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**Groupe de travail à composition non limitée des Parties
au Protocole de Montréal relatif à des substances
qui appauvrissent la couche d'ozone**
Vingt-cinquième réunion

**Rapport du Comité Exécutif sur les utilisations des Agents de Transformation
dans les Pays visés à l'article 5 et
niveaux d'émission associés**

Introduction

1. Dans la décision X/14, les Parties ont demandé au Groupe de l'évaluation technique et économique et au Comité exécutif de faire rapport à la Réunion des Parties de 2001 sur les progrès accomplis dans la réduction des émissions de substances réglementées utilisées comme agents de transformation, et sur la mise en œuvre et l'élaboration de techniques de réduction des émissions et de solutions de remplacement non fondées sur les substances qui appauvrissent la couche d'ozone, d'examiner les tableaux A et B de la présente décision et de faire des recommandations pour tous les changements nécessaires. Le Comité exécutif a préparé et présenté le document UNEP/OzL.Pro.13/8 à la treizième Réunion des Parties en octobre 2001, en réponse à cette demande.

2. La décision X/14 indique aussi, entre autres, que le Comité exécutif peut examiner toute une gamme de moyens pour réduire les émissions de substances réglementées découlant de l'utilisation d'agents de transformation dans les pays visés à l'article 5 à des niveaux convenus par le Comité exécutif pouvant être atteints pour un rapport coût-efficacité raisonnable, sans abandon inutile des infrastructures. Les coûts différentiels d'une vaste gamme de mesures rentables, comme par exemple la reconversion de procédés, la fermeture d'usines, les technologies de contrôle des émissions et la rationalisation industrielle, visant à réduire les émissions de substances réglementées à ces niveaux, devraient être admissibles à un appui financier en vertu des règles et des lignes directrices du Comité exécutif du Fonds multilatéral.

3. Dans la décision XV/7, les Parties demandent au Groupe de l'évaluation technique et économique et au Comité exécutif de faire rapport au Groupe de travail à composition non limitée à sa vingt-cinquième réunion sur les progrès accomplis pour réduire les émissions de substances réglementées utilisées comme agents de transformation, et sur la mise au point et l'application de techniques de réduction des émissions et de procédés de remplacement ne faisant pas appel à des substances qui appauvrissent la couche d'ozone. Le présent document a

été préparé en réponse à la demande concernant les Parties visées à l'article 5(1) du Protocole de Montréal.

Contexte

4. Afin de préparer ce rapport, la 44^e réunion du Comité exécutif a autorisé le Secrétariat du Fonds à embaucher un consultant expert afin de cataloguer les utilisations des agents de transformation dans les pays visés à l'article 5 et les niveaux d'émission associés, étant entendu que les moyens de réduire les émissions ne seraient pas analysés (décision 44/65). Les résultats sont présentés dans une étude technique intitulée « Une étude pour cataloguer les utilisations des agents de transformation et les émissions de substances réglementées en vertu du Protocole de Montréal dans les pays visés à l'article 5.1 du Protocole ». L'étude est présentée intégralement à l'annexe I du présent document.

5. La méthode utilisée pour l'étude comprend un sondage sur les utilisations des agents de transformation dans les pays visés à l'article 5 mené au moyen de questionnaires distribués aux pays pouvant avoir une consommation d'agents de transformation; une analyse des réponses au questionnaire; une analyse de l'information fournie dans tous les documents de projets d'agents de transformation présentés au Comité exécutif et une analyse des données de consommation officielles rapportées aux Secrétariats du Fonds et de l'ozone. Les principaux résultats ont été intégrés au présent rapport.

6. L'étude des pays a été menée en distribuant un questionnaire à 26 pays visés à l'article 5. Ces 26 pays ont été choisis parce qu'ils ont rapporté explicitement une consommation dans le secteur des agents de transformation ou une consommation de plus d'une tonne PAO d'un ou plusieurs agents de transformation dans des rapports antérieurs (notamment le tétrachlorure de carbone, le CFC-113 et le bromochlorométhane). Cette mesure a été prise afin de s'assurer que les utilisations comme agents de transformation n'étaient pas oubliées accidentellement parce qu'elles avaient été rapportées antérieurement comme des utilisations comme solvants. L'étude théorique contient une description complète de la méthode, comprenant les questionnaires.

Niveaux de consommation des SAO comme agents de transformation dans les pays visés à l'article 5

7. L'information sur les utilisations des agents de transformation fournie dans le sondage réalisé dans le cadre de l'étude et les détails de la consommation dans les entreprises fournis dans les documents de projet révèlent que les pays visés à l'article 5 utilisent 13 623 tonnes PAO de SAO comme agents de transformation au cours d'une année. Les données recueillies au moyen du questionnaire portent sur l'année 2003. Les données dans les documents de projet portent sur les années 2000 à 2002.

8. Environ 13 500 tonnes PAO des quelque 13 600 tonnes PAO identifiées représentent l'utilisation du tétrachlorure de carbone. En ce qui concerne la quantité restante, le CFC-113 représente 40 tonnes PAO dans un pays visé à l'article 5 et un autre pays visé à l'article 5 fait mention d'une utilisation unique de 12 tonnes PAO de bromochlorométhane.

9. Quatre-vingt-dix-sept pour cent de la quantité totale ont été consommés dans trois pays : la Chine (10 538 tonnes PAO), l'Inde (2 268 tonnes PAO) et la République populaire démocratique de Corée (432 tonnes PAO).

10. Quelque 94 pour cent de la consommation identifié, c'est-à-dire 12 800 tonnes PAO, sert à des utilisations approuvées figurant sur la liste des agents de transformation des décisions XV/6 et XV/7 de la quinzième Réunion des Parties. Les six pour cent restants, ou 817 tonnes PAO, ont été utilisées à 18 fins non comprises dans ces décisions. Six des 18 utilisations ont été recommandées comme des agents de transformation dans le rapport du Groupe de l'évaluation technique et économique de 2004 découlant de propositions de la République populaire démocratique de Corée (quatre utilisations) et de la Roumanie (deux utilisations), mais les Parties n'ont pris aucune décision à ce sujet à leur seizième réunion. Une des 18 utilisations figurait sur la liste originale de la décision X/14 mais a été retirée de la liste à la décision XV/6. Les 11 utilisations restantes ne semblent pas encore avoir été proposées au Groupe de l'évaluation technique et économique. L'étude technique révèle qu'une de ces 11 utilisations, notamment le bromochlorométhane en Turquie, porte sur une matière première plutôt qu'un agent de transformation.

11. Les pays visés à l'article 5 ont aussi fourni de l'information sur la consommation nationale dans le secteur des agents de transformation dans leur rapport annuel au Secrétariat du Fonds sur les progrès accomplis dans la mise en œuvre des programmes de pays, et au Secrétariat de l'ozone, en vertu de l'article 7 du Protocole. La somme des plus récents niveaux de consommation rapportés au Secrétariat du Fonds dans les données des programme de pays est de 21 185 tonnes PAO. Les détails sur la consommation nationale d'agents de transformation rapportée sont fournis à l'annexe II au présent rapport.

12. Il y a des différences importantes entre la quantité totale d'agents de transformation utilisée relevée dans l'information sur les projets (13.598 tonnes PAO) et provenant de la consommation officielle d'agents de transformation rapportée au Secrétariat du Fonds dans les programmes de pays (21.194 tonnes PAO en 2003). De plus, la consommation officielle rapportée varie aussi beaucoup d'année en année (11.282 tonnes PAO en 2001 et 5.914 tonnes PAO en 2002). L'annexe II propose une comparaison complète des utilisations reconnues d'agents de transformation et la consommation officielle d'agents de transformation rapportée. Les différences peuvent être attribuables à un ou plusieurs facteurs suivants :

- Des incertitudes associées au calcul descendant de la consommation d'agents de transformation, commençant par la production annuelle, plus les importations, moins les exportations, moins les quantités utilisées comme matière première et à d'autres fins, sans laisser de marge pour les changements annuels dans les stocks.
- Des incertitudes associées aux interprétations différentes de la définition de l'utilisation réglementée, en tenant compte des utilisations reconnues d'agents de transformation, d'autres utilisations possibles d'agents de transformation et des utilisations comme matière première.
- Des incertitudes associées aux évaluations ascendantes fondées sur l'identification de toutes les utilisations dans les entreprises au pays.

13. En ce qui concerne ce dernier point, une Partie, à savoir l'Iran, a explicitement indiqué dans le questionnaire que des travaux plus poussés seront nécessaires afin d'identifier les utilisations supplémentaires possibles des agents de transformation au pays.

Activités pour l'élimination de la consommation des agents de transformation relevant du Fonds multilatéral

14. En réponse à la décision X/14, la 27^e réunion du Comité exécutif a adopté, à la décision 27/78, des lignes directrices de cadre de travail/principes généraux pour l'examen des propositions sur les agents de transformation. Le texte de la décision 27/78 est joint en annexe (annexe III) au présent rapport. Les lignes directrices indiquent que les examens et les approbations de projet permettront de constituer une banque d'informations sur le rapport coût-efficacité, les limites d'émissions et d'autres exigences liées à l'admissibilité et la détermination des coûts différentiels.

15. Se fondant sur ces lignes directrices et les listes d'utilisations d'agents de transformation déjà approuvées adoptées dans la décision X/14 et, plus tard, dans les décisions XV/6 et XV/7 des Parties, le Comité exécutif a approuvé 13 projets individuels pour éliminer 1 214 tonnes PAO de tétrachlorure de carbone utilisé comme agent de transformation, pour un coût total de 5 192 304 \$US (annexe IV). Le plus récent projet individuel a été approuvé en décembre 2001. Tous les projets ont fait appel à la reconversion des procédés afin d'éliminer complètement l'utilisation de tétrachlorure de carbone, évitant ainsi le besoin de se conformer à des niveaux d'émission résiduels acceptables.

16. Trois plans nationaux pluriannuels d'élimination du tétrachlorure de carbone ont aussi été approuvés, en principe (Chine, République populaire démocratique de Corée et Inde), au coût total de 122 684 044 \$US (comprenant l'élimination de la production de tétrachlorure de carbone en Chine et en Inde). Le financement de ces projets au moyen de tranches annuelles est en cours.

