Short Chain Chlorinated Paraffins (SCCP)
Substance Dossier

FINAL DRAFT II

Prepared for:
UNECE ad hoc Expert Group on POPs

Revised:  May 16, 2003
NOTE TO READERS

This Draft II Substance Dossier on Short-chain chlorinated paraffins was prepared by Canada for consideration by the UNECE Convention on Long-range Transboundary Air Pollution’s Expert Group on POPs at its fourth meeting - March 17-19, 2003 in Oslo, Norway. The May 16, 2003 version incorporates consideration of comments and advice received from Experts at the Oslo meeting.

While the Expert Group has assisted Canada in preparing this dossier by providing comments and information, all conclusions reflect the opinion of the Canadian team of experts that prepared the Dossier.

CONTACT

Greg Filyk
A/Chief Hazardous Air Pollutants
Environment Canada
Transboundary Air Issues Branch
351 St. Joseph Blvd., 11th Floor
K1A 0H3
Canada

tel. (819) 953-5945
fax. (819) 994-3479
email greg.filyk@ec.gc.ca

ACKNOWLEDGEMENTS

I would like to thank the following individuals for their significant investment of time, effort and expertise in preparing this dossier:

- Lesley Lander and Marisol Eggleton - Environment Canada - Toxics Pollution Prevention Directorate
- Dr. Derek Muir - Environment Canada - National Water Research Institute
- Dr. Keith Puckett - Environment Canada - Meteorological Service of Canada

I would also like to thank members of the Expert Group and private organizations who have provided comments on this substance dossier. These comments have been considered and I hope that you will find improvements in this second draft of the SCCP dossier as a result.

Greg Filyk
Canadian Expert on the Expert Group on POPs
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1. INTRODUCTION

1. DEVELOPMENT OF A DOSSIER FOR THE UNECE AD HOC EXPERT GROUP ON SHORT-CHAIN CHLORINATED PARAFFINS (SCCPs)

The second meeting of the UNECE Convention on Long-range Transboundary Air Pollution’s Expert Group on Persistent Organic Pollutants (POPs) was held in Torun, Poland on October 24-26, 2001. At that meeting, the Expert Group noted interest to consider short-chain chlorinated paraffins (SCCPs) as a possible new substance for addition to the UNECE POPs Protocol. In response, Canadian expert Greg Filyk offered to prepare an information dossier on this substance. The work would be based on the assessment information developed in Canada and take account of material prepared in the framework of Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and of the European Community.

A preliminary draft SCCP Dossier of March 2002 (hereafter referred to as the “Draft 1 SCCP Dossier”) was presented by Mr. Filyk at the third meeting of the Expert Group, which was held in Geneva, Switzerland on June 5-6, 2002. The Expert Group provided comments on the Draft 1 SCCP Dossier prior to and during the meeting (Appendix 3A). In response to these comments, Canada prepared a separate “Responses to Comments” document, which was submitted to the UNECE secretariat on January 21, 2003 (included as Appendix 3B). This Draft II SCCP Dossier has been modified to reflect the “Response to Comments” (Appendices 3C and 3D), as well as additional comments received prior to the Feb. 28, 2003 submission of this document to the UNECE secretariat for consideration by the Expert Group at its March 17-19, 2003 meeting in Oslo, Norway.

2. CANADIAN WORK ON SCCPs

Environment Canada is currently preparing a domestic follow-up report on short-, medium- and long-chain chlorinated paraffins for the Canadian Priority Substances Assessment Program. The first Priority Substances report on chlorinated paraffins was published in 1993, but contained many data gaps. The follow-up report will contain more recent information on environmental concentrations of short-chain chlorinated paraffins, provided by Canadian scientists.

New information on chlorinated paraffins, including SCCPs, has been developed by Canadian scientists and more information is anticipated. As this information becomes available, Environment Canada is willing to respond further to comments received by the Expert Group and to provide this information to support further development of the SCCP Dossier. Therefore, this SCCP Dossier is considered to be a working document, subject to future revision at the discretion of the Expert Group and Canada as lead author.
PART I. RISK PROFILE

A. CHEMICAL IDENTITY

Chlorinated paraffins (CPs) are chlorinated derivatives of n-alkanes, having carbon chain lengths ranging from 10 to 38, and a chlorine content ranging from about 30 to 70% (by weight). Commercial products, of which there are over 2000, (Serrone et al., 1987) are complex mixtures of homologues and isomers. The products vary in the distribution, possibly type, and range of chain lengths, and in the degree of chlorination. The 2001 Questionnaire on the use and production of POPs and other substances in the UNECE region (UNECE questionnaire) defines SCCPs as having a carbon length of between 10 and 13 carbon atoms, and a chlorine content of between 30% and 70%, by weight.

Short Chain Chlorinated Paraffins (SCCPs) have low vapour pressure values ($2.8 \times 10^{-7}$ to 0.5 Pa) that are in the range of some persistent organic pollutants that are known to undergo long-range atmospheric transport (Tomy et al., 1998a). Vapour pressures tend to decrease with increasing carbon chain length and degree of chlorination (Drouillard et al., 1998). Henry’s law constants for C$_{10-12}$ SCCPs range from 0.7 to 18 Pa·m$^3$/mol (ibid), which is similar to the range of Henry’s law constants for some chlorinated pesticides (e.g., hexachlorocyclohexane, toxaphene) and implies partitioning from water to air or from moist soils to air, depending on environmental conditions and prevailing concentrations in each compartment.

The melting point of CPs increases with increasing carbon chain length and with increasing chlorine content. Consequently, at room temperature, CPs range from colourless to yellowish liquids at about 40% chlorine, to white solids (softening point at about 90°C) at 70% chlorine. Chlorinated paraffins have very low solubilities in water, ranging from from 22.4 to 994 µg/L for some of the short chain mixtures (Drouillard et al. 1998b in Tomy et al. 1998a). Log octanol/water partition coefficients ($K_{ow}$) for SCCPs measured by Sijm and Sinnige (1995) and Fisk et al. (1998a) ranged from 5.85 to 7.14 (in Tomy et al., 1998a).

B. PERSISTENT ORGANIC POLLUTANT CHARACTERISTICS

1. Potential for long range atmospheric transport

According to Decision 1998/2 of the POPs to the UNECE 1979 Convention on Long-Range Transboundary Air Pollution (hereafter referred to as the UNECE POPs Protocol) (see Appendix 1), potential for long-range transboundary atmospheric transport is determined by evidence that the substance has a vapour pressure below 1,000 Pa and an atmospheric half-life greater than two days. Alternatively, monitoring data showing that the substance is found in remote regions may be used as evidence.
This section presents the evidence that SCCPs are subject to long-range transboundary atmospheric transport, with modelled half-life data, as well as data from air, sediment and biota samples from the Canadian Arctic and other locations in the northern hemisphere.

*Atmospheric Half-Life*

No experimental data are available on the fate of any chlorinated paraffin which volatilizes into the atmosphere. However, it may be assumed that they would be subject to attack by hydroxyl radicals in the troposphere (Government of Canada, 1993a). The Syracuse Research Corporation AOPWIN (v1.86) computer program was used to estimate rate constants for several SCCPs. This program uses the methodology outlined by Meylan and Howard (1993), which builds on work carried out in several papers published by R Atkinson (e.g. Atkinson, 1987). The results of the estimates are shown in Table 1. The program estimates atmospheric half-lives from the estimated rate constants by assuming an atmospheric hydroxyl radical concentration of $1.5 \times 10^6$ molecules/cm$^3$ during sunlight hours. In the risk assessment methodology used in the EU, a lower concentration of $5 \times 10^5$ molecules/cm$^3$ is generally used as a daily (24 hour) average, which is typically found in relatively unpolluted air. The estimated half-lives obtained using both the AOP program and the EU methodology are included in Table 1. The estimated atmospheric half-life is greater than 2 days for a large number of example structures, which would classify SCCPs as having the potential for long-range transboundary atmospheric transport, pursuant to Decision 1998/2, Paragraph 1(a) of the UNECE POPs Protocol (see Appendix 1).

Assessment of the physical properties of SCCPs using a plot of air-water partition coefficient versus octanol-water partition coefficient (van de Meent et al. 2000) shows that SCCPs are “multimedia” chemicals. They partition into more than one environmental medium depending on prevailing conditions. At low temperatures (<0°C) SCCPs will be transported on aerosols. There is evidence that particle-borne transport is an important pathway for POPs, e.g. observations of elevated DDT, polychlorinated naphthalenes (PCNs) and polycyclic aromatic hydrocarbons (PAHs) in winter time at Alert (northern tip of Ellesmere Island, Nunavut, Canada). Unfortunately, there are few measurements of SCCPs in particles. SCCPs were not detected in particles trapped on filters at Alert (1994 archived sample extracts). Measurements in the UK have demonstrated that SCCPs are mainly (>95%) in the gas phase at temperatures ranging from 9-28°C (Peters et al. 2000).

The major structures observed in environmental samples, such as in Arctic air and beluga, C$_{10}$H$_{17}$Cl$_5$, C$_{10}$H$_{16}$Cl$_6$, C$_{10}$H$_{15}$Cl$_7$, C$_{11}$H$_{18}$Cl$_6$, C$_{11}$H$_{17}$Cl$_7$, C$_{12}$H$_{20}$Cl$_6$, C$_{12}$H$_{19}$Cl$_7$, all have estimated atmospheric half-lives > 2 days. Furthermore these structures predominate in SCCP products analysed by Tomy (1997).
Table 1. Estimated atmospheric half-lives for SCCPs calculated using the Syracuse Research Corporation AOPWIN computer program

<table>
<thead>
<tr>
<th>Example structure</th>
<th>Chlorine content (% by weight)</th>
<th>Estimated kOH ( \text{cm}^3 \text{ molecule}^{-1} \text{s}^{-1} )</th>
<th>Estimated atmospheric half-life (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{C}<em>{10}\text{H}</em>{21}\text{Cl} )</td>
<td>20.1</td>
<td>( 9.75 \times 10^{-12} )</td>
<td>( [\text{OH}] = 1.5 \times 10^6 ) molecules/cm(^3) (12 hours sunlight/day)</td>
</tr>
<tr>
<td>( \text{C}<em>{10}\text{H}</em>{20}\text{Cl}_2 )</td>
<td>33.6</td>
<td>( 8.16 \times 10^{-12} )</td>
<td>( 1.3 )</td>
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<tr>
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<td>43.4</td>
<td>( 6.57 \times 10^{-12} )</td>
<td>( 1.6 )</td>
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<tr>
<td>( \text{C}<em>{10}\text{H}</em>{18}\text{Cl}_4 )</td>
<td>50.7</td>
<td>( 5.17 \times 10^{-12} )</td>
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<tr>
<td>( \text{C}<em>{10}\text{H}</em>{17}\text{Cl}_5 )</td>
<td>56.4</td>
<td>( 5.22 \times 10^{-12} )</td>
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<tr>
<td>( \text{C}<em>{10}\text{H}</em>{16}\text{Cl}_6 )</td>
<td>61.0</td>
<td>( 3.77 \times 10^{-12} )</td>
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<tr>
<td>( \text{C}<em>{10}\text{H}</em>{15}\text{Cl}_7 )</td>
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<td>( \text{C}<em>{10}\text{H}</em>{14}\text{Cl}_8 )</td>
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<td>( \text{C}<em>{10}\text{H}</em>{13}\text{Cl}_9 )</td>
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<td>( \text{C}<em>{10}\text{H}</em>{12}\text{Cl}_{10} )</td>
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<td>( \text{C}<em>{13}\text{H}</em>{22}\text{Cl}_1 )</td>
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<td>( \text{C}<em>{13}\text{H}</em>{21}\text{Cl}_2 )</td>
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<td>( 9.35 \times 10^{-12} )</td>
<td>( 1.1 )</td>
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<td>( \text{C}<em>{13}\text{H}</em>{19}\text{Cl}_4 )</td>
<td>44.1</td>
<td>( 7.76 \times 10^{-12} )</td>
<td>( 1.4 )</td>
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<td>( \text{C}<em>{13}\text{H}</em>{18}\text{Cl}_5 )</td>
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<td>( \text{C}<em>{13}\text{H}</em>{17}\text{Cl}_6 )</td>
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<td>( \text{C}<em>{13}\text{H}</em>{16}\text{Cl}_7 )</td>
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<td>( 4.39 \times 10^{-12} )</td>
<td>( 2.4 )</td>
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<td>( \text{C}<em>{13}\text{H}</em>{13}\text{Cl}_{10} )</td>
<td>67.1</td>
<td>( 3.34 \times 10^{-12} )</td>
<td>( 3.2 )</td>
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<td>( \text{C}<em>{13}\text{H}</em>{12}\text{Cl}_{11} )</td>
<td>69.3</td>
<td>( 2.30 \times 10^{-12} )</td>
<td>( 4.7 )</td>
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<td>( \text{C}<em>{13}\text{H}</em>{11}\text{Cl}_{12} )</td>
<td>71.3</td>
<td>( 1.40 \times 10^{-12} )</td>
<td>( 7.7 )</td>
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<tr>
<td>( \text{C}<em>{13}\text{H}</em>{10}\text{Cl}_{13} )</td>
<td>73.0</td>
<td>( 1.31 \times 10^{-12} )</td>
<td>( 8.2 )</td>
</tr>
</tbody>
</table>

Van Pul et al (1998) modelled the atmospheric transport of SCCPs. Taking into account wet and dry deposition processes, and using a relatively long photochemical degradation half-life of 96 hours, they predicted atmospheric half-lives for SCCP of 23 hours over land, and 27 hours over the sea. Unfortunately the physical property data used by Van Pul et al (1998) for SCCPs are not provided and their source is unclear. Their study predates the publication of VPs by Drouillard et al (1998) as well as other physical properties that apply to individual formula groups.
Ambient air

Canadian government scientists conducted studies designed to determine whether SCCPs were present in remote Canadian environments, to compare samples from remote and more industrialized regions and to examine sewage treatment effluents. All analyses were done by high-resolution gas chromatography negative ion mass spectrometry, as reported by Tomy et al. (1997). The use of this method results in higher specificity than was achieved with previous methods, which used low-resolution gas chromatography negative ion mass spectrometry to measure the SCCP parent ions or chloride ions (Jansson et al., 1993; Reiger and Ballschmiter, 1995).

Air samples were collected in high-volume samplers containing 20-cm-diameter polyurethane foam plugs with a glass fibre filter. Samples were collected over 1-week periods with nominal air volumes of about 11 400 m³ (Fellin et al., 1996). SCCPs were detected in four individual samples of air collected at Alert, Nunavut, at the northern tip of Ellesmere Island in the high Canadian Arctic (Table 2). Concentrations ranged from <1 to 8.5 pg/m³ in gas-phase samples.

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Total SCCP concentration (pg/m³)</th>
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<tbody>
<tr>
<td>Alert, Nunavut¹</td>
<td>September 14, 1992</td>
<td>5.7</td>
</tr>
<tr>
<td>Alert, Nunavut</td>
<td>September 21, 1992</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Alert, Nunavut</td>
<td>September 28, 1992</td>
<td>2.1</td>
</tr>
<tr>
<td>Alert, Nunavut</td>
<td>December 28, 1992</td>
<td>8.5</td>
</tr>
<tr>
<td>Alert, Nunavut²</td>
<td>July (Weeks 25-28) 1994</td>
<td>4.39</td>
</tr>
<tr>
<td>Alert, Nunavut</td>
<td>Aug (Weeks 29-32) 1994</td>
<td>7.25</td>
</tr>
<tr>
<td>Alert, Nunavut</td>
<td>Sept (Weeks 33-36) 1994</td>
<td>6.14</td>
</tr>
<tr>
<td>Egbert, Ontario³</td>
<td>May 2, 1990</td>
<td>65</td>
</tr>
<tr>
<td>Egbert, Ontario</td>
<td>May 26, 1990</td>
<td>500</td>
</tr>
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<td>Egbert, Ontario</td>
<td>June 19, 1990</td>
<td>525</td>
</tr>
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<td>Egbert, Ontario</td>
<td>July 13, 1990</td>
<td>924</td>
</tr>
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<td>Lake Ontario⁴,⁵</td>
<td>July 1999</td>
<td>249, 1510</td>
</tr>
<tr>
<td>Lake Ontario⁵</td>
<td>October 2000</td>
<td>120, 430</td>
</tr>
</tbody>
</table>

¹ Alert data from Tomy (1997). Note: The blank values for the Alert data were about 1 pg/m³. The blank value was not subtracted from the sample values in the Table.
² Bidleman et al. 2001
³ Egbert data from Tomy et al. 1998a and Tomy (1997)
⁵ Muir, D.C.G. unpublished data 2001. Blank subtracted results from 2 hi vol air samples collected from the CSS Limnos July 7-9/99 and October 30/00 over Lake Ontario

Recent measurements of SCCPs in archived samples from Alert in 1994 have confirmed concentrations observed earlier by Tomy (1997). These recent results were reported in a Northern Contaminants Program Synopsis report (Bidleman et al. 2001) and are in the
Canadian Arctic Monitoring and Assessment Program POPs assessment (October 2002). SCCPs were also measured in Arctic air by the Norwegian Institute for Air Research at Ny Alesund in Svalbard, Norway (Borgen et al. 2000).

Blank samples from the air sampling program at Alert also contained low levels of SCCPs (1 pg/m$^3$), which is lower than concentrations found in the air samples. Heptachloroundecane was the major component of the SCCPs. The higher SCCP concentrations at Egbert (Table 2) are consistent with its location near the highly populated and industrial area of southern Ontario.

In the U.K., Peters et al. (2000) reported a mean SCCP concentration of 99 pg/m$^3$ in air collected from a semi-rural site in Lancaster. As discussed in Stern and Tomy (2000), SCCP concentrations in air were ranked such that Egbert $>$ Lancaster $>$ Alert, and most likely reflects the proximity of Egbert and Lancaster to local source areas.

The profiles of SCCPs at Alert resemble those measured in Lancaster but are quite different from those at Egbert and over western Lake Ontario. This is illustrated in Figures 1 and 2. In Figure 1 the individual “formula groups” for each carbon chain length within the SCCP mixture are plotted for Egbert and Lancaster. These graphics are taken from Tomy et al. (1998) and Peters et al. (2000). From Figure 2 it is clear that Egbert air samples have higher proportions of penta-, hexa- and heptachlorodecanes and undecanes compared to Lancaster, while Lancaster air has higher proportions of hexa-,hepta- and octa- dodecanes and tridecanes than Egbert air. Both locations are north of major urban areas (Lancaster is about 70 km north of the Manchester –Liverpool area and Egbert is about 50 km north of Toronto), so the reasons for the differences in homologue patterns between Lancaster and Egbert are not clear.

In Figure 2, the proportions of SCCP chain length groups are compared at 4 locations. It can be seen that the profile of SCCP components in Egbert air in summer 1990 resembles air over western Lake Ontario collected in July 1999 (Muir et al. 2000) in that both have high proportions of chlorodecanes and -undecanes. However, the profile in Alert air resembles that at Lancaster but differs from the southern Ontario sites by having higher proportions of chlorododecanes. These differences appear to be consistent over time. Analysis of air samples collected in October 2000 over western Lake Ontario showed the same profile as in July i.e. higher chloro-decanes and –undecanes despite much lower air temperatures (Muir, Unpublished data). The reasons for these differences are not clear. The Alert site is very remote from urban areas and does receive air predominately from sources in Europe and Asia because of its unique geographic location. However this is more pronounced in winter than summer months (Halstall et al. 1997). The three other sites are outside of, but within 100 km of urban areas.

Borgen et al. (2000) measured SCCPs in arctic air samples taken at Mt. Zeppelin, Svalbard, Norway during the period March to May, 1999. Concentrations ranging from 9.0 to 57 pg/m$^3$ were found, which are higher than those found at Alert.
from Egbert, ON in 1990 (Tomy et al. 1998a) and Lancaster UK air (Peters et al. 2000)

Figure 2. Proportions of SCCP chain length groups in air at four locations. Lake Ontario data from Muir et al. (2000)

Water

The very low solubility in water and low vapour pressure of SCCPs would predict low mobility, but monitoring data in the U.K. and Sweden indicate widespread low levels of contamination in water, sediments, aquatic and terrestrial organisms and even commercial foods (Government of Canada, 1993b). Some airborne and possibly waterborne dispersion does therefore occur.

Ocean transport of SCCPs may also be important. Water solubilities of SCCPs are higher than for cyclic or aromatic organochlorines.
Sediments

Surface sediment samples collected during the 1997 and 1998 Joint Ocean Ice Studies (JOIS) cruise track through the Canadian Archipelago to the Surface Heat Budget of the Arctic (SHEBA) site in the Canadian Basin interior were analyzed for SCCPs (Stern 2003). Sediment concentrations ranged from 4.8 to 77.4 ng/g. A clear decreasing trend in concentrations was observed from south (Barrow Strait) to north (Peary Channel) and western Arctic (M’Clure Strait/Viscount Melville) sediment concentrations were lower than in the eastern Arctic (Nanisivik/Lancaster Sound) sediments. Lower chlorinated C_{10} and C_{11} formula groups predominate in the sediment relative to that of water from the same region and Alert air suggesting that these two groups may be less susceptible to microbial degradation.

SCCPs have also been detected in sediments from Hazen Lake (northern Ellesmere Is.) and in Yaya River, (Mackenzie river delta, N.W.T) in the Canadian Arctic (Tomy et al., 1999), and recently in sediments from lake DV09 a very remote on Devon Island, Nunavut (Stern 2003; see Figure 3) at low ng/g levels. Results for Hazen Lake and. (Tomy et al. 1999), are close to detection limits, however the analysis also showed that SCCPs are readily detectable above a method detection limit (MDL) based on sediment samples predating 1900 that were used as blanks.

The sediment core from Lake DV09, Devon Island, Nunavut, Canada is laminated (or varved) and therefore has much less mixing than the cores analysed by Tomy et al. (1999) hence the SCCP profile is sharper than reported in the latter paper (Figure 3). A full geochemical description of this core is given by Lockhart et al. (2000). SCCP concentrations in DV09 surface sediments were higher than in Hazen and Yaya. However the SCCP stratigraphy in DV09 shows the same trends as Hazen Lake and Yaya River.

The detection of SCCPs in DV09 is very good evidence for long range transport and deposition in the arctic. The downcore profile clearly shows that SCCPs concentrations are well above concentrations in the lowest depth slices, dated to prior to manufacture of SCCPs. These “premanufacture” sediments are good indicators of the relative amount of sampling and laboratory contamination especially in the case of laminated sediments where little or no physical mixing occurs. The detection of SCCPs at this remote site and also in other remote arctic lakes especially Yaya River in the Mackenzie river delta, where levels were also well above background, illustrates the wide dispersal of these compounds.

Table 3. Locations, concentrations and fluxes of SCCPs in 3 Arctic lake sediment cores (Tomy et al. 1999; Stern 2003)

<table>
<thead>
<tr>
<th>Lake</th>
<th>Lat/Long</th>
<th>Surface conc (ng/g dw)</th>
<th>Sedimentation rate (g m^{-2} yr^{-1})</th>
<th>Focusing Factor</th>
<th>Flux (ng m^{-2} yr^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yaya</td>
<td>69°10’N;134°39’W</td>
<td>1.6</td>
<td>476</td>
<td>1.6</td>
<td>454</td>
</tr>
<tr>
<td>DV09</td>
<td>75°34’N;89°19’W</td>
<td>17.6</td>
<td>304</td>
<td>2.4</td>
<td>2214</td>
</tr>
<tr>
<td>Hazen</td>
<td>81°45’N;71°30’W</td>
<td>4.5</td>
<td>278</td>
<td>4.5</td>
<td>893</td>
</tr>
</tbody>
</table>
Focussing factor is the particle focussing estimated from the ratio of unsupported Pb$^{210}$ in the sediment divided by unsupported Pb$^{210}$ in soils at the same latitude. Particle focussing occurs in lakes as fine particles move from shallower to deeper zones.

