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A News Letter from ENVIS Centre - Central Pollution Control Board

Editorial

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Editorial

In response to the first issue of the PARIVESH, we have received encouraging comments and useful suggestions, the excerpts of which are reproduced in the *Redare's Column*.

In, this issue, we would like to share with you some important information relating to Ozone Layer Depletion which has become a subject of global concern.

My colleagues Dr. S.A. Dutta and Dr.(Mrs.) K.K. Saxena along with Dr. J.S. Sharma, Senior Chemist, ONGC provided useful inputs for this issue.

Dilip Biswas
Chairman, CPCB

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OZONE SPECIAL ISSUE

DEPLETION OF OZONE LAYER AND ITS IMPLICATIONS :

Ozone

Ozone is a simple molecule of three oxygen atoms and it is present in the two lowest layers of the atmosphere - troposphere and stratosphere. The troposphere extends from the surface of the earth upto 12 km and stratosphere extends upto about 50 km from the surface of the earth. Almost ninety percent of all ozone in the atmosphere is in the stratosphere.

Ozone is naturally formed due to the action of sunlight with oxygen molecule. Molecular oxygen is broken down in the stratosphere by solar radiation to yield atomic oxygen, which then combines with molecular oxygen to form ozone. Ozone is also formed in the lower atmosphere due to man-made activities. In presence of sunlight it is formed due to catalytic reaction of nitrogen oxides and hydrocarbons.

Stratosphere ozone acts as a shield thereby preventing the harmful ultra violet radiation from the sun reaching the earth. . Radiation at such wavelength is responsible for sunburn; skin cancer, cataract and can weaken the immune systems that protect us from infection. UV Radiation retards plant growth and damages the genetic structure of plants and animals.

Although the presence of ozone in the upper atmosphere allows life to flourish, it is a toxic gas, which is irritating to the respiratory system while present in the lower tropospheric layer. Ozone is also one of the gases responsible for increasing the temperature of the earth.

Ozone measurement

The concentration of ozone in vertical atmospheric column is measured directly or indirectly by remote system. The indirect system of measurement can be ground based or satellite based, while direct system can be balloon, rocket or air craft based. The concentration of ozone is measured in terms of Dobson Unit. Dobson spectrophotometer is a standard instrument for measuring the ozone concentration. Beside optical methods, electro chemical method is used especially on balloon measurements.

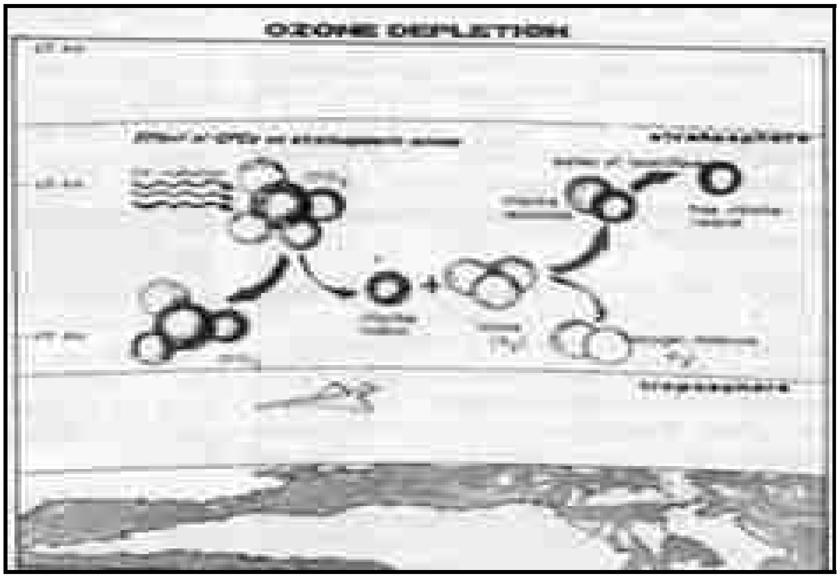
Ozone depletion

Over the past 10-15 years, there has been a large and unexpected loss of ozone in the stratosphere each spring above the Antarctica. The ozone concentration has dropped from 320 Dobson units in 1957-64 periods to about 200 Dobson units. Ozone layer is not only diminishing above Antarctica but also in other parts of northern and southern hemisphere. The rate of degradation of Ozone layer is estimated to be around 1% per 10 years. Above northern Europe, the decrease is estimated to be about 3.5% per 10 years during winter.