17. Les projets pour la Chine et la République populaire démocratique de Corée contiennent des dispositions à l'effet que les pays peuvent demander une assistance supplémentaire du Fonds multilatéral pour mener à terme l'élimination d'un niveau précis de consommation dans des utilisations identifiées comme agents de transformation non comprises à la décision X/14 en tant qu'utilisations approuvées comme agents de transformation au moment où les projets étaient à l'étude par le Comité exécutif. Les utilisations supplémentaires de la Chine ont ensuite été approuvées à la décision XV/6 des Parties. La République populaire démocratique de Corée affiche encore quatre utilisations non comprises dans la liste approuvée à la décision XV/6. Les quatre utilisations figurent parmi les utilisations recommandées par le Groupe de l'évaluation technique et économique dans son rapport de 2004. L'Inde a identifié huit utilisations non prévues à la décision XV/6. Par contre, l'Inde a convenu avec le Comité exécutif d'éliminer toute la consommation de tétrachlorure de carbone sans assistance supplémentaire du Fonds multilatéral, et l'accord lui assure la discrétion nécessaire pour réaffecter les fonds de la façon la plus efficace possible pour réaliser l'élimination.

18. Étant donné que les trois importants consommateurs responsables de 97 pour cent de la consommation totale possèdent un plan national d'élimination du tétrachlorure de carbone en vigueur ou prévu pour les nouvelles utilisations, la consommation, selon sa définition dans le Protocole de Montréal, cessera dans ces pays dès l'achèvement des projets du Fonds multilatéral, indépendamment des contradictions au chapitre des données.

19. En comptant le Pakistan, le seul autre pays pour lequel le Fonds multilatéral a financé un projet sur les agents de transformation, l'élimination de 98 pour cent des utilisations connues des SAO comme agents de transformation dans les pays visés à l'article 5 a déjà été ciblée ou a été quantifiée et reconnue par le Comité exécutif comme étant possiblement admissible à de futures demandes de financement. L'étude technique révèle que toutes les utilisations connues sauf 0,2 pour cent sont décrites dans les documents de projet.

20. À la suite de l'étude effectuée dans le cadre de cette analyse technique, la Chine a informé la 45^e réunion du Comité exécutif que plusieurs utilisations supplémentaires d'agents de transformation nécessitant une consommation importante de tétrachlorure de carbone (quelque 3 000 tonnes PAO) avait maintenant été recensées en Chine. Les utilisations nouvellement identifiées ne figurent pas sur la liste des utilisations des décisions X/14 et XV/6. L'accord actuel pour l'élimination de la production et de la consommation de tétrachlorure de carbone, conclu entre le Comité exécutif et le gouvernement de la Chine, stipule que toute consommation supplémentaire de tétrachlorure de carbone non prévue dans le plan sectoriel serait éliminée par la Chine sans coût supplémentaire pour le Fonds multilatéral.

Contrôle des émissions ou changement de procédé

21. Les décisions X/14 et XV/7 prévoyaient l'émergence d'informations sur la mise en œuvre et la création de techniques de réduction des émissions, entre autres. À cette fin et dans le respect des lignes directrices des projets d'agents de transformation établies par le Comité exécutif dans sa décision 27/78, tous les projets individuels examinés par le Comité exécutif devaient proposer un examen comparatif des conséquences technologiques et financières du contrôle des émissions par rapport à l'élimination de l'utilisation des SAO concernées (habituellement le tétrachlorure de carbone) par un changement de procédé. Dans chacun des cas, le contrôle des émissions s'est avéré énormément plus onéreux et/ou irréalisable du point de vue technologique. Les trois plans nationaux d'élimination du tétrachlorure de carbone proposent également des propositions pour modifier le procédé et éliminer l'utilisation visée de SAO pour toutes les utilisations d'agents de transformation pour lesquelles une autre solution technologique a été identifiée.

22. Au total, quelque 91 pour cent de l'élimination des SAO comme agents de transformation financée ou identifiée dans des projets individuels ou des plans nationaux d'élimination seront réalisés en changeant la technologie à une substance non réglementée ou en fermant l'usine. Neuf pour cent, seulement, de l'élimination sera réalisée en contrôlant les émissions afin de minimiser, capter et détruire les substances réglementées dégagées dans l'atmosphère, et ce pourcentage pourrait diminuer si les technologies de remplacement pour les changements de procédé dans les utilisations visées ne sont pas identifiés avant la date de mise en œuvre proposée pour les sous-projets portant sur ces utilisations.

23. Les neuf pour cent traités en contrôlant les émissions sont associés à trois procédés en Chine pour lesquels l'agence d'exécution n'a pas encore été capable de trouver un procédé de remplacement. Une de ces trois utilisations, qui porte sur l'utilisation du tétrachlorure de carbone, représente 8,6 pour cent de cette quantité. Une utilisation semblable, mais non identique, en République populaire démocratique de Corée, sera éliminée en changeant le procédé afin d'éliminer l'utilisation du tétrachlorure de carbone, ce qui signifie que cette solution pourrait peut-être aussi être utilisée pour l'utilisation en Chine. Le Comité exécutif a invité l'agence d'exécution concernée à se pencher sur la question.

24. Aucun détail des technologies proposées pour réduire les émissions dans les trois utilisations n'est encore connu car les activités sont prévues pour de futures années du plan national d'élimination pour lesquelles les détails n'ont pas encore été publiés.

25. Au moment de prendre les décisions X/14 et les décisions subséquentes du Comité exécutif, on supposait que le contrôle des émissions jouerait un rôle important dans

l'élimination des SAO dans les utilisations comme agents de transformation. Cette hypothèse ne s'est jamais concrétisée. Si des techniques de contrôle des émissions sont proposées à l'avenir pour une ou plusieurs des trois utilisations en Chine, ou pour toute autre utilisation encore inconnue, le Comité exécutif songera à établir des niveaux d'émission atteignables de façon rentable sans abandon excessif d'infrastructures, comme exigé dans la décision X/14, au cas par cas.

Comparaison des niveaux d'émission et de la consommation

26. L'information contenue dans les documents de projet et dans les réponses au questionnaire n'indique pas que les pays visés à l'article 5 récupèrent et détruisent les émissions associées aux utilisations comme agents de transformation. Pour ces raisons, les quantités perdues dans l'environnement, « les émissions », sont toujours égales à la quantité totale utilisée pour reconstituer la matière dans le procédé, c'est-à-dire la « quantité de constitution » rapportée comme une consommation dans le cadre des projets. La valeur ainsi obtenue peut être comparée à la définition du niveau d'émission « négligeable » indiqué dans le tableau B de la décision X/14 qui s'applique aux pays non visés à l'article 5, où le niveau d'émission moyen est de moins de cinq pour cent de la quantité de constitution.

Conclusions

27. Le questionnaire et l'analyse de l'information sur la consommation fournie dans les projets présentés au Comité exécutif révèlent que la consommation de SAO pour les utilisations comme agents de transformation dans les pays visés à l'article 5 est d'environ 13 600 tonnes PAO, dont la quasi-totalité est du tétrachlorure de carbone.

28. Quelque 98 pour cent seront éliminés par la mise en œuvre de projets individuels et les trois plans nationaux d'élimination du tétrachlorure de carbone déjà financés ou approuvés, en principe, par le Comité exécutif, ou ont été quantifiés dans les plans nationaux pertinents, et reconnus par le Comité exécutif comme pouvant possiblement être admissibles à une future demande de financement.

29. L'élimination des SAO, qui regroupe environ 91 pur cent de l'élimination totale dans les projets approuvés ou supervisés, sera réalisé au moyen d'un changement de technologie qui permettra d'utiliser un agent de transformation qui n'est pas une substance réglementée ou en fermant l'usine. Les changements de procédé qui ne créent aucune émission résiduelle représentent le principal moyen de réaliser l'élimination dans le secteur des agents de transformation dans les pays visés à l'article 5.

30. Aucune information n'a été reçue révélant que les pays visés à l'article 5 récupèrent et détruisent les émissions associées aux utilisations comme agents de transformation. Ainsi, les quantités de SAO identifiées comme une consommation dans les projets sont dégagées dans l'environnement.

Annex I

**A Study to Catalogue Process Agent Uses and Emissions
Levels Involving Substances Controlled under the
Montreal Protocol in Countries Operating under Article
5.1 of the Protocol**

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Disclaimer

While every effort has been made to ensure the accuracy of the text the author does not accept any responsibility for errors and/or omissions however caused and accepts no responsibility for subsequent use of the information contained in this report.

Executive Summary

The aim of this study is to catalogue process agent uses and related emission levels in countries operating under Article 5.1 of the Montreal Protocol (developing countries). Analysis of options for emissions reductions was specifically excluded.

The survey involved a desk study of annual ODS consumption data, provided by the Parties, to the Ozone Secretariat under Article 7 of the Protocol and to the Fund Secretariat under annual reports on the progress of implementation of country programmes. These, together with the project plans and phase-out plans provided most of the information. The study was followed up by a questionnaire to relevant Article 5.1 countries to ascertain their current usage of controlled substances for process agent applications and the levels of emissions from the processes. Use of controlled substances as chemical feedstocks for fluorocarbons manufacture in the People's Republic of China and in India and for the production of the intermediate chemical DV acid chloride in India were not included in this study.

Some 26 countries were surveyed; the criterion for inclusion being process agent or solvent use of a controlled substance comprising more than 1 ODP tonne per year. To date, 12 responses have been received. The principal findings from the information in the projects and phase-out plans already held by the Secretariats and the responses to questionnaires are:

- In most cases, the process agent is used as a process solvent. This is particularly so for carbon tetrachloride (CTC) which constitutes all but 0.4% of the emissions¹.
- With two exceptions, some form of recycle of the process solvent is carried out. The exceptions are the production of Ketotifen in the People's Republic of China and l-Ascorbic acid in the Democratic People's Republic of Korea.
- The most informative measure of the effectiveness of containment of the solvent in the whole process is the use factor (or *usage*); this is the annual quantity of process agent consumed (also known as the "makeup quantity") relative to the annual quantity of product made.
- The closer the use factor is to zero, the more effective is the recycle of process agent and values range from 0.006 to 13.4 for all uses. Even in the six applications using more than 1,000 ODP tonnes per year of process agent, use factors from 0.12 to 1.6 were reported. Thus the effectiveness of recycling is highly variable. Nevertheless, in any particular process, improved recycling would be as effective in reducing process agent emissions as the capture and destruction of the emissions.
- No Party provided evidence for current destruction of process agents and so the quantities that are lost into the environment are equal to the quantities used to replenish material in the process - the "makeup quantities". All of the process agents under consideration will tend to migrate into the atmospheric compartment of the environment (as against water, soil or biota).

¹ The rest of the emissions are CFC-113 and bromochloromethane (BCM).