Fluxes of SCCPs to these Arctic lakes are higher than for PCBs which range from about 100-500 ng m$^{-2}$yr$^{-1}$ at these latitudes (Muir et al. 1996a).

**Figure 3. Concentration profile of SCCPs in a dated, laminated, core from Lake DV09 on Devon Island, Nunavut, Canada. (Stern 2003)**

**Biota**

Tomy *et al.* (2000) reported SCCPs in the blubber of ringed seal (*Phoca hispida*) from Eureka, Nunavut, Canada, southwest Ellesmere Island, beluga whales (*Delphinapterus leucas*) from northwest Greenland and the Mackenzie Delta, Northwest Territories, Canada, and walrus (*Odobenus rosmarus*) from northwest Greenland at concentrations ranging from 110 to 770 ng/g wet weight (Table 4). The data in Table 4 show that concentrations of SCCPs in the St. Lawrence beluga were approximately 4 times higher than concentrations of SCCPs in Greenland and Mackenzie Delta belugas. The elevated levels of SCCPs in belugas from the St. Lawrence River are consistent with the findings of elevated levels of other organochlorines by Muir *et al.* (1996b), who suggested that this was a food chain effect attributed to local source contamination.

In comparing average concentrations in Arctic and St. Lawrence beluga, there are differences in concentrations of about 4-fold. Why there are not greater differences is not known but one possibility is that cetaceans are capable of degrading SCCPs so that high concentrations are not achieved. The same is true for 2378-TCDD in beluga which was not detected in both St. Lawrence and Arctic animals. Similarly, hexacyclohexane (HCH) isomers are present at similar levels in both groups.

The pattern of SCCP chain length/chlorine groups differs between the Arctic and St. Lawrence beluga which points to different sources, i.e., Arctic animals have a pattern
enriched with more volatile (mobile) components. Similar differences are seen for PCB congeners between Arctic and St. Lawrence beluga.

The concentrations of contaminants observed in beluga in the St Lawrence cannot be compared with concentrations measured in seals in Ellesmere Island. Only within species comparisons are possible because pinnipeds (i.e. seals, walrus) are known to handle persistent organochlorines quite differently from cetaceans (i.e. whales). For example 2378-TCDD (dioxin) does not bioaccumulate to any extent in cetaceans which seem to have a unique capacity to degrade planar organics, but does bioaccumulate in pinnipeds.

Tomy et al. (1998b) reported mean SCCP concentrations of 630, 200, 320 and 460 ng/g in blubber from male beluga collected in Hendrickson Island (Southern Beaufort Sea near the Mackenzie River delta), Arviat (western Hudson Bay), Sanikluaq (Belcher Island area in southern Hudson Bay) and Pangnirtung (south eastern Baffin Island), Canada, respectively.

Stern and Tomy (2000) noted that Arctic animal formula group profiles showed higher proportions of the lower chlorinated congeners (Cl5-Cl7), and Tomy et al. (2000) also observed that the concentration profiles for the Arctic marine mammals show a predominance of the shorter carbon chain length congeners, i.e., the C10 and C11 formula groups. This is significant, because Drouillard et al. (1998) have shown that these less chlorinated formula groups and shorter-chain congeners are the more volatile components of SCCP mixtures, which show a trend of decreasing vapour pressures with increasing carbon chain length and degree of chlorination. Tomy et al. (2000) concluded that “although only a few samples have been analyzed in this study, it is clear that SCCPs are present in Arctic food webs and are being transported to these remote regions either in the atmosphere or ocean currents.”
In St. Lawrence beluga, the formula group profile more closely resembles that of PCA-60 which implies that local sources of polychlorinated \( n \)-alkanes, possibly from the Great Lakes and/or the lower industrialized regions of the St. Lawrence River, predominate in the St. Lawrence River estuary (Tomy et al. 2000).

There are few other published data on SCCPs in marine mammals for comparison, and differences in analytical methodology make comparisons between studies problematic. Jansson et al. (1993) reported a chlorinated paraffin concentration of 130 ng/g lipid weight in ringed seal blubber from Svalbard, Iceland, which is 3 to 6 times less than levels found by Tomy et al. (2000) in ringed seal from Ellesmere Island. (Note: the substances measured in Jansson’s study were chlorinated paraffins of unspecified chain length with 6-16 chlorine atoms/molecule, and so could have also included medium-chain chlorinated paraffins).

Jansson et al. (1993) found SCCP concentrations in other marine biota in locations above the Arctic Circle (60° N) ranging from 130 ng/g in ringed seal from Kongsfjorden.
Svalbard, Iceland to 4400 ng/g in moose from Grimsö, Sweden. The SCCP concentrations in whitefish (Lake Strovindeln), was 280 ng/g, and herring from the Bothnian Sea were 1400 ng/g.

Conclusions

Estimates of atmospheric half-lives for SCCPs using the AOPWIN and EU methodology are greater than 2 days for a large number of example structures, which would classify them as having the potential for long-range transboundary atmospheric transport, pursuant to Decision 1998/2, Paragraph 1(a) of the UNECE POPs Protocol (see Appendix 1). As well, the detection of the more volatile shorter carbon chain length congeners of SCCPs in Arctic air samples, biota and lake sediments in the absence of significant sources of SCCPs in this region suggests that these residues are present due to long-range atmospheric transport.

2. Toxicity

According to Decision 1998/2 of the UNECE POPs Protocol (see Appendix 1), a substance may be considered as toxic if it has potential to adversely affect human health and/or the environment. This section presents information on the toxicity of SCCPs.

Human Health

The Canadian risk assessment of chlorinated paraffins (Government of Canada 1993a) concluded that SCCPs were toxic based on their potential danger to human life and health in Canada. A brief summary of the data used to arrive at this conclusion is presented below.

The Canadian risk assessment of chlorinated paraffins concluded that SCCPs are carcinogenic, and therefore toxic as defined under Paragraph 11(c) of CEPA 1988 (Government of Canada 1993a). This conclusion was based primarily on a carcinogenesis bioassay (NTP 1986a; Bucher et al. 1987) which showed “clear evidence of carcinogenicity of chlorinated paraffins (C₁₂, 60% Cl) in B6C3F₁ mice and F344/N rats” (Government of Canada 1993a). SCCPs were therefore classified as being non-threshold toxicants - substances for which there is some probability of harm for the critical effect at any level of exposure.

The following information taken directly from UN Economic and Social Council (ESC) (2002) provides further information about the health effects of SCCPs:

“The main environmental source of human exposure is food and, to a lesser extent, drinking water. The risk of human exposure related to long-range transboundary atmospheric transport is difficult to quantify but should not be neglected. The lack of monitoring data hampers reliable exposure estimation. Levels in food in the range of 30 to several thousands µg/kg have been measured. The European
Union’s risk assessment report considers a human uptake value of about 20 µg/kg bw/day as a reasonable worst-case value.

The main target organs for repeated doses of SCCPs seem to be the liver, kidney and thyroid. SCCPs show neoplastic effects in the liver of mice and rats, however the relevance of this evidence for humans is uncertain.

In 1996, WHO recommended that daily doses of SCCPs for the general population should not exceed 11 µg/kg bw for neoplastic effects (tumor formation).

Long-range transboundary atmospheric transport is an important aspect of the global distribution of SCCPs and is responsible for their occurrence in remote areas.

The EU risk assessment report (European Commission 2000) concludes that there is no significant risk to man exposed to SCCPs via the environment. However, the EU worst-case human uptake estimate is greater than the guideline value established by WHO.”

Europeans may therefore be exposed to concentrations of SCCPs in excess of the WHO human health guideline.

High concentrations of SCCPs (100-770 µg/kg) have been found in the blubber of belugas, ringed seals and walrus from areas remote from point sources (see Table 4). Aboriginal peoples living in the Arctic consume these animals as food, and therefore may be exposed to SCCPs at concentrations greater than the WHO health guideline.

Aquatic

There have been only a limited number of recent studies on the aquatic toxicity of SCCPs published since the reviews of Tomy et al., (1998a) and the risk assessment of SCCPs by the European Union (European Commission, 2000). Fisk et al (1999) studied the toxicity of four C10, C11 and C12-SCCP compounds (single chain lengths with mixtures of isomers) to Japanese medaka (Oryias latipes) embryos. Lowest observable effects concentrations (LOECs) ranged from 55 ug/L for C12H20Cl7 to 460 ug/L for C10H15Cl7. Toxicity was independent of carbon chain length and chlorine content. The mechanism of acute toxicity of the embryos was suggested to be narcosis.

Cooley et al. (2001) examined the behavior and liver and thyroid histology of juvenile rainbow trout of the same four C10, C11 and C12-SCCP compounds via dietary exposure. The exposed trout showed responses indicative of a narcotic mode-of-action such as delayed or absent startle response and reduced feeding. Severe liver histopathologies were observed in trout exposed to C10H15Cl7 and C11H18Cl6 (whole fish concentrations of 0.92 and 5.5 ug/g wet wt., respectively) consisting of extensive fibrous lesions not seen in controls or lower exposed fish. No thyroid lesions were observed.
The concentrations causing adverse effects in the above studies are within the range of SCCPs concentrations seen in carp from Hamilton Harbour (Muir et al. 2000) and in yellow perch from the Detroit River (Tomy et al 1997) but considerably higher than found in Lake Ontario fishes (see Table 10). Nevertheless this suggests that histological effects could occur in fish in near field exposures such as Areas of Concern in the Great Lakes.

The aquatic toxicity presented below represent critical studies that were reported in the assessment that was completed and published in 1993 (Government of Canada, 1993a). Statistically significant effects were observed in the common mussel following chronic exposure to concentrations greater than and equal to 9.3 \( \mu \text{g/L} \) of a short chain CP (58\% Cl) (Thompson and Shillabeer, 1983). Fifty percent mortality occurred for daphnia after 6 days of exposure to 10 \( \mu \text{g/L} \) (Thompson and Madeley, 1983a), and for the mysid shrimp after 96 h exposure to 14 \( \mu \text{g/L} \) (Thompson and Madeley, 1983b). Lethal effects of a 58\% Cl SCCP were observed in rainbow trout at concentrations greater and equal to 33 \( \mu \text{g/L} \) after 9 to 12 days (Madeley and Maddock, 1983a).

The most sensitive measurement endpoint identified for a pelagic freshwater aquatic species is 5 \( \mu \text{g/L} \), which is the 21-day chronic No-Observed-Effect Concentration (NOEC) for \textit{Daphnia magna} (Thompson and Madeley, 1983a). This was also the same endpoint used by the European Union (European Commission, 2000) to determine their Predicted No-Effect Concentration (PNEC) for the aquatic compartment. Effects on \textit{Daphnia magna} have been reported at concentrations not much higher than the NOEC; for example, in a 14-day static-renewal study using daphnids, 50\% mortality was observed after 5 days at 10 \( \mu \text{g/L} \) (Thompson and Madeley, 1983a). The most sensitive measurement endpoint identified for a marine species by Government of Canada (1993a) and by European Commission (2000) is 7.3 \( \mu \text{g/L} \), which is the 28-day chronic NOEC for the mysid shrimp \textit{Mysis bahia} (Thompson and Madeley, 1983b).

The critical toxicity values described above are comparable or above values of SCCPs which have been found in the environment and wildlife:

Concentrations of CPs measured in marine and fresh waters remote from industry in the U.K (from European Commission 2000): The concentration of C10-20 chlorinated paraffins in marine waters are in the range 0.5-4 \( \mu \text{g/l} \). Around half the samples contained detectable amounts of chlorinated paraffins. By inference, the levels of the short chain length chlorinated paraffins are probably in the range 0.1-1 \( \mu \text{g/l} \) (European Commission 2000). In the fresh and other non-marine water samples from areas remote from industry, the C10-20 chlorinated paraffins were detected in just under half the samples in the range 0.5 - 1 \( \mu \text{g/l} \). This corresponds to probable short chain length chlorinated paraffin concentrations of 0.1- 0.3 \( \mu \text{g/l} \) (European Commission 2000).

Tomy et al. (2000) reported SCCPs in the blubber of ringed seal (\textit{Phoca hispida}) from Eureka, Nunavut, Canada, southwest Ellesmere Island, beluga whales (\textit{Delphinapterus leucas}) from northwest Greenland and the Mackenzie Delta, Northwest Territories,
Canada, and walrus (*Odobenus rosmarus*) from northwest Greenland at concentrations ranging from 110 to 770 ng/g wet weight (Refer to Table 4).

Tomy *et al.* (1998b) reported mean SCCP concentrations of 0.63, 0.20, 0.32 and 0.46 µg/g in blubber from male beluga collected in Hendrickson Island (Southern Beaufort Sea near the Mackenzie River delta), Arviat (western Hudson Bay), Sanikluaq (Belcher Island area in southern Hudson Bay) and Pangnirtung (south eastern Baffin Island), Canada, respectively (refer to Section B, Biota).

**Benthic organisms**

Two different equilibrium partitioning approaches for calculating a No Observed Effect Concentration (NOEC) or a Predicted No Effect Concentration (PNEC) are presented below. The first approach by Di Toro *et al.* (1991) is the approach typically used in Canadian risk assessments. The second approach is from the European Technical Guidance Document for risk assessments (TGD).

These approaches use the most sensitive measurement endpoint identified for a pelagic freshwater aquatic species (5 µg/L) to estimate the toxicity to benthic organisms, since a valid measurement endpoint was not available for a sediment-dwelling invertebrate. A study was conducted using the midge *Chironomus tentans*, but exposure was via water only.

The following equation from Di Toro et al. (1991) is used to calculate the NOEC for benthic invertebrates:

\[
\text{NOEC}_{\text{benthic}} = \text{f}_{oc} \cdot K_{oc} \cdot \text{NOEC}_{\text{pelagic}}
\]

where:

- \( \text{f}_{oc} \) is 0.02, based on the mean organic carbon content for surficial sediment samples from Lake Ontario, expressed on a dry weight basis (Kemp *et al.*, 1977),
- \( K_{oc} \) is the organic carbon/water partition coefficient, 199 500 L/kg for a C₁₀ and C₁₃ paraffin with around 55% by weight chlorine content (Thompson *et al.*, 1998), and
- \( \text{NOEC}_{\text{pelagic}} \) is 5 µg/L, based on a 21-day chronic study for *Daphnia magna* (Thompson and Madeley, 1983a).

Therefore:

\[
\text{NOEC}_{\text{benthic}} = 0.02 \times 199 500 \text{ L/kg} \times 5 \text{ µg/L} = 19 950 \mu\text{g/kg dry weight} = 19.95 \mu\text{g/g dry weight}
\]

Below is the calculation for the PNEC for sediment-dwelling organisms using the method described in the European TGD. The Equation numbers refer to those given in the TGD.
PNEC_{sed} = \frac{K_{susp-water} \cdot \text{NOEC}_{pelagic} \text{(mg/kg)} \cdot \text{1000}}{\text{RHO}_{susp}(\text{kg/m}^3)} \quad (\text{Equation } 70)

\text{RHO}_{susp} = F_{solids} \cdot \text{RHO}_{solids} + F_{water} \cdot \text{RHO}_{water} \quad (\text{Equation } 18)

K_{susp-water} = F_{water} + F_{solid} \cdot \frac{(F_{oc} \cdot K_{oc})}{1000} \cdot \text{RHO}_{solid} \quad (\text{Equation } 24)

Where

PNEC_{sed} = \text{Predicted No Effect Concentration in sediment (mg/kg)}

\text{RHO}_{susp} = \text{bulk density of wet suspended matter (kg/m}^3\text{)}

K_{susp-water} = \text{partition coefficient suspended matter-water (m}^3\text{/m}^3\text{)}

F_{solids} = \text{Volume fraction solids in suspended matter (m}^3\text{/m}^3\text{)}

F_{water} = \text{volume fraction water in suspended matter (m}^3\text{/m}^3\text{)}

F_{oc} = \text{weight fraction organic carbon in suspended solids (kg}_{oc}/\text{kg}_{solid})

K_{oc} = \text{organic carbon-water partition coefficient (m}^3\text{/m}^3\text{)}

Using standard environmental characteristics (Table 5, Chapter 3 TGD), as well as the NOEC_{pelagic} of 5 \mu g/L, which has been divided by an assessment factor of 10,

\text{RHO}_{susp} = 0.1(2500 \text{ kg/m}^3) + 0.9(1000 \text{ kg/m}^3)

\text{RHO}_{susp} = 1150 \text{ kg/m}^3

K_{susp-water} = 0.9 + 0.1(0.1*199500 \text{ L/kg})/1000 *2500 \text{ kg/m}^3

K_{susp-water} = 4988

Therefore,

PNEC_{sed} = \frac{4988 \cdot 5 \times 10^{-4} \text{ mg/L} \cdot 1000}{1150 \text{ kg/m}^3}

PNEC_{sed} = 2.17 \text{ mg/kg or } \mu g/g

Since the PNEC_{sed} calculation applies an assessment factor of 10 to the NOEC_{pelagic} of 5 \mu g/L, to convert this back to a NOEC_{benthic} value which can be compared to the Canadian NOEC_{benthic} value, it is necessary to multiply the PNEC_{sed} by 10, which gives a value of 21.7 mg/kg, which is very similar to the Canadian NOEC_{benthic} value of 19.95 mg/kg.

Conclusions

Based on the very high concentrations of SCCPs that have been found in arctic marine wildlife (100–770 \mu g/kg), such as seals and beluga, it is possible that Aboriginal peoples living in the arctic are exposed to SCCP concentrations above the WHO guideline of 11 \mu g/kg body weight (No studies of this have been conducted).

Toxicity studies with aquatic invertebrates and fish have shown that SCCPs are toxic at the \mu g/L level. SCCPs have been predicted to be toxic to benthic invertebrates at the \mu
Jansson et al. (1993) found CPs (unspecified chain length) at the ng/g to µg/g level lipid weight in marine and terrestrial biota from remote, arctic locations in Scandinavia. Though Jansson et al. (1993) did not determine specifically what proportion of his measured levels were SCCPs, SCCPs are known to be the most volatile congeners and therefore probably constitute a large portion of the total CPs in these locations. High concentrations of SCCPs in arctic marine wildlife have also been found by Tomy et al. (2000) as described above.

SCCPs are therefore considered to be “toxic” to the environment and to human health pursuant to Decision 1998/2, Paragraph 1(b) of the UNECE POPs Protocol (see Appendix 1).

3. Persistence

According to Decision 1998/2 of the UNECE POPs Protocol (see Appendix 1), a substance may be considered as persistent if the substance’s half-life in water is greater than two months, or that its half-life in soils or sediments is greater than six months, or that there is alternative evidence that the substance is otherwise sufficiently persistent to be of concern. This section presents data on abiotic and biotic degradation of SCCPs and on half-life of SCCPs in sediments.

**Abiotic Degradation**

Chlorinated paraffins are generally considered persistent. In the aqueous phase, rates of hydrolysis, photolysis with visible or near UV radiation, oxidation and volatilization are insignificant under ambient temperatures (Government of Canada, 1993b).

**Biotic Degradation**

Chlorinated paraffins are generally stable, but studies have shown that degradation is possible by microorganisms. Madeley and Birtley (1980, in Government of Canada, 1993b) reported that the ability of aerobic microorganisms to oxidize a range of chlorinated paraffins depended upon their previous acclimatization, the chain length and degree of chlorination. The longer the carbon chain, the slower the biodegradation. For a particular carbon chain, the biodegradation decreases with increasing chlorine percentage (Madeley and Birtley (1980) in Mukherjee 1990). In another study, seventy enrichment cultures of microorganisms were found to be incapable of using CPs as the sole carbon source (Omori et al. 1987 in Government of Canada, 1993b).

In the European Communities Risk Assessment (2000), it was reported that certain bacteria had been shown to dechlorinate SCCPs with high chlorine contents in a co-metabolic process and that so under certain conditions, biodegradation of these compounds might also be expected to occur slowly in the environment.
Sediment

Tomy et al. (1999) reported SCCP residues from the surficial sediments in Lake Winnipeg, Manitoba, Fox Lake in the Yukon, Lake Nipigon in northwest Ontario and Hazen Lake in the Arctic to be 176, 257, 18 and 7 ng/g dry weight, respectively. Concentration profiles of SCCP residues in sediments from Lake Winnipeg and Fox Lake indicated that residues were present in the slice dated at 1933 in Lake Winnipeg sediments and in the slice dated at 1926 in Fox Lake sediments. SCCP residues in sediments were observed from the west basin of Lake Ontario dating back to 1913. The highest concentration (800 ng/g dry weight) was observed in the slice dated at 1971 (Figure 2).

SCCP residues were also found in a laminated lake core from Lake DV09 on Devon Island, Nunavut, Canada (Stern 2003). Concentrations of SCCPs (<0.2 ng/g d.w.) were found dating back to 1931. From 1943 SCCP concentrations increased steadily to 0.8 ng/g d.w. in 1956. SCCP concentrations then dropped to <0.2 ng/g d.w. between 1970 and 1980. Concentrations then showed an increasing trend until the last year of measurement, 1997 (0.9 ng/g d.w.).

In the absence of information on loading for any of the years at any of these locations, it is not possible to calculate half-lives from these data for comparison with the criterion for persistence in sediment stipulated in Paragraph 1c) of the UNECE POPs Protocol (Appendix 1). However, the fact that SCCP residues were detected in sediment cores dating back to the 1920s and 1930s at these locations is convincing evidence that SCCPs are persistent in sediment. SCCPs were not manufactured in Canada until the 1940s. Residues observed in slices dated earlier can be explained by diffusion of residues vertically through the sediment core or contamination as an artifact of core sampling. Weight of evidence indicates that the half-life of SCCPs in sediment is greater than 1 year.

A laboratory study examining the half-life of SCCPs in sediment during oligochaete exposures assuming first-order decay showed a half-life of 13–30 days (Fisk et al., 1998a). It should be noted that the extent of degradation in this study was determined at day 0 and day 14 based on the difference between toluene-extractable 14C measurements (taken to represent unchanged chlorinated paraffin) and total 14C measurements (taken to represent degraded chlorinated paraffin). The identity of the 14C present in the samples was, however, not determined and it was only assumed that the non-extractable 14C represented transformation products. This study, therefore, would not provide any indication of the mineralisation or ultimate degradation half-life for SCCPs.

Conclusions

SCCPs do not appear to degrade in water by abiotic mechanisms under ambient conditions. Chlorinated paraffins seem capable of being biodegraded to some (unquantified) extent, but do not appear to be able to be utilized as the sole carbon source.
SCCP residues have been detected in lake sediment cores dating back to the 1920s and 1930s at several locations in Canada, indicating that their half-lives in sediment is much longer than 1 year.

The above evidence indicates that SCCPs are persistent in water and sediment, pursuant to Decision 1998/2 Paragraph 1(c) of the UNECE POPs Protocol (see Appendix 1).

4. Bioaccumulation

According to the Decision 1998/2 of the UNECE POPs Protocol (see Appendix 1), a substance may be considered as bioaccumulative if the bioconcentration factor (BCF) or bioaccumulation factor (BAF) for the substance is greater than 5,000 or the log Kow is greater than 5. This section will discuss the evidence that SCCPs are bioaccumulative.

Individual SCCP congeners had half-lives in juvenile rainbow trout (Oncorhynchus mykiss) ranging from 7 to about 53 days in laboratory studies (Fisk et al., 1998b). These half-lives were shorter than those for 2,4-substituted polychlorinated biphenyl (PCB) congeners in studies under the same conditions (Fisk et al., 1998c).

Bioaccumulation factors (BAFs) for SCCP homologue groups in western Lake Ontario lake trout (Salvelinus namaycush) range from 21,250 to 114,444 (Table 5). Chlorinated dodecanes (C12) are the most prominent SCCPs in lake water and fish. The highest BAFs are seen for the tridecanes (C13). The overall BAF for SCCPs (C10–13) in lake trout from western Lake Ontario is 36,500.