Mechanism of ozone depletion

The reason for ozone depletion was earlier explained by various theories. Later on, it was confirmed that the depletion is attributable to chemicals released by human activity. Not so long ago, it was thought that Nitrogen oxides released from supersonic aircraft, industrial process, etc. are the major agents of Ozone depletion. Now, there is strong scientific evidence that man-made chlorine and bromine as well as organic compounds like chlorofluorocarbons (CFCs), halons, etc. are mostly responsible for ozone depletion in the upper atmosphere. In the lower atmosphere the chemically inert CFCs and halons are virtually uncreative while in stratosphere they react with ozone and deplete the ozone level thereby creating so-called 'ozone hole'.

Solar radiations break down many of gases in the stratosphere that constrain chlorine and bromine. Chlorine, in presence of sunlight, reacts with ozone breaking it down to form oxygen and chlorine monoxide. The latter reacts with free oxygen to form chlorine and the cycle starts again. One molecule of chlorine monoxide can destroy 10,000 to 1,00,000 ozone molecules.



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OZONE DEPLETING SUBSTANCES (ODS) & THEIR SUBSTITUTES :

Fully halogenated chlorofluorocarbons (CFCs) contain only chlorine, fluorine and carbon and have a high ozone depleting potential. Similar compounds, which are not fully halogenated and contain hydrogen, in addition to chlorine, fluorine and carbon are called hydro chlorofluorocarbons or HCFCs. The presence of hydrogen in HCFCs reduces their persistence in the atmosphere and they have a less destructive effect on the ozone layer. Chemicals containing fluorine, carbon and hydrogen but no chlorine or bromine are known as hydro fluorocarbons or HFCs. The HFCs are currently being developed as CFC substitute that do not damage the ozone layer. One commonly used measure of a compound's ozone destroying capacity is its ozone depletion potential (ODP). It provides a useful basis for estimating the ozone depletion potential of various chemicals relative to CFC-11, which has an ODP of 1.0.s.

CFCs and related chemicals have been used in a wide variety of products since the 1930s when CFC-12 began replacing ammonia and sulphur dioxide as primary coolant. CFCs are used in refrigerators as primary coolant and till now have been a crucial ingredient in refrigeration and air conditioning units. They are used to make soft and rigid foams for furniture, cushions, mattress, packaging, building insulation material, computer cabinets, tennis racket, steering wheels, etc. Other CFCs are used as solvents, propellants in aerosol and as a fire extinguisher (halons) in fire fighting equipment. Two other chemicals that significantly damage the ozone layer are carbon tetrachloride (CTC) and methyl chloroform (MCF). CTC is used as a feedstock in production of CFC-11, CFC-12 and many pesticides, as a solvent in manufacture of synthetic rubber and dyes, as a metal degreaser, and as a dry cleaning agent. Methyl chloroform is used mainly as an all purpose industrial solvent for vapour degreasing operations and cold degreasing of fabricated metal parts, etc.

Substitutes for Ozone Depleting Substances (ODS)

Searching of substitutes for these seemingly indispensable chemicals began in 1987 with the signing of Montreal Protocol. Under the aegis of UNDP, a Technology Panel was established drawing knowledge of 110 experts from 22 countries, which reported on substitutes for ozone depleting substances. The Panel recognized that the CFC substitutes should not be toxic in nature and these should not contribute to global warming. Based on the available substitutes, the time schedule for phase out of CFCs has been worked out

As a short-term measure, one of the available alternatives is to use HCFCs, which destroy ozone to a lesser extent. To replace chlorine-containing substances, several substitutes have been developed while research is on to find other substitutes. As of now, the most viable compound to replace CFC-12 is HFC-134a. For foam blowing HCFC-22, HCFC-141b and HFC-123 are some of the substitutes. In fire fighting sector, there is no substitute for Halon. Some of the alternatives are dry chemical powder and CO2. In Aerosol sector, hydrocarbons, dimethyl ether, compressed CO2, N2 and N2O can be sued as substitutes for propellants. The alternative aerosol system includes finger and trigger pumps, mechanical pressure dispenser, etc. The currently available alternatives in sterilization sector are steam sterilization, ethylene oxide, carbon dioxide etc.

