone depleting potential of 0.11 and a global warming potential of 0.09.

Contact: Ningbo Synkemi Import & Export Company Ltd., B, 14/F, Mingyang Tower, No. 18, Jiefang Road, Hangzhou City, Zhejiang Province, China. Tel: +86 (571) 8717 1465; Fax: +86 (571) 8717 1466.

Website: www.synkemi.en.alibaba.com

HALONS

HFC-227ea fire extinguishing systems

HFC-227ea fire extinguishing agent is a clean, low toxic, gaseous product that does not deplete the ozone layer. it is a successfully developed fire-extinguishing agent until today. HFC-227ea is a good replacement for Halon in total flooding and fully immersing fire extinguishing systems.

Wofu Fire Fighting & Security Co., China, offers fire extinguishing systems with HFC-227ea extinguishant. These systems have a design working pressure of 4.2 MPa, and an operational working pressure of minimum 3.6 MPa and maximum 5.4 MPa. They come with a gas cylinder with a capacity of 20, 30, 40, 60, 70, 100, 120, 150, 180 or 250 litres. They work from a DC power supply of 24 V. 0.5 A, and feature automatic and pneumatic manual start-up.

Contact: Ms. Michelle Xue, Export Manager, Wofu Fire Fighting & Security Co. Ltd., Shuangdong, Tianyuan, Cixi, Ningbo, China 528251. Tel: +86 (746) 222 8119; Fax: +86 (746) 221 3716.

Website: www.wofufire.com

Fire suppression systems that use FM-200

Metalcraft Inc., the United States, has designed and developed fast-acting engineered automatic fire suppression systems that use FM-200, an environmentally responsible fire suppression agent that is approved by the Environmental Protection Agency. FM-200 is a dry extinguishant that makes waterless fire extinguishing systems possible. Unlike water, FM-200 is non-conductive and non-corrosive, and therefore it is safe to use around all types of electronics and electrical equipment. The FM-200 suppression systems carry a United States Coast Guard approval, and are CE component certified for the European Union Market, besides the approval of Det Norske Veritas.

The fire suppression systems from Metalcraft are highly flexible and custom-configured to cater to different application areas, both small-scale and large-scale. The company has developed, in conjunction with Great Lakes Chemical Corporation, a line of portable FM-200 fire extinguishers for applications such as aerospace, data centres, electronic facilities, mission critical facilities, defence and marine use.

Contact: Metalcraft Inc., Sea-Fire Marine Division, 9331-A Philadelphia Road, Baltimore, Maryland, MD21237, United States of America. Tel: +1 (410) 887 5500; Fax: +1 (410) 887 5603

E-mail: info@sea-fire.com

Website: www.boatingbg.com

Next-generation fire extinguisher

Koryo Pyrotechnics Co., the Republic of Korea, offers next-generation fire extinguishers. FireWall fire extinguisher is totally environment-friendly with zero ozone depletion potential and zero global warming potential. It is non-toxic, non-corrosive, and the solid extinguishant does not need pressurized container. This aerosol fire extinguisher is three times more effective than Halon-based fire extinguishers, and is suitable for electronic equipment, panel board, engine room, special facilities, motor vehicles, ships and train.

Contact: Koryo Pyrotechnics Co. Limited, 8F, Wooyang Building, 39-5, 10KA, Chungmu-dong, Seo-ku, Busan, 602-011 Republic of Korea. Tel: +82 (51) 256 1771; Fax: +82 (51) 256 7366

E-mail: gelee@kpyro.com

Website: www.fireexpo.co.kr

Aerosol fire extinguishers

Dynameco aerosol fire extinguishing technology, from Dynamit Nobel Defence GmbH of Germany, is based on a pyrotechnical extinguishing charge. In case of a fire, this extinguishing charge consisting of potassium nitrate and nitroguanidine is ignited electrically, thermally or manually to react. The chemical reaction generates potassium carbonate, which flows through a cooling area along with the simultaneously generated reactive gases and then out of the openings at the bottom of the extinguisher, emerging into the environment as a fine aerosol.