Table 5. Bioaccumulation factors for SCCPs in lake trout of western Lake Ontario (from Muir et al., 2000)

<table>
<thead>
<tr>
<th>Homologue</th>
<th>Concentration in water (ng/L)</th>
<th>Concentration in lake trout1 (ng/g wet weight)</th>
<th>BAFww</th>
</tr>
</thead>
<tbody>
<tr>
<td>C10</td>
<td>0.16</td>
<td>3.4</td>
<td>21,250</td>
</tr>
<tr>
<td>C11</td>
<td>0.48</td>
<td>18.3</td>
<td>38,125</td>
</tr>
<tr>
<td>C12</td>
<td>0.98</td>
<td>33.6</td>
<td>34,286</td>
</tr>
<tr>
<td>C13</td>
<td>0.09</td>
<td>10.3</td>
<td>114,444</td>
</tr>
<tr>
<td>ΣC10–C13</td>
<td>1.8</td>
<td>65.7</td>
<td>36,500</td>
</tr>
</tbody>
</table>

1 Concentrations in whole fish (wet weight).

Reported bioconcentration factors (BCFs) calculated from laboratory studies for SCCPs vary widely among different species and range from <1 in marine algae (Skeletonema costatum) to 140,000 in the common mussel (Mytilus edulis) (Tomy et al., 1998b).

The EU Risk Assessment (European Commission 2000) also describes several accumulation studies in fish and molluscs: Madeley and Maddock, 1983 a and b; Bengtsson et al, 1979; Bentsson and Baumann-Ofstad, 1982; Lombardo et al, 1975; Fisk et al, 1996; Madeley et al, 1983; and Madeley and Thompson, 1983. SCCPs were shown
to bioconcentrate to a high degree in fish and molluscs. Madeley and Maddock (1983b) found BCFs of 3,600 to 5,300 in rainbow trout with a C_{10-12}, 58% Cl SCCP. Mussels had BCFs ranging from 24,800 to 40,900 with a 59.1% Cl undecane (Madeley et al. 1983). Similar high BCFs in mussels (5,785-25,952) were found after exposure to a 58% Cl SCCP (Madeley and Thompson 1983).

**Conclusions**

Based on the BAFs/BCFs found in fish and mussels, and estimated Log $K_{ow}$ range for SCCPs of 5.06 to 8.12 (Lyman *et al.* 1990 in Tomy *et al.*, 1998a), it is concluded that SCCPs are a bioaccumulative substance according to the criteria stipulated in Decision 1998/2 of Paragraph 1(d) of the UNECE POPs Protocol (see Appendix 1).
PART II. SUMMARY REPORT

A. EXTENT OF RELEASE TO THE ENVIRONMENT

This section presents information on the production, uses, pathways to the environment, and emissions of SCCPs. To a large extent this section draws on responses received to the 2001 Questionnaire on the use and production of POPs and other substances in the UNECE region (UNECE questionnaire). Respondent countries were Armenia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Georgia, Germany, Kazakhstan, Latvia, Monaco, Netherlands, Norway, Poland, Slovakia, Spain, Sweden, Switzerland, the United Kingdom and United States of America.

A summary of responses regarding Short-chain chlorinated paraffins (Parts 1-5 of Section H) is included as Appendix 2 to the current report.

1. Production

The 1999 EU Risk Assessment Report on C_{10-13} chloroalkanes reported that as of 1996 SCCPs were being manufactured, under a variety of trade names, by two companies in the EU. (In 1992/93 there were five producers). Total annual production, based on 1994 Euro-Chlor figures, was estimated at less than or equal to 15,000 tonnes per year.

The UNECE questionnaire covers both historical and current production of SCCPs in Part I, questions H2 - H5. Countries confirming historical production of SCCPs were Germany (unknown date to 1995), Slovakia, the UK (unknown date to present) and USA (ongoing production). Current production of SCCPs was confirmed by the Czech Republic (unstated quantity), the UK (commercially confidential quantities) and USA (20,000 metric tones/year). In their response Germany indicated that a 1997/98 estimate of production in Western Europe was 114,000 tonnes/year. This figure is at odds with the Euro-Chlor figure of 15,000 tonnes per year for all of the EU.

The 2001 OSPAR Background Document on Short Chain Chlorinated Paraffins cited a 1999 report indicating that in 1997 total production of SCCP, MCCP and LCCP in China was about 100,000 tonnes. The UNECE questionnaire (in questions H21-H22) also asked about production outside the UNECE region, and Sweden cited the above information regarding China’s production.

SCCPs are not manufactured in Canada (Abt Associates 1996), however, MCCPs and LCCPs are manufactured at a PCI Canada plant in Cornwall, Ontario (Camford Information Services 2001).

The UNECE questionnaire also covers import information, in questions H6-H9.
Belgium, Canada, Denmark, Finland, Germany, Norway, Spain, Sweden, Switzerland and USA indicated historical imports. Except for Germany (current information not given), Spain (current import data not available), and Norway (no current imports) the same countries also confirmed current imports. Annual import quantities ranged from 10 tonnes per year to 5,500 metric tones per year (USA).

Several countries also provided comments in Part 1.

In Canada, a 1995 survey estimated total imports of SCCPs into Canada in 1994 to be approximately 538 tonnes (Abt Associates 1996). This is a marked decline in Canadian SCCP usage, from 650 tonnes in 1991. SCCP was imported into Canada from manufacturers in the U.K. and U.S., and also from formulators in the U.S. Formulators combine SCCP mixtures with other ingredients to prepare high pressure lubricants used in the metal working industry.

2. Uses

The EU Assessment identified and described the following applications for SCCPs: metal working, rubber, paints, sealants, leather, textiles and other unspecified uses. Table 6 is excerpted from the EU Assessment (Euro-Chlor, 1995 in European Commission, 2000).

Table 6. Applications for SCCPs

<table>
<thead>
<tr>
<th>Application</th>
<th>Quantity used (tonnes/year)</th>
<th>Percentage of total use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal working</td>
<td>9,380</td>
<td>71.02%</td>
</tr>
<tr>
<td>Rubber</td>
<td>1,310</td>
<td>9.91%</td>
</tr>
<tr>
<td>Paints</td>
<td>1,150</td>
<td>8.71%</td>
</tr>
<tr>
<td>Sealants</td>
<td>695</td>
<td>5.26%</td>
</tr>
<tr>
<td>Leather</td>
<td>390</td>
<td>2.95%</td>
</tr>
<tr>
<td>Textiles</td>
<td>183</td>
<td>1.40%</td>
</tr>
<tr>
<td>Others</td>
<td>100</td>
<td>0.75%</td>
</tr>
<tr>
<td>Total</td>
<td>13,208</td>
<td>100%</td>
</tr>
</tbody>
</table>

As indicated in Table 6, the largest uses of SCCPs are in the metal working industry, generally in lubricating or cutting oils used in both ferrous and non-ferrous applications. Common applications for SCCP-based cutting oils include grinding, polishing, honing, cutting, drilling, stamping, drawing and broaching.

The OSPAR Report stated that the main uses of SCCPs are in metal working fluids, as plasticisers in paints, coatings and sealants, as flame retardant in rubbers and textiles, and in leather processing. The OSPAR Report also indicated that use of SCCP in Europe had decreased from 13,000 tonnes in 1994 to 4,000 tonnes in 1998 (Chlorinated Paraffins Sector Group of CEFIC, 1999 in OSPAR, 2001) and confirmed that in 1998 the main use was still in metal working fluids (49.5%). Interestingly, the figures showed an unexplained increase from 0.75% to 15.9% in unspecified “other” applications of SCCPs.
from 1994 to 1998. The use of SCCPs in Europe is expected to further decrease with the implementation of EU Directive 2002/45/EC, which is described in Section C1.

The UNECE questionnaire covers SCCP use in Part 2, questions H10-H14. Historical use was confirmed by Belgium, Canada, Czech Republic, Denmark, Finland, Georgia, Germany, Netherlands, Norway, Spain, Sweden, Switzerland, UK and USA. Except for Norway and Spain, SCCPs were also reported to be currently in use in the same countries (as of the 2001 survey). Uses reported were chiefly those listed in Table 6, above. In addition, Georgia reported minor uses for laboratory purposes or other noncommercial small scale uses, Belgium reported use in softener for PVC and Finland in dye additive. Annual quantities used ranged from 10 tonnes per year to the USA’s 25,500 metric tones/year which assumed that all domestically manufactured and imported quantities were used in the USA.

In Canada, 1995 surveys indicated that SCCPs were used primarily as lubricants in the metal working industry, with other uses including rubber, sealants and flame retardants for rubber and soft plastics (Abt Associates 1996).

3. Emissions and pathways to the environment

Chlorinated paraffins, including SCCPs, are not known to occur naturally (Government of Canada, 1993b). As described below, the two major sources of release of SCCPs into the environment are during their production and during their use in metalworking. During production most emissions are to wastewater although emissions to air are also possible (European Commission, 2000). The possible sources of releases to water during production include spills, facility wash-down and stormwater runoff. Formulation and use of metalworking/cutting fluids are also potential sources of chlorinated paraffin release into aquatic environments. Releases can result from wash-down of drums during recycling, carry-off from work pieces and spent bath discharge (CPIA 1992 in Government of Canada, 1993b). These releases are collected in sewer systems and ultimately end up in the effluents, including sludge of sewage treatment plants.

The OSPAR Report noted that if SCCPs reach the marine environment, they will do so via rivers and via the atmosphere. The main compartments to which releases occur were identified as sediment and surface waters in rivers, lakes and seas, air, and soil spread with sewage sludge.

The very low solubility in water and low vapour pressure of SCCPs would predict low mobility, but monitoring data in the U.K. and Sweden indicate widespread low levels of contamination in water, sediments, aquatic and terrestrial organisms and even commercial foods (Government of Canada, 1993b). Some airborne and waterborne dispersion does therefore occur.

Release from existing uses
The EU Assessment identifies sources having potential for releases of SCCPs to water, air and soil. These sources include production sites for SCCP, production sites for the formulation of metal working fluids and leather finishing agents, metal working, rubber working and leather finishing plants.

The EU Assessment also presents estimates of releases to air and water from the production and use of SCCPs. The estimates are made mostly using emissions factors. Uses are metal working (formulation and use), rubber formulations, paints and sealants, and leather and textile applications. Summary data estimate total releases from both production and use in the EU is 393.9 kg/year to air; and 1,784 tonnes/year to water. The largest estimated releases are associated with metal working applications (formulation and use). The EU Assessment cautions that these estimates are uncertain due to the many assumptions made in their calculation.

Presence in products

The OSPAR Report considered different products containing SCCP to be potential sources of emissions, and that this could be the case not only during production and use (see above), but also when the articles become waste and are sent to landfill. SCCPs were also identified as a possible source of polychlorinated biphenyls (PCBs) and polychlorinated naphthalenes (PCNs), formed via incineration of wastes (CSTEE 1998; in OSPAR, 2001). The estimate of annual emissions was nine tonnes per year in Europe from surfaces with paint containing SCCP (ibid). Other products that are potential sources of SCCP emissions include: rubber, textiles, sealants and polymers.

In the EU risk assessment, emissions from articles and products that may contain and emit SCCPs are described as including:

- Flame retardants in rubber (proportion 1-10%), with applications mostly in high density conveyor belts. Belts may also be recycled into other products at the end of their life.
- Plasticisers in paints and other coatings; also to improve water resistance, chemical resistance and nonflammability. Mostly industrial/specialist applications; used in proportions of 1-10% in paints.
- Additives in sealing compounds in building, automotive and industrial applications. The leachability and volatility of short chain length chlorinated paraffins over the lifetime of the sealant (typically 20 years) was reported to be low.
- Leather - as a fat liquoring agent, usually applied to moist dressed leather in the form of an emulsion.
- Textiles - SCCPs used mostly in backcoating operations for sail cloths, industrial protective clothing, lorry tarpaulins, etc.

The EU Assessment concludes that product scenarios posing greater than negligible risk to consumers include use of metal working fluids and exaggerated wearing of leather garments that have been treated with SCCPs. Unverified information collected in a 1995
survey of Canadian industry indicated that for the chemical, plastics and rubber industries, SCCPs become an integral part of the product and that any losses would occur during manufacturing.

Waste Stockpiles

The UNECE survey covered stockpiles and disposal of SCCPs in Part 3, questions H15 - H18. No respondent countries confirmed existing stockpiles of SCCPs. Austria, Belgium, Denmark, Finland, Norway, Sweden and USA indicated measures were taken to dispose of SCCPs. Disposal requirements were generally cited as those pertaining to hazardous or environmentally dangerous wastes. Sweden indicated that high temperature incineration was required and the USA indicated that disposal of SCCPs included with hazardous wastes would take place only in specially designed landfills.

B. ENVIRONMENTAL LEVELS AND BIOAVAILABILITY

This section discusses concentrations of SCCPs found in the environment and in biota in Canadian and international locations. Analytical methods are discussed in Section 1. Levels of SCCPs found in wastewater treatment effluents, surface waters, sediments, as well as in fish, terrestrial and marine mammals are presented in Sections 2 to 5.

1. Analytical Methods

Analytical measurements of SCCPs are extremely difficult, and only a small number of laboratories in the world currently have the expertise to do so. While PCBs consist of 129 congeners and isomers, the number of SCCPs may number in the thousands. Therefore, instead of being able to resolve individual peaks corresponding to specific substances using analytical measurements, what is observed is an unresolved envelope of these substances. This results in much more difficult detection of SCCPs through analytical methods.

European Communities (2000) states that none of the analytical methods used for SCCPs is perfect. “Of those available, the methods of Ballschmiter, 1994 and Murray et al., 1987 are similar and are considered to be the best methods currently available for specifically measuring short chain length chlorinated paraffins [These methods used gas chromatography/ mass spectrometry (GC/MS) with negative chemical ionization (NCI), which may slightly underestimate SCCP concentrations]. The results from all the methods used are dependent to some extent on the substance(s) used as reference.” However, the EU risk assessment was written prior to publication of the high-resolution electron capture negative ion mass spectrometry (HRECNIMS) method of Tomy et al. (1999, 2000) which has been the method used in almost all studies in Canada. Most recent work has used high-resolution MS (e.g. Muir et al. 2000; Tomy et al 1999;2000; Peters et al 2000) except for Nicholls et al (2001) and the analyses that measure the carbon skeleton (Koh et al. (2002)).
Canadian government scientists conducted studies designed to determine whether SCCPs were present in remote Canadian environments, to compare samples from remote and more industrialized regions and to examine sewage treatment effluents. All analyses were done by high-resolution gas chromatography negative ion mass spectrometry, as reported by Tomy et al. (1997). The use of this method results in higher specificity than was achieved with previous methods, which used low-resolution gas chromatography negative ion mass spectrometry to measure the SCCP parent ions or chloride ions (Jansson et al., 1993; Reiger and Ballschmiter, 1995).

2. Wastewater treatment effluents

Wastewater treatment effluents were obtained in 1996 from eight municipal wastewater treatment plants located in western Lake Ontario. Final effluents (4 L) were collected in glass bottles and then extracted with dichloromethane. Extracts were exchanged into hexane for cleanup on an alumina column.

SCCPs were detected in all sewage treatment plant final effluents from southern Ontario at ng/L concentrations. The highest concentrations were found in samples from treatment plants in the most industrialized areas, including Hamilton, St. Catharines and Galt, compared with lower concentrations in samples from treatment plants in non-industrial towns, such as Niagara-on-the-Lake and Niagara Falls (Table 7).
Table 7. SCCP concentrations in final effluent of sewage treatment plants in southern Ontario based on samples collected in 1996 (from Muir et al., 2000).

<table>
<thead>
<tr>
<th>Sewage treatment plant</th>
<th>Concentration (ng/L)</th>
<th>C_{10}</th>
<th>C_{11}</th>
<th>C_{12}</th>
<th>C_{13}</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodward Avenue, Hamilton, Ontario</td>
<td>128</td>
<td>155</td>
<td>153</td>
<td>11.5</td>
<td>448</td>
<td></td>
</tr>
<tr>
<td>Halton Skyway, Burlington, Ontario</td>
<td>38</td>
<td>19</td>
<td>12</td>
<td>&lt;1</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>Stanford, Niagara Falls, Ontario</td>
<td>11</td>
<td>34</td>
<td>36</td>
<td>1</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Port Dalhousie, St. Catharines, Ontario</td>
<td>19</td>
<td>39</td>
<td>47</td>
<td>5</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Port Weller, St. Catharines, Ontario</td>
<td>22</td>
<td>27</td>
<td>28</td>
<td>4</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>Niagara-on-the-Lake, Ontario</td>
<td>13</td>
<td>18</td>
<td>27</td>
<td>1</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Galt, Ontario</td>
<td>82</td>
<td>85</td>
<td>86</td>
<td>11</td>
<td>264</td>
<td></td>
</tr>
<tr>
<td>Guelph, Ontario</td>
<td>23</td>
<td>32</td>
<td>34</td>
<td>4</td>
<td>93</td>
<td></td>
</tr>
</tbody>
</table>

3. Surface waters

Large-volume water samples (100 L) collected in mid-Lake Ontario in 1999 show low levels of SCCPs (Figure 4). The highest concentration (1.8 ng/L) was observed in the western basin and probably resulted from sewage treatment plant sources from large urbanized areas, such as Toronto and Hamilton. Notwithstanding the high dilution factor that would be involved in Lake Ontario, the fact that this concentration was observed is an indication that considerable inputs of SCCPs are occurring.

Nicholls et al. (2001) measured the concentrations of short and medium length CPs in water bodies near industrial and agricultural areas in the U.K, by GC/MS-NCI). In contrast to the study by Campbell and McConnell (1980), they found no detectable concentrations of CPs (<0.1 µg/L) in 19 of the 20 water bodies they sampled, including at locations near industries using or producing chlorinated paraffins. They measured concentrations of 0.2-1.7 µg/L near a sewage treatment works at Darwen, U.K.

Tomy (1997) measured 0.02 to 0.05 ug/L of 50-70% Cl SCCPs in the Red River at Selkirk, Manitoba, Canada, which is a site remote from industry, by high resolution gas chromatography/electron capture negative ion high resolution mass spectrometry (HRGC/ECNHRMS).

Reiger and Ballschmiter (1995) reported C_{10-13} (62% chlorine) SCCP concentrations of 70–120 ng/L in water upstream and downstream of a sewage treatment plant in Germany.
4. Sediments, Soils and Sludge

4.1 Canadian Lake Sediments

Surficial sediments were obtained with an Ekman grab sampler (~0–5 cm depth) from three harbour areas along Lake Ontario — Toronto (three locations), Port Credit (one site) and Hamilton (three sites) — in 1996. Sediment was centrifuged to remove excess water, mixed with sodium sulphate and Soxhlet-extracted with dichloromethane. SCCPs were detected in all surface sediment samples, at concentrations ranging from 5.9 to 290 ng/g dry weight (Table 8). The highest concentrations were found at the most industrialized site (Windermere Basin, Hamilton Harbour), which has well-documented heavy metal, polycyclic aromatic hydrocarbon (PAH) and PCB contamination. In comparison, surface sediments from cores at more remote sites in Lake Winnipeg, Lake Nipigon, Fox Lake and Hazen Lake had concentrations ranging from 7 to 257 ng/g dry weight (Tomy et al., 1999).
Table 8. SCCP concentrations in surface sediment grab samples collected in 1996 from Lake Ontario harbours (from Muir et al., 2000)

<table>
<thead>
<tr>
<th>Location</th>
<th>Concentration (ng/g dry weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C10</td>
</tr>
<tr>
<td>Toronto Harbour: inner harbour</td>
<td>0.7</td>
</tr>
<tr>
<td>Toronto Harbour: inner harbour duplicate</td>
<td>0.6</td>
</tr>
<tr>
<td>Toronto Harbour: Humber River mouth</td>
<td>0.9</td>
</tr>
<tr>
<td>Port Credit Harbour</td>
<td>1.4</td>
</tr>
<tr>
<td>Hamilton Harbour, site 1: west harbour</td>
<td>3.3</td>
</tr>
<tr>
<td>Hamilton Harbour, site 1: west harbour duplicate</td>
<td>2.2</td>
</tr>
<tr>
<td>Hamilton Harbour, site 2: Windermere Basin</td>
<td>11</td>
</tr>
<tr>
<td>Hamilton Harbour, site 3: Skyway WWCP1 discharge</td>
<td>2.9</td>
</tr>
</tbody>
</table>

1 WWCP = wastewater control plant.

A sediment core was obtained from the western basin of Lake Ontario (43°26'01"N; 79°24'00"W) from the CSS Limnos in June 1998 using a box corer. The sampling site is located approximately 40 km from the nearest sewage treatment plant. Three cores (10 cm in diameter) were obtained from the box corer, sliced on-board ship into 0.5-cm slices (top 0–5 cm of core) and 1-cm slices (bottom 5–30 cm of core) and stored in plastic “WhirlPak” polyethylene bags at 4°C until analysed. One core was dated using 210Pb. Sediment slices from the second core were centrifuged to remove excess water, mixed with sodium sulphate and extracted with dichloromethane in a pressurized fluid extractor.

The historical concentration profile of SCCPs is shown in Figure 5. SCCP residues are found dating back to 1913, with the maximum residues (800 ng/g dry weight) occurring in the 1970s. SCCPs were not manufactured in Canada until the 1940s, and residues found prior to that time can be explained by diffusion of residues through the sediment core or contamination due to an artifact of sampling. SCCP residues observed in 1996 in the surface sediment layer are approximately 390 ng/g dry weight.
Fluxes (ng/m² per year) of SCCPs to various Canadian lake sediments are plotted in Figure 6. These fluxes are for surface slices of each sediment core and represent recent (last 5–10 years) inputs. The highest fluxes are observed in lake sediments near urban areas (western Lake Ontario and the south basin of Lake Winnipeg). The lowest fluxes are observed in more remote lakes, including Lake Superior, which are influenced mainly by atmospheric inputs. These results suggest that SCCP residues observed in lake sediments are mainly associated with urban areas. The sources contributing to SCCP residues observed in Fox Lake, Yukon, are uncertain.

SCCPs were determined in a dated sediment core collected in Lake St. Francis/Lac St. Francois (at 45.02°N;74.68°W, at 12 m depth), downstream of Cornwall in 1996. Lac St. Francois is a widening of the St. Lawrence River and the sampling site is downstream of the chlorinated paraffin manufacturing plant at Cornwall, Ontario. The historical profiles of SCCPs in the core are shown in Figure 7. These are preliminary results for 6 samples representing 0-2 cm slices with median dates of 1972 to 1995); analysis of additional samples is underway. The results show the presence of relatively low levels of SCCPs compared to Lake Ontario. Much higher levels of MCCPs were found in this core (Muir et al. 2002). The highest SCCP concentrations were found in slice 6, which has a median date of 1985 ± 4 yrs (Turner 1996). The predominate chain length groups in sediments were C11 and C12. These were present at almost equal proportions of total SCCP.
Figure 6: Fluxes (µg/m² per year) of SCCPs to lake sediments in Canada (from Muir et al., 1999)

4.2 International data

Ballschmiter (1994) found SCCPs concentrations in river sediments at locations remote from industry in Germany ranging from 17 to 83 ng/g dry weight (analysis by HRGC/ECNI-MS). By contrast, sediments of an impoundment ditch near an industrial facility in Ohio producing SCCPs contained SCCPs at concentrations of 600–10 000 ng/g dry weight (Murray et al., 1988). The water from this same impoundment ditch contained C₁₀–₁₃ (60% chlorine) SCCP concentrations of <150–3300 ng/L (Murray et al., 1988).

Figure 7. Profiles of SCCPs in a sediment core from Lake St. Francis in the St. Lawrence River downstream of Cornwall ON. Upper panel shows concentrations of total SCCP and lower panel present results for chain length groups.
Levels of 0.5-48 ug/g dry matter of chlorinated paraffins (C10-C30) have been measured in household waste collected from the Uppsala municipality in Sweden in 1995 (Nilsson et al., 2000).