- The year to year variation in the consumption reported by Parties can be misleading and high. This is particularly the case where process agent uses are calculated as the remainder after accounting for imports, exports, domestic production and feedstock use, without allowing for changes in stock holding (inventory).
- Calculated from the best available data in national plans and the reports to the Protocol Secretariats, total process agent use in Article 5.1 countries was in the region of 13,600 ODP tonnes per year in 2003. However, for the reasons given above, the uncertainty of this number is large. For example, the simple sum of all reported data in 2003 is 23,300 ODP tonnes; a value that is almost certainly in error since it would have required a doubling in process agent use by one Party in direct contravention of its national plan for phase-out.
- The applications of all but 0.2% of the 13,600 ODP tonnes used are described in national plans or in individually approved projects but 7,350 ODP tonnes of this, while already identified in phase-out plans, may be the subject of additional requests for support from the Multilateral Fund.
- Some 94% of the identified consumption is in applications that are now listed as process agents under decisions XV/6 and XV/7 taken at the Fifteenth Meeting of the Parties.
- About 91% of the reduction in process agent use is proposed to be accomplished by changes in technology (including change in the process agent to a substance that is not controlled) or by shutting down the plant. The other 9% is expected to be achieved by emission controls to minimise, capture and destroy controlled substances vented to atmosphere. However, no evidence was presented to indicate that such procedures are happening now.

Introduction

At their fifteenth meeting the Parties to the Montreal Protocol requested the Executive Committee to report to the twenty fifth session of the Open-ended Working Group (in July 2005) on the progress made in reducing emissions of controlled substances from process-agent uses and on the implementation and development of emissions-reduction techniques and alternative processes not using ozone-depleting substances. Subsequently at its 44th Meeting, the Executive Committee of the Multilateral Fund authorised the study in this form to catalogue process agent uses and related emission levels (excluding the analysis of options for emissions reductions) in countries operating under Article 5.1 of the Montreal Protocol (developing countries).

The survey involved a desk study of annual ODS consumption data provided to the Ozone Secretariat under Article 7 of the Protocol and to the Fund Secretariat under annual reports on progress with implementation of country programmes, followed up by a questionnaire to relevant Article 5 countries to ascertain their usage of controlled substances for process agent applications and the levels of emissions from the processes.

31.

The Nature of Process Agents

A Process Agent is defined in the Process Agent Task Force Report of 1997 [1] as a controlled substance that because of its unique chemical or physical properties facilitates an intended chemical reaction or inhibits an unintended (undesired) chemical reaction. Thus a solvent that facilitates a chemical reaction simply by dissolving the reagents and does not react itself with those reagents meets the criteria for a process agent. Many of the process agent applications described in this report fall into that category.

In a broader context, the chemical and physical properties that make a controlled substance suitable for use as a process agent in a chemical process include:

- chemical inertness in the chemical reaction process,
- appropriate physical properties, e.g.
 - Boiling point
 - Vapour pressure
 - Specific solvency,
- non-flammability and the ability to suppress explosion.

They are used:

- to facilitate reactions, including entering into the reaction acting as chain transfer agents,
- to control the desired physical properties of a process, e.g.,
 - Molecular weight
 - Viscosity,
- to increase plant yield and
- to minimise undesirable by-product formation.

The complete definition is given in Appendix A.

Where the controlled substance is a major component of the reaction mixture and becomes transformed during the reaction and is incorporated chemically into the product, it should be treated as a chemical feedstock.

The process agents considered in this report comprise only those that were listed in the responses from Article 5.1 Parties:

Carbon tetrachloride (CTC, CCl₄),
Fluorotrichloromethane (CFC-12, CCl₂F₂),
Trichlorotrifluoroethane (CFC-113, CCl₂FCClF₂) and
Bromochloromethane (BCM, CH₂ClBr)

and, throughout the report, the materials will be referred to by their short names - CTC, CFC-12, CFC-113 and BCM.

Approved uses covered by Decisions XV/6 and XV/7, taken at the Fifteenth Meeting of the Parties are listed in Appendix B, Table 1, plus brief descriptions of the reasons for using the agent and ways that emissions can be reduced. Appendix B, Table 2 carries a similar list for applications not yet approved. In both cases, only the applications that have been identified by Article 5.1 Parties are listed.

Reductions in emissions may be accomplished in a number of ways through optimisation of the process. On the other hand, elimination of emissions requires more radical approaches. These involve changes to the process to avoid use of controlled substances, shut-down of the process (and cessation of manufacture) or treatment of the process streams that are released into the environment to destroy the controlled substances they contain. The extent of emission of the controlled substance is different for each process agent application.

In the general case where controlled substances are used as process agents, the supply is utilized to replenish process inventory lost as the result of transformation, destruction and emissions to the atmosphere from the process and/or trace quantities slowly emitted from the product. Therefore the supply required for replenishment of lost inventory is referred to as "makeup" and defined as follows:

Make up quantity: The quantity of controlled substance per year, needed to continue the manufacture of products in a plant, due to transformation, destruction and inadvertent losses (i.e. emissions and residual amounts in final product) [2].

Feedstock Uses

Carbon tetrachloride is used in India and China as a chemical feedstock in the manufacture of CFCs 11 and 12 (fluorotrichloromethane and dichlorodifluoromethane), in the course of which all of the quantity used is either chemically converted or lost into the environment from process leaks [3, 4]. It is not a process agent in this application.

Carbon tetrachloride is also used in India as a chemical feedstock to make "DV acid chloride", 3-(2,2-dichloroethenyl)-2,2-dimethyl cyclopropane carbonyl chloride or *cypermethric acid chloride*. This is an intermediate in the manufacture of insecticides. No details of the process were made available but the consumption is significant, at several thousand tonnes per year, and increasing rapidly. Emissions of CTC from the process were stated to be much less than 7% of the make-up quantities and this use is not treated as process agent in this report [3].

Emissions

CTC

This is the most significant process agent in terms of both its range of applications and the quantities involved. In a large number of the processes, CTC is used as a solvent (*see Appendix B, Tables 1 and 2*) to facilitate the chemical reaction. It is recovered and recycled within the process by a variety of means: distillation and decantation being the more common. The recovery and recycle regime can be highly effective; for example in the average chlorinated rubber process in China the instantaneous inventory is in the region of 10 tonnes but some 160 tonnes/year of CTC passes through each processes [4]. It can also be non-existent; in the same country the production of Ketotifen is accompanied by total loss of the 13.4 tonnes of CTC used to make each tonne of product [4]. The data in Appendix B contain values, as reported in the reference documents, for:

The use ratio (also reported as usage). This is the quantity of process agent consumed per unit of product and is a measure of the overall efficiencies of use, recovery and recycle. With total recovery and recycle, the use ratio would be zero but, in practical situations, some makeup quantities are required and some material is destroyed within the process. The use ratio combines all of these influences and so is reported here. Furthermore, most of the reference documents provide enough information to calculate use ratios.

The emission ratio (instantaneous quantity of process agent not recovered relative to the quantity in use). There are many fewer data for this and the number itself is less informative than the use ratio. A low emission ratio simply indicates that only a small proportion of the mass in circulation in the process is lost each time it passes through. That could still mean that the use ratio is significant. For example, if the emission ratio were 4% and 30 tonnes of process agent were circulated for each tonne of product, then 1.2 tonnes of process agent would be lost for each tonne of product, giving a use ratio of 1.2.

None of the processes is completely sealed and losses occur by leakage of CTC directly into the atmosphere (from storage and processing vessels) and also indirectly, after being released into surface water. It has been demonstrated that chlorinated solvent (such as CTC) in a contaminated surface water course rapidly migrates into the atmosphere, rather than remaining in the water [5, 6]

Emission ratios vary from 100% (total loss of the material as it is used) to a few percent (effective recycle procedures) but, in an established process unless specific procedures have been put in place to collect and destroy the potential emissions ("emission control technology"), the quantity required each year for process agent use is equal to the quantity lost into the environment. Although the possibility of emission control technology was discussed in some national plans [3, 4], no party claimed that emission control is currently being operated (or indeed that it has been installed). Consequently, the quantity of material emitted was set equal to the quantity used.

With very few exceptions, the process agents are recycled to some extent through the processes, with varying degrees of success in their recovery and containment. However, for most, if not all, of the CTC uses reported by Article 5.1 Parties, there is no transformation within the process and no deliberate destruction and so make-up quantities are equal to the quantities emitted.

CFC-12

Consumption of this controlled substance as a process agent was reported historically by one Party (see Table 5). While it was thought to be used as a purifying agent in primary aluminium production, the exact nature of the process agent application was not made available and, although the material and this application were included in the survey, no details could be given in Appendix B. No CFC-12 is now used in this application.

CFC-113

The single process agent application for CFC-113 considered here is in the production of fluoropolymer resins. In this case, emissions may be reduced by capture and treatment of the process streams that are released into the atmosphere [4].

BCM

Two uses for this material are included in Appendix B. In the first, the manufacture of the pharmaceutical Losartan Potassium (Losartan K), use of BCM as a process agent was approved under Decisions XV/6 and XV/7 of the Fifteenth Meeting of Parties. In the second, BCM is a reagent and solvent in the chloromethylation of Sulbactam to make chloromethylpenicillinate-S,S-dioxide. In the course of this reaction it is a chemical reagent that is completely incorporated into the product molecule and gives rise to sodium bromide as a co-product. Although this use is still included in those subsequently listed in this report as process agents, it would appear that it is more accurately characterised as a feedstock.

Box 1.

Article 5.1 Parties reporting consumption under Article 7 of the Montreal Protocol

Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Democratic Republic of Congo, Cook Islands, Costa Rica, Côte d'Ivoire, Croatia, Cuba, Cyprus, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Federated States of Micronesia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea Bissau, Guyana, Haiti, Honduras, India, Indonesia, Islamic Republic of Iran, Jamaica, Jordan, Kenya, Kiribati, Democratic People's Republic of Korea, Republic of Korea, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Lebanon, Lesotho, Liberia, Libyan Arab Jamahiriya, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, Niue, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Romania, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia and Montenegro, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, South Africa, Sri Lanka, Sudan, Suriname, Swaziland, Syrian Arab Republic, United Republic of Tanzania, Thailand, The Former Yugoslav Republic of Macedonia, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Tuvalu, Uganda, United Arab Emirates, Uruguay, Vanuatu, Venezuela, Viet Nam, Yemen, Zambia, Zimbabwe.
Source, reference [7]

Table 1. Summary of Country Studies

Country	Not examined - use less than 1 ODP tonne	Individual Process Agent Application(s)	Process Agent(s) approved as part of National Plan	Potential Process Agent use	Responded to questionnaire	Included in further study
Algeria				✓		
Argentina		✓			✓	✓
Bahamas				✓		
Bahrain	✓					
Bangladesh				✓		
Barbados	✓					
Bolivia	✓					
Brazil		✓				
China, PR			✓			✓
Colombia		✓			✓	✓
Congo, DR				✓		
Cuba	✓					
Egypt		✓			✓	
Ghana	✓					
India			✓			✓
Indonesia				✓		
Iran *				✓	✓	
Jordan				✓	✓	
Korea, DPR			✓			✓
Lebanon	✓					
Mauritius	✓					
Mexico		✓			✓	
Morocco	✓					
Myanmar	✓					
Nepal	✓					
Nigeria				✓		
Oman	✓					
Pakistan		✓				✓
Paraguay				✓		
Peru	✓					
Romania		✓			✓	✓
Sri Lanka		✓			✓	✓
Sudan		✓				
Syria				✓	✓	
Tanzania	✓					
Tunisia	✓					
Turkey		✓			✓	✓
Uganda	✓					
Uruguay	✓					
Venezuela				✓		
Yemen **				✓	✓	
Zimbabwe				✓	✓	

* The response from Iran indicated that a further survey would be required to ascertain applications and quantities of process agents

** In the period of writing this report, consumption of Process Agent reported by Yemen was amended to below the 1 ODP tonne threshold.