Among the HCFC and HFC alternatives only HCFC-22, HCFC-142b, HFC-152a AND HFC-134a are currently available and can be made available in large quantities at relatively short notice. Halon replacement chemicals are not at the same stage of development as CFC replacements for refrigeration, solvents and other applications.

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RECOVERY AND REUSE OF ODS :

The recovery, recycling, containment and leakage control are necessary to (a) minimize ODS emission to the atmosphere, (b) ensure that controlled substances are available to service the existing equipment beyond the phase out period particularly for critical applications and essential uses and (c) offset the demand for ODS in developing countries.

Commercially demonstrated and effective technologies are available for recovery, recycling, containment and leakage control of various Ozone depleting substances. In principle, it is possible to meet a portion of the demand for ODS from supplies recovered and recycled. However, with the exception of halons, recovery and recycling of ODS is difficult due to lack of proper infrastructure, equipment and training.

CFC refrigerant recovery and recycling equipment is available in developed countries with a wide range of feature and prices. Solvent recovery systems are also available for cold cleaning, vapour liquid cleaning and continuous automatic leaning.

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DESTRUCTION TECHNOLOGIES FOR OZONE DEPLETING SUBSTANCES :

The purpose of destruction of CFCs, halons, 1,1,1 trichloroethane and carbon tetrachloride is to convert them into safe materials. Technologies in this regard are in the research stage and as yet there are no commercially available plants. Only thermal destruction of PCB at high temperature is a proven technology for treating chlorinated organic compounds.

In principle, the safe destruction of CFCs and other halogenated compounds requires three steps.

1. dissociation of C-F and C-CI bonds in the molecules
2. conversion of constituent atoms to stable molecules, i.e. C to CO_2, F to HF, CI to HCI, Br to HBr.
3. neutralization of the acids; since CFCs and other fullyhalogenated carbon compounds have no hydrogen, it is necessary to treat them with hydrogen containing substance such as petroleum.

For the destruction of CFCs and relevant compounds, energy or promoter is required to dissociate the strong C-F, C-CI and C-Br bonds in the molecules. Depending on the means of initiating the dissociation, the technologies are classified as follows:

Energy-oriented destruction

- Incineration/Thermal decomposition (Thermal energy)
- Plasma decomposition (Electric energy)
- Reagent decomposition (Chemical energy)
- Photochemical/Radioactive Ray decomposition (Radiation energy)

Promoter-oriented destruction

- Catalytic decomposition
- Biological decomposition

CFCs are thermally and chemically stable substances. It is extremely difficult to decompose them, when compared with hydrocarbons, and there has been no necessity to do so, either. Consequently, extensive research has not been done in this respect. Transformation of CFCs includes (a) returning to raw materials such as hydrogen chloride and hydrogen fluoride by decomposing constituent elements and (b) synthesis of alternatives to CFCs such as HCFs, as well as polymers such as Teflon from CFCs.

In the Incineration and Thermal Decomposition, CFCs are decomposed in internal combustion or external burners with burning petroleum. Thermal decomposition of CFCs requires a temperature of more than 700oC.

Under the Plasma Decomposition Method, it is possible to have continuo0us decomposition reaction in a radio-frequency inductive-coupling plasma reactor. In this method, inductive heating at radio frequency around the tubular plasma torch under atmospheric pressure in presence of Argon produces plasma within the torch. Plasma, having temperature distribution, reaches a maximum temperature of nearly 10,000oC at its center. When gaseous CFCs are introduced into this flow, CFCs are decomposed rapidly.

In Catalytic Decomposition Method, CFCs are decomposed by continuously circulating CFCs and steam on a solid catalyst. The high performance solid catalysts include zeolite, alumina, binary oxide of TiO_2 - ZrO_2 and iron oxide supported on activated carbon.

In Reagent Decomposition Method, CFCs are reductively decomposed by a sodium naphthalene reagent dissolved in an organic solvent, which reacts with gaseous or liquid CFCs and thereby gives NaCl and NaF through the neutralization between Na^+ ions in the reagent and Cl and F in CFCs.