Nicholls et al. (2001) measured concentrations of short and medium chain CPs in sediment from water bodies in the U.K. receiving discharges from industries known to use chlorinated paraffins in their products or manufacturing processes (ie. metalworking, PVC production), by GC/MS-NCI. They found concentrations ranging from <0.2 to 63.0 mg/kg dry wt.

In agricultural areas, Nicholls et al. (2001) found CP concentrations in digested sewage sludge of 1.8 to 93.1 mg/kg dw, at all 8 locations sampled. Though no detectable concentrations of CPs were found in agricultural soils to which the digested sewage sludge had been applied, there were CPs present in earthworms living in these same soils (<0.1 to 1.7 mg/kg wet wt.).

5. Levels found in Biota

Aquatic Biota

Jansson et al. (1993) found total CPs at a concentration of 1000 ug/kg dry weight (dw) in whitefish and 570 ug/kg dw in Arctic char from lakes in Sweden remote from industry, and at concentrations of 1,400-1,600 ug/kg dw in herring from the Bothnian Sea, the Baltic Proper and Skagerrak, locations also considered to be remote from industry. Analysis was by HRGC/ECNI-MS.

Nicholls et al. (2001) measured concentrations of short and medium chain CPs in fish and benthos species from water bodies receiving discharges from industries known to use chlorinated paraffins in their products or manufacturing processes (ie. metalworking, PVC production) in the U.K. At many of the sampling sites, CP concentrations in fish were below detection (<0.2 mg/kg wet wt.) or lower than 1 mg/kg wet wt. The highest concentration detected was 5.2 mg/kg w/wt. SCCP in Stone Loach from Darwen, Blackburn. The concentration of CPs found in benthos at this same site was <0.05 mg/kg w/wt. All average benthos concentrations were below 1 mg/kg w/wt.

North American Fish

Carp (Cyprinus carpio) collected from Hamilton Harbour on Lake Ontario and lake trout (Oncorhynchus mykiss) collected from two locations in western Lake Ontario (Port Credit [northwest] and Niagara-on-the-Lake [southwest]) in 1996 were analysed for SCCPs.
SCCPs were detected in all samples of carp and lake trout from Lake Ontario (Table 9). The higher concentrations observed in carp are probably due to higher exposure of fish to SCCPs in Hamilton Harbour. Table 7 shows a higher concentration of SCCPs in sediment at Hamilton Harbour than was found at Port Credit Harbour which would imply that the water concentrations in Hamilton Harbour may also have been higher. The higher concentrations of SCCPs in carp from Hamilton Harbour could also be as a result of bioconcentration.

In the United States, yellow perch, catfish and zebra mussels from the Detroit River, Michigan, had measured mean SCCP concentrations of 1,100, 300 and 1,200 ng/g, respectively (Tomy et al., 1997).

### Table 9. SCCP concentrations in whole fish samples collected in 1996 from Lake Ontario (from Muir et al., 2000)

<table>
<thead>
<tr>
<th>Species</th>
<th>Location</th>
<th>N</th>
<th>Concentration (ng/g wet weight)</th>
<th>C10</th>
<th>C11</th>
<th>C12</th>
<th>C13</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carp</td>
<td>Hamilton Harbour</td>
<td>3</td>
<td></td>
<td>14.2</td>
<td>355</td>
<td>1090</td>
<td>1170</td>
<td>2630</td>
</tr>
<tr>
<td>Lake trout</td>
<td>Niagara-on-the-Lake</td>
<td>5</td>
<td></td>
<td>3.1</td>
<td>16.4</td>
<td>30.1</td>
<td>9.3</td>
<td>58.8</td>
</tr>
<tr>
<td>Lake trout</td>
<td>Port Credit</td>
<td>5</td>
<td></td>
<td>3.8</td>
<td>20.2</td>
<td>37.1</td>
<td>11.4</td>
<td>72.6</td>
</tr>
</tbody>
</table>

Marine mammals

SCCPs have been detected at concentrations ranging from 110 to 1360 ng/g wet weight in marine mammals in Canada. Tomy et al. (2000) reported levels of SCCPs in the blubber of ringed seal (Phoca hispida) from Eureka, Nunavut, Canada, southwest Ellesmere Island, beluga whales (Delphinapterus leucas) from northwest Greenland, the Mackenzie Delta, Northwest Territories, Canada, and the St. Lawrence River estuary, and walrus (Odobenus rosmarus) from northwest Greenland (Table 4). The data in Table 4 show that concentrations of SCCPs in the St. Lawrence beluga were approximately 4 times higher than concentrations in Greenland and Mackenzie Delta belugas. The elevated levels of SCCPs in belugas from the St. Lawrence River are consistent with the findings of elevated levels of other organochlorines by Muir et al. (1996), who suggested that this was a food chain effect attributed to local source contamination. The data also show that SCCP concentrations in Arctic biota are generally lower than those of other persistent organochlorines.

Jansson et al. (1993) found concentrations of total CPs of 130 ug/kg dw in ringed seal from Kongsfjorden, Sweden, and 280 ug/kg dw in grey seal from the Baltic Sea, Sweden, in locations remote from industry. Analysis was by HRGC/ECNI-HRMS.

**Terrestrial Wildlife**

To date, very limited information is available on SCCPs in tissues of terrestrial mammals. In Sweden, Jansson et al. (1993) reported CP concentrations (unspecified chain length),
in rabbit (Revingeshed, Skåne), moose (Grismsö, Västmanland), reindeer (Ottsjö, Jaämtland) and osprey (from various regions in Sweden) to be 2.9, 4.4, 0.14 and 0.53 µg/g lipid wt., respectively.

Food

Levels of total (C10-C24) chlorinated paraffins in food, fish and marine animals have recently been reported (Greenpeace, 1995 in European Communities 2000). The levels measured (on a lipid weight basis) were 271 µg/kg in mackerel, 62 µg/kg in fish oil (herring), 98 µg/kg in margarine containing fish oil, 16-114 µg/kg in common porpoise, 963 µg/kg in fin whale, 69 µg/kg in pork, 74 µg/kg in cows milk and 45 µg/kg in human breast milk. The average chlorine content of the chlorinated paraffins detected was thought to be around 33%. Short chain length chlorinated paraffins were thought to make up a very small percentage of the total in mackerel, fish oil, porpoise and fin whale, around 7% in human milk, 11.5% in margarine, 21% in cows milk and 30% in pork.

6. Summary

SCCPs are being released as a result of human activity into air and water. In Canada, SCCPs were detected in all sewage treatment plant final effluents from southern Ontario and in all surface sediment samples from harbour areas along Lake Ontario at ng/L concentrations. The highest concentrations were found in samples in industrialized areas. SCCPs have also been detected in sediments in Germany and the U.S.A. at similar or higher levels.

SCCPs are also present in biota in Canada, the US and Europe, in both temperate and arctic regions. SCCPs have been detected in all samples of carp and lake trout taken from Lake Ontario in the ng/g range, and have been detected in marine and terrestrial mammals in the µg/g range.

C. SOCIO-ECONOMIC FACTORS

This section covers national and international regulation, alternatives or substitutes to SCCPs that have been proposed or used, emission control techniques and costs and benefits of control.

1. National and International Regulation

Part 4 of the UNECE Questionnaire deals with actions taken or proposed to control the production, use, storage and/or disposal of short-chain chlorinated paraffins. Austria, Belgium, Canada, Denmark, Finland, Georgia, Germany, Netherlands, Norway, Spain, Sweden, Switzerland, UK and the USA indicated that actions had been taken or were proposed.
SCCP Regulation in the European Union

In their responses several countries cited the OSPAR work, the Paris Commission (PARCOM) Decision 95/1 and EU Directives 76/769/EEC and 2000/60/EC.

PARCOM Decision 95/1 sets out phase out targets for SCCP use with dates of 1999 and 2004.

EU Directive 2002/45/EC, which amended 76/769/EEC and was adopted in June 2002, deals with marketing and use restrictions, in particular for metal working and leather finishing. It restricts the concentration of SCCPs in metalworking and leather fat liquoring preparations to 1% or less.

Euro Chlor, a European Chlorinated Paraffins industry group, says that PARCOM Decision 95/1 and the amendment to EU Directive 76/769/EEC “are somewhat contradictory”. “The ban in PARCOM goes much further than in the EU Directive. Euro Chlor believes that only the EU Directive should be taken into consideration, because it is based on a full-fledged scientifically-based Risk Assessment. The science in this Risk Assessment is more recent than for the PARCOM decision, based in part on the precautionary principle (Euro Chlor 2002).”

EU Directive 2000/60/EC is a Water Framework Directive. Under this Directive SCCPs have recently been added to a list of priority hazardous substances.

The OSPAR Strategy for Hazardous Substances objective for SCCP is to move towards targets for discharges, emissions and losses by 2020 with the ultimate aim of achieving concentrations in the marine environment close to zero.

SCCP Regulation in the U.S.A.

The U.S.A. does not regulate the use or marketing of SCCPs. Substances not listed on US Inventory cannot be used or manufactured. Three SCCP related substances are listed on the EPAs Toxic Substances Control Act (TSCA) Inventory, allowing them to be used and manufactured in the U.S.A., and two of these have been reported as being both manufactured and imported in 1997:

I) Alkanes, chloro; chloroparaffins (CAS 61788-76-9);
II) Par waxes and h/c waxes, chlorinated (CAS 63449-39-8); and
III) Alkanes, C6-18, chloro (CAS 68920-70-7).

The U.S.A. regulates the disposal of SCCPs when they are present in designated hazardous wastes. Disposal of SCCPs found in hazardous wastes are subject to regulations to ensure disposal occurs in an environmentally safe manner and only in specifically designed landfills.

SCCPs are not otherwise subject to regulatory control actions in the U.S.A. Three categories of SCCPs are manufactured and used as reported in the U.S. Toxic Substances
Control Act (TSCA). For substances not on the TSCA Inventory of chemicals, any intended industrial chemical-type use requires 90-day advance premanufacture notification (PMN) (See 40 CFR 720 for the USEPA PMN regulations). The required notification provides the U.S. EPA with the opportunity to review the substance for potential unreasonable risks and to take action, where appropriate, to control those risks.

**SCCP Regulation in Canada**

An environmental and human health risk assessment of SCCPs was completed and published in 1993 (Government of Canada 1993a). Short-chain chlorinated paraffins (SCCPs) were declared “toxic” for human health under Paragraph 11(c) of the *Canadian Environmental Protection Act (CEPA 1988)* and slated for “virtual elimination” in Canada because of their persistence and bioaccumulation. However, no conclusions about the toxicity of chlorinated paraffins to the Canadian environment were possible, since data were not identified on the concentrations of short, medium, or long chain chlorinated paraffins in the Canadian environment. As such, there were no data with which to compare levels reported as causing adverse effects in biota, making it impossible to assess whether these compounds are ‘toxic’ as defined under Paragraph 11(a) of CEPA [1988].”

In order to reconsider the persistence criteria for SCCPs and other chlorinated paraffins and whether SCCPs and other CPs are “toxic” to the Canadian environment under Paragraph 64(a) of CEPA 1999, scientists at the National Water Research Institute of Environment Canada and the Department of Fisheries and Oceans have generated new scientific information on levels of CPs in various Canadian environmental media, including Arctic air, marine mammals, wastewater treatment effluents from southern Ontario, Canadian lake sediments, Lake Ontario fish and Lake Ontario water, some of which is included in this Dossier. Environment Canada is currently incorporating this new information into a Priority Substances List Follow-Up report on Chlorinated Paraffins, which is expected to be completed later this year.

2. **Alternatives/Substitutes**

Executive Body Decision 1998/2 indicates that summary reports should describe alternatives to the existing uses and their efficacy. As well, information should include any known adverse environmental or human health effects associated with the alternatives.

The OSPAR Report (OSPAR, 2000) suggested the following possible alternatives or substitutes to SCCPs (Table 10). Some are currently used as alternatives and others may be possible replacements.

Considerations in substitution include:
- health and environmental risks associated with the substitute chemical (for example higher chain chlorinated paraffins);
• degree to which the substitute chemical fulfills technical and security demands;
• cost for substitution in proportion to health and environmental benefits; and
• SCCPs are often contaminants in MCCPs at a concentration of <1%.

Table 10. Possible Alternatives or Substitutes to SCCP

<table>
<thead>
<tr>
<th>Use</th>
<th>Possible Alternative to SCCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme pressure additives in metal working fluids</td>
<td>MCCPs, LCCPs, alkyl phosphate esters, sulfonated fatty acid esters</td>
</tr>
<tr>
<td>Plasticizers in paints</td>
<td>MCCPs</td>
</tr>
<tr>
<td>Additives in sealants</td>
<td>MCCPs, LCCPs, phthalate esters</td>
</tr>
<tr>
<td>Leather industry</td>
<td>LCCPs, natural animal and vegetable oils</td>
</tr>
<tr>
<td>Paints, coatings</td>
<td>LCCPs, phthalate esters, polyacrylic esters, disobutyrate and phosphate and boron containing compounds</td>
</tr>
<tr>
<td>Flame retardant in rubber, textiles and PVC</td>
<td>Antimony trioxide, aluminum trioxide, acrylic polymers and phosphate containing compounds</td>
</tr>
<tr>
<td>Rubber</td>
<td>LCCPs</td>
</tr>
</tbody>
</table>

Information collected in 1995 Canadian surveys (Abt Associates 1996) revealed that metal working includes applications of SCCPs in both straight (oil-based) and soluble (water soluble) cutting oils. Substitution away from water-based cutting oils is more difficult because most substitutes at the time of the survey were higher chain chlorinated paraffins which are difficult to dissolve in water.

At the time of the 1995 survey three broad classes of options to replace SCCP-based cutting oils were identified as:
• mixtures of medium and long chain chlorinated paraffins;
• sulfur-chlorinated products; and
• non-chlorinated products.

Chlorine, as well as phosphorus and sulfur, is considered an “extreme pressure” agent. Chlorine-based products are therefore used in the most demanding metal working applications.

A variety of non-chlorinated compounds had also been introduced on the market or were under development. They involved the use of phosphorus/nitrogen or sulfur/calcium combinations in a sulfonate base. The sulfonate base provides water solubility. To achieve the same result as SCCP these products are formulated to liberate an active element such as sulfur or phosphorus in lieu of chlorine during the metal working operation.

Replacement options for SCCP-based fire retardants can be bromine-based and also present health and environmental hazards. At the time of the 1995 Canadian industry
survey by Abt Associates (1996), some research was underway involving antimony oxide to replace SCCP although the resulting product may not have as much adhesive strength as the SCCP-based product.

Candidate replacements for SCCPs in rubber products could include bromine compounds, and magnesium carbonate or magnesium hydroxide in combination with aluminum trihydrate (Abt Associates 1996).

It has been suggested that MCCPs and LCCPs should not be considered as possible alternatives to SCCPs, since MCCPs and LCCPs may also be POPs. Currently, there is no conclusive evidence that MCCPs and LCCPs are POPs, as defined by the UNECE POPs Protocol. For example, MCCPs meet some of the criteria listed in the Convention (i.e. Toxicity, vapour pressure, lack of biodegradation, Kow>5), but the BCF was only 1,087 and no evidence was given in the U.K. draft risk assessment report of MCCPs (U.K. Environment 2002) that MCCPs undergo long-range atmospheric transport. The atmospheric half-life was estimated to be 2 days using EUSES (U.K 2002).

As mentioned in Section C.1., Environment Canada is currently reviewing available information on MCCPs and LCCPs, to update a risk assessment report, which is expected to be available in 2003.

2.1 Discussion of Alternatives to SCCPs in Leather Processing and Metal Working

The U.K. Department of the Environment commissioned two reports that discuss alternatives to SCCPs used in leather processing (RPA 1997a) and metal working (RPA 1997b). Excerpts from these reports discussing the feasibility of alternatives to SCCPs are given below.

**Leather Processing**

SCCPs are used as inexpensive additives to fatliquors to provide greater product volume (i.e. they are bulking agents). Fatliquors replace oils that are lost during the tanning process, however it appears that no fatliquoring properties are conferred by the use of SCCPs. The only benefits that they offer over alternatives appear to be their odour-free nature and their reasonable price. However, no tanner has indicated that the use of alternatives (any of a range of animal, vegetable or mineral oils) would alter the quality of end-products. Although alternatives are around 15% more expensive than SCCPs, this is equivalent to only 0.075% of turnover arising from SCCP-treated hide for a small tanner (i.e. a tanner with <50 employees). The environmental risks posed by alternatives appear to be less than those posed by SCCPs.

Alternatives to SCCPs have been listed as MCCPs and longer chain length chlorinated paraffins, and any natural animal, vegetable or mineral oils, such as: animal oils which are usually derived from beef tallow; vegetable oils such as corn,
soya, palm, and to some extent rapeseed. The consensus is that MCCPs pose lower risks to the environment and human health than SCCPs. Given the nature of other alternatives, this is likely to be the case for these also.

Therefore, the use of alternatives to SCCPs in leather processing appears to be practical, both from a technical feasibility, environmental and economic standpoint.

### Metalworking

The U.K. Department of the Environment commissioned a report that discusses alternatives to SCCPs used in metalworking (RPA 1997b). This report provides the following information about alternatives to SCCPs in metalworking:

**Feasibility and Costs of Alternatives to SCCPs**

Historically, due to their availability and thus cheap supply, SCCPs have been added to a wide range of metalworking fluids. As many processes have now grown accustomed to SCCP-based fluids, it is difficult to determine which processes require the use of SCCPs. Consultation suggests that these are broaching, precision gear cutting, grinding, and some forms of milling and reaming; however, there appears to be no consensus on this issue within the industry.

The low dependence of Germany on the use of SCCPs results from legislation which has increased the costs of disposal for chlorinated waste oils. As a result, users have replaced SCCP-based fluids with chlorine-free alternatives.

Across the Member States, there is a general expectation that the use of SCCPs in metalworking fluids will be restricted through legislation as a result of the PARCOM (Paris Commission) Decision (95/1) to phase out their use. In response to this, and pressures from specific legislation in countries such as Germany, formulators are involved in research and development into chlorine-free alternatives.

Implementation of a total ban on the use of SCCPs in all fluids is expected to result in increased annual costs of around £4 million across the UK as a result of higher fluid prices alone. It is estimated that these costs would be spread over roughly 26,000 UK metalworking companies. These companies could also face additional costs associated with reduced tool life, increased machine down-time or reduced quality of finished pieces which may add significant costs to this estimate. As indicated above, these and additional costs could be of an equal magnitude to the increase in fluid prices. Operators in other countries have also reported reduced levels of output associated with the adoption of chlorine-free alternatives.

The report (RPA 1997b) notes that cost increases would be reduced if the alternative chosen was MCCPs:
“Again, for a medium sized user of metalworking fluids, the marginal increase in costs associated with higher fluid prices is estimated at around £450 per annum. Where MCCP-based emulsions are adopted, a medium sized company may incur costs of only around £80 per annum stemming from increased fluid prices.”

Toxicity of Alternatives

The toxicities of alternatives to SCCPs for use in metalworking are tabulated in Annex 3 and Annex 4 of RPA 1997b. The least toxic of the alternatives with respect to human health effects is trixylyl phosphate, has an LD50 of >5 g/kg (rat) and causes no skin or eye irritation. This compares with LD50s of >4 g/kg for SCCP compounds, which cause slight skin and eye irritation (RPA 1997b).

With respect to environmental effects, the effects of long-term exposure to many of the alternatives to SCCPs, including trixylyl phosphate has not been evaluated. MCCPs do not appear to be mutagenic, as are SCCPs, or genotoxic (RPA 1997b). However, MCCPs do not biodegrade. The following information on the health and environmental effects of alternatives to SCCPs in metalworking is given in RPA1997b:

**MCCPs**

MCCPs are considered to be less toxic and less persistent than SCCPs. MCCPs are, however, already present in higher concentrations in the environment than SCCPs and the effects of increasing the MCCP load is not known. It is not possible to make a clear statement as to the costs and benefits of replacing SCCPs with MCCPs, therefore, but current information indicates that there would be net benefits to the environment associated with a move to MCCPs.

With respect to human health, while there is contention over whether SCCPs or MCCPs pose lower risks, there does appear to be a general consensus that a move to MCCPs would be beneficial.

**Chlorine-Free Extreme Pressure Additives**

In general terms, movement to sulphur-based products could result in slight reductions in aquatic risk, as most formulations appear to be slightly less toxic than SCCPs. However, some formulations appear to be more toxic, and it is perhaps safest to say that there will be no net change in risks to the aquatic environment associated with the increased use of sulphur-based products.

Movement to phosphorus additives may either reduce or increase risks to the aquatic environment, depending on the nature and quality of the receiving waters. Thus, where phosphorus-based products are the most likely and most efficacious replacements for SCCPs for a given process, it may be worthwhile considering these processes as candidates for a derogation until other alternatives are developed.
With respect to human health, the change in benefits associated with a move to sulphur and phosphorus are unclear. The use of certain formulations may actually increase the impacts on human health.

3. Emission Control Techniques

Executive Body Decision 1998/2 indicates that this section could consider process changes, control technologies, operating practices and other pollution prevention techniques which may be used to reduce emissions; along with comment on their applicability and effectiveness.

As stated above, most emissions during use of SCCPs are from their metal working applications and thus this is the focus of this section.

1995 Canadian surveys indicated that some machine tools have their own lubricant recycling system with appropriate filtering (Abt Associates, 1996). However, the SCCP content of the lubricant deteriorates over time since the main reason for using SCCP is that it liberates chlorine during its use. Some of this chlorine dissipates to the atmosphere and some combines with the metal itself to form chloride salts on the metal surface.

The Abt Associates (1996) survey also asked about disposal practices. Once the quality of the lubricant charge deteriorates to the point where it no longer meets specifications, the charge is drawn out and replaced with a fresh charge. If the lubricant is an oil based lubricant it is hauled away for disposal by an authorized hazardous waste disposal company. If it is water-based, the water is extracted and the waxy residue is then hauled away for disposal.

Based on information from the Canadian survey there was no attempt to ship used SCCP out for recycling. Survey responses indicated that used high pressure lubricant containing SCCP are usually disposed of in cement kilns or other high temperature incineration operations. Some metal working operations process filings soaked with lubricant through a “chip spinner” - a centrifuge where oil is spun off the metal filings and is then returned to the lubricating system.

In terms of overall pollution prevention during metal working with cutting oils, oil-based cutting oils will likely require some form of degreasing with a cleaning agent or alkaline water in order to be removed from the final product, whereas a water soluble cutting oil may be removed with a water wash.

4. Costs and Benefits of Control

Executive Body Decision 1998/2 indicates that non-monetary costs and benefits as well as quantifiable costs and benefits associated with the use of alternatives/substitutes and or techniques may be considered in this section.
In general, the benefits of identifying alternatives or substitutes for persistent organic pollutants, or of identifying process changes that decrease their use, include:
- lower emissions to the environment,
- lower worker exposure to the substance, and
- products that do not contain the substance will not release the substance either during their use or during subsequent recycling or disposal.

Generally, costs of alternatives or substitutes will include research and development costs and any actual costs associated with use of substitutes.

A Canadian report (Abt Associates, 1996) stated that a major Canadian manufacturer of sealants and its SCCP supplier estimated that to find a satisfactory replacement would involve a $2 to $3 million dollar (Canadian) research project lasting five to seven years. Although competitive replacement products (sealants) imported from the US did exist, they were silicon-based and cost twice as much as the SCCP-based domestic product.