Methodology- Survey by Questionnaire

Based on submissions of the Parties to the Ozone Secretariat (as required by Article 7 of the Montreal Protocol) and submissions to the Fund Secretariat, a list of candidate Parties was compiled. The criteria for inclusion in this initial screen of the 143 Article 5.1 Parties, that report under Article 7 (see Box 1), was that they should have either declared a process agent consumption or the consumption of a compound of interest in the "solvent" application category. Throughout this study, it has been assumed that submissions by parties are accurate and exact numerically but this is not always consistent with the actual results.

The list of Parties surveyed is shown in Table 1 and comprises 42 of the 143 eligible Parties. At this stage, 16 countries were deselected because, although they had reported individual consumption as either a process agent or solvent, the value was less than 1 ODP tonne. Although this is a rather arbitrary cut-point, it represents only 1/100th of 1 percent of the total process agent use by Article 5.1 Parties and is a defensible *de minimis* level.

The remaining 26 Parties received questionnaires individually designed to elicit their latest data for the quantities, nature and applications of process agent use. For the 10 Parties with process agent uses declared in individually approved projects and the three Parties whose process agent declarations were part of National Plans, the questionnaire sought to update the information previously provided. In addition, the questionnaire provided the opportunity for the Party to list any other applications of the controlled substances as process agents that had not been submitted as approved projects or in applications that have not yet been approved (as process agents by Parties), although they could meet the criteria.

The general form of this questionnaire is shown in Appendix C. In the particular case cited, one of the process agent applications that was part of the National Plan is no longer approved by the Parties (the manufacture of Ketotifen). However, when the National Plan was drawn up, Ketotifen was on the approved list and it appears to remain, technically, a process agent application of CTC, so was cited in this part of the form for this country.

The thirteen parties remaining had submitted data that showed solvent applications for one of the controlled substances of interest. In these cases a questionnaire of the form shown in Appendix D was employed with the aim of eliciting whether or not any part of that use could have been as a process agent and, if so, in what application.

In total twelve responses were received. In the absence of a response from countries receiving a general questionnaire, it was assumed that their solvent applications had been correctly reported and that they could be excluded from further study. The responses from three Parties also enabled them to be eliminated:

Argentina, where BCM is no longer used in the manufacture of Losartan K and the 13.86 tonnes of CTC used in petroleum reforming catalyst treatment has been reclassified by the party as feedstock because it is destroyed;

Egypt, where 51 ODP tonnes of CFC-12 had been declared as a process agent apparently to purify primary production aluminium, reported that controlled substances were no longer used for this application and

Mexico, where a 26.4 ODP tonne use of CFC-113 had actually been miscategorised.

Process agent applications in Colombia, Romania, Sri Lanka, Sudan and Turkey were examined on the basis of their responses to the questionnaires and information supplied to the Ozone and Fund Secretariats. Similar applications in China, India, D.P.R. of Korea and Pakistan were studied using the National Plans or individual process agent approvals.

Results

There are three classes of Application:

1. Those that are approved under Decisions XV/6 and XV/7 from the Fifteenth meeting of Parties. The method of use of the process agent is well described and the essentials are listed in Appendix B, Table B.1.
2. Those that are not approved under a decision of the Parties but which are also well documented and are listed in Appendix B, Table B.2. In some cases, although the method of use of the controlled substance is documented, no actual use is reported by any of the Parties.
3. Those for which quantities are claimed by some Parties but which are not well documented. These are listed without further comment at the end of Table B.2.

The quantities used in each application are listed in Table 2 which also shows the source of information and the countries reporting use. In total, some 13,621 ODP tonnes of process agents have been reported as being used by Article 5.1 Parties, comprising 13,569 ODP tonnes of CTC, 40 of CFC-113 and 12 of BCM. The last figure is material used in Turkey for the manufacture of Sultamicillin antibiotic that, in fact, may be feedstock.

The values were taken from the latest information that gave consumption in individual applications; either the responses to the questionnaires or data submitted to the Fund Secretariat and Ozone Secretariat. This has resulted in total values that are significantly less than the total value for the year 2003 published by the Ozone Secretariat. This is almost wholly due to the values reported by the People's Republic of China and will be discussed later.

Emissions were assumed to equal consumption. Firstly, no Party reported that emissions were any different from consumption in their responses to the questionnaire, and secondly, the technical data summarised in Appendix B suggests that, in most cases, emission reductions would result only from changes in process agent use. The exceptions are the uses of CFC-113 for fluoropolymer resins, CTC for Ketotifen and CTC for the manufacture of chlorosulphonated polyolefin in the People's Republic of China, where vents treatment systems that will reduce emissions by destroying the controlled substance component are planned [4]. These applications account for 9% of the emissions that potentially can be abated. Alternative technology has been proposed to stop emissions of CTC from the manufacture of chlorosulphonated polyolefin in the DPR of Korea by changing to a new, solvent free fluidised bed process [10].

In the region of 94% of the quoted consumption is in applications that have been approved under Decisions XV/6 and XV/7 by the Fifteenth Meeting of the Parties and are shown on the first page of Table 2. The remainder, shown on the second page of Table 2 have yet to be considered by the Parties for approval, or were dropped from the approved list for procedural reasons. For example, the manufacture of Ketotifen was in the list approved initially [1] but is not on the current list although it is included in a national plan that was approved in the meantime [4].

Table 2. Process Agent Use and Emission by Article 5.1 Parties

Process Agent	Application (approved under decisions XV/6 and XV/7)	References	Emission, equal to Use ODP tonnes	Countries
CTC	Elimination of nitrogen trichloride in the production of chlorine	1, 8, 9	2.75	Colombia
CTC	Manufacture of chlorinated rubber	3,4,10,11	1908	China, India, DPR Korea
CTC	Manufacture of Endosulphan insecticide	1,3,12,13	290	India
CTC	Manufacture of isobutyl acetophenone (Ibuprofen analgesic)	3, 14, 15, 16, 17, 18, 19	274	India, Pakistan
CTC	Manufacture of 1,1-bis (4-chlorophenyl) 2,2,2-trichloroethanol (Dicofol insecticide)	1, 3, 20	76	India
CTC	Manufacture of chlorosulphonated polyolefin (CSM)	1,4, 10, 21	1375	China, DPR Korea
CFC-113	Manufacture of fluoropolymer resins	4, 22	40	China
CTC	Manufacture of chlorinated paraffin	1, 3, 4, 23	1442	China, India
CTC	Manufacture of bromohexine hydrochloride	3, 24, 25, 26, 27, 28	234	India
CTC	Manufacture of Diclofenac sodium	3, 29, 30	561	India
CTC	Manufacture of phenyl glycine	3, 31, 32, 33	15	India
CTC	Manufacture of chlorinated polypropylene	4	1942	China
	Manufacture of chlorinated EVA			
CTC	Manufacture of methyl isocyanate derivatives	4	1440	China
CTC	Manufacture of 3-phenoxybenzaldehyde	4	520	China
CTC	Manufacture of 2-chloro-5-methylpyridine	4	282	China
CTC	Manufacture of Imidacloprid	4	1230	China
CTC	Manufacture of Bupropfenin	4	964	China
CTC	Manufacture of Oxadiazon	4	17	China
CTC	Manufacture of chloridized N-methylaniline	4	103	China
CTC	Manufacture of Mefenacet	4	23	China
CTC	Manufacture of 1,3-dichlorobenzothiazole	4	28	China
BCM	Manufacture of Losartan potassium	2,34	2.4	Argentina

Process Agent	Application (not yet approved)	References	Emission, equal to Use ODP tonnes	Countries
BCM	Manufacture of Sultamicillin	35	12	Turkey
CFC-11	Purification of aluminium	no data	0	Egypt
CTC	Manufacture of Ampicillin	3, 31, 32, 33	<i>Included in phenyl glycine above</i>	
CTC	Manufacture of ascorbic acid	2, 10, 36	79.2	DPR Korea
CTC	Manufacture of betamethazone phosphate	33		
CTC	Manufacture of Cefaclor®	33		
CTC	Manufacture of Ceftriaxone®	33		
CTC	Manufacture of Chlorophenesin	33	44	India
CTC	Manufacture of Ciprofloxacin	2, 10, 33, 36	82.5	DPR Korea
CTC	Manufacture of Clotrimazole	33		
CTC	Manufacture of Cloxacillin	33		
CTC	Manufacture of dexamethazone phosphate	33	55	India
CTC	Manufacture of estramustine phosphate	33		
CTC	Manufacture of the herbicide 2,4-D	2, 37	22	Romania
CTC	Manufacture of the herbicide DHEPC	2, 37	135.3	Romania
CTC	Manufacture of isosorbide mononitrate	33	6	India
CTC	Manufacture of Ketotifen	4	13	China
CTC	Manufacture of Naproxen	33		
CTC	Manufacture of Norfloxacin	2, 10, 33, 36	<i>Included in Ciprofloxacin above</i>	DPR Korea
CTC	Manufacture of Omeprazol	33		
CTC	Manufacture of trityl chloride	33	130	India
CTC	Production of the disinfectant sodium dichloroisocyanurate	2, 10, 33, 36	68.2	DPR Korea
CTC	Conditioning of Petroleum Reforming Catalyst	34, 38	13.86	Argentina
CTC	Production of Vinyl Chloride Monomer	39	0	Brazil
CTC	Manufacture of Carbimazole	3	8	India
CTC	Production of p-nitrobenzyl bromide	3	103	India
CTC	Production of benzophenone	3	45	India
CTC	Production of ethyl-4-chloroacetoacetate	3	11	India
CTC	Absorption quality testing of activated carbon	no data	16.65	Sri Lanka

Tables 3 and 4 carry information similar to Table 2, grouped into applications approved under decisions XV/6 and XV/7 and those not so approved. Furthermore, within each table, the results are grouped by Party. The year to which the results actually correspond is also given. However, in most cases, values in the plan and more recent information are similar.