The Super Critical Water Decomposition Method utilizes the fact that a super critical state is formed in water beyond the critical point of water, state-facilitating hydrolysis. It is reported that CFC-11 and CFC-113 are almost completely decomposed at 400oC and 320 atm.

Study is being conducted on synthesizing chlorotrifluoroethylene monomers by dechlorinating or hydrogenationdehydrochlorinating of CFC-113 to make fluorine polymers (polychlorotrifluoroethylene). For these processes, various technologies are being studied, including thermal decomposition, catalysis and electrochemistry.

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THE MONTREAL PROTOCOL & ITS AMENDMENTS :

In September 1987, 24 nations met to negotiate the final text and sign the Montreal Protocol on Substances that deplete the Ozone Layer (ODS). The agreed Montreal Protocol, which entered into force on January 1, 1989, limited production of most commonly used ODSs, i.e. chlorofluorocarbons (CFCs) and halons. The Protocol required each party's production of chlorofluorocarbons (CFC-11, 12, 112, 113, 114 and 115) first to be frozen at 1986 levels and ultimately reduced to 50% of 1986 levels by 1998. Production of halons 1211, 1301 and 2402 were to be restricted to 1986 levels. The Protocol called for a freeze in production of halons at 1986 levels beginning in 1992.

The London Amendment

Shortly after the 1987 Protocol was negotiated, new scientific evidence showed that ozone depletion was occurring at a rate significantly faster than previously assumed. Hence, in June 1990, the parties to the Protocol met in London and agreed to amendments that required more stringent controls on ODSs included in the original agreement. The London agreement added further controls on other important ODSs such as carbon tetrachloride (CTC) and 1,1,1-trichloroethane (1,1,1-TCE) also known as methyl chloroform (MC).

The London Amendment limited production of commonly used CFCs to 50 percent of 1986 levels by 1995 and 15% by 1997. Under the amended agreement, CFCs, halons and CTC production is to be phased out by the year 2000, and methyl chloroform is to be phased out by 2005. The 1990 amendment also introduced the concept of transitional substances, such as the HCFCs. These are envisaged to be chemical replacement for CFCs and other controlled substances and have relatively small ozone depletion potential. A non-binding resolution by the parties calls for a phase out of HCFCs by the year 2020, if possible, but not later than 2040. The London Amendment to the Protocol entered into force in August 1992.

The Copenhagen Amendment

Scientific data on depletion of the ozone layer presented to the Parties at their November meeting in Copenhagen revealed that depletion has been occurring at a rate twice as fast as originally observed. For example, at latitudes where 2% depletion had been observed over the last decade, new evidence showed that actual depletion is closer to 3 - 5%. The Copenhagen Amendment calls for an accelerated phase-out of ODS for the developed countries (CFCs, CTC, and, MC by 1996; HCFCs by 2030). Additionally, the Copenhagen Amendment calls for measures against hydrobromofluorocarbons (HBFCs) and methyl bromide. The Copenhagen Amendment to the Protocol was adopted in November 1992 to be effective from January 1, 1994, with ratification by at least twenty countries. As of May 1994, twenty-four countries have done so.

The developed country signatories of the Protocol are thus committed by the Copenhagen Amendment to a freeze of CFC production and consumption at 1986 levels from mid-1989 through 1993 followed by phased reductions of both production and consumption (defined as production plus imports minus export of bulk chemicals) leading to a complete phase-out of CFC and halons by 1996 (under November 1992 revised reduction schedule).

The Protocol grants a 10-year grace period on all phase out dates and interim reduction deadlines for developing countries whose per capital consumption of Annexure A chemicals is less than 0.3 kg/year. Annexure A chemicals include the five main CFCs: CFC-11, CFC-12, CFC-113, CFC-114, CFC-115; and halons. For most developing countries this allows some leeway to expand CFC consumption over the next several years. However, by the terms of the Protocol, such expansion is allowed only to "meet basic domestic needs". Production for export has been excluded from the definition of domestic needs.