The same Canadian report indicated that SCCPs were a very cost-effective high pressure lubricant for use in metal working. However, there was overall agreement that SCCP use is declining and will continue to decline. The reasons included:
- a lesser use of cutting oils in general due to more efficient lubrication systems in machine tools, harder cutting edges (ceramics, nitriding of tool steel) and greater environmental consciousness; and
- problems in disposing of any waste material containing chlorine and an overall desire to control the use of chlorine based products.
III. SUMMARY AND CONCLUSIONS

PART I

Part I of this substance dossier contains a risk profile and reviews SCCP characteristics in relation to the POPs criteria outlined in UNECE Decision 1998/2 (Appendix 1). SCCPs meet all of the POPs criteria outlined in UNECE Decision 1998/2:

*Long-range Atmospheric Transport Potential*

SCCPs have low vapour pressures, ranging from $2.8 \times 10^{-7}$ to 0.5 Pa, and estimates of atmospheric half-life for SCCPs are greater than 2 days for a large number of structures. Vapour pressures tend to increase with decreasing carbon chain length and decreasing degree of chlorination. SCCP vapour pressures are within the range of some POPs shown to undergo long-range transport. For some congeners, transport on particles may be an important pathway, especially at cold temperatures.

The detection of the more volatile shorter carbon chain length and lower degree of chlorination congeners of SCCPs in Arctic air, biota and in Arctic lake sediments in the absence of significant sources of SCCPs in this region provides additional evidence that SCCPs are undergoing long-range atmospheric transport. Fluxes of SCCPs to Arctic lake sediments were found to be greater than fluxes of PCBs to these same lakes.

Therefore, SCCPs meet all of the criteria for long-range atmospheric transport as described in Executive Body decision 1998/2, paragraph 1(a).

*Toxicity*

The Canadian risk assessment of chlorinated paraffins concluded that SCCPs are carcinogenic, and therefore toxic to human health as defined under the *Canadian Environmental Protection Act 1988*. Toxicity studies with aquatic invertebrates and fish have shown SCCPs to be toxic at the $\mu$g/L level, while toxicity to benthic invertebrates has been predicted at the $\mu$g/g level.

Therefore, SCCPs meet the characteristics for toxicity described in Executive Body decision 1998/2, paragraph 1(b).

*Persistence*

SCCP residues are detected in Canadian lake sediment cores dating back over 50 years. In the absence of information on loading for any of the years at any of these locations, it is not possible to calculate half-lives from these data for comparison with the criterion for persistence in sediment stipulated in Paragraph 1c) of the UNECE POPs Protocol. However, the fact that such old SCCP residues have been found is convincing evidence
that SCCPs are persistent in sediment. Therefore, SCCPs meet the criteria for persistence in sediment as described in Executive Body decision 1998/2, paragraph 1(c).

**Bioaccumulation**

Bioaccumulation Factors/Bioconcentration Factors (BAFs/BCFs) for SCCPs in fish and mussels are greater than 21,000. Calculated and measured Log \( K_{ow} \) ranging from 5.06 to 8.12. Therefore, it is concluded that SCCPs are a bioaccumulative substance according to the indicative criteria stipulated in UNECE Executive Body decision 1998/2, paragraph 1(d).

**PART II**

Part II of this substance dossier contains a summary report on extent of releases to the environment, environmental levels and bioavailability as well as socio-economic factors.

**Emission Characteristics**

The major application (71%, 1995 in the EU) of SCCP is as an extreme pressure additive in metal working fluids. Minor applications include plasticisers in paints, coatings and sealants; flame retardants in rubbers and textiles, and in leather processing. These activities represent potential emission sources.

Estimated total production in UNECE Region:
- European Union - 15,000 tonnes per year (Euro-Chlor, 1994);
- United States - 20,000 tonnes per year (2001 survey).

**Estimated use in UNECE Region:**

- Use of SCCPs in Europe decreased from 13,000 tonnes in 1994 to 4,000 tonnes in 1998 (OSPAR, 2001). Use in the EU is expected to further decrease with the implementation of EU Directive 2002/45/EC on SCCPs (June 2002);
- United States - 25,500 tonnes (2001 survey);
- Outside of the EU and the U.S., Canada, Czech Republic, Georgia, Norway, and Switzerland also report current use (2001 survey).

Outside of the UNECE Region, production and use is occurring in several countries, e.g., China.

**Environmental Levels and Bioavailability**

SCCPs are detected over a wide range of locations in wastewater effluents, surface waters, lake sediments, air samples, biota and food products. For example, SCCPs were detected in air samples (at pg/m\(^3\) levels) from remote monitoring stations in the Arctic at Alert, Canada (<1 to 8.5) and Svalbard, Norway (9 to 57), and at semi-rural locations in Egbert, Canada (<65 to 925) and Lancaster, UK (99).
The Joint Task Force on the Health Aspect of Air Pollution in its report on the Health Risks of POPs from Long-range Transboundary Air Pollution concluded that Europeans might be exposed to SCCPs at levels above the World Health Organization (WHO) daily guideline of 11 µg/kg body weight. High concentrations of SCCPs (100-770 µg/kg wet wt.) have been found in Arctic aquatic biota. Aboriginal peoples living in the Arctic consume these animals as food, and therefore may be exposed to SCCPs at concentrations greater than the WHO health guideline.

Socio-Economic Factors

There are national and international regulations respecting SCCPs in the UNECE Region. In Europe, the Paris Commission (PARCOM) Decision 95/1 and European Union Directive 2000/60/EC and most recently 2002/45/EC place phase-out targets and severe restrictions on use and discharge of SCCPs. In the United States, three categories of SCCPs are manufactured and used as reported in the Toxic Substances Control Act (TSCA) inventory. Canada is currently re-evaluating the environmental risk of SCCPs based on new environmental concentration data. A report is expected to be completed in late 2003.

Although some possible alternatives and substitutes for SCCPs have been proposed, the alternatives themselves may present health and environmental risks (for example higher chain chlorinated paraffins and bromine-based substitutes). The dossier briefly discusses costs of control, including possible higher costs of substitutes, environmental and health benefits of control, and research and development costs to identify substitutes.

Conclusions

The dossier concludes that SCCPs are a candidate for inclusion into the UNECE Protocol on POPs.
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APPENDIX 1

PROTOCOL TO THE 1979 CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION ON PERSISTENT ORGANIC POLLUTANTS

EXECUTIVE BODY DECISION 1998/2 ON INFORMATION TO BE SUBMITTED AND THE PROCEDURE FOR ADDING SUBSTANCES TO ANNEXES I, II OR III TO THE PROTOCOL ON PERSISTENT ORGANIC POLLUTANTS

The Executive Body,

Resolved to act as early as possible to develop criteria and procedures for adding substances to the forthcoming protocol on persistent organic pollutants,

Adopts, with reference to article 14, paragraph 6, of the protocol, the requirements for information to be submitted and the procedure for adding substances to annexes I, II or III to the protocol on persistent organic pollutants set out below.

INFORMATION TO BE SUBMITTED AND THE PROCEDURE FOR ADDING SUBSTANCES TO ANNEXES I, II OR III TO THE PROTOCOL ON PERSISTENT ORGANIC POLLUTANTS

1. A Party submitting a proposal to amend annexes I, II or III in accordance with article 14, paragraph 6, shall provide the Executive Body with a risk profile on the substance and information on the characteristics below, following the guidance and indicative numerical values, which demonstrate:

(a) Potential for long-range transboundary atmospheric transport: evidence that the substance has a vapour pressure below 1,000 Pa and an atmospheric half-life greater than two days. Alternatively, monitoring data showing that the substance is found in remote regions; and

(b) Toxicity: potential to adversely affect human health and/or the environment; and

(c) Persistence: evidence that the substance's half-life in water is greater than two months, or that its half-life in soils is greater than six months, or that its half-life in sediments is greater than six months. Alternatively, evidence that the substance is otherwise sufficiently persistent to be of concern within the scope of the protocol; and

(d) Bio-accumulation:
(i) Evidence that the BCF or BAF for the substance is greater than 5,000 or the log Kow is greater than 5; or

(ii) Alternatively, if the bio-accumulative potential is significantly lower than (i) above, other factors, such as the high toxicity of the substance, that make it of concern within the scope of the protocol.

The proposal shall also contain a summary report and include, as available, information on:

(i) Production/uses/emissions, measured environmental levels in areas distant from sources, abiotic and biotic degradation processes and rates, degradation products, bio-availability; and

(ii) Socio-economic factors related to the alternatives and/or the techniques available to reduce the emissions of the proposed substance including:

- Alternatives to the existing uses and their efficacy;
- Any known adverse environmental or human health effects associated with the alternatives;
- Process changes, control technologies, operating practices and other pollution prevention techniques which can be used to reduce the emissions of the substance, and their applicability and effectiveness; and
- The non-monetary costs and benefits as well as the quantifiable costs and benefits associated with the use of these alternatives and/or techniques.

2. Upon receipt of a submission prepared in accordance with paragraph 1 above and if the risk profile is deemed acceptable, the Parties shall, at a meeting of the Executive Body and by consensus, ensure that one or more technical reviews of the proposal are conducted if, on the basis of the submission and any other relevant information submitted to the Executive Body, further consideration of the substance is determined to be warranted. Any such technical reviews shall be in writing and evaluate, inter alia:

(a) The monitoring or equivalent scientific information suggesting long-range transboundary atmospheric transport; and

(b) Whether sufficient information exists to suggest that the substance is likely to have significant adverse human health and/or environmental effects as a result of its long-range transboundary atmospheric transport; and

(c) A list of the sources of the substance in the atmosphere, including the use of products, estimates of the total emissions from these sources and the methodologies used; and
(d) Whether measures exist to reduce the risk of adverse effects on human health and/or the environment as a result of its long-range transboundary atmospheric transport, and whether they are technically feasible, as well as their associated effects and costs.

3. The term risk profile mentioned in paragraphs 1 and 2 above refers to a comprehensive review of the scientific information related to the determination of general human health and environmental risks associated with the uses and releases of a substance. Such a review need not explicitly address risks associated with long-range transboundary air pollution, but must provide suitable information for the assessment of such risk.

4. On the basis of the submission specified in paragraph 1 above and any technical review(s) that may have been prepared in accordance with paragraph 2 above, the Parties shall, at a meeting of the Executive Body, complete their evaluation of the proposal taking into account the objective of the protocol set out in article 2.
### APPENDIX 2

**SUMMARY OF COUNTRY RESPONSES TO UNECE POPS QUESTIONNAIRE**

**Part 1 Production / Importation Information on Short-chain chlorinated paraffins (Historical and / or Current Information)**

<table>
<thead>
<tr>
<th>Country</th>
<th>H2 - Have SCCPs ever been produced in your country?</th>
<th>H3 - Are SCCPs currently being produced in your country?</th>
<th>H4 - Estimated Total Quantity of SCCPs Produced</th>
<th>H5 - Estimated Year(s) in which SCCP Production has taken place (e.g., 19xx to 19xx)</th>
<th>H6 - Have SCCPs ever been imported in to your country?</th>
<th>H7 - Are SCCPs currently being imported in to your country?</th>
<th>H8 - Estimated total quantity of SCCPs imported</th>
<th>H9 - Estimated years in which SCCP importation has taken place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armenia</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>unknown</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Austria</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>unknown</td>
<td>yes</td>
<td>yes</td>
<td>250 tpa for 1995</td>
<td>data only known for 1993, 94 and 95</td>
</tr>
<tr>
<td>Belgium</td>
<td>unknown</td>
<td>no</td>
<td>---</td>
<td>yes</td>
<td>yes</td>
<td>538.5 tonnes (1994)</td>
<td>on-going</td>
<td>---</td>
</tr>
<tr>
<td>Canada</td>
<td><em>unknown</em></td>
<td>no</td>
<td>---</td>
<td>yes</td>
<td>yes</td>
<td>30 (1997) metric tonnes</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>unknown</td>
<td>yes</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Denmark</td>
<td>unknown</td>
<td>no</td>
<td>0</td>
<td>yes</td>
<td>yes</td>
<td>27 tonnes in 1997</td>
<td>at least from 1970s</td>
<td>---</td>
</tr>
<tr>
<td>Finland</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>yes</td>
<td>yes</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>France</td>
<td>unknown</td>
<td>no</td>
<td>---</td>
<td>yes</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Georgia</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Germany</td>
<td>yes</td>
<td>no</td>
<td>1997/98 estimated: 114 000 t/a in Western Europe</td>
<td>19xx to 1995</td>
<td>yes</td>
<td>unknown</td>
<td>possibly ongoing (cf. Comments)</td>
<td>---</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
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</tr>
</tbody>
</table>
## Responses to Questionnaire

<table>
<thead>
<tr>
<th>Country</th>
<th>H2 - Have SCCPs ever been produced in your country?</th>
<th>H3 - Are SCCPs currently being produced in your country?</th>
<th>H4 - Estimated Total Quantity of SCCPs Produced</th>
<th>H5 - Estimated Year(s) in which SCCP Production has taken place (e.g., 19xx? to 19xx)</th>
<th>H6 - Have SCCPs ever been imported into your country?</th>
<th>H7 - Are SCCPs currently being imported into your country?</th>
<th>H8 - Estimated total quantity of SCCPs imported</th>
<th>H9 - Estimated years in which SCCP importation has taken place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latvia</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>---</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Monaco</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>unknown</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Netherlands</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>---</td>
<td>yes</td>
<td>---</td>
<td>---</td>
<td>Information not available</td>
</tr>
<tr>
<td>Norway</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>---</td>
<td>yes</td>
<td>no</td>
<td>---</td>
<td>Information not available</td>
</tr>
<tr>
<td>Poland</td>
<td>no</td>
<td>no</td>
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<td>---</td>
<td>---</td>
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<td>---</td>
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</tr>
<tr>
<td>Slovakia</td>
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<td>unknown</td>
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<tr>
<td>Spain</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>not available</td>
<td>yes</td>
<td>current data not available</td>
<td>data not available</td>
<td>not available</td>
</tr>
<tr>
<td>Sweden</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>never</td>
<td>yes</td>
<td>yes</td>
<td>10-15 metric tonnes</td>
<td>from 1950? To present</td>
</tr>
<tr>
<td>Switzerland</td>
<td>unknown</td>
<td>no</td>
<td>---</td>
<td>---</td>
<td>yes</td>
<td>yes</td>
<td>70 metric tonnes/year</td>
<td>since 1993</td>
</tr>
<tr>
<td>UK</td>
<td>yes</td>
<td>yes</td>
<td>commercially confidential</td>
<td>? to present</td>
<td>unknown</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
</tr>
<tr>
<td>USA</td>
<td>yes</td>
<td>yes</td>
<td>20,000 metric tonnes/year</td>
<td>ongoing; specific historical information not available</td>
<td>yes</td>
<td>yes</td>
<td>5,500 metric tonnes/year</td>
<td>ongoing; specific historical information not available</td>
</tr>
<tr>
<td>Country</td>
<td>Information</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Belgium</td>
<td>The estimated SCCP imported is a minimum considering that for the 2 used of SCCP in Belgium, we only have information for the use in metalworking: 100 tpa for 1993, 230 tpa for 1994 and 250 tpa for 1995. Source: - risk benefit analysis on the use of SCCP in cutting fluids in the metalworking industry. Final report, January 1997 prepared by RPA, Farthing Green House. London; Norfolk Tel: 01508528465, fax: 01508520758, - Survey from our office in June 2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>*Note for Canada’s response above - Chlorinated paraffins (CPs) of unknown chain length were being produced at an Imperial Chemical Industries (ICI) plant in Canada in 1991, but it is not known whether this plant is still producing CPs. A 1995 survey (Abt Assoc. 1996) did not identify any producers of SCCPs in Canada.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>ad H3: SCCP have to be assumed as technical impurities (detailed figures not at hand) in MCCP, the latter still being produced in Germany. ad H7-9: there is considerable evidence, that SCCP are still imported as constituents of motor oil additives (sold by car accessories dealers) and as constituents of metal working fluids for highly specialised niche applications in minor quantities. sources: personal communications, cf. acknowledgement section of: Hans-Christian Stolzenberg: Risk Reduction in Germany for Chlorinated Paraffins Used in Metalworking Fluids: Regulator's View on Triggers, Driving Forces, Perspectives In: Organohalogen Compounds, Vol 47, pp. 131-134, Ed. Michael S. Denison, UC Davis, 2000 - ISBN 0-9703315-2-5 further source of information: see OSPAR-SMLCCPS-Background Document</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>EU RAR CAS No.: 85535-84-8 EINECS-No.: 287-476-5, Alkanes, C10-13, Chloro. EUR 19010 First Prioritylist, Volume 4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>The Swedish Products Register</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>SCCPs have probably been imported in to the UK both in finished products leather etc and in intermediate chemicals such as cutting fluids.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
USA

Below is information for specific SCCPs from EPA’s Toxic Substances Control Act (TSCA) Inventory. If a substance is not on the Inventory, it cannot be used or manufactured in the U.S. (with the exception of certain exemptions). Three of the identified CAS numbers are listed on the Inventory. Two of these substances (61788-76-9 and 63449-39-8) were reported through the 1998 TSCA Inventory Update Rule as being both manufactured in and imported into the U.S. in 1997. Total reported volumes were provided above.

<table>
<thead>
<tr>
<th>CAS#</th>
<th>Chemical Name</th>
<th>TSCA Inventory status</th>
</tr>
</thead>
<tbody>
<tr>
<td>85535-84-8</td>
<td>Alkanes (C10-13), chloro (50-70%)</td>
<td>not listed</td>
</tr>
<tr>
<td>85681-73-8</td>
<td>Alkanes (C10-14), chloro</td>
<td>not listed</td>
</tr>
<tr>
<td>108171-26-2</td>
<td>C12, 60% chlorine</td>
<td>not listed</td>
</tr>
<tr>
<td>51990-12-6</td>
<td>Chlorowax</td>
<td>not listed</td>
</tr>
<tr>
<td>61788-76-9</td>
<td>Alkanes, chloro; chloroparaffins</td>
<td>listed</td>
</tr>
<tr>
<td>63449-39-8</td>
<td>Par waxes and h/c waxes, chlorinated</td>
<td>listed</td>
</tr>
<tr>
<td>68920-70-7</td>
<td>Alkanes, C6-18, chloro</td>
<td>listed</td>
</tr>
<tr>
<td>85422-92-0</td>
<td>Paraoils, chlorinated</td>
<td>not listed</td>
</tr>
<tr>
<td>97553-43-0</td>
<td>Normal paraffins x&gt;10, chloro</td>
<td>not listed</td>
</tr>
</tbody>
</table>

Releases for these chemicals as a category (under “polychlorinated alkanes”) are reported through EPA’s Toxic Release Inventory (TRI). For the category, 1999 total air emissions were reported to be 5,788 pounds. See Error! Bookmark not defined. USEPA’s TRI regulations include, inter alia, obligations for certain facilities that manufacture, import, process or otherwise use subject chemicals to report estimated release amounts.

Part 2 Use Information on Short-chain chlorinated paraffins (Historical and / or Current Uses)

<table>
<thead>
<tr>
<th>Country</th>
<th>H10 - Have SCCPs ever been used in your country?</th>
<th>H11 - Are SCCPs currently being used in your country?</th>
<th>H12 - Types of uses for SCCPs in your country?</th>
<th>H13 - Estimated Total Quantity of SCCPs Used</th>
<th>H14 - Estimated Year(s) in which SCCPs have been Used (e.g., 19xx to 19xx)</th>
<th>Comments / Source of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armenia</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Austria</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Country</td>
<td>H10 - Have SCCPs ever been used in your country?</td>
<td>H11 - Are SCCPs currently being used in your country?</td>
<td>H12 - Types of uses for SCCPs in your country?</td>
<td>H13 - Estimated Total Quantity of SCCPs Used</td>
<td>H14 - Estimated Year(s) in which SCCPs have been Used (e.g., 19xx to 19xx)</td>
<td>Comments / Source of Information</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------------------------</td>
<td>----------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>yes</td>
<td>yes</td>
<td>metal working fluids, softener for PVC and flame retardant in rubber</td>
<td>see H8 and the related comment</td>
<td>see H9</td>
<td>Source: -risk benefit analysis on the use of SCCP in cutting fluids in the metalworking industry. Final report, January 1997 prepared by RPA, Farthing Green House. London; Norfolk Tel : 01508528465, fax : 01508520758, -Survey from our office in June 2000</td>
</tr>
<tr>
<td>Canada</td>
<td>yes</td>
<td>yes</td>
<td>plasticizer and flame retardant in plastics (65%), metal working fluids (20%), in rubber (8%), paints (3%), adhesives and sealants (2%)</td>
<td>538.5 tonnes (1994)</td>
<td>---</td>
<td>See comments for Part I.</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>yes</td>
<td>yes</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Denmark</td>
<td>yes</td>
<td>yes</td>
<td>Boring, milling, drilling, cutting, shaving, thread</td>
<td>30 metric tonnes</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Country</td>
<td>H10 - Have SCCPs ever been used in your country?</td>
<td>H11 - Are SCCPs currently being used in your country?</td>
<td>H12 - Types of uses for SCCPs in your country?</td>
<td>H13 - Estimated Total Quantity of SCCPs Used</td>
<td>H14 - Estimated Year(s) in which SCCPs have been Used (e.g., 19xx to 19xx)</td>
<td>Comments / Source of Information</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Finland</td>
<td>yes</td>
<td>yes</td>
<td>Lubricant in metal works, Additive in roof paints, Additive in dye and rubber products</td>
<td>27 tonnes in 1997</td>
<td>at least from 1970s</td>
<td>The Finnish Chemical Products Register, questionnaires to the users</td>
</tr>
<tr>
<td>France</td>
<td>yes</td>
<td>yes</td>
<td>metal working fluid, leather treatment, plasticizers, flame retardant</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Georgia</td>
<td>yes</td>
<td>yes</td>
<td>Minor uses for laboratory research, other noncommercial small scale, if any.</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Germany</td>
<td>yes</td>
<td>yes</td>
<td>SEE BELOW</td>
<td>unknown</td>
<td>possibly ongoing, cf H12</td>
<td>cf. Part 1</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Latvia</td>
<td>no</td>
<td>no</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>Data base on chemical substances and chemical products (Latvian Environment Agency, 1995-2000)</td>
</tr>
<tr>
<td>Monaco</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Country</td>
<td>H10 - Have SCCPs ever been used in your country?</td>
<td>H11 - Are SCCPs currently being used in your country?</td>
<td>H12 - Types of uses for SCCPs in your country?</td>
<td>H13 - Estimated Total Quantity of SCCPs Used</td>
<td>H14 - Estimated Year(s) in which SCCPs have been Used (e.g., 19xx to 19xx)</td>
<td>Comments / Source of Information</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Netherlands</td>
<td>yes</td>
<td>yes</td>
<td>Metal cutting fluids, Rubber industry, Paint industry, Ceiling components, Leather industry, Textile industry</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Norway</td>
<td>yes</td>
<td>no</td>
<td>Information not available</td>
<td>Exact information is not available</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Poland</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Slovakia</td>
<td>unknown</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Spain</td>
<td>yes</td>
<td>no</td>
<td>only used in the past</td>
<td>not available</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Sweden</td>
<td>yes</td>
<td>yes</td>
<td>In year 2000, 10 tonnes were used as flame retardants and softeners in paints. A small amount was used in metalworking cutting fluid and sealants.</td>
<td>10 to 15 metric tonnes</td>
<td>1950? To present</td>
<td>The Swedish Products Register</td>
</tr>
<tr>
<td>Switzerland</td>
<td>yes</td>
<td>yes</td>
<td>As plasticizer (in paints, coatings and sealant), As flame retardant, As metal working fluids</td>
<td>70 metric tonnes/year</td>
<td>since 1993</td>
<td>---</td>
</tr>
<tr>
<td>Country</td>
<td>H10 - Have SCCPs ever been used in your country?</td>
<td>H11 - Are SCCPs currently being used in your country?</td>
<td>H12 - Types of uses for SCCPs in your country?</td>
<td>H13 - Estimated Total Quantity of SCCPs Used</td>
<td>H14 - Estimated Year(s) in which SCCPs have been Used (e.g., 19xx to 19xx)</td>
<td>Comments / Source of Information</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------</td>
<td>----------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>UK</td>
<td>yes</td>
<td>yes</td>
<td>Leather treatment, cutting fluids lubricants etc.</td>
<td>not known</td>
<td>to present</td>
<td>---</td>
</tr>
<tr>
<td>USA</td>
<td>yes</td>
<td>yes</td>
<td>SEE BELOW</td>
<td>* 25,500 metric tones/year</td>
<td>ongoing; specific historical information not available</td>
<td>*An assumption was made that all material manufactured in the US and imported into the US in 1997 that was reported during the 1998 IUR reporting cycle referred to above under Part 1 was used within the country. Some material may have been exported. Exported material was not identified. **Information from the Chlorinated Paraffins Industry Association (CPIA) website, <a href="http://www.regnet.com/cpia/index.html">http://www.regnet.com/cpia/index.html</a>, January 14, 2002</td>
</tr>
</tbody>
</table>

**Country H12 Responses**

**Germany**

metal working fluids (ca. 99% historical); SCCP production in Germany has ceased in 1995 – however ongoing import as constituent of various products (e.g. in paints, sealants, plastics, motor oil additives, very special metal working fluids, …, cf. comments on part 1) cannot be excluded
According to an industry trade group, the overwhelming use of chlorinated paraffins (CPs) in North America is as additives in cutting oils and high pressure lubricating oils where the requirements for chemical stability are high. CPs are often used as secondary plasticizers (or extenders) in polyvinyl chloride (PVC). CPs can also be used in other plastics, such as flexible vinyl, acrylonitrile-butadiene-styrene (ABS) resins, unsaturated polyester resins, polyethylene, polypropylene, and urethane foam. CPs can also be found in rubbers, paints, adhesives, caulks and sealants as either plasticizers or flame retardants. There was not specific information on the use of SCCPs.