The data in the column describing the use factor for each application in each Party were extracted from the national data reported in the quoted reference. In almost all cases where carbon tetrachloride is used as a process solvent it is recycled. The exceptions are Ketotifen production in the People's Republic of China and ascorbic acid production in the Democratic People's Republic of Korea. The effectiveness of recycling is variable and this is partly responsible for the wide variation in the use factors, which are also impacted by process technology considerations. For some applications, the national data did not give enough information to calculate a usage factor; generally because the process agent use was quoted without giving a value for the production. Nevertheless, in any one process, improved recycling would be as effective in reducing process agent emissions as the capture and destruction of the emissions.

Table 3. Process Agent Usage and Emissions in Activities Approved under Decisions XV/6 and XV/7.

Party	Activity	ODS used	Year	Emission, equal to Use ODP tonnes	Use factor metric tonnes per tonne of product	Ref.
Argentina	Manufacture of Losartan potassium	BCM	2000	2.4	id	34
China (PR)	Manufacture of chlorinated rubber	CTC	2000	1494	0.55	4
	Manufacture of chlorosulphonated polyolefin (CSM)	CTC	2000	1202	0.44	4
	Manufacture of fluoropolymer resins	CFC-113	2000	40	0.006	4
	Manufacture of chlorinated paraffin	CTC	2000	1243	0.20	4
	Manufacture of chlorinated polypropylene	CTC	2000	1942	0.73	4
	Manufacture of chlorinated EVA	CTC				
	Manufacture of methyl isocyanate derivatives	CTC	2000	1440	0.12	4
	Manufacture of 3-phenoxybenzaldehyde	CTC	2000	520	0.40	4
	Manufacture of 2-chloro-5-methylpyridine	CTC	2000	282	4.07	4
	Manufacture of Imidacloprid	CTC	2000	1230	1.60	4
	Manufacture of Bupropfenin	CTC	2000	964	0.29	4
	Manufacture of Oxadiazon	CTC	2000	17	0.28	4
	Manufacture of chloridized N-methylaniline	CTC	2000	103	0.18	4
Manufacture of Mefenacet	CTC	2000	23	0.70	4	
Manufacture of 1,3-dichlorobenzothiazole	CTC	2000	28	0.35	4	
Colombia	Elimination of nitrogen trichloride in the production of chlorine	CTC	2000*	2.75	na	8
India	Manufacture of chlorinated rubber	CTC	2000	305	id	3
	Manufacture of Endosulphan insecticide	CTC	2000	290	0.067	12
	Manufacture of isobutyl acetophenone (Ibuprofen analgesic)	CTC	2000	186	0.68	14
	Manufacture of 1,1-bis (4-chlorophenyl) 2,2,2-trichloroethanol (Dicofol insecticide)	CTC	2000	76	id	3
	Manufacture of chlorinated paraffin	CTC	2000	199	id	3
	Manufacture of bromohexine hydrochloride	CTC	2000	234	0.92	24
	Manufacture of Diclofenac sodium	CTC	2000	561	1.14	29
Manufacture of phenyl glycine	CTC	2000	15	0.083	31	
Korea (DPR of)	Manufacture of chlorinated rubber	CTC	2002	109	id	10
	Manufacture of chlorosulphonated polyolefin (CSM)	CTC	2002	173	id	10
Pakistan	Manufacture of isobutyl acetophenone (Ibuprofen analgesic)	CTC	2003	88	0.78	14

Notes: id insufficient data in references to complete calculation
na not applicable
* average over the period 1997-2001

Table 4. Process Agent Usage and Emissions in Activities not Approved under Decisions XV/6 and XV/7.

Party	Activity	ODS used	Year	Emission, equal to Use ODP tonnes	Use factor metric tonnes per tonne of product	Ref.
Argentina	Conditioning of Petroleum Reforming Catalyst	CTC	2002	13.86	na	38
Brazil	Production of Vinyl Chloride Monomer	CTC	2003	68.38	na	39
China (PR)	Manufacture of Ketotifen	CTC	2000	12	13.4	4
Egypt	Purification of aluminium	CFC-12	2003	0	na	
India	Manufacture of Chlorophenesin	CTC	2000	44	id	3
	Manufacture of dexamethazone phosphate	CTC	2000	55	id	3
	Manufacture of isosorbide mononitrate	CTC	2000	6	id	3
	Manufacture of trityl chloride	CTC	2000	130	id	3
	Manufacture of Carbimazole	CTC	2000	8	id	3
	Production of p-nitrobenzyl bromide	CTC	2000	103	id	3
	Production of benzophenone	CTC	2000	45	id	3
	Production of ethyl-4-chloroacetoacetate	CTC	2000	11	id	3
Korea (DPR of)	Manufacture of ascorbic acid	CTC	2002	79.2	0.92	36
	Manufacture of Ciprofloxacin	CTC	2002	82.5	4.6	36
	Manufacture of Norfloxacin	CTC			4	36
	Production of the disinfectant sodium dichloroisocyanurate	CTC	2002	68.2	0.24	36
Romania	Manufacture of the herbicide 2,4-D	CTC	2003	22	0.56	37
	Manufacture of DEHPC	CTC	2003	135.3	1.38	37
SriLanka	Absorption quality testing of activated carbon	CTC	2003	16.65	na	
Turkey	Manufacture of Sultamicillin *	BCM	2003	12	7.3	35

Notes: * This may not be a process agent application
 id insufficient data in references to complete calculation
 na not applicable

Table 5 summarises the total consumptions listed for each party in Tables 3 and 4 and also the latest reported total data from the Ozone Secretariat [40]. The report from Argentina to the Ozone Secretariat under Article 7 of the Protocol did not contain information on either of the process agent uses mentioned in reference [34]. In the cases of Brazil, Egypt and Mexico, use has been discontinued, so that the most recent (2004) reported consumptions are all zero.

In Pakistan, Romania, Sri Lanka and Turkey, there is no significant change in use and the reduction in Colombia is more apparent than real because of the effect of sporadic imports on the accounting for process agent use (without allowing for stockholding).

There would seem to be a similar problem, on a much larger scale, with the data from the People's Republic of China. It is apparent that the usage rate for CTC as a process agent is calculated from its annual production, plus imports, minus exports, less the quantity used as feedstock. The remainder is given as the quantity used as process agent *without allowing for stock changes*. In the year 2001, the process agent use was reported as 10,637 ODP tonnes [41] so that the apparent 88% growth rate in process agent use over two years between 2001 and 2003 is almost certainly the result of such stock changes not being properly accounted.

Because neither Party responded to the questionnaire, there are no data to substantiate the reasons for the fall in use of CTC in India by 9% between 2000 and 2002, nor the rise in use of CTC in the Democratic People's Republic of Korea by 69% between 2002 and 2003. As with the data from China, these could be artefacts of the accounting and reporting procedures.

Table 5 Summary of Uses of Process Agents by the Parties

Party	ODS used	Sum of latest individually denominated uses				Latest reported total [40, 42]	
		Activities not approved by the Parties		Activities approved under Decisions XV/6 and XV/7			
		Year	Use ODP tonnes	Year	Use ODP tonnes	Year	Use ODP tonnes
Argentina	BCM			2004	0	2003	2.4
	CTC	2004	0			2003	0
Brazil	CTC	2003	68.38			2003	68.38
PR of China	CFC-113			2000	40	2003	17.11
	CTC	2000	13	2000	10485	2003	20014.36
Colombia	CTC			2000	2.75	2004	1.38
Egypt	CFC-12	2004	0			2003	51
India	CFC-113					2002	23.58
	CTC	2000	402	2000	1866	2002	2065.8
DPR of Korea	CTC	2002	229.9	2002	202	2003	731.5
Pakistan	CTC	2001	88			2003	88
Romania	CTC	2002	173			2004	157.3
Sri Lanka	CTC	2003	16.65			2003	16.65
Sudan	CTC					2003	1.1
Turkey	BCM	2003	12			2003	12

Viewed as uncertainties, these discrepancies would suggest that country data could be in error by an average of about 30 to 50% in any one year but the remedy is to account for the use as actual quantities used in the process operations ("bottom-up accounting") rather than attempting to assess the usage from overall production and use in other major outlets without allowing for stock changes.

Conclusions

Some 143 Parties to the Montreal Protocol operating under Article 5.1 report data on their consumption of controlled substances to the Protocol Secretariats. From these data, only 26 Parties were determined to use (or could potentially be using) controlled substances as process agents. Each was sent a questionnaire individually designed to elicit their latest values for the quantities of process agent used and to ascertain the applications in which they were employed, together with estimates of the emissions from these applications.

The results showed that, in total, some 13,599 ODP tonnes per year of process agents were used by Article 5.1 Parties, comprising 13,562 ODP tonnes of CTC, 40 of CFC-113 and 12 ODP tonnes of BCM. The estimate relates to years in the period 2000 to 2003 but the year to year variation in the values quoted by Parties can be misleading and high. This is particularly the case where process agent uses are calculated as the remainder after accounting for imports, exports, domestic production and feedstock use, without allowing for changes in stock holding (inventory). For example, the simple sum of all reported data in 2003 is 23,300 ODP tonnes; a value that is almost certainly in error since it would have required a doubling in process agent use by one Party in direct contravention of its national plan for phase-out.

Applications of all but 0.2% of the 13,600 ODP tonnes used are described in national plans or in individually approved projects but 7,350 ODP tonnes of this, while already identified in phase-out plans, may be the subject of additional requests for support from the Multilateral Fund.

Some 94% of the consumption is in applications that are now listed as process agents under decisions XV/6 and XV/7 taken at the Fifteenth Meeting of the Parties. In most cases, the process agent is used as a process solvent. This is particularly so for carbon tetrachloride (CTC) which constitutes all but 0.4% of the emissions.

With two exceptions, some form of recycle of the process solvent is carried out. The exceptions are the production of Ketotifen in the People's Republic of China and l-Ascorbic acid in the Democratic People's Republic of Korea. The effectiveness of recycling is variable and this is partly responsible for the wide variation in the use factors, which are also impacted by process technology considerations. Nevertheless, in any particular process, improved recycling would be as effective in reducing process agent emissions as the capture and destruction of the emissions.

About 91% of the reduction in process agent use is proposed to be accomplished by changes in technology (including change in the process agent to a substance that is not controlled) or by shutting down the plant. The other 9% is expected to be achieved by emission controls to minimise, capture and destroy controlled substances vented to atmosphere.

However, no Party provided evidence for current destruction of process agents and so all of the material lost must be emitted into the environment. All of the process agents under consideration will tend to migrate into the atmospheric compartment of the environment (as against water, soil or biota). The quantities that are lost are equal to the quantities used to replenish material in the process - the "make-up quantities".

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Appendix A - Definitions from the 1997 PATF Report

“**Feedstock:** A controlled substance that undergoes transformation in a process in which it is converted from its original composition except for insignificant trace emissions as allowed by Decision IV/12.”

“**Process Agent:** A controlled substance that because of its unique chemical and/or physical properties facilitates an intended chemical reaction and/or inhibits an unintended (undesired) chemical reaction.