The list of ODS that are regulated by the Montreal Protocol are thus:

- Chlorofluorocarbons (CFC), CFC-11, 12, 113, 114, 115 aw well as mixtures of these substances
- Halons 1211, 1301 and 2402

- 1,1,1-trichloroethane (methyl chloroform)
- Carbon tetrachloride (CTC)
- HCFC, HBFC
- Methyl bromide

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THE MULTILATERA FUND FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL :

The Montreal Protocol calls on the developed countries to provide financial and technical assistance to developing countries. This has resulted in the establishment of the "Multilateral Fund" (MF) for the implementation of the Protocol. The fund is to offer assistance to developing countries to acquire technologies to substitute ODSs with alternative technology. The Fund assisted activities are implemented through four agencies:

- The United Nations Environment Programme (UNEP)
- The United Nations Development Programme (UNDP)
- The United Nations Industrial Development Organization (UNIDO)
- The World Bank

Provisions also exist for direct bilateral assistance between the parties. Bilateral assistance, however, has to be consistent with the criteria established by the Executive Committee.

UNEP (Nairobi Headquarters) also provides the organizational umbrella for the Fund's secretariat, and serves as the treasurer receiving all contributions to the MF and disburses funds according to the decisions of the Executive Committee.

Eligibility to the Multilateral Fund

Only developing countries which are parties to the Protocol and with an annual per capita consumption less than 0.3 kg are eligible for assistance from MF. India belongs to this group of countries having about 0.01 kg per capita annual consumption of specified ozone depleting chemicals.

Assistance from the Fund

The MF gives assistance in the following areas:

- Identifying country needs
- Project proposal eliminating the use of ODS
- Training and networking and conducting workshops
- Information dissemination

Project proposals

Project proposals (exceeding US$ 0.5 million) should contain all the details of a specific project in a specific sector or a group of projects and should contain the following main components:

- Project Cover Sheet; it provides a summary of basic data, including ownership of the enterprise concerned, consumption, time frame, impact, budget, implementing agency and national coordinating agency and brief summary of technical, institutional and policy issues
- Project title
- Sector data
- Project description; the project's short and long term objectives and their relationship with the Country Programme or the national strategy to be described along with the activities required to accomplish the project objectives
- Project time frame
- Outputs
- Budget; the budget should clearly describe how the incremental cost figures are calculated
- Institutional framework
- Technical appraisal

Project Proposals for Investment Projects under US$ 0.5 million

Documentation that is needed on investment projects submitted to the Executive Committee for final approval within a work programme should cover the following information:

- Country or Region
- Sector(s) covered
- Project title
- Technology to be used (where applicable)
- Project impact (ODS phased-out/year, beginning in where applicable)
- Project duration
- Total Cost
- Ownership of enterprise
- Incremental cost
- Cost effectiveness
- Implementation Agency
- National Coordinating Agency
- Technical review

In general, the Multilateral Fund is designed for payment only for eligible costs of national enterprises or corresponding shares of joint ventures and not for any part owned by transnational companies.

Accessing the Fund

All applications requesting Protocol funding should be made via the National Government and submitted for approval to the Executive Committee through the Fund Secretariat. Interested countries can apply through three channels:

- **By contacting the MF Secretariat (MFS):**

  The MFS can assist a country in identifying a relevant Implementing Agency that can help prepare a Country Programme (CP) or Project Programme (PP); and supply information necessary to develop a CP or PP. The MFS also provides liaison with recipient countries, the Implementing Agencies and the Executive Committee.
- **By contacting one of the Implementing Agencies (IA):**

  Countries can contact one of the IA (S) to develop CP and/or PPs.
- **By contacting a bilateral Donor Agency:**

  A country can also seek direct bilateral assistance from one of the donor Parties. The assistance is limited to a maximum of 20% and the assistance activities should comply with the guidelines set by the Executive Committee.

  All PPs and CPs requiring funding from MF must be submitted and approved by the Executive Committee. They should also include the designated IA(s). The Committee holds three meetings a year at which action on requests for funding and other issues are taken.