<table>
<thead>
<tr>
<th>Country</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>According to an industry trade group, the overwhelming use of chlorinated paraffins (CPs) in North America is as additives in cutting oils and high pressure lubricating oils where the requirements for chemical stability are high. CPs are often used as secondary plasticizers (or extenders) in polyvinyl chloride (PVC). CPs can also be used in other plastics, such as flexible vinyl, acrylonitrile-butadiene-styrene (ABS) resins, unsaturated polyester resins, polyethylene, polypropylene, and urethane foam. CPs can also be found in rubbers, paints, adhesives, caulks and sealants as either plasticizers or flame retardants. There was not specific information on the use of SCCPs.**</td>
</tr>
</tbody>
</table>

### Part 3 Stockpile and Disposal Information on Short-chain chlorinated paraffins

<table>
<thead>
<tr>
<th>Country</th>
<th>H15 - Does your country have stockpiles of SCCPs?</th>
<th>H16 - Estimated Total Quantity of SCCPs Stockpiled</th>
<th>H17 - Does your country take measures to dispose of SCCPs?</th>
<th>H18 - If YES, please provide a short description of disposal measures</th>
<th>Comments / Source of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armenia</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Austria</td>
<td>no</td>
<td>---</td>
<td>yes</td>
<td>---</td>
<td>SCCPs are considered as hazardous waste and thus underlying certain requirements for disposal.</td>
</tr>
<tr>
<td>Belgium</td>
<td>no</td>
<td>---</td>
<td>yes and no</td>
<td>---</td>
<td>In the Flemish waste management policy SCCPs are classified as hazardous waste.</td>
</tr>
<tr>
<td>Canada</td>
<td>no</td>
<td>---</td>
<td>no</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>unknown</td>
<td>---</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Denmark</td>
<td>unknown</td>
<td>---</td>
<td>yes</td>
<td>---</td>
<td>Together with other chemicals, SCCP is regarded as chemical waste. Waste with SCCP is treated as dangerous waste and has to be handled in that way.</td>
</tr>
<tr>
<td>Finland</td>
<td>unknown</td>
<td>---</td>
<td>yes</td>
<td>---</td>
<td>Used metal working fluids and SCCPs are classified as hazardous waste according to waste legislation and have to be treated accordingly.</td>
</tr>
<tr>
<td>France</td>
<td>unknown</td>
<td>---</td>
<td>unknown</td>
<td>---</td>
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</tr>
<tr>
<td>Georgia</td>
<td>no</td>
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<td>Kazakhstan</td>
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<tr>
<td>Latvia</td>
<td>unknown</td>
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<td>no</td>
<td>---</td>
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<tr>
<td>Monaco</td>
<td>unknown</td>
<td>---</td>
<td>no</td>
<td>---</td>
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</tr>
<tr>
<td>Country</td>
<td>H15 - Does your country have stockpiles of SCCPs?</td>
<td>H16 - Estimated Total Quantity of SCCPs Stockpiled</td>
<td>H17 - Does your country take measures to dispose of SCCPs?</td>
<td>H18 - If YES, please provide a short description of disposal measures</td>
<td>Comments / Source of Information</td>
</tr>
<tr>
<td>-------------</td>
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<tr>
<td>Netherlands</td>
<td>unknown</td>
<td>---</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Norway</td>
<td>no</td>
<td>---</td>
<td>yes</td>
<td>Any disposal of SCCP is covered by the ordinary system for hazardous waste.</td>
<td>---</td>
</tr>
<tr>
<td>Poland</td>
<td>---</td>
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</tr>
<tr>
<td>Slovakia</td>
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</tr>
<tr>
<td>Spain</td>
<td>no</td>
<td>---</td>
<td>no</td>
<td>---</td>
<td>European legal framework under discussion</td>
</tr>
<tr>
<td>Sweden</td>
<td>no</td>
<td>---</td>
<td>yes</td>
<td>---</td>
<td>SCCPs are regarded and treated as environmental dangerous waste and should be collected and burned in waste treatment plants (High temperature incineration)</td>
</tr>
<tr>
<td>Switzerland</td>
<td>no</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>UK</td>
<td>unknown</td>
<td>---</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Country</td>
<td>H15 - Does your country have stockpiles of SCCPs?</td>
<td>H16 - Estimated Total Quantity of SCCPs Stockpiled</td>
<td>H17 - Does your country take measures to dispose of SCCPs?</td>
<td>H18 - If YES, please provide a short description of disposal measures</td>
<td>Comments / Source of Information</td>
</tr>
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<td>-------------------------------------------------</td>
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<td>-----------------------------</td>
</tr>
<tr>
<td>USA</td>
<td>unknown</td>
<td>---</td>
<td>yes*</td>
<td>Disposal of SCCPs in hazardous wastes would take place only in specifically designed landfills (e.g., double liners, landfill leachate collection and monitoring, and other waste input restrictions).</td>
<td>* When SCCPs are present in hazardous wastes, they are subject to stringent regulations under the Resource Conservation Recovery Act that govern their disposal. These regulations ensure that disposal of all hazardous wastes occur in an environmentally sound manner. While SCCPs are not specifically identified in the regulations, they would be controlled under the regulations as halogenated organics.</td>
</tr>
</tbody>
</table>
### Part 4  Actions Taken or Proposed To Control the Production, Use, Storage and/or Disposal of Short-chain chlorinated paraffins

<table>
<thead>
<tr>
<th>Country</th>
<th>H19 - Are SCCPs subject to existing or proposed regulatory control actions in your country?</th>
<th>H20 - If YES, please provide a short description of existing or proposed control actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armenia</td>
<td>no</td>
<td>---</td>
</tr>
<tr>
<td>Austria</td>
<td>yes</td>
<td>proposed controls will be in line with the relevant EU-legislation</td>
</tr>
<tr>
<td>Belgium</td>
<td>yes</td>
<td>There is a proposed regulatory with regards with the OSPAR Decision 95/1 on the Phasing out of SCCP and a draft EU Directive on the marketing and use. In the Flamish waste management policy SCCP’s are clasified as hazardous waste. The disposal of SCCP’s is restricted to some regulations because of the classifying as hazardous waste.</td>
</tr>
<tr>
<td>Canada</td>
<td>yes</td>
<td>Canada will be developing control measures for SCCPs, pending the outcome of an updated Canadian risk assessment report expected to be available in 2003 (refer to Part II C of SCCP Dossier for further information).</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>no</td>
<td>---</td>
</tr>
<tr>
<td>Denmark</td>
<td>yes</td>
<td>The EU has proposed a ban on the use of SCCP in certain uses from the year 2003, which Denmark is going to implement</td>
</tr>
<tr>
<td>Finland</td>
<td>yes</td>
<td>Implementation of the EU Water Framework Directive (2000/60/EC), Forthcoming amendment of the EU Marketing and Use Restriction Directive (76/769/EEC) PARCOM Decision 95/1</td>
</tr>
<tr>
<td>Country</td>
<td>H19 - Are SCCPs subject to existing or proposed regulatory control actions in your country?</td>
<td>H20 - If YES, please provide a short description of existing or proposed control actions</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>France</td>
<td>yes</td>
<td>SCCPs are, according to the directive on the classification, packaging and labelling of dangerous substances (67/548/EEC), classified as Dangerous for the Environment R50/53 and Harmful, Carcinogen, cat. 3. The Commission has proposed an amendment to Directive 76/769 based on an agreed risk reduction strategy under Regulation 793/93 which partly includes the application covered by PARCOM Decision 95/1. This concluded that limitations on marketing and use within the framework of the 76/769/EEC directive, in particular for metal working and leather finishing, should be considered to limit the risks, with a review to take place within three years to take account of i.a. issues raised in PARCOM Decision 95/1. A common position was agreed in June 2001 and adoption was expected in 2002. Within the Water Framework Directive (2000/60/EC) the SCCPs are on the agreed list of priority substances and identified as priority hazardous substances. France will transpose the EU directive.</td>
</tr>
<tr>
<td>Georgia</td>
<td>yes</td>
<td>----</td>
</tr>
<tr>
<td>Germany</td>
<td>yes</td>
<td>direct or indirect pressure due to various regulatory instruments (e.g. Federal Ambient Pollution Control Act BImSchG, Water Protection Act WHG, Chemical Substance Act ChemG, Technical Regulation to Avoid Waste TA Abfall, Environmental Liability Act UmweltHG, Commercial and Industrial Waste Management Act KrW-/AbfG, Environmental Label ‘Blue Angel’ for selected lubricants).</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>unknown</td>
<td>----</td>
</tr>
<tr>
<td>Latvia</td>
<td>unknown</td>
<td>----</td>
</tr>
<tr>
<td>Monaco</td>
<td>no</td>
<td>----</td>
</tr>
<tr>
<td>Netherlands</td>
<td>yes</td>
<td>EU-regulation</td>
</tr>
<tr>
<td>Country</td>
<td>H19 - Are SCCPs subject to existing or proposed regulatory control actions in your country?</td>
<td>H20 - If YES, please provide a short description of existing or proposed control actions</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Norway  | yes                                                                              | The production, import, export, sale and use of SCCP in pure form, in preparations, or in finished products is prohibited.  
The prohibition of production, import and export entered into force 1 January 2001, while the prohibition of the sale and use of SCCP came into force 1 January 2002.  
In accordance with OSPAR decision 95/1 the regulation with respect to conveyor belts in the mining industry and sealing materials in dams containing SCCP, comes into force 1 January 2005. However, such uses are not relevant for the situation in Norway. |
| Poland  | ---                                                                              | ---                                                                                                                             |
| Slovakia | unknown                                                                          | New European legal framework                                                                                                  |
| Spain   | yes                                                                              | The uses of SCCPs has been reduced by more than 95 % in Sweden through voluntarily agreements by industry. In a governmental bill in 1997 the goal was to eliminate SCCP:s by year 2000. Some development work remains to substitute the remaining use of SCCP:s in the paint industry.  
According to a proposed regulation of SCCPs in EU, the uses on metal working fluids and leather finishing will be limited. |
| Switzerland | yes                                                                            | It is proposed to ban most applications according to PARCOM decision 95/1                                                                 |
| UK      | yes                                                                              | A risk assessment and risk reduction strategy have been completed under the EU existing substances regulations recommending action to reduce exposure to SCCPs. Marketing and use restrictions are currently being negotiated and a new Directive is expected to be adopted this year. |
| USA     | no*                                                                             | ---                                                                                                                             |

<table>
<thead>
<tr>
<th>Country</th>
<th>Part 4 Comments / Source of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>EU-directive 76/769/EEC</td>
</tr>
<tr>
<td>Norway</td>
<td>The regulatory control actions are stated in &quot;Regulation governing short-chain chlorinated paraffins&quot; laid down by the Ministry of Environment 13 December 2000.</td>
</tr>
<tr>
<td>Sweden</td>
<td>The Swedish Products Register and contacts with the industry.</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td>US</td>
<td>*Note response under H17 above. Also, for substances not on the Toxic Substances Control Act Section 8(b) Inventory of chemicals, any intended industrial chemical-type use would require 90-day advance premanufacture notification (PMN). The required notification would provide USEPA the opportunity to review the substance for potential unreasonable risks and to take action, where appropriate, to control those risks before they can occur. See 40 CFR 720 for the USEPA PMN regulations.</td>
</tr>
</tbody>
</table>

## Part 5  Production of Short-chain chlorinated paraffins outside the UNECE Region

<table>
<thead>
<tr>
<th>Country</th>
<th>H21 - Are you aware of production of SCCPs outside of the UNECE Region?</th>
<th>H22 - If YES, please indicate country(ies) producing SCCPs and/or sources/contacts for further information</th>
<th>Comments / Source of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armenia</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Austria</td>
<td>no</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Belgium</td>
<td>no</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Canada</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>unknown</td>
<td>---</td>
<td>As far as SCCPs similarly as some other candidate POPs will be a subject of research projects connected with implementation of Stockholm Convention</td>
</tr>
<tr>
<td>Denmark</td>
<td>no</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Finland</td>
<td>no</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>France</td>
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<td>---</td>
</tr>
<tr>
<td>Georgia</td>
<td>no</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Germany</td>
<td>no</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>unknown</td>
<td>---</td>
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</tr>
<tr>
<td>Latvia</td>
<td>no</td>
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<tr>
<td>Monaco</td>
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<td>---</td>
</tr>
<tr>
<td>Netherlands</td>
<td>unknown</td>
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<td>---</td>
</tr>
<tr>
<td>Norway</td>
<td>unknown</td>
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</tr>
<tr>
<td>Poland</td>
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<tr>
<td>Slovakia</td>
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<td>---</td>
</tr>
<tr>
<td>Spain</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Sweden</td>
<td>yes</td>
<td>According to a recent report (1999), the total production of SCCP, MCCP and LCCP in China 1997 was about 100 000 metric tonnes.</td>
<td>OSPAR background document on SCCPs</td>
</tr>
<tr>
<td>Switzerland</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>UK</td>
<td>unknown</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>USA</td>
<td>no</td>
<td>---</td>
<td>Information not available at this time</td>
</tr>
</tbody>
</table>
APPENDIX 3

COMMENTS RECEIVED AND CANADA’S RESPONSE TO COMMENTS ON THE DRAFT 1 OF SCCP DOSSIER (OF MARCH 2002)

This Appendix is separated in successive parts (A to D), reflecting the iterative process of receiving and responding to comments.

Appendices 3A and 3B reflect the first round of comments-response (March 2002 to January 17, 2003):

- Appendix 3A is a compilation of all comments received on the Draft 1 SCCP Dossier (of March 2002);
- Appendix 3B is Canada’s “Response to Comments Received” on the Draft 1 SCCP Dossier. This document was provided to the Expert Group on January 20, 2003.

Appendices 3C and 3D reflect the second round of comments-response (January 20 to February 28, 2003):

- Appendix 3C is a compilation of all comments received by February 28, 2003 on Canada’s “Response to Comments Received”.
- Appendix 3D is Canada’s response to comments received in this second round.
APPENDIX 3A

COMPILATION OF COMMENTS RECEIVED ON DRAFT 1 OF SCCP DOSSIER (MARCH 2002)

Comments submitted by:
1. Euro Chlor
2. Chlorinated Paraffins Industry Association
3. The Netherlands
4. United States
5. France
1. Euro Chlor Comments on UNECE SCCP Substance dossier

PART I – RISK PROFILE

A. CHEMICAL IDENTITY

This section is a mixture of information on SCCPs and general CPs. It would be more appropriate to the SCCPs if it was more specific.

B. PERSISTENT ORGANIC POLLUTANT CHARACTERISTICS

1. Potential for long range atmospheric transport

*Atmospheric Half-Life* and Table 1.

*The range of half-lives given in Table 1 is misleading, since it includes SCCP structures (high chlorination levels) for which the (subcooled liquid) vapour pressures (scl-VP) would be extremely low. Vapour pressures for SCCPs were determined by Drouillard et al (1998) who derived a relationship to predict the vapour pressure for each structure:

\[
\log \text{scl-VP} = -0.353(\text{No of C atoms}) - 0.654(\text{No of Cl atoms}) + 4.462
\]

From this relationship, it can be shown that all predicted half-lives greater than 2 days (in Table 1, AOPWIN OH-level) are associated with structures for which the scl-VP is less than 0.002 Pa for C\textsubscript{10} structures and less than 0.00003 Pa for C\textsubscript{13} structures.

Propensity for photochemical breakdown is not the criterion in the UNECE protocol and is not the only factor controlling atmospheric half-life. Wania and Mackay (1996) showed that, regardless of any degradation in the atmosphere, substances with scl-VP less than $10^{-3}$ Pa show low tendency to volatilise to the atmosphere and a rapid condensation near to sources. Drouillard et al (1998) also showed that Henry’s Law Constants (HLC) for polychlorinated alkanes fall more rapidly than vapour pressure with increasing carbon number and chlorination. This implies that the tendency to volatilise from water or moist solids is lower than would be expected from scl-VP. Thus, it can be concluded that those SCCPs with any tendency for volatilisation and slow deposition are those with a rapid breakdown by hydroxyl radicals.

Van Pul et al (1998) modelled the atmospheric transport of SCCPs and their data should be added to the dossier. Taking into account wet and dry deposition processes, and using a relatively long photochemical degradation half-life of 96
hours, they predicted atmospheric half-lives for SCCP of 23 hours over land, and 27 hours over the sea.

**AMBIENT AIR**

The data for air concentrations at Alert in Table 2 are referenced as Tomy et al. (1998); however, these data could not be found in that reference.

The text following Table 2 states that reagent blanks at Alert “also contained low levels of SCCPs but at concentrations lower than in the air samples”. Since the detection limit appears to have been 1 pg/m³ and the maximum sample value was 8.5 pg/m³, the blank values should be stated and whether these have been subtracted to derive the air values.

*Considering the low levels measured, the evidence for sample contamination, the possibility of interferences from other chlorinated compounds and the possibility of relatively local sources (Alert is a military base with an airstrip and a population until recently of about 200; Hazen Lake was the site of a former military base), 4 values from a single location should not be considered sufficient to demonstrate long range atmospheric transport.*

The paragraph following Table 2 states that the distribution profiles for Alert and Ontario were similar. However, the next paragraph suggests they were different. Comparisons with the technical PCA-60 mixture are not relevant since this is only one of very many commercial products with differing profiles. Also, in the absence of congener-specific data for volatilisation, atmospheric degradation and deposition, inferring sources from distribution profiles is highly speculative.

**SEDIMENTS**

*The unpublished sediment data for 1997/98 and the Hazen Lake sample are stated to range from 4.8 to 77.8 ng/g. Tomy et al. (1997) reported a method detection limit (MDL) for sediment of 23 ng/g. Presumably, this MDL was improved but this suggests that some of these determinations were close to the MDL. The MDL and blank results should be stated and the possibility of interferences and sample contamination should be discussed. As discussed above, Hazen Lake is not free of potential local sources.*

(See also comments on #3 Persistence, Sediments)

**BIOTA**

*Paragraphs 1 and 4 imply that the congener profile in Arctic mammals (“more volatile components”; “lower chlorinated congeners”) indicates atmospheric transport. However, these profiles also reflect the more soluble congeners*
and, as stated by Tomy (2000), could equally suggest a route via water (sea and ocean currents).

The data in Table 3 reveal an important anomaly. There is a remarkable similarity between the SCCP values across a wide range of species and locations. For example, values for beluga in the St Lawrence River (which can be considered subject to ongoing local industrial and urban emission sources) are not significantly different from values given for ringed seal from Ellesmere Island. This in marked contrast to the data for PCBs and DDT from the same animals, which are 2 to 3 orders of magnitude higher in the St Lawrence than at Ellesmere, even though new emissions of these substances have been virtually eliminated in N. America. This strongly indicates that the environmental transport and distribution pattern for SCCPs is very different to that of these established POPs, or that the analytical methods for SCCPs are subject to interferences.

CONCLUSIONS

The AOPWIN/EU methodology does not provide “estimates of atmospheric half-lives”; it only provides estimates of atmospheric photochemical degradation, which is only one factor governing atmospheric half-life.

We would also point out that legitimate usage of SCCPs as flame retardants, oil additives, plasticisers, water-proofing agents is possible and probable in arctic regions. Populations living and working in arctic latitudes carry out activities of engineering and maintenance of shipping, motor vehicles and aircraft, as well as oil exploration, mining and mineral extraction, all of which provide a legitimate source of SCCPs from substances in general use. The presence of SCCPs in arctic latitudes does not necessarily imply long range atmospheric transport.

2. TOXICITY

AQUATIC BIOTA

The reference to “delayed toxicity” in the rainbow trout study (Madeley and Maddock, 1983) is misleading. It should be added that the authors effectively repeated the study (Madeley and Maddock, 1983b). Trout were exposed to a slightly higher measured concentration (17.2 µg/l) for the same period as in the original study (168 days), followed by depuration in clean water for a longer period (99 days compared with 69 days in the original study). The new study did not observe any significant mortality during exposure or depuration and there was no significant effect on the growth rate of the trout. A lower concentration (3.4 µg/l) was also tested with the same results. Thus the mortalities observed during depuration in the earlier study were not reproducible, and although the cause remained unknown, the evidence from the repeat study suggests that it was more likely a disease problem than delayed toxicity.
3. PERSISTENCE

SEDIMENT

The analyses from Canadian lake sediments should be interpreted with caution. Tomy et al (1997) reported that Winnipeg and Fox lakes were subject to local sources of SCCPs, the former from large conurbations and the latter being situated on the Alaska Highway. Muir and Tomy (1997) also report that Lake Nipigon “cannot be considered a remote lake because it is accessible by road and used by fishers” and that the shores of Lake Hazen (Ellesmere Island) have been used in the past as a military base.

It is not logical to state (Paragraph 2) that “SCCP residues … in sediment cores dating back to the 1920’s and 1930’s … is convincing evidence that SCCPs are persistent in sediment” when, in the same paragraph it is stated that residues in pre-1940’s sediment “can be explained by diffusion … through the sediment or contamination [during] core sampling”. Prior to industry commentators pointing out that production of SCCPs on a commercial scale did not start until the 1940’s, Muir and Tomy (1997) stated that the sediment cores were “dated with Pb210 and Cs137 and shown to be undisturbed”. Of particular concern is that for Lakes Fox and Winnipeg, SCCP levels in 1933 sediments were in excess of all the values (1944 to 1986) given for the most northerly Hazen Lake. This raises serious doubt about the validity of these low level measurements.

4. BIOACCUMULATION

BIOTA

Table 4: It is misleading to quote bioaccumulation factors based on isolated field measurements such as these, when the fish and water were sampled from different locations and at different times. It is not possible to verify that the water levels measured were representative of those to which the fish were exposed, either spatially or temporally. The fish values given are in fact a mean of fish from 2 different locations, one of which was close to Toronto. The cited paper (Muir et al 2000) does not make this BAF calculation.