Controlled substances are typically used in chemical processes as process agents for at least two of the following unique chemical and/or physical properties:

1. Chemically inert during a chemical reaction
2. Physical properties, e.g.
 - Boiling point
 - Vapour pressure
 - Specific solvency
3. To act as a chain transfer agent
4. To control the desired physical properties of a process, e.g.,
 - Molecular weight
 - Viscosity
5. To increase plant yield
6. Non-flammable/non explosive
7. To minimise undesirable by-product formation

Note 1: Refrigeration, solvent cleaning, sterilisation, aerosol propellants and firefighting are not process agents according to this definition

Note 2: Parties need not consider use of ODS for foam blowing, tobacco puffing, caffeine extraction, or fumigation because these uses are already covered in other Decisions and/or by Technical Option Committee Reports.” [1]

APPENDIX B Summary of Process Agent Applications featured in this Report

Table B.1 Activities Approved under Decisions XV/6 and XV/7

Activity	ODS used	Details of use of process agent	Fate of Process agent		Source of information
			Internal Recycle	Emission	
Elimination of nitrogen trichloride in the production of chlorine	CTC	Solvent for nitrogen trichloride used in the destruction process	Yes, ratio variable	Make-up quantities are transferred into the atmosphere unless captured and destroyed.	9
Manufacture of chlorinated rubber	CTC	Solvent for the chlorination of rubber using chlorine. No process details	No process details.	Make-up quantities are transferred into the atmosphere unless destroyed. Usage 0.55t/t	4
Manufacture of Endosulphan insecticide	CTC	Solvent for reaction of HET diol with thionyl chloride.	Recovery by distillation.	Make-up quantities are transferred into the atmosphere unless destroyed.	13
Manufacture of isobutyl acetophenone (Ibuprofen analgesic)	CTC	Solvent for reaction of isobutyl benzene with acetyl chloride and aluminium chloride. Recovery by distillation.	Yes. No information on ratio	Make-up quantities are transferred into the atmosphere unless destroyed.	18, 19
Manufacture of 1,1-bis (4-chlorophenyl) 2,2,2-trichloroethanol (Dicofol insecticide)	CTC	Solvent in chlorination of technical DDE, whence it is recovered by distillation. And solvent to purify technical dicofol, whence it is removed by distillation.	Yes. No information on ratio	Make-up quantities are transferred into the atmosphere unless destroyed. Emission ratio = 5%	20

Table B.1 continued					
Activity	ODS used	Details of use of process agent	Fate of Process agent		Source of information
			Internal Recycle	Emission	
Manufacture of chlorosulphonated polyolefin (CSM)	CTC	Solvent for the reaction of polyethylene with chlorine and sulphur dioxide. The released CTC from the reactor and rear operations is recovered, purified and recycled by condensation and absorption.	Yes. No information on ratio	Make-up quantities are transferred into the atmosphere unless destroyed. Emission ratio = 3%	21
Manufacture of fluoropolymer resins	CFC-113	Resins, process agents (solvents), and other reactants are batch charged into reaction vessels followed by product isolation, product purification, and solvent recovery.	Vent collection and recovery systems capture and recycle 99% of CFC-113 in the primary vents.	Make-up quantities are transferred into the atmosphere unless destroyed separately by thermal oxidation. Emission ratio = 1%	4, 22
Manufacture of chlorinated paraffin	CTC	Solvent for reaction of paraffin wax with chlorine	During paraffin dissolution and chlorination, the evaporated CTC is recovered by condensation and recycled upstream for the process.	Make-up quantities are transferred into the atmosphere unless destroyed. Emission ratio = 3%	23
Manufacture of bromohexine hydrochloride	CTC	Solvent for bromination of o-nitrotoluene to o-nitrobenzylbromide, whence it passes through several other process steps and is recovered by distillation from the crude product	Yes	Make-up quantities are transferred into the atmosphere unless destroyed.	27, 28

Table B.1 continued					
Activity	ODS used	Details of use of process agent	Fate of Process agent		Source of information
			Internal Recycle	Emission	
Manufacture of Diclofenac sodium	CTC	Solvent for chlorination of phenol to 2,6-dichlorophenol	No data	Make-up quantities are transferred into the atmosphere unless destroyed.	30
Manufacture of phenyl glycine, intermediate in manufacture of Ampicillin and Cefaclor.	CTC	Solvent for hydrochlorination of D(-) alpha phenyl glycine and for product purification.	Separation by filtration, solvent recycled to reaction stage.	Make-up quantities are transferred into the atmosphere unless destroyed.	32, 33
Manufacture of chlorinated polypropylene	CTC	Solvent for direct chlorination of polypropylene but no process details	Tail gas treatment by active carbon adsorption	Make-up quantities are transferred into the atmosphere unless destroyed. Usage from 0.68t/t to 0.62t/t.	4
Manufacture of chlorinated EVA	CTC	Solvent for direct chlorination of ethyl vinyl acetate but no process details	Tail gas treatment by active carbon adsorption	Make-up quantities are transferred into the atmosphere unless destroyed. Usage from 0.68t/t to 0.62t/t.	4
Manufacture of methyl isocyanate derivatives	CTC	Used as a nonflammable and non-explosive diluent in producing methyl isocyanate intermediate (rather than the final products of MIC series pesticides).	Recycled by distillation	Make-up quantities are transferred into the atmosphere unless destroyed. Usage in range 0.2-0.3t/t (CTC/MIC)	4
Manufacture of 3-phenoxybenzaldehyde	CTC	No data		Usage 0.4t/t	4

Table B.1 continued

Activity	ODS used	Details of use of process agent	Fate of Process agent		Source of information
			Internal Recycle	Emission	
Manufacture of Imidacloprid	CTC	Solvent in the chlorination of 2-chloro-5-methyl-pyridine to 2-chloro-5-chloromethyl pyridine with chlorine.	Captured from the tail gas by condensation and then recycled.	Make-up quantities are transferred into the atmosphere unless destroyed. Usage from 1 to 2 t/t	4
Manufacture of Bupropfenin	CTC	Solvent for chlorination of N-methylaniline (to chloridized N-methylaniline) with chlorine.	Partial recycle	"CTC consumption ratio found to vary from 0.20t/t to 0.60t/t (CTC/intermediate), and 75% of the CTC consumed is emitted from the tail gas to atmosphere due to inefficient cooling capacity."	4
Manufacture of Oxadiazon	CTC	Diluent agent and inert solvent for the chlorination reaction but no details of the production process.	Sixty percent of the CTC consumption results from tail gas emissions, and 30% more is contained in wastewater.	"CTC consumption ratios are about 0.3t/t"	4
Manufacture of chloridized N-methylaniline	CTC	See <i>Manufacture of Bupropfenin</i> above			4
Manufacture of Mefenacet	CTC	Solvent in production of intermediate 1,3-dichloro-benzothiazole; process details not available.	Recycle with two-stage brine condensers.	Make-up quantities are transferred into the atmosphere unless destroyed. Consumption ratio of 0.4~0.7t/t (intermediate)	4
Manufacture of 1,3-dichlorobenzothiazole	CTC	See <i>Manufacture of Mefenacet</i> above			4
Manufacture of Losartan potassium	BCM	Reaction solvent for bromination of mBTT and for subsequent product purification.	Yes, by distillation	Make-up quantities are transferred into the atmosphere unless destroyed. Emission ratio 25%.	2, 34

Table B. 2 Activities not Approved under Decisions XV/6 and XV/7

Activity	ODS used	Details of use of process agent	Fate of Process agent		Source of information
			Internal Recycle	Emission	
Manufacture of Sultamicillin	BCM	BCM is a reagent and solvent for the chloromethylation of sulbactam into chloromethylpenicillinate-S,S-dioxide	Excess BCM recovered and recycled by distillation.	BCM appears to be a chemical feedstock in this process, not a process agent.	35
Manufacture of Ampicillin	CTC	See <i>Manufacture of</i>			33
Manufacture of ascorbic acid	CTC	Conversion of L-gulonic acid diketal to L-gulonic acid ethyl ester is performed with hydrogen chloride (HCl) in a mixture of ethanol and CTC		Total usage sent to drain (hence to atmosphere)	2, 10
Manufacture of betamethazone phosphate	CTC	Solvent in the production of pyrophosphoryl chloride	Solvent removed and recycled.	Make-up quantities are transferred into the atmosphere unless destroyed.	33
Manufacture of Cefaclor®	CTC	See <i>Manufacture of phenyl glycine</i> above			33
Manufacture of Ceftriaxone®	CTC	Solvent for production of 2-(2-chloroacetamido-4-thiazolyl)-2-	Solvent removed from oily product and recycled (no technical data)	Make-up quantities are transferred into the atmosphere unless destroyed.	33

Table B. 2 continued					
Activity	ODS used	Details of use of process agent	Fate of Process agent		Source of information
			Internal Recycle	Emission	
Manufacture of Chlorophenesin	CTC	Solvent for chlorination of phenol (intermediate)	Solvent removed and returned to chlorination step.	Make-up quantities are transferred into the atmosphere unless destroyed.	33
Manufacture of Ciprofloxacin	CTC	Solvent for the reaction of 1-chloro-4-nitrobenzene with chlorine in the presence of FeCl ₃ (Korea) or Solvent in the	Recovered, purified and recycled by distillation	In DPR Korea - the mother liquor, a solution of FeCl ₃ and some chloronitrobenzenes, 'is disposed of'. Otherwise, make-up quantities are transferred into the atmosphere unless destroyed.	2, 10, 33
Manufacture of Clotrimazole	CTC	Solvent in chlorination of 2-chlorotoluene	Solvent removed and returned to chlorination step.	Make-up quantities are transferred into the atmosphere unless destroyed.	33
Manufacture of Cloxacillin	CTC	Solvent in chlorination of 2-chlorobenzaldehyde oxime (intermediate)	Unspecified solvent recovery	Make-up quantities are transferred into the atmosphere unless destroyed.	33
Manufacture of dexamethazone phosphate	CTC	See <i>Manufacture of betamethazone phosphate</i> above			33
Manufacture of estramustine phosphate	CTC	See <i>Manufacture of betamethazone phosphate</i> above			33
Manufacture of the herbicide 2,4-D	CTC	Solvent in two chlorination stages and in product purification.	The CTC is recovered and recycled.	Emissions of CTC to the environment take place in each of the process stages.	2, 37
Manufacture of the "herbicide" DEHPC. <i>Actually, the product (diethylhexylperoxycarbonate) is an unstable polymerisation initiator used to make PVC.</i>	CTC	Solvent in two stages of the process.	Reaction product contains DEHPC dissolved in CTC and this solution is used directly to polymerise PVC. Also emissions of CTC during intermediate stages of the process.	The CTC remains unchanged in the polymer and is released into the environment through the plastic lifetime.	2, 37