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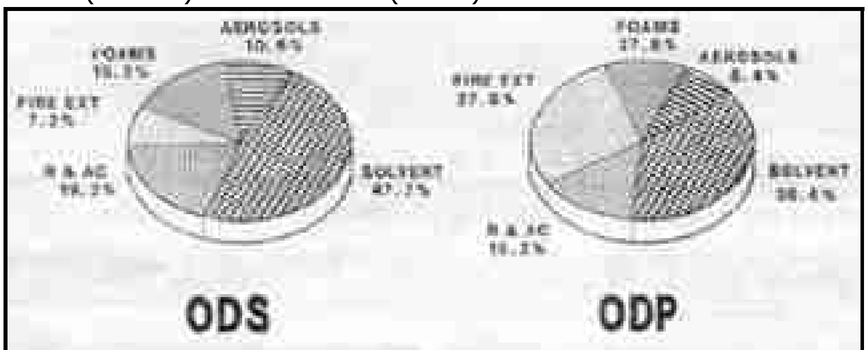
PRODUCTION AND CONSUMPTION OF OZONE DEPLETING SUBSTANCES IN INDIA :

India produces and uses the following seven of the twenty substances controlled under the amended Montreal Protocol.

Annexure A, Group I	CFC-11, CFC-12, CFC-113
Annexure A, Group II	Halon-1211, Halon-1301
Annexure B, Group II	Carbon tetrachloride (CTC)
Annexure B, Group III	Methyl chloroform (MCF)

The production, consumption and import of these seven ODS and their ozone depletion potential (ODP) equivalent in 1991 are shown in Table below. India's ODS consumption in 1991 assessed on the basis of producers' data and estimates refined by user groups was about 10,330 tones. In ODP terms, the total consumption in 1991 was 13,111 tones.

In ODS terms, solvents was the major user sector accounting for 47.7% followed by Refrigeration and Air conditioning sector (19.2%), foams (15.2%) Aerosol (10.6%) and Fire extinguishing (7.2%). In ODP terms, solvent was again the larger user sector accounting for 36.6% of total ODP use. This was followed by the fire extinguishing (27.8%)& R&AC (15.2%), Foam (12.0%) and Aerosols (8.4%).



1991 ODS/ODP Consumption in India by Sector

There are six enterprises in India which are engaged in manufacture of ODS.

Small-scale industries are major users of foams, aerosols, solvents and halons. It is estimated that about two thirds of the total production of CFC in the country is utilized by the small scale and informal sector. DCSSI has undertaken a project on survey of ODS consuming enterprises in small-scale and informal sector of India. CPCB has also done survey of ODS consuming/producing enterprises in the domestic refrigerator, automotive and air conditioning sector of the national capital Region, Delhi. Similar surveys are also being conducted for Maharastra region.

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INDIA'S ROLE IN IMPLEMENTING MONTREAL PROTOCOL :

The Government of India acceded to the Montreal Protocol along with its London Amendments on 19.6.92 and it came into force from 17.9.92. The Government has not acceded to the Copenhagen Amendments. The Country Programme (CP) for phasing out of ODS submitted by Government of India was approved by the Executive Committee in its 11th meeting in November 1993. Country Programme (CP) was prepared with active involvement of industry, industry association, Government departments, research laboratories and other institutes. Action Plan has been drawn in CP for phase-out of ODS in country. The activities listed in the action programme are investment projects, information dissemination, study of small sector, incentives, ecomark, use restrictions, legislation, etc. The phase out of ODS will be through various non-ODS technology projects submitted by industries consuming or production enterprises..

The Ministry of Environment and Forests, Government of India has set up an Ozone Cell which is a focal point for coordinating with the industry and provide necessary support to the Steering Committee and its three Standing Committees. The Ozone Cell has organized workshops for projects preparation. So far, a number of projects have been submitted by different enterprises to the Ozone Cell for grants from Multilateral Fund. As on March 1994, 22 projects have been approved by the Executive Committee of Multilateral Fund. The implementation of the projects will be initially monitored by the financial intermediary (IDBI) till their completion. To monitor the phase out of ozone depleting substance resulting from these projects, a Monitoring Standing Committee headed by the Chairman; Central Pollution Control Board has been set up. The Monitoring Committee also helps the ozone Cell in collection and analysis of data relating to annual production, import and export of ODS.

The project proposals received by the Ozone Cell of the Ministry of Environment & Forests, which is located at India Habitat Centre, zone IV, East Court, 2nd floor, Lodi Road, New Delhi - 110 003. The proposals are reviewed by the Technology and finance Committee and on approval of the Steering Committee, these projects are submitted to the Implementing agency for forwarding it to Multilateral Fund Executive Committee.