The most reliable bioconcentration factor (BCF) for fish is provided by Madeley and Maddock (1983), who obtained whole fish BCFs of 3550 and 5260 in rainbow trout exposed for 168 days to measured concentrations of 3.1 and 14.3 µg/l, respectively. These BCFs were based on measurement of $^{14}$C residues. Parent compound analysis of individual tissues gave lower values than the radiolabel, suggesting some metabolism of the SCCP and lower BCFs, but whole fish BCFs were not given.
PART II - SUMMARY REPORT

A. Extent of release to the Environment

1. Production

The figure mentioned by Germany for 1997/1998 (114,000 t/yr.) relates to ALL CPs, not only SCCPs. The same remark is valid for the response to questionnaire H4 by Germany in Appendix 2.

It is mentioned elsewhere in the report that current SCCP production in Western Europe is unclear. In fact, it is slightly higher than the total uses given in the Table in attachment 1, due to exports, and significantly lower than the 15,000 t/yr given for 1994. We cannot give an exact figure, because we do not collect this information from our members.

2. Uses

The Table in attachment 1 gives updated data on current uses. You will notice that the consumption of SCCPs in the EU has decreased from 13,208 t in 1995 to only <confidential> t in 2001. If the main use in 1995 and 1998 was in metal working fluids (resp. 71.0% and 49.5%), this use has become minor nowadays and represents only 16.9% of a much lower total.

The footnote remarks that “other uses” increased from 0.75% to 15.9% between 1995 and 1998. It should be noted that the “other” uses are often well-known applications described in the table, but the split between those applications could not be calculated because the product was sold through distributors. The same remark applies to the 21.9% of other uses in 2001.

3. EMISSIONS AND PATHWAYS TO THE ENVIRONMENT

BIOTIC TRANSFORMATION

The description of the work of Omori et al (1987) is misleading. The enrichment cultures were not “incapable” of degrading SCCP, but did not grow well on SCCP as the sole carbon source. However, using soil-isolated bacteria, they demonstrated cometabolic dechlorination of SCCP when in the presence of non-chlorinated paraffins (n-alkanes, widely found in the environment from natural sources). Their
finding of 21% dechlorination is significant considering the short duration (36 hours) and the relatively high level of chlorination (63%) of the SCCP.

B. ENVIRONMENTAL LEVELS AND BIOAVAILABILITY

CANADIAN LAKE SEDIMENTS

(See comments on Part I, B3 Persistence/Sediments, above)

4. Levels found in biota

Marine mammals

(See comments on Part I, B1. Biota, above)

5. Summary

It is interesting to note that all sewage treatment samples showed the presence of SCCPs. Can we be convinced that the analytical methodology was able to show non-detectable levels in blanks? There are many instances of memory effects in apparatus which can give rise to blank samples showing the presence of CPs.

C. Socio-economic factors

1. National and International Regulation

PARCOM Decision 95/1 and the future amendment to EU Directive 76/769/EEC, mentioned by several countries, are somewhat contradictory. The ban in PARCOM goes much further than in the EU Directive. Euro Chlor believes that only the EU Directive should be taken into consideration, because it is based on a full-fledged scientifically-based Risk Assessment. The science in this Risk Assessment is more recent than for the PARCOM decision, based in part on the precautionary principle. When science becomes available, the precautionary principle should subside.

2. Alternatives/Substitutes

The text mentions that SCCPs are often contaminants in MCCPs and LCCPs. This might be true to an extent of less than 1% in MCCPs, but it is certainly not true for LCCPs.

Additional References (others as in Draft UNECE dossier)


Appendix 2

In response to questionnaire H12, Belgium mentions the use of SCCPs as softener for PVC. This is not a current use anymore.

Attachment 1

<confidential>
2. Chlorinated Paraffins Industry Association (CPIA) Comments

I. INTRODUCTION AND SUMMARY

The Chlorinated Paraffins Industry Association (CPIA) appreciates the opportunity to submit comments on the draft report “Short Chain Chlorinated Paraffins (SCCP) Substance Dossier (Draft March, 2002),” which has been prepared for review by an UNECE ad hoc Expert Group on POPs meeting in Geneva on June 5-6, 2002. CPIA members represent the major North American manufacturers of all chlorinated paraffins, including SCCPs and as such have a significant interest in this proceeding. It is further significant to note that the United States industry is one of the major consumers of SCCPs in the western world and these products are safely and effectively employed in many applications including as an extreme pressure additive in metalworking, fire retardant in rubber, moisture repellent in road paints, plasticizer in polymers and anti-wear in gear oils.

CPIA has been closely following the deliberations by the UNECE in establishing the 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs) (hereinafter POPs Protocol). During the discussions of the protocol in the mid 1990’s, there were some countries suggesting that SCCPs should be included on the initial list of POPs, however due to the inadequacy of the information, the decision was made not to include SCCPs. SCCPs are once again being considered for inclusion in the POPs Protocol, although this time they are being judged against the criteria specified in Executive Body Decision 1998/2, “Information to Be Submitted and the Procedure for Adding Substances to Annexes I, II or III to the Protocol on Persistent Organic Pollutants.”

As described further in these comments, CPIA does not believe that the available information supports the inclusion of SCCPs in the POPs Protocol. The objective of the POPs Protocol (see Article II) “is to control, reduce or eliminate discharges, emissions and losses of persistent organic pollutants.”

Article 1 defines a persistent organic pollutant (POP) as an organic substance that meets four criteria:

\[(i) \text{ possess toxic characteristics; (ii) are persistent; (iii) bioaccumulate; (iv) are prone to long-range transboundary atmospheric transport and}\]

\[\text{...}\]

\[\text{...}\]

\[1\text{ CPIA members include: Dover Chemical Corporation; Ferro Corporation, Keil Chemical Division; and Pioneer Americas, Inc.}\]
As will be succinctly described below, despite the assertions present in the draft SCCP dossier, SCCPs do not meet all of the stated POPs criteria. Of particular significance:

- SCCPs have a very low vapor pressure (ranges from 0.5 Pa to 2.8 \times 10^{-7} \text{ Pa}) and therefore have little, if any potential for long-range transport.

- Assuming that the reported measurements of SCCPs in remote regions is correct, there is more than adequate explanation that the source of the material in the environment is due to local use (e.g., hard rock mining, open gear lubricants, gas and oil exploration) rather than long-range transport;

- The modeled data suggesting half-life values greater than 2 days provide little justification given the very low propensity for these substance to volatilize to air; and,

- The trace levels that are found in the environment do not universally support the conclusion that they are “likely to cause significant adverse human heath or environment effects.” In fact, US EPA concluded as part of its assessment that there was no need to control any use of SCCPs, which further reinforces that these compounds can be effectively managed.

II. SCCPS DO NOT HAVE THE POTENTIAL FOR LONG RANGE TRANSBOUNDARY ATMOSPHERIC TRANSPORT GIVEN A LOW VAPOR PRESSURE AND SHORT HALF-LIFE IN AIR

According to the POPs Protocol, for a substance to have the potential for long-range transboundary atmospheric transport, there should be:

evidence that the substance has a vapour pressure less than 1,000 \text{ Pa} and an atmospheric half-life greater than two days. Alternatively, monitoring data showing that the substance is found in remote regions.

A. Vapor Pressure

Most materials have a vapor pressure less than 1000 \text{ Pa}. As such, in assessing the appropriateness of including a compound on the POPs list, it is important to consider whether the substance’s vapor pressure suggests the likelihood of volatilization into air and transport. Clearly chemicals that have a very low vapor pressure, and therefore a very low probability to volatilize into air, have a very low probability of long-range transport and should be assigned a very low priority for inclusion in the POPs Protocol.
As previously stated, the vapor pressures associated with SCCPs are reported by Canada to range from a high of 0.5 to 2.8 X 10^-7 Pa. These compounds accordingly have a very low vapor pressure and therefore should have a low potential for transport.

The SCCP Dossier acknowledges the low vapor pressure but suggests that there is significant potential for transport because SCCPs were found in various environmental media. As discussed further below, CPIA maintains that the presence of trace levels of SCCPs in environmental should not be considered an indication of transport but more likely the result of local use.

B. Atmospheric Half-Life

The SCCP Dossier acknowledges that there are no experimental data on the half-life of SCCPs in air. The document presents modelled data based on the Syracuse Research Corporation AOPWIN (v1.86) computer program. Calculated half-lives are presented for specific chlorinated alkane isomers which range from a low of 0.8 to a high of 10.5 days. Several important issues need to be considered in assessing the significance of these results against the POPs Protocol criteria:

1. Canada’s estimated half-life data for SCCPs are not the only calculated values that have been made. Other published estimates have shown lower values – most notably values less than 2 days. The World Health Organization, International Programme on Chemical Safety, Environmental Health Criteria 181, on Chlorinated Paraffins cites a published study by Slooff et al., (1992) which reports half-life values of 1.2-1.8 days.

2. In evaluating the specific half-life information, it is important to consider the relative vapor pressure of the specific substances. It is significant to note that the compounds showing the longer half-lives (recognizing of course that the longest one cited is less than 11 days) are the specific isomers that have the lowest vapor pressure and therefore the lowest probability of finding their way into the air.

---

3. As discussed in greater detail in the attached comments developed by the European industry organization, Euro Chlor, the range of half-lives given in Table 1 is misleading, since it includes SCCP structures (high chlorination levels) for which the subcooled liquid vapour pressures (scl-VP) would be extremely low. According to estimates developed by Drouillard et al. (1998), isomers with an AOPWIN calculated value greater than 2 days are associated with structures for which the scl-VP is less than 0.002 Pa for the C_{10} structures and less than 0.00003 Pa for the C_{13} structures. Wania and Mackay (1996) showed that, regardless of any degradation in the atmosphere, substances with scl-VP less than 10^{-3} Pa show low tendency to volatilise to the atmosphere and a rapid condensation near to sources. Drouillard et al. (1998) also showed that Henry’s Law Constants (HLC) for polychlorinated alkanes fall more rapidly than vapour pressure with increasing carbon number and chlorination. This implies that the tendency to volatilise from water or moist solids is lower than would be expected from scl-VP. Thus, it can be concluded that those SCCPs with any tendency for volatilisation and slow deposition are those with a rapid breakdown by hydroxyl radicals.

4. All isomers should not be considered equally relevant in assessing vapor pressure and atmospheric half-lives. The half-live values presented in Table 1 address a range of isomers with 10 carbons and 13 carbons, i.e., the ends of the SCCP spectrum. It is important to recognize that these species make up the smallest fraction of the commercial SCCPs, which consists of a range of carbon chain lengths. A typical SCCP contains less than 10% chlorinated carbon chain length species with 10 and 13 carbons and over 90% contains carbon chain lengths of 11 and 12. Moreover, some of the isomers, particularly those with the larger number of chlorine atoms, and the ones AOPWIN predicts as having the longest half-lives, are the least likely to be found in commercial SCCP formulations.

III. WHEN SCCPS ARE FOUND IN THE ENVIRONMENT, IT IS MORE LIKELY THE RESULT OF LOCAL USE

There are numerous questions regarding the reliability of the analytical results reported as documenting the presence of SCCPs in the different environment media. These include:

- SCCPs were reported in the “blank” samples which raises questions on the reliability of the analytical methods;

- the measured values reported are not significantly different than the minimum detection limit. Before values are considered reliable, they
should be found to be reproducible in different laboratories at levels above their quantification levels;

- possibilities for sample contamination; and,

- lack of peer review and round robin confirmation of the analytical method.

In addressing sediment, the SCCP Dossier offers the finding of SCCP residues in sediment cores dating back to the 1920’s and 1930’s as evidence that SCCPs are persistent in sediment while at the same time the document indicates that residues in pre-1940’s sediment “can be explained by diffusion … through the sediment or contamination [during] core sampling.” SCCPs were not in commercial production before the 1940’s. Also, the fact that the 1933 sediment cores from Lakes Fox and Winnipeg, had higher concentrations than the cores takes from 1944 to 1986 reinforces the concern over the validity of these low level measurements.

Nonetheless, assuming that the analytical measurements are completely accurate, there are numerous local source opportunities, which can explain the presence of SCCPs in the environment, and as such should not be considered as supporting evidence of long-range transport. The SCCP Dossier states that:

*the detection of the more volatile shorter carbon chain length congeners of SCCPs in Arctic air samples, Arctic biota and in Arctic lake sediments in the absence of significant sources of SCCPs in this region suggests that these residues are present due to long-range atmospheric transport*

Given the very low concentrations that are reported for these media, CPIA believes that there are more than adequate potential sources of SCCPs to explain these concentrations. SCCPs have a wide range of uses and applications many of which include use in operations that are conducted in remote regions. Simply finding trace levels of a substance in a remote area should not by itself be construed to suggest long-range transport without convincing evidence that the source was truly the result of atmospheric transport. Even the SCCP Dossier itself notes that the SCCP concentrations in air are likely the result of local sources.

Some of the uses of fluids/products that could result in SCCPs being released to the Arctic environment include:

- Gear oil packages
- Fluid used in hard rock mining
- Fluids and equipment used in oil and gas exploration
- Fluid and equipment used in mining
- Manufacture of seamless pipe
- Metalworking and operation of turbines and gears on ships.

Moreover, while not in compliance with local laws and regulations, there have been numerous instances where ships have released oils and other fluids into the oceans, which could very likely contain SCCPs.

**IV. THE TRACE LEVELS REPORTED IN THE ENVIRONMENT DO NOT UNIVERSALLY SUPPORT THE CONCLUSION THAT THEY ARE “LIKELY TO CAUSE SIGNIFICANT ADVERSE HUMAN HEATH OR ENVIRONMENT EFFECTS”**

For a substance to be considered a POP it is to be “likely to cause significant adverse human health or environmental effects near to and distant from their sources.” CPIA recognizes that Environment Canada has declared SCCPs to be “toxic” in accordance with the Canadian Environment Protection Act. Additionally, the European Union has decided, based on its risk assessment, that there is a need to restrict the use of SCCPs for metalworking fluids and for leather treatment. These conclusions were not driven by concerns of long-range transport but largely due to local discharges resulting in environmental concentrations in excess of concern levels. More importantly, these conclusions are in stark contrast to US EPA’s assessment of SCCPs, which found that there was no need to restrict the use of SCCPs given that very few localities, using worst-case exposure assumptions, are likely to contain environmental concentration levels above EPA’s risk level of concern.

EPA conducted a Risk Management (RM2) evaluation of SCCPs. EPA’s assessment examined both ecological risk, which EPA considered to be the major concern, and human health risk. Using an aquatic simulation model, EPA predicted a “low probability of any effect to any trophic level at a water concentration of 1.0 ug/l” which EPA considered to be the low end of the No Observed Effect Concentration.

For a substance to be included in the POPs Protocol, it should have a reasonable likelihood of presenting significant adverse human health or environmental effects in most UNECE counties from long-range transport. The fact some jurisdictions have concluded that the use of the substance presents a risk, and some have concluded otherwise, should in and of itself be inadequate to justify inclusion in the POPs Protocol.
V. CONCLUSION

The 1998 POPs Protocol should be reserved for compounds clearly meeting the criteria for Persistent Organic Pollutants. As described in these comments, there is inadequate evidence to support a conclusion that SCCPs meet the criteria for adding new substances to the POPs Protocol in accordance with Executive Body Decision 1998/2.
3. Comments from the Netherlands

Page 5: Homologue patterns in southern Ontario are discussed in the second paragraph. For the UNECE framework it is more logical to discuss these patterns – if possible with quantitative data - in Alert (and compare to the technical mixtures).

Page 9: What is the relevance of calculating a NOEC_{benthic}?

Page 10: What is the BCF (or BAF) used in the EU Risk Assessment Report (e.g. in the secondary poisoning scenario) as in this report an evaluation is made of all studies mentioned and a most reliable or preferred value determined?

Page 17: The paragraphs on "Abiotic transformation" and "Biotic Transformation" should be moved and integrated with Section 3 of the Risk Profile.

Page 18: Can section B on environmental levels more focuss on monitoring data in remote areas?

Page 24: What are the actions taken by the USA on SCCPs? Can the – since this is the most important decision in the EU to reduce emissions of SCCPs – EU Directive 76/769/EEC be more specified (e.g. what is the expected reduction in use?)?

Page 26: What is the conclusion on alternatives for SCCPs considering that also MCCPs and LCCPs are probably POPs?
4. Comments from the United States

Sally L. Shaver
Director, Emission Standards Division
Office of Air Quality Planning and Standards
Office of Air and Radiation
US Environmental Protection Agency
(See attached file: final US comments on SCCPs.doc)
(See attached file: final US comments on SCCPs.doc)

To: David Stone, Chair of ad hoc Experts Group on LRTAP/POP
Henning Wuester, Secretariat, UNECE

The United States is pleased to provide the attached comments on both summary documents and dossiers for substances included in the protocol (either on the POP list or designated for evaluation or reassessment) and for substances not included in the protocol. We commend the authors on the extent of work accomplished. The information provided is informative and has moved the state of knowledge forward.

Part I includes the U.S. comments on summary documents for substances already included in the protocol. Part II includes comments on summary documents for substances not included in the protocol. Parts III and IV include comments on the full dossiers for substances included in the protocol and for substances that are not included in the protocol, respectively.

In regard to substances not included in the protocol, we believe it is important to set a high standard for the type, objectivity, and quality of information to be included in nomination dossiers. We hope that our comments will assist countries in preparing dossiers on substances that may be proposed by a Party for inclusion in the Protocol. In keeping with the expert group's instructions, these comments generally are of a technical nature. In them, we attempt to provide assistance to dossier authors by pointing out what we perceive to be data gaps or other insufficiencies in the data contained in the dossiers [and in certain cases by providing additional information to the authors.]

A number of the dossiers, and their corresponding summaries, contain conclusory statements about whether the state of the science (as summarized in the dossiers) supports a conclusion that a substance does or does not meet particular listing criteria. The United States provides no opinion as to the correctness of these conclusory statements; nor does it endorse or fail to endorse these statements. In general, the United States believes that it is beyond the instructions of this experts group to provide a formal opinion as to whether the scientific information concerning a particular substance summarized in the dossiers supports a conclusion as to whether the substance meets particular listing criteria. Rather, the instructions of the group as described in Section 1.5 of Annex VI of the Report of the Nineteenth Session of the Executive Body, is to "prepare a compendium of
information provided by national experts on substances not included in the Protocol after technical evaluation of this material."

Thus, in keeping with these instructions, the United States has limited its comments to the sufficiency and validity of the information contained in the draft dossier. Moreover, the United States believes that, when forwarding information to the Work Group on Strategies and Review or to the Executive Body, any summary or compendium of information of the ad hoc group should indicate that the group has assisted the authors by providing additional information or technical comments, but that all conclusions in the dossiers are the opinions of the authors.
5. Comments from France

RE: French comments on all the dossiers to be discussed at the POP expert group meeting (Geneva, 5-6 June, 2002) (From Sylvain Bintein).

Dear colleagues,

Please find below our comments on the dossiers dealing with substances that will be discussed during our next expert group meeting.

**SHORT CHAIN CHLORINATED PARAFFINS**

Part I, Section 2-benthic organisms.

The derivation of the NOEC for benthic organisms seems to not follow the methods, which should be applied. Indeed, at the EU level the NOEC benthic derived from the NOEC aquatic should be calculated as follow:

\[
\text{NOEC}_\text{benthic} = K_{\text{susp-water}} \times \text{NOEC}_\text{pelagic} \times 1000 / \text{Density of suspended matter}
\]

\[
\text{Having: } K_{\text{susp-water}} = 0.9 + 0.1 \times k_{oc} \times f_{oc\text{ susp}} \times \text{density of solid} / 1000
\]

We used the foc for suspended matter (foc susp) as well as the density for suspended matter as we used this method to compare the PNECbenthic derived from the NOECbenthic with the concentration (PECsediment) in freshly deposited sediment to evaluate the risk (PECsediment/PNECbenthic).

It should be noted also that for highly lipophilic substances, the PECsediment/PNECbenthic ratio is increased by a factor 10 in order to take uptake via ingestion of sediment into account.

Part II, Section C, Socio-economic factor

At the EU level, based on the conclusions of the risk assessment a strategy for risk reduction has been elaborated. In order to decide which measures could be taken to manage the risk, a cost/analysis benefit study has been conducted for each use for which a risk has been identified (i.e., in cutting fluids in the metal working fluids, in leather processing). We enclosed in the e-mail these two studies, which could be helpful for the SCCPs dossier.
APPENDIX 3B

Response to Comments Received on

Short-Chain Chlorinated Paraffins (SCCP)
Substance Dossier
(Draft 1 of March 2002)

Prepared by:
Environment Canada

for:
UNECE ad hoc Expert Group on POPs

January 17, 2003
CONTACT

Greg Filyk
A/Chief Hazardous Air Pollutants
Environment Canada
Transboundary Air Issues Branch
351 St. Joseph Blvd., 11th Floor
K1A 0H3
Canada

tel.  (819) 953-5945
fax.  (819) 994-3479
email  greg.filyk@ec.gc.ca
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INTRODUCTION

Canada is the lead author of an information dossier on short-chain chlorinated paraffins (SCCPs) being prepared for the UNECE ad hoc Expert Group on persistent organic pollutants (POPs) and has prepared this document (the “Response Document”) to respond to comments received on the draft SCCP Dossier of March 2002 (the “Draft 1 SCCP Dossier”).

The Draft 1 SCCP Dossier is available at the UNECE ad hoc Expert Group on POPs website: http://www.unece.org/env/popsxg/

As indicated below in Next Steps, a Draft 2 SCCP Dossier is anticipated to be developed for Feb. 28, 2003 review by Experts and presentation at the fourth meeting of the Expert Group in March 2003.

1. HISTORY

The second meeting of the UNECE ad hoc Expert Group on (POPs) was held in Torun, Poland on October 24-26, 2001. At that meeting, the Expert Group noted interest to consider short-chain chlorinated paraffins as a possible new substance for addition to the UNECE POPs Protocol. In response, Canadian Expert Group representative Greg Filyk offered to prepare an information dossier on this substance. The work would be based on the assessment information developed in Canada and take account of material prepared in the framework of Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and of the European Community.

A preliminary draft SCCP Dossier of March 2002 (hereafter referred to as the “Draft 1 SCCP Dossier”) was presented by Mr. Filyk at the third meeting of the Expert Group, which was held in Geneva, Switzerland on June 5-6, 2002. The Expert Group provided comments on the Draft 1 SCCP Dossier prior to and during the meeting, and the Mr. Filyk offered to take into account the comments received and to present a revised draft at a future meeting of the Expert Group.

2. CURRENT STATUS

Environment Canada is currently preparing a domestic follow-up report on short-, medium- and long-chain chlorinated paraffins for the Canadian Priority Substances Assessment Program. The first Priority Substances report on chlorinated paraffins was published in 1993, but contained many data gaps. The follow-up report will contain more recent information on environmental concentrations of short-chain chlorinated paraffins.

Canadian scientists continue to work on the follow-up Priority Substances report, which will also contribute to development of an SCCP Dossier being prepared by Canada. In this process new information on SCCPs has been developed and more information is anticipated. As this information becomes available, Environment Canada is willing to
respond further to comments received by the Expert Group and to provide this information to support further development of the SCCP Dossier. Therefore, both the Response Document and SCCP Dossiers are considered to be working documents, subject to future revision at the discretion of the Expert Group and Canada as lead author.

3. **PROPOSED NEXT STEPS**

Experts are currently preparing for the fourth meeting of the Expert Group in Oslo, Norway on March 17-19, 2003, where Canada intends to present a revised Draft 2 SCCP Dossier. This Response Document provides Environment Canada’s response to the many specific comments received on the Draft 1 SCCP Dossier. It is therefore a key element in further development of the Dossier for the fourth meeting of the Expert Group. Once Experts have had an opportunity to review the responses according to the schedule below (from the Dec. 9, 2002 letter of Dr. David Stone), a revised draft Dossier will be forthcoming. This Draft 2 SCCP Dossier will consider all Expert Group comments and any additional scientific information from Canada and other countries.