Table B.2 continued					
Activity	ODS used	Details of use of process agent	Fate of Process agent		Source of information
			Internal Recycle	Emission	
Manufacture of isosorbide mononitrate	CTC	Solvent (together with pyridine) in the condensation of	CTC recovered for recycle by distillation.	Make-up quantities are transferred into the atmosphere unless destroyed.	33
Manufacture of Ketotifen	CTC	Used as a process solvent in one step of the 18 stage process	No data	Usage between 13 and 21 tons of CTC per ton of ketotifen	33
Manufacture of Naproxen	CTC	Solvent in condensation of acetyl chloride with 2-methoxynaphthalene and in subsequent product	Recovered, purified and recycled by distillation	Make-up quantities are transferred into the atmosphere unless destroyed separately by thermal oxidation.	33
Manufacture of Norfloxacin	CTC	Solvent for the reaction of 1-chloro-4-nitrobenzene with chlorine in the presence of FeCl ₃ (Korea) or Solvent in the chlorination of benzoic acid to trichlorobenzoic acid intermediate (more generally used).	Recovered, purified and recycled by distillation	In DPR Korea - the mother liquor, a solution of FeCl ₃ and some chloronitrobenzenes, 'is disposed of'. Otherwise, make-up quantities are transferred into the atmosphere unless destroyed.	2, 10, 33
Manufacture of Omeprazol	CTC	Suspending agent in chlorination of 2-hydroxymethyl-3,5-dimethyl-4-methoxy pyridine (intermediate) using thionyl chloride.	Solid product is removed and solution of thionyl chloride is recycled	Solvent carried on solid product to next stage of process.	33
Manufacture of trityl chloride	CTC	Solvent (and reagent) in condensation of benzene with carbon tetrachloride	No data	Make-up quantities are transferred into the atmosphere unless destroyed.	33

Table B.2 continued

Activity	ODS used	Details of use of process agent	Fate of Process agent		Source of information
			Internal Recycle	Emission	
Production of the disinfectant sodium dichloroisocyanurate	CTC	Removal of NCl ₃ from product of chlorination of isocyanuric acid.	The aqueous layer containing the desired product and the CTC layer containing the NCl ₃ are separated, and the NCl ₃ is chemically destroyed by reaction with aqueous sodium thiosulfate. The now-clean CTC is returned to the process.	Make-up quantities are transferred into the atmosphere unless destroyed.	2, 10
Production of Vinyl Chloride Monomer	CTC	Carbon Tetrachloride (CTC) is added to EDC feed in order to increase the productivity of the cracking furnaces. CTC acts as a free radical chain initiator.	CTC is lost from the process in a light ends stream containing non saturated hydrocarbons	Part of the quantity used can be transferred into the atmosphere unless destroyed.	39
Catalyst conditioning and regeneration	CTC	Regeneration of petroleum reforming catalyst	No data	Part of the quantity used can be transferred into the atmosphere unless destroyed.	38
Adsorption quality testing of activated carbon	CTC	Measurement of the quantity of CTC adsorbed onto samples	No data	No data	<i>Response to Questionnaire by Sri Lanka</i>
Manufacture of carbimazole	CTC	No data	No data	No data	3
Manufacture of p-nitrobenzyl bromide	CTC	No data	No data	No data	3
Manufacture of benzophenone	CTC	No data	No data	No data	3
Manufacture of ethyl-4-chloroacetoacetate	CTC	No data	No data	No data	3

Appendix C - Example of Specific Questionnaire for a Country with a National Emissions Reduction Plan

QUESTIONNAIRE TO ASSIST THE FUND SECRETARIAT TO OBTAIN INFORMATION ON THE LEVEL OF EMISSION OF OZONE DEPLETING SUBSTANCES USED AS PROCESS AGENTS

Please return to: A. McCulloch, c/o Secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol

FAX No +1 514 282 0068

by: 28 February 2005

In the information supplied by **Country** to the Fund Secretariat for the year 2002, consumption of 100 ODP tonnes of CFC-113 and 1000 ODP tonnes of carbon tetrachloride (CTC) was reported as Process Agents.

There are two Tables. The first table covers applications for which process agent use in your country was reported in *Plan for Phaseout of ODS in Chemical Process Agent Applications in Country*. The second table contains other process agent applications adopted by Decisions XV/6 and XV/7 of the Fifteenth Meeting of Parties, plus additional applications not so far approved but known to exist in some countries. Table 2 also has space for reporting other applications.

1. Please update the information for applications reported in project documentation

Table 1

Application	ODS used	Number of approved enterprises in year 2000	Total Quantity of Process Agent		Numbers of enterprises in 2003			
			Consumed in 2003 ODP tonnes	Emitted in 2003 ODP tonnes	Using ODS	Using ODS with emission control technology	Manufacturing but not using ODS	Not manufacturing / closed
Chlorinated Rubber (CR)	CTC	7						
Chlorinated Paraffin (CP70)	CTC	9						
Chlorosulphonated polyolefin (CSM)	CTC	3						
PTFE	CFC-113	5						
Ketotifen	CTC	1						

2. Please indicate how much Process Agent, if any, was used in Country in the following activities:

Table 2

Activity	ODS used	Yes	No	No information	If YES, how much ODS was used in 2003? (ODP tonnes)	If YES, how much ODS was emitted in 2003? (ODP tonnes)
Applications approved by Parties (Decisions XV/6 & XV/7)						
Elimination of nitrogen trichloride in the production of chlorine	CTC					
Recovery of chlorine in tail gas from production of chlorine	CTC					
Manufacture of Endosulphan insecticide	CTC					
Manufacture of isobutyl acetophenone (Ibuprofen analgesic)	CTC					
Manufacture of 1,1-bis (4-chlorophenyl) 2,2,2-trichloroethanol (Dicofol insecticide)	CTC					
Manufacture of polyphenylene terephthalamide (PPTA)	CTC					
Manufacture of fine synthetic polyolefin fibre sheet	CFC-11					
Manufacture of styrene butadiene rubber (SBR)	CTC					
Photochemical synthesis of perfluoropolyether polyperoxide precursors of Z-perfluoropolyethers and difunctional derivatives	CFC-12					
Reduction of perfluoropolyether polyperoxide intermediate for production of perfluoropolyether diesters	CFC-113					
Preparation of perfluoropolyether diols with high functionality	CFC-113					
Manufacture of bromohexine hydrochloride	CTC					
Manufacture of Diclofenac sodium	CTC					
Manufacture of phenyl glycine	CTC					
Manufacture of Cyclodime	CTC					
Manufacture of chlorinated polypropylene	CTC					
Manufacture of chlorinated EVA	CTC					
Manufacture of methyl isocyanate derivatives	CTC					
Manufacture of 3-phenoxybenzaldehyde	CTC					
Manufacture of 2-chloro-5-methylpyridine	CTC					
Manufacture of Imidacloprid	CTC					
Manufacture of Bupropfenin	CTC					
Manufacture of Oxadiazon	CTC					
Manufacture of chloridized N-methylaniline	CTC					
Manufacture of Mefenacet	CTC					
Manufacture of 1,3-dichlorobenzothiazole	CTC					
Bromination of a styrenic polymer	BCM					
Manufacture of Losartan potassium	BCM					

3. Table 2 Country continued....

Activity	ODS used	Yes	No	No information	If YES, how much ODS was used in 2003? (ODP tonnes)	If YES, how much ODS was emitted? (ODP tonnes)
Other Process Agent uses (not approved by Parties)						
Manufacture of Sultamicillin	BCM					
Purification of aluminium	CFC-11					
Manufacture of Ampicillin	CTC					
Manufacture of Anticol	CTC					
Manufacture of ascorbic acid	CTC					
Manufacture of betamethazone phosphate	CTC					
Manufacture of Cefaclo®	CTC					
Manufacture of Ceftriaxone®	CTC					
Manufacture of Chlorophenesin	CTC					
Manufacture of Ciprofloxacin	CTC					
Manufacture of Clotrimazole	CTC					
Manufacture of Cloxacillin	CTC					
Manufacture of dexamethazone phosphate	CTC					
Manufacture of Disulfiram	CTC					
Manufacture of estramustine phosphate	CTC					
Manufacture of the herbicide 2,4-D	CTC					
Manufacture of the herbicide DHEPC	CTC					
Manufacture of isosorbide mononitrate	CTC					
Manufacture of Naproxen	CTC					
Manufacture of Norfloxacin	CTC					
Manufacture of Omeprazol	CTC					
Manufacture of Tralomethrine	CTC					
Manufacture of trityl chloride	CTC					
Production of the disinfectant sodium dichloroisocyanurate	CTC					
Other uses, please specify:						

Appendix D - Form of General Questionnaire

QUESTIONNAIRE TO ASSIST THE FUND SECRETARIAT TO OBTAIN INFORMATION ON THE LEVEL OF EMISSION OF OZONE DEPLETING SUBSTANCES USED AS PROCESS AGENTS

Please return to: A. McCulloch, c/o Secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol

FAX No +1 514 282 0068

by: 28 February 2005

In the information supplied by **Country** to the Multilateral Fund Secretariat and/or to the Ozone Secretariat for the year 2003, consumption of 1000 ODP tonnes of carbon tetrachloride (CTC) was reported in the solvent sector.

1. Please confirm that the above consumption of controlled substance was in the solvent sector and not as process agent.

<input type="checkbox"/>	YES
<input type="checkbox"/>	NO

2. Please confirm that NO additional amounts of controlled substances were used as process agents.

<input type="checkbox"/>	YES, no additional amounts were used as process agents.
<input type="checkbox"/>	NO, there are additional amounts used as process agents.

3. If your answers to questions 1 and 2 are both YES, you do not need to continue the questionnaire and you should return it now. Otherwise, please continue with questions 4 and 5 below.
4. If controlled substances were used in **Country** as process agents please indicate whether any of the following activities took place (List of uses of controlled substances as process agents adopted by Decisions XV/6 and XV/7 of the Fifteenth Meeting of Parties).