As per Montreal Protocol commitment, India also has to report data on ODS consumption of production import & export of ODS every year. To streamline the process of data collection, as recommended by the Monitoring Committee, a notification under the Environment (Protection) Act, 1986 will be issued by the Ministry of Environment & Forests, Government of India whereby the concerned organizations/enterprises in the country will be directed to furnish the relevant data on a regular basis is prescribed formats.

LIST OF SOME INDIAN PROJECTS APPROVED BY THE EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND OF THE MONTREAL PROTOCOL (as on March, 1994)

1. Feasibility study for the recovery and recycling of CFC refrigerants.
2. Substitution of CFC-11 refrigerant by HCFC-123 in centrifugal chillers.
3. Conversion of compressor manufacture from CFC-12 to HFC-134a designs.
4. Modification of CFC-12 MAC manufacturing for HFC-134a at Subros Ltd.
5. Conversion of compressor designs for refrigerators and appliances from CFC-12 to HFC-134a at Kirloskar Copeland.
6. Conversion of CFC-11/Polyol systems to low non-ODS formulations at Manali Petrochemicals ltd. (MPL).
7. Conversion of CFC-11/Polyol system to low non-ODS formulation at UB Petrochemical Ltd.
8. Phase-out of the use of CFC in the manufacturing extruded polyethylene foam sheet at Camphor and Allied Products Ltd.
9. Phase-out of the use of CFC in the manufacture of rigid PUF Panels at Sunpra ltd.
10. Phase-out of the use of CFC in the manufacturing of rigid PUF for thermo ware at Eagle Flask Industries Limited.

11. Aeropharma Aerosol conversion to hydrocarbon propellants.
12. Project formulation for the conversion of electronic cleaning process from CFC-113/alcohol blended and 1,1,1 trichloroethan to non-CFC cleaning.

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INDIA ON THE STEERING PANEL :

The tenth meeting of the Open-Ended Working Group (OEWG) of parties to Montreal Protocol held at Bangkok in July 1994 decided to hold a review of financial mechanism of Montreal protocol to support efforts of developing countries for ODS phase out. A Steering Panel of six members, 3 from developed and 3 from developing countries were set up to supervise the review. India is one of the members. Canada, France, Mauritius, Mexico and USA are other members of the panel.

The OEWG has decided that the members of the Panel will also obtain the views of the Non-Governmental Organizations in their countries.

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INFORMATION DISSEMINATION EFFORTS ON ODS PHASE OUT IN INDIA :

Following efforts have been made for information dissemination of ODS phase out in India;

1. India has organized country programme workshops in which a number of organizations participated.
2. The Ozone Cell created in the Ministry of Environment and Forests (MEF) directly sends relevant documents to the enterprises that intend to submit project proposals for phase out of ozone depleting substances. The Industry Associations have also been involved in this process.
3. A newsletter titled VATIS, an update of ozone layer protection is being published by the Asia Pacific Centre for Transfer of Technology with the support of the Ministry. So far, three issues have been brought out of six to be brought out annually. These are being distributed to individuals/organizations interested in protection of ozone layer.
4. A film is under preparation to address the industry, industry associations and others
5. Proposals for information dissemination are under preparation separately for large and medium size industries and small-scale and informal sectors.

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2. Environmental Audit, NOCIL - Agrochemicals
3. Guidelines for Environmental Audit
4. Environmental Auditing in Polluting Industries
5. Retting of Jute Fibre - its Impact on Environment
6. Report of the Expert Group on Utilization of Fly ash in Cement Industry
7. Action Points for Pollution Control in Problem Areas
8. Status Report of H- Acid and G. Salt
9. Comprehensive Industry Document on Edible Oil & Vanaspati Industry
10. Comprehensive Industry Document on Lime Kiln Industry
11. Pesticide Industry Status
12. Comprehensive Industry Document on Starch & Glucose (Maize Processing) Industry
13. Waste Water Management in Pesticides Industry
14. Water Quality Atlas of India.
15. Basin & Sub - Basin Industry of water Pollution- Narmada Basin
16. Basin & Sub - Basin Industry of water Pollution- Tapi Basin
17. Comprehensive Ind. Doccument - Diary Industry
18. Guidelines for Establishement, Evaluation and Gradation of Environmental Laboratories.
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