The average particle size of the aerosol is between 0.5 m and 2.5 m. The extinguishing principle is not based on the removal of the oxygen important for combustion or on cooling, as is the case with other fire extinguishers. It is the combination of a physical and a chemical process. The ionization in the flame draws energy from the combustion process. Free radicals in the flame are bound by the potassium carbonate, thus stopping the chain reaction.

Dynameco fire extinguishers are manufactured as per the major standards and is listed by the United States Environmental Protection Agency as a Halon substitute. They are designed for fire suppression in a wide range of fields, including electro-technical facilities and equipment, kitchens, machines, ships and vehicles. They have zero ozone depletion potential and zero global warming potential.

Contact: Dynamit Nobel Defence GmbH, Dr.-Hermann-Fleck-Allee 8, D-57299 Burbach-Wrgendorf, Germany.

E-mail: info@dynameco.com

Website: www.dynameco.com

Low-ODP fire extinguishers

Bestfriend brand fire extinguishers, from Riser Enterprises Philippines, use HCFC-123 and FE-36 chemicals. These chemicals, manufactured by DuPont, are very advanced and pre-engineered fire extinguishants with low ozone depleting potential (ODP). HCFC-123, a viable replacement for the Halon 1211, is a multi-purpose vapour type fire extinguisher that has low ODP and low toxicity levels. FE-36, considered the perfected version of HCFC-123, is non-toxic and has zero ODP.

Contact: Mr. Almond Yatco, Luzon Buying Office Inc., 340 Dr. J. Fernandez Street, Mandaluyong City, Metro Manila 1550, The Philippines. Tel: +63 (2) 531 3850; Fax: +63 (2) 718 4695.

Website: www.alibaba.com

AF11E fire extinguishing agent

Hartindo AF11E fire extinguishing agent, from MSE Enviro-Tech Corp. in the United States, is claimed to be the worlds only proven 1:1 direct replacement for both Halon 1301 and 1211. It belongs to the halocarbon group of vaporizing liquid fire extinguishing chemicals. It is similar in action to Halons, but without any of the environmental or toxicity problems associated with them. In portable form, Hartindo AF11E equals Halon 1211 BCF (LPC-UK, EN3) in performance. It is electrically non-conductive and does not leave any residue.

Contact: MSE Enviro-tech Corp., 330 Franklin Road, Suite 135A, Brentwood, TN 37027, United States of America. Tel: +1 (615) 376 5601; +1 (615) 373 0472

E-mail: info@mseenviro-tech.com

Website: www.macreport.net

SOLVENTS

Defluxer for lead-free PCBs

Micro Care Corp., the United States, has launched a new product, PowerCleanTM II, for cleaning lead-free circuit boards during manufacturing, rework and repair. Using a unique formulation of chemistries based on Vertrel solvents from DuPont and the VersaTrans solvents from PPG, this new cleaner out-performs older formulations and is claimed to be an ideal replacement for ozone-depleting solvents such as Genesolv 2004.

Micro Cares newest introduction breaks with the tradition by not using alcohol in the formulation. This is because the new lead-free pastes and fluxes often react chemically with alcohols in solvents, producing troublesome white residues. Alcohol-free PowerClean II avoids this situation, delivering sound cleaning without white residues. It also features extra cleaning power because of the need for faster, more effective cleaning of the high-temperature fluxes used in lead-free materials.

Website: www.trafalgar2.com

Cleaning solution for electronics

CT Associates in the United States has secured a patent on a cleaning solution composition for use on electronic components and equipment. The cleaning solution comprises ultra-pure water containing carbonic acid and an oxidizing agent selected from hydrogen peroxide, ozone and combinations thereof. The novel cleaning solution is prepared by contacting carbon dioxide gas with ultra-pure water and an oxidizing agent. The invention also includes a method of removing contaminants from electronic components, containers and associated equipment using the new cleaning solution.