Table 1

Activity	ODS used	Yes	No	No information	If YES, how much ODS was used in 2003? (ODP tonnes)	If YES, how much ODS was emitted in 2003? (ODP tonnes)
Elimination of nitrogen trichloride in the production of chlorine	CTC					
Recovery of chlorine in tail gas from production of chlorine	CTC					
Manufacture of chlorinated rubber	CTC					
Manufacture of Endosulphan insecticide	CTC					
Manufacture of isobutyl acetophenone (Ibuprofen analgesic)	CTC					
Manufacture of 1,1-bis (4-chlorophenyl) 2,2,2-trichloroethanol (Dicofol insecticide)	CTC					
Manufacture of chlorosulphonated polyolefin (CSM)	CTC					
Manufacture of polyphenylene terephthalamide (PPTA)	CTC					
Manufacture of fluoropolymer resins	CFC-113					
Manufacture of fine synthetic polyolefin fibre sheet	CFC-11					
Manufacture of styrene butadiene rubber (SBR)	CTC					
Manufacture of chlorinated paraffin	CTC					
Photochemical synthesis of perfluoropolyether polyperoxide precursors of Z-perfluoropolyethers and difunctional derivatives	CFC-12					
Reduction of perfluoropolyether polyperoxide intermediate for production of perfluoropolyether diesters	CFC-113					
Preparation of perfluoropolyether diols with high functionality	CFC-113					
Manufacture of bromohexine hydrochloride	CTC					
Manufacture of Diclofenac sodium	CTC					
Manufacture of phenyl glycine	CTC					
Manufacture of Cyclo dime	CTC					
Manufacture of chlorinated polypropylene	CTC					
Manufacture of chlorinated EVA	CTC					
Manufacture of methyl isocyanate derivatives	CTC					
Manufacture of 3-phenoxybenzaldehyde	CTC					
Manufacture of 2-chloro-5-methylpyridine	CTC					
Manufacture of Imidacloprid	CTC					
Manufacture of Bupropfenzin	CTC					
Manufacture of Oxadiazon	CTC					
Manufacture of chloridized N-methylaniline	CTC					
Manufacture of Mefenacet	CTC					
Manufacture of 1,3-dichlorobenzothiazole	CTC					
Bromination of a styrenic polymer	BCM					
Manufacture of Losartan potassium	BCM					

Annexe II

Tableau I : Consommation dans les utilisations comme agents de transformation

	Total des utilisations individuelles comme agents de transformation recensées (tonnes PAO)		Utilisation comme agents de transformation rapportée au Secrétariat du Fonds (tonnes PAO)		
	Utilisations approuvées par les Parties	Autres utilisations possibles comme agents de transformation	2001	2002	2003
Tétrachlorure de carbone					
Brésil		68,4		35,2	68,4
Chine	10 485,0	13,0	3 434,8	2 744,4	20 014,4
Colombie	2,8		-	0,9	-
Inde	1 866,0	402,0	6 192,4	2 065,8	
RPD Corée	202,0	229,9	753,5	753,5	731,5
Pakistan		88,0	88,0	88,0	88,0
Roumanie		173,0	71,9	196,9	157,3
Sri Lanka		16,7	21,5	29,1	16,7
Soudan			-	-	1,1
Total, tétrachlorure de carbone	12 555,8	990,9	11 282,1	5 913,9	21 077,3
CFC-11					
Égypte			65,0	60,0	51,0
Total, CFC-11			65,0	60,0	51,0
CFC-113					
Chine	40,0		-	95,5	21,4
Inde			-	29,5	
Mexique			-	57,0	33,0
Total, CFC-113	40,0	-	-	182,0	54,4
Bromochlorométhane					
Argentine					2,4
Turquie		12,0	-	-	8,8
Total, bromochloro- méthane	-	12,0	-	-	11,2
Total, SAO	12 595,8	1 002,9	11 347,1	6 155,8	21 193,9

Remarques :

- Argentine : Dans ses réponses au questionnaire, l'Argentine a indiqué que le bromochlorométhane n'est plus utilisé dans la fabrication de potassium losartan.
- Égypte : Une lettre de l'Administrateur de l'ozone datée du 23 février 2005 indique que l'entreprise a cessé l'utilisation du CFC-12 comme agent de transformation.
- Mexique : La consommation de CFC-113 a été associée par erreur au secteur des agents de transformation au lieu du secteur des solvants.

Annexe III

Décision 27/78 : Agents de transformation : Exécution de la décision X/14 (paragraphe 3, 5 et 6) de la dixième Réunion des Parties

Ayant pris note des observations et recommandations du Sous-comité sur l'examen des projets (UNEP/OzL.Pro/ExCom/27/13, paragraphes 122-126), et notamment du projet de directives-cadre/principes généraux pour les projets d'agents de transformation proposé par le Sous-comité aux fins d'adoption par le Comité exécutif (UNEP/OzL.Pro/ExCom/27/13, paragraphe 124), le Comité exécutif a décidé :

- a) qu'une première application de la décision X/14 pourrait commencer en suivant la démarche parallèle décrite dans le document UNEP/OzL.Pro/ExCom/27/40 ;
- b) d'adopter le projet de directives-cadre/principes généraux pour les projets sur les agents de transformation, proposé par le Sous-comité sur l'examen des projets, figurant à l'annexe II au présent rapport ;
- c) que, en application des principes généraux convenus, les agences d'exécution pourraient soumettre à l'examen de la vingt-huitième réunion un nombre limité de projets conformes à ces principes généraux convenus ;
- d) que, à mesure que des projets supplémentaires sont examinés et approuvés, il se créera une base d'information sur les rapports coût-efficacité, les limites des émissions, et autres conditions relatives à la recevabilité des demandes et au calcul des surcoûts. En se fondant sur cette base, le Comité exécutif pourra faire rapport aux Parties sur les limites des émissions (aux fins d'application de la décision X/14), en vue d'élaborer éventuellement à un stade ultérieur des lignes directrices plus détaillées pour chacune des utilisations des agents de transformation mentionnés dans la décision.

Lignes directrices du cadre de travail/principes généraux pour les projets d'agents de transformation

Principes généraux

1. Lors de la présentation de leur premier projet, les pays doivent remettre un survol approfondi du secteur regroupant toutes les entreprises, fournir toutes les données sur la consommation et les émissions, et préciser les entreprises pour lesquelles le pays demande l'assistance du Fonds multilatéral. Le pays doit préciser si l'information sur la consommation visée a été fournie dans le cadre des rapports de consommation visés à l'article 7 et, si ce n'est pas le cas, ses intentions et ses progrès à cet égard.

2. En ce qui concerne les propositions de projet, la consommation par l'entreprise est la quantité d'agent de transformation, exprimée en tonnes PAO, utilisée chaque année par l'entreprise en tant que substance de constitution pour le procédé visé. L'information sur la

quantité de SAO contenue dans l'équipement de traitement doit être fournie avec la proposition de projet.

3. Afin de permettre un examen pertinent des possibilités de rationalisation industrielle, la proposition de projet doit porter sur toutes les installations de production qui existent au pays pour l'utilisation à l'étude.
4. Les propositions de projet doivent être préparées en vertu de toutes les politiques et lignes directrices du Comité exécutif. Notamment, le remplacement du vieux par du neuf dans les usines et les mises à niveau technologiques doivent être examinés en vertu des décisions 18/25 et 26/37.
5. Les projets originaux seront examinés pour les utilisations figurant au tableau A de la décision X/14 afin de fournir de l'information sur les réductions d'émissions réalistes réalisables et les coûts associés.
6. Les projets doivent préciser les mesures pertinentes proposées afin de contrôler les émissions (p. ex., technologies de contrôle des émissions, reconversion des procédés, rationalisation ou fermeture de l'usine), le rapport coût-efficacité et les réductions d'émissions qui seront réalisées.
7. Qu'il s'agisse de contrôle des émissions ou de changement de procédé, la proposition doit inclure une évaluation des coûts différentiels de la réalisation de réductions importantes des niveaux d'émission pour chaque technique.
8. Le rapport coût-efficacité des projets d'agents de transformation sera d'abord examiné au cas par cas afin d'obtenir suffisamment d'information pour établir un rapport coût-efficacité pertinent, en temps et lieu.

Annexe IV

Projets d'agents de transformation approuvés par le Comité exécutif

Pays	Agence	Titre du projet	PAO à éliminer	Date de l'approbation	Montant total approuvé
Projets individuels					
Inde	BIRD	Élimination du tétrachlorure de carbone comme agent de transformation dans la production d'endosulfan à Excel Industries Limited	375,0	Juillet 1999	366 000
Inde	ONUDI	Reconversion du tétrachlorure de carbone au dichlorure d'éthylène comme agent de transformation à Satya Deeptha Pharmaceuticals Ltd., Humnabad	27,9	Décembre 2000	260 133
Inde	ONUDI	Reconversion du tétrachlorure de carbone au trichlorométhane comme agent de transformation à M/S Alpha Drugs India Ltd., Patiala	69,7	Décembre 2000	145 505
Inde	ONUDI	Reconversion du tétrachlorure de carbone au dichlorure d'éthylène comme agent de transformation à Svis Labs Ltd., Ranipet	54,2	Décembre 2000	249 463
Inde	ONUDI	Reconversion du tétrachlorure de carbone au dichlorure d'éthylène comme agent de transformation à Doctors Organic Chemicals Ltd., Tanuku	94,6	Décembre 2000	288 180
Inde	ONUDI	Reconversion du tétrachlorure de carbone au monochlorobenzène comme agent de transformation à M/S Benzo Chemical Industries, Tarapore	23,0	Juillet 2001	136 786
Inde	ONUDI	Reconversion du tétrachlorure de carbone au monochlorobenzène comme agent de transformation à Pradeep Shetye Ltd., Alibagh	133,9	Juillet 2001	279 001
Inde	ONUDI	Reconversion du tétrachlorure de carbone au dichlorure d'éthylène comme agent de transformation à Chiplun Fine Chemicals Ltd., Ratnagiri	16,7	Juillet 2001	155 830
Inde	ONUDI	Reconversion du tétrachlorure de carbone au monochlorobenzène comme agent de transformation à FDC Limited, Roha	34,1	Juillet 2001	238 371
Inde	ONUDI	Reconversion du tétrachlorure de carbone au monochlorobenzène comme agent de transformation à GRD Chemicals Ltd., Indore, M.P.	17,9	Juillet 2001	127 667
Inde	BIRD	Reconversion du tétrachlorure de carbone à un procédé sans SAO dans la fabrication de caoutchouc chloré à Rishiroop Organics Pvt. Ltd.	248,8	Juillet 2001	2 074 300
Inde	ONUDI	Reconversion du tétrachlorure de carbone au cyclohexane comme agent de transformation à Amoli Organics Limited, Mumbai	38,5	Décembre 2001	385 367
Pakistan	ONUDI	Reconversion du tétrachlorure de carbone au 1,2-dichloroéthane comme agent de transformation à Himont Chemicals Ltd.	80,0	Décembre 2001	485 701

Plans sectoriels					
Chine	BIRD	Élimination de la production et de la consommation de tétrachlorure de carbone comme agent de transformation et autres utilisations non identifiées (phase I)		Novembre 2002	65 000 000
Inde	BIRD/France/ Allemagne/ Japon	Élimination des secteurs de la production et de la consommation de tétrachlorure de carbone		Juillet 2003	52 000 000
RPD Corée	ONUDI	Plan pour l'élimination finale de tétrachlorure de carbone		Décembre 2003	5 684 844