Website: www.freepatentsonline.com

High-quality cleaning at reduced costs

The Microsolve ultrasonic cleaning systems from Guyson International, the United Kingdom, attain the highest cleaning standards yet keep running costs low. Solvent retention features unique to the latest Microsolve machines triple coil reflux cooling, vapour break, 150 per cent freeboard, optional superheat, auto top-up and solvent monitoring ensure operational and environmental safety for the systems.

Microsolve co-solvent systems generally provide two cleaning stages, both with ultrasonics and filtration, followed by vapour rinsing and optional drying. In the first cleaning tank, a mixture of hydrofluoroether (HFE) and a hydrocarbon solvating agent, agitated by ultrasonic transducers and the boiling action, removes gross contamination from the components. The solvating agent takes up large quantities of soluble contamination, making the process particularly suitable for heavy-duty cleaning applications involving oils, greases, waxes and fluxes. In the second stage, pure HFE distillate, also ultrasonically assisted, removes from the components residues carried over from the primary cleaning tank.

Cleaning is followed by a rinse in the vapour zone above the tanks and then a dwell in the freeboard zone to dry the components. An optional automatic HFE top-up system logs the rate of solvent usage. This device demonstrated a total consumption of only 2.4 litres over a 7-day test of a high capacity M350 C co-solvent unit.

Website: www.drilling-machines-info.blogspot.com

Dry cleaning process with non-aqueous and aqueous steps

Dry cleaning of laundry articles involves one or more immersions in solvent liquids, rinsing and drying. Unilever Home & Personal Care, the United States, has obtained a patent on a sequential process for dry cleaning laundry articles. The process comprises: at least one non-aqueous dry cleaning step, at least one aqueous dry cleaning step and, optionally, at least one rinsing step. The first two steps involve different compositions of water, surfactant, a co-solvent, and a non-inflammable, non-chlorinated organic solvent selected from the group consisting of hydrofluorocarbons, hydrofluoroethers or mixtures thereof.

The solvents used in traditional dry cleaning are chlorinated solvents like chlorocarbons (such as

perchloroethylene) and chlorofluorocarbons (such as 1,1,2,-trichloro-1,2,2-trifluoroethane) either alone or in admixture with one or more co-solvents (such as aliphatic alcohols or other low molecular weight, polar compounds). Since many of these organic solvents pose environmental problems.

The invention effectively cleans a variety of stains and offers good garment care including a reduction in shrinkage and in the formation of wrinkles. Avoiding wrinkles is a significant benefit since this would save time and energy involved in ironing of the laundry articles. With the new process, it is possible to use very low volumes of organic solvent (liquid to cloth ratio) and still obtain effective cleaning and/or garment care.

Website: www.freepatentsonline.com

High-power brake cleaner

The High-Power Brake Cleaner 08180 from the multinational 3M, is a non-chlorinated, general-purpose degreaser designed to quickly remove oil, grease, brake fluid and other contaminants from all types of brake assemblies and parts without disassembling the unit. The product has powerful flushing action that dries without leaving residue and helps eliminate disc brake squeal and chatter. The formula contains less than 45 per cent VOC and has no ozone-depleting ingredient. It comes in 14 fluid ounce can with a wide spray button designed for comfort.

Contact: 3M Headquarters, 3M Centre, I-94 and McKnight Road, St. Paul, Minnesotta, MN 55144-1000, United States of America. Tel: +1 (651) 733 1110; Fax: +1 (651) 733 9973.

Website: www.solutions.3m.com

HAP-free solvent and degreaser

Ultra-Force II from Krylon Products Group, the United States, is a non-inflammable, fast evaporating cleaner that penetrates instantly to remove dirt, oil, grease and wax. It degreases faster and more thoroughly than alkaline cleaners. It does not contain any hazardous air pollutant (HAP), and is safe on all ferrous and nonferrous metals, and most plastics. The non-ozone-depleting solvent has a dielectric strength of 15,000 V, and is suitable for electric motors, air tools, sprockets, dies, relays, locks, generators, brakes, chains, wire ropes, moulds, air-conditioners, etc.

Contact: Krylon Products Group, 101 W. Prospect Avenue, Cleveland, OH 44115, United States of America. Tel: +1 (216) 515 7804; Fax: +1 (216) 515 4932.

Website: www.kpg-industrial.com

FUMIGANTS

Chemical alternative to methyl bromide

Finally, there might be an effective alternative: It is called Midas and is manufactured by the Japan-based Arysta LifeScience North America Corp. Midas, which uses iodine as its key ingredient, was granted an

experimental use permit by the United States Environmental Protection Agency in 2006. Midas literally destroys cells and disrupts metabolism, according to Mr. Jim Gilreath, who formerly studied tomato plant pests at the University of Floridas agriculture station.

A few tomato growers had agreed to field-test Midas early this year, and its prospects look good so far, said Mr. Gilreath. Like methyl bromide, Midas is applied to the soil before planting. It does not seem to impact the ozone, and the hazard to farm workers is about the same as methyl bromide. After four months of testing, Mr. Gilreath, who is now consultant to Arysta, rates effectiveness at 90 to 95 per cent for killing soil-borne pests.

Website: www.bradenton.com

Methyl bromide phase-out in glasshouse industries

Application technology remains the main barrier to the adoption of alternatives to methyl bromide (MB) for production of crops in glasshouses in Australia. In large, open-ended glasshouses injected fumigants, eg. Telone C-35, may be suitable alternatives. The inability of injection rigs to fumigate around the supporting structures, however, increases the risk of re-invasion of pathogens into fumigated soil. Crop hygiene, therefore, becomes even more important in the absence of MB.

Other options include dazomet, steam or alternative substrate production. Some growers have found steam to be a very useful alternative. The cost of equipment, slope and size of the glasshouse and time for treatment, however, have limited its widespread adoption. Other growers have moved out of soil production altogether, and are now growing crops in alternative substrates in boxes or bags.

Website: www.dpi.vic.gov.au

PUBLICATIONS

Refrigeration Fundamentals

This publication deals with refrigeration fundamentals, components of refrigeration plants, the refrigerants and lubricants used, and control systems. It is a valuable useful tool for technicians and engineers. Each page comprises diagrams and/or photos illustrating the theme covered, and a text summarizing key knowledge in the specific field dealt with. Main topics covered are: Refrig-eration fundamentals; Vapour compression cycles; Refrigerant properties; Lubricants; Components of a vapour-compression refrigerating plant; Plant design; and Control systems.

Contact: International Institute of Refrigeration, 177, boulevard Malesherbes, 75017 Paris, France. Tel: +33 (1) 4227 3235; Fax: +33 (1) 4763 1798.

Handbook for the Montreal Protocol

Unlike the last edition of the Handbook for the International Treaties for the Protection of the Ozone Layer, which was published by combining the information on the Vienna Convention and the Montreal Protocol, this seventh edition contains only information on the Montreal Protocol on Substances that Deplete the Ozone Layer. This separate edition is to accommodate the substantial number of decisions of the Parties to the

Montreal Protocol that were taken from the 15th to 17th Meetings of the Parties between 2003 and 2005, which up until now have only been available from the reports of the Meetings.

Section 1 remains unchanged while Section 2, on decisions of the Meetings of the Parties, has been made current. Section 3, which covers destruction procedures for ozone-depleting substances based on the decisions of the Parties, has been updated.

Contact: United Nations Environment Programme, United Nations Avenue, Gigiri, P.O. Box 30552, Nairobi, Kenya.

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