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<td>Draft 2 SCCP Dossier will be sent to Expert Group via Secretariat</td>
<td>Feb. 28, 2003</td>
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<td>Draft 2 SCCP Dossier presented by Canada at fourth Expert Group meeting</td>
<td>Mar. 17-19, 2003</td>
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RESPONSES TO COMMENTS RECEIVED FROM EXPERTS

Note: Throughout this document, Expert Group comments received are italicized and Environment Canada’s responses are provided in regular font.

A. COMMENTS RECEIVED FROM FRANCE - MINISTERE DE L’ÉCOLOGIE ET DU DEVELOPMENT DURABLE (SYLVAIN BINTEIN, 17 MAY 02)

1. CALCULATION OF NOEC FOR BENTHIC ORGANISMS (PART 1, SECTION 2)

France: Comment was received that Canada’s calculation did not follow the European methods (as described in the Technical Guidance Document(TGD)).

RESPONSE:
This calculation is re-done below using the TGD method. According to the TGD,

\[
P_{\text{NOC}_\text{sed}} = \frac{K_{\text{susp-water}} \cdot \text{NOEC}_{\text{pelagic}} \cdot 1000}{\rho_{\text{susp}}}
\]

\[
\rho_{\text{susp}} = F_{\text{solids}} \cdot \rho_{\text{solids}} + F_{\text{water}} \cdot \rho_{\text{water}}
\]

\[
K_{\text{susp-water}} = \frac{F_{\text{water}} + F_{\text{solid}} \cdot (F_{\text{oc}} \cdot K_{\text{oc}})/1000 \cdot \rho_{\text{solid}}}{\rho_{\text{susp}}}
\]

Where

- \(P_{\text{NOC}_\text{sed}}\) = Predicted No Effect Concentration in sediment (mg/kg)
- \(\rho_{\text{susp}}\) = bulk density of wet suspended matter (kg/m³)
- \(K_{\text{susp-water}}\) = partition coefficient suspended matter-water (m³/m³)
- \(F_{\text{solids}}\) = Volume fraction solids in suspended matter (m³/m³)
- \(F_{\text{water}}\) = volume fraction water in suspended matter (m³/m³)
- \(F_{\text{oc}}\) = weight fraction organic carbon in suspended solids (kgoc/kgsolid)
- \(K_{\text{oc}}\) = organic carbon-water partition coefficient (m³/m³)

Using standard environmental characteristics (Table 5, Chapter 3 TGD), as well as \(F_{\text{oc}}\) and \(K_{\text{oc}}\) from the Canadian SCCPs dossier,

\[
\rho_{\text{susp}} = 0.1(2500 \text{ kg/m}^3) + 0.9(1000 \text{ kg/m}^3)
\]

\[= 1150 \text{ kg/m}^3\]

\[
K_{\text{susp-water}} = 0.9 + 0.1(0.02*199.5 \text{ m}^3/\text{kg})/1000 \cdot 2500 \text{ kg/m}^3
\]

\[= 1.8975\]

Therefore,
Using the TGD method, PNEC for sediment is $8.25 \times 10^{-3}$ mg/kg, which is three orders of magnitude smaller than the NOEC\textsubscript{benthic} of 19.95 mg/kg calculated using the Canadian method in the Draft 1 SCCP Dossier. Therefore, using the European calculation method for PNEC, benthic organisms appear to be two orders of magnitude more sensitive to SCCPs than using the Canadian methodology.

2. **PART II, SECTION C, SOCIO-ECONOMIC FACTORS**

*France:* At the EU level, based on the conclusions of the risk assessment a strategy for risk reduction has been elaborated. In order to decide which measures could be taken to manage the risk, a cost/benefit study has been conducted for each use for which a risk has been identified (i.e., in cutting fluids in the metal working fluids, in leather processing). We enclosed in the e-mail these two studies, which could be helpful for the SCCPs dossier.

**RESPONSE:**
A summary of this information is contained in Section C - Comments from the Netherlands, last response.

**B. COMMENTS RECEIVED FROM THE CHLORINATED PARAFFINS INDUSTRY ASSOCIATION (CPIA) AND EURO CHLOR**

(E-mail with attachments to G. Filyk from R. Fensterheim (CPIA), May 17, 2002)

*CPIA:* As will be succinctly described below, despite the assertions present in the draft SCCP dossier, SCCPs do not meet all of the stated POPs criteria. Of particular significance:

1. **VAPOUR PRESSSURE AND ATMOSPHERIC HALF-LIVES**

*CPIA:* SCCPs have a very low vapor pressure (VP) (ranges from 0.5 Pa to $2.8 \times 10^{-7}$ Pa) and therefore have little, if any potential for long-range transport.

**RESPONSE:**
While VPs are relatively low it should be kept in mind that SCCPs can also be transported on aerosols. There is evidence that particle-borne transport is an important pathway for POPs e.g. observations of elevated DDT, polychlorinated naphthalenes (PCNs) and polycyclic aromatic hydrocarbons (PAHs) in winter time at Alert.
Unfortunately, there are few measurements of SCCPs in particles. SCCPs were not detected in particles trapped on filters at Alert (1994 archived sample extracts).

CPIA: The modeled data suggesting half-life values greater than 2 days provide little justification given the very low propensity for these substance to volatilize to air.

In evaluating the specific half-life information, it is important to consider the relative vapor pressure of the specific substances. It is significant to note that the compounds showing the longer half-lives (recognizing of course that the longest one cited is less than 11 days) are the specific isomers that have the lowest vapor pressure and therefore the lowest probability of finding their way into the air.

As discussed in greater detail in the attached comments developed by the European industry organization, Euro Chlor, the range of half-lives given in Table 1 is misleading, since it includes SCCP structures (high chlorination levels) for which the subcooled liquid vapour pressures (scl-VP) would be extremely low. According to estimates developed by Drouillard et al. (1998), isomers with an AOPWIN calculated value greater than 2 days are associated with structures for which the scl-VP is less than 0.002 Pa for the C_{10} structures and less than 0.00003 Pa for the C_{13} structures. Wania and Mackay (1996) showed that, regardless of any degradation in the atmosphere, substances with scl-VP less than 10^{-3} Pa show low tendency to volatilise to the atmosphere and a rapid condensation near to sources. Drouillard et al. (1998) also showed that Henry’s Law Constants (HLC) for polychlorinated alkanes fall more rapidly than vapour pressure with increasing carbon number and chlorination. This implies that the tendency to volatilise from water or moist solids is lower than would be expected from scl-VP. Thus, it can be concluded that those SCCPs with any tendency for volatilisation and slow deposition are those with a rapid breakdown by hydroxyl radicals.

All isomers should not be considered equally relevant in assessing vapor pressure and atmospheric half-lives. The half-live values presented in Table 1 address a range of isomers with 10 carbons and 13 carbons, i.e., the ends of the SCCP spectrum. It is important to recognize that these species make up the smallest fraction of the commercial SCCPs, which consists of a range of carbon chain lengths. A typical SCCP contains less than 10% chlorinated carbon chain length species with 10 and 13 carbons and over 90% contains carbon chain lengths of 11 and 12.

Moreover, some of the isomers, particularly those with the larger number of chlorine atoms, and the ones AOPWIN predicts as having the longest half-lives, are the least likely to be found in commercial SCCP formulations.

Euro Chlor: Van Pul et al (1998) modelled the atmospheric transport of SCCPs and their data should be added to the dossier. Taking into account wet and dry deposition processes, and using a relatively long photochemical degradation half-life of 96 hours, they predicted atmospheric half-lives for SCCP of 23 hours over land, and 27 hours over the sea.

RESPONSE:
Henry’s law Constant or air-water partition coefficients for SCCPs are relatively high (0.5-1 Pa m^3 mol) – higher in fact that many POPs such as hexachlorohexanes.
Furthermore vapor pressures of SCCPs are similar to many other POPs, e.g. pentachlorobiphenyls, and higher than tetra and pentabromodiphenyl ethers which have also been found in gas phase in temperate and Arctic sampling sites.

Contrary to statements in the CPIA and EuroChlor comments, the major structures observed in environmental samples, such as C_{10}H_{17}Cl_{5}, C_{10}H_{16}Cl_{6}, C_{10}H_{15}Cl_{7}, C_{11}H_{18}Cl_{6}, C_{11}H_{17}Cl_{7}, C_{12}H_{20}Cl_{6}, C_{12}H_{19}Cl_{7} all will have estimated atmospheric half-lives > 2 days. These are the components that predominate in Arctic air and in beluga in the Arctic. Furthermore these structures predominate in SCCP products analysed by Tomy (1997 thesis).

New work has been produced since the Wania and Mackay (1996) paper regarding the vapour pressure value of <0.001Pa. This newer work emphasizes the importance of air-water and plant-air partitioning along with VP.

2. EVIDENCE OF LONG-RANGE ATMOSPHERIC TRANSPORT

CPIA and Euro Chlor Comments:

Nonetheless, assuming that the analytical measurements are completely accurate, there are numerous local source opportunities, which can explain the presence of SCCPs in the environment, and as such should not be considered as supporting evidence of long-range transport. The SCCP Dossier states that:

> the detection of the more volatile shorter carbon chain length congeners of SCCPs in Arctic air samples, Arctic biota and in Arctic lake sediments in the absence of significant sources of SCCPs in this region suggests that these residues are present due to long-range atmospheric transport.

Given the very low concentrations that are reported for these media, CPIA believes that there are more than adequate potential sources of SCCPs to explain these concentrations. SCCPs have a wide range of uses and applications many of which include use in operations that are conducted in remote regions. Simply finding trace levels of a substance in a remote area should not by itself be construed to suggest long-range transport without convincing evidence that the source was truly the result of atmospheric transport. Even the SCCP Dossier itself notes that the SCCP concentrations in air are likely the result of local sources.

RESPONSE:
The draft Draft 1 SCCP Dossier presents information that higher concentrations of SCCPs have been found in proximity to local source areas (ie. Urban areas). Environment Canada is currently seeking clarification concerning the data from Lancaster and Alert.

Some of the uses of fluids/products that could result in SCCPs being released to the Arctic environment include:
• Gear oil packages
• Fluid used in hard rock mining
• Fluids and equipment used in oil and gas exploration
• Fluid and equipment used in mining
• Manufacture of seamless pipe
• Metalworking and operation of turbines and gears on ships.

Moreover, while not in compliance with local laws and regulations, there have been numerous instances where ships have released oils and other fluids into the oceans, which could very likely contain SCCPs.

RESPONSE:

Although SCCPs are undoubtedly used in Arctic communities and at military and mining sites it is unlikely that this use affects levels seen in seals and beluga. In the case of PCBs, where actual contamination of harbour sediments has been documented in the Canadian Arctic at former military sites (Resolution Island, Nunavut, Cambridge Bay Nunavut and Sagleq Bay Labrador), there is no evidence that this contamination is detectable in marine mammals within the region despite detailed studies delineating the extent of contamination. The reason for this is probably that the animals are feeding in a vast area (thousands of square km) and contaminated regions are measured in hectares.

The very low solubility in water and low vapour pressure of SCCPs would predict low mobility, but monitoring data in the U.K. and Sweden indicate widespread low levels of contamination in water, sediments, aquatic and terrestrial organisms and even commercial foods (Government of Canada, 1993b). Some airborne dispersion does therefore occur.

SCCPs have also been detected in the water column around the Bermuda Islands despite the absence of significant sources of SCCPs in this region, which suggests that these residues are due to long range atmospheric transport (UN ESC 2002).

3. MEASURED LEVELS OF SCCPS IN ARCTIC AIR - VALIDITY OF ANALYTICAL RESULTS

There are numerous questions regarding the reliability of the analytical results reported as documenting the presence of SCCPs in the different environment media. These include:

• The data for air concentrations at Alert in Table 2 are referenced as Tomy et al. (1998); however, these data could not be found in that reference.

RESPONSE:

The text following Table 2 states that reagent blanks at Alert “also contained low levels of SCCPs but at concentrations lower than in the air samples”. Since the detection limit appears to have been 1 pg/m³ and the maximum sample value was 8.5 pg/m³, the blank values should be stated and whether these have been subtracted to derive the air values.

RESPONSE:
The blank values for the Alert data were about 1 pg/m³. The blank value was not subtracted from the sample values that appear in Table 2.

- the measured values reported are not significantly different than the minimum detection limit. Before values are considered reliable, they should be found to be reproducible in different laboratories at levels above their quantification levels;
- possibilities for sample contamination; and,
- lack of peer review and round robin confirmation of the analytical method.

RESPONSE:
Recent measurements of SCCPs in archived samples from Alert in 1994 have confirmed concentrations observed earlier by Tomy (1997 Thesis). These recent results were reported in a Northern Contaminants Program Synopsis report (Bidleman et al. 2001) and are in the Canadian Arctic Monitoring and Assessment Program POPs assessment (October 2002). SCCPs were also measured in Arctic air by the Norwegian Institute for Air Research at Ny Alesund in Svalbard, Norway (Borgen et al. 2000).

Although contamination from SCCP use in building products cannot be completely ruled out, both air monitoring programs have a long history of operation and have rigorous quality assurance and control procedures for cleaning PUFs and filters, blank analysis and sample handling.

Also, the paragraph following Table 2 states that the distribution profiles for Alert and Ontario were similar. However, the next paragraph suggests they were different.

RESPONSE:
The distribution profiles at Alert resemble those measured in Lancaster but are quite different from those at Egbert, Ontario. Environment Canada will revise the confusing text in the next draft of the SCCP Dossier and include a clearer comparison of the sites.

4. LEVELS IN SEDIMENTS

CPIA: In addressing sediment, the SCCP Dossier offers the finding of SCCP residues in sediment cores dating back to the 1920's and 1930's as evidence that SCCPs are persistent in sediment while at the same time the document indicates that residues in pre-1940’s sediment “can be explained by diffusion ... through the sediment or contamination [during]core sampling.” SCCPs were not in commercial production before
the 1940’s. Also, the fact that the 1933 sediment cores from Lakes Fox and Winnipeg, had higher concentrations than the cores takes from 1944 to 1986 reinforces the concern over the validity of these low level measurements.

RESPONSE:
When viewing the presence of SCCPs in deep sediments predating manufacture it should be noted that there is the possibility of movement of some particles from more highly contaminated upper slices and also that the temporal resolution of the cores is +/- 5 to 10 years depending on the sedimentation rate. The sediment core from Lake DV09, Devon Island, Nunavut, Canada is laminated (or varved) and therefore has much less mixing than the cores analysed by Tomy et al. (1999) hence the SCCP profile is sharper. However it shows the same trends as two other remote systems at Hazen Lake in the Arctic and Yaya River, Northwest Territories.

CPIA: The unpublished sediment data for 1997/98 and the Hazen Lake sample are stated to range from 4.8 to 77.8 ng/g. Tomy et al. (1997) reported a method detection limit (MDL) for sediment of 23 ng/g. Presumably, this MDL was improved but this suggests that some of these determinations were close to the MDL. The MDL and blank results should be stated and the possibility of interferences and sample contamination should be discussed. As discussed below, Hazen Lake is not free of potential local sources.

RESPONSE:
Results for remote lake sediments from Hazen Lake in the Arctic and the Yaya River, N.W.T., are close to detection limits, however the analysis also showed that SCCPs are readily detectable above a method detection limit (MDL) based on sediment samples predating 1900 that were used as blanks. In recent work by Stern et al. (Unpublished; appearing in the forthcoming Canadian Arctic Contaminants Assessment Report) SCCPs were detected in another core from a remote lake DV09 on Devon Island, Nunavut (see Appendix) at low ng/g levels.

The analyses from Canadian lake sediments should be interpreted with caution. Tomy et al (1997) reported that Winnipeg and Fox lakes were subject to local sources of SCCPs, the former from large conurbations (urban communities) and the latter being situated on the Alaska Highway. Muir and Tomy (1997) also report that Lake Nipigon “cannot be considered a remote lake because it is accessible by road and used by fishers” and that the shores of Lake Hazen (Ellesmere Island) have been used in the past as a military base.

RESPONSE: The leachability and volatility of SCCPs from plastics is considered to be low (European Communities 2000). Therefore, the main source of SCCPs to the Canadian environment is from use as a lubricating additive in metalworking. Even though Lake Nipigon is accessible by road and used by fishers, fishers are unlikely to be a source of SCCPs to this lake. It is unknown whether metalworking occurred as part of military operations at Lake Hazen. Environment Canada will investigate whether this information exists and is available.
Both the Yaya River and Lake DV09 are undisturbed and have received contaminants solely from atmospheric deposition.

5. BIOTA

Euro Chlor: Paragraphs 1 and 4 imply that the congener profile in Arctic mammals (“more volatile components”; “lower chlorinated congeners”) indicates atmospheric transport. However, these profiles also reflect the more soluble congeners and, as stated by Tomy (2000), could equally suggest a route via water (sea and ocean currents).

RESPONSE:
As mentioned in the Draft 1 SCCP Dossier, Environment Canada agrees that ocean transport of SCCPs could be important, because water solubilities are higher than for cyclic or aromatic organochlorines.

Euro Chlor: The data in Table 3 reveal an important anomaly. There is a remarkable similarity between the SCCP values across a wide range of species and locations. For example, values for beluga in the St Lawrence River (which can be considered subject to ongoing local industrial and urban emission sources) are not significantly different from values given for ringed seal from Ellesmere Island. This in marked contrast to the data for PCBs and DDT from the same animals, which are 2 to 3 orders of magnitude higher in the St Lawrence than at Ellesmere, even though new emissions of these substances have been virtually eliminated in N. America. This strongly indicates that the environmental transport and distribution pattern for SCCPs is very different to that of these established POPs, or that the analytical methods for SCCPs are subject to interferences.

RESPONSE:
The beluga in the St Lawrence cannot be compared to seals in Ellesmere Island. Only within species comparisons are possible because pinnipeds are known to handle persistent organochlorines quite differently from cetaceans. For example 2378TCDD (dioxin) does not bioaccumulate to any extent in cetaceans which seem to have a unique capacity to degrade planar organics, but does bioaccumulate in pinnipeds.

In comparing Arctic and St. Lawrence beluga, there are differences in concentrations of 2 to 3 fold. Why there are not greater differences is not known but one possibility is that cetaceans are capable of degrading SCCPs so that high concentrations are not achieved. The same is true for 2378TCDD in beluga which was not detected in both St. Lawrence and Arctic animals. Similarly, hexacyclohexane (HCH) isomers are present at similar levels in both groups.

The pattern of SCCP chain length/chlorine groups does differ between the Arctic and St. Lawrence beluga which points to different sources, i.e., Arctic animals have a pattern
enriched with more volatile (mobile) components. Similar differences are seen for PCB congeners between Arctic and St. Lawrence beluga.

6. **TOXICITY (PART I, B. 2.)**

Euro Chlor: The reference to “delayed toxicity” in the rainbow trout study (Madeley and Maddock, 1983) is misleading. It should be added that the authors effectively repeated the study (Madeley and Maddock, 1983b). Trout were exposed to a slightly higher measured concentration (17.2 µg/l) for the same period as in the original study (168 days), followed by depuration in clean water for a longer period (99 days compared with 69 days in the original study). The new study did not observe any significant mortality during exposure or depuration and there was no significant effect on the growth rate of the trout. A lower concentration (3.4 µg/l) was also tested with the same results. Thus the mortalities observed during depuration in the earlier study were not reproducible, and although the cause remained unknown, the evidence from the repeat study suggests that it was more likely a disease problem than delayed toxicity.

RESPONSE:

Environment Canada agrees with this comment and will consider removing the reference to delayed toxicity in the next draft of the SCCP Dossier.

7. **BIOACCUMULATION**

Euro Chlor: Table 4: It is misleading to quote bioaccumulation factors based on isolated field measurements such as these, when the fish and water were sampled from different locations and at different times. It is not possible to verify that the water levels measured were representative of those to which the fish were exposed, either spatially or temporally. The fish values given are in fact a mean of fish from 2 different locations, one of which was close to Toronto. The cited paper (Muir et al 2000) does not make this BAF calculation.

The most reliable bioconcentration factor (BCF) for fish is provided by Madeley and Maddock (1983), who obtained whole fish BCFs of 3550 and 5260 in rainbow trout exposed for 168 days to measured concentrations of 3.1 and 14.3 µg/l, respectively. These BCFs were based on measurement of $^{14}$C residues. Parent compound analysis of individual tissues gave lower values than the radiolabel, suggesting some metabolism of the SCCP and lower BCFs, but whole fish BCFs were not given.

RESPONSE:

The paper by Muir et al. (2000) quoted bioaccumulation factors (BAFs) for lake trout in Lake Ontario based on a simple ratio of concentration in fish (lipid weight) divided by dissolved concentration in water. The water concentrations were based on lake wide averages and the fish are known to be quite mobile so these BAFs are appropriate for
Lake Ontario. However they represent uptake from both water and food by a top predator.

Also, there are several other studies indicating that SCCPs are highly bioaccumulative, such as the BCFs of 5,785 to 40,900 found with the common mussel (Madeley and Thompson 1983, Tomy et al. 1998). These studies are discussed in the European Union Risk Assessment Report (RAR) (European Communities, 2000).

8. SEWAGE TREATMENT PLANT EFFLUENT SAMPLES

Euro Chlor: It is interesting to note that all sewage treatment samples showed the presence of SCCPs. Can we be convinced that the analytical methodology was able to show non-detectable levels in blanks? There are many instances of memory effects in apparatus which can give rise to blank samples showing the presence of CPs.

RESPONSE:
It is not surprising that all sewage treatment plant effluent samples from southern Ontario contain SCCPs, as southern Ontario is a highly industrialised and populated area.

9. HUMAN AND ENVIRONMENTAL HEALTH CONCERNS OF SCCPS

CPIA: The trace levels that are found in the environment do not universally support the conclusion that they are “likely to cause significant adverse human health or environment effects.”

For a substance to be considered a POP it is to be “likely to cause significant adverse human health or environmental effects near to and distant from their sources.” CPIA recognizes that Environment Canada has declared SCCPs to be “toxic” in accordance with the Canadian Environment Protection Act. Additionally, the European Union has decided, based on its risk assessment, that there is a need to restrict the use of SCCPs for metalworking fluids and for leather treatment. These conclusions were not driven by concerns of long-range transport but largely due to local discharges resulting in environmental concentrations in excess of concern levels. More importantly, these conclusions are in stark contrast to US EPA’s assessment of SCCPs, which found that there was no need to restrict the use of SCCPs given that very few localities, using worst-case exposure assumptions, are likely to contain environmental concentration levels above EPA’s risk level of concern.

EPA conducted a Risk Management (RM2) evaluation of SCCPs. EPA’s assessment examined both ecological risk, which EPA considered to be the major concern, and human health risk. Using an aquatic simulation model, EPA predicted a “low probability of any effect to any trophic level at a water concentration of 1.0 ug/l” which EPA considered to be the low end of the No Observed Effect Concentration.

For a substance to be included in the POPs Protocol, it should have a reasonable likelihood of presenting significant adverse human health or environmental effects in most UNECE countries from long-range transport. The fact some jurisdictions have concluded that the use of the
RESPONSE:
As a result of Canada’s Priority Substances List Assessment Report of Chlorinated Paraffins (Government of Canada 1993), chlorinated paraffins were declared toxic under Paragraph 11(c) of CEPA - constituting or that may constitute a danger in Canada to human life or health. This decision was based on the classification of SCCPs by Health Canada as “Probably Carcinogenic to Humans”. Under this classification, SCCPs are considered to be non-threshold toxicants - substances for which there is some probability of harm for the critical effect at any level of exposure.

The following information taken directly from UN Economic and Social Council (ESC) (2002) provides further information about the health effects of SCCPs:

“The main environmental source of human exposure is food and, to a lesser extent, drinking water. The risk of human exposure related to long-range transboundary atmospheric transport is difficult to quantify but should not be neglected. The lack of monitoring data hampers reliable exposure estimation. Levels in food in the range of 30 to several thousands µg/kg have been measured. The European Union’s risk assessment report considers a human uptake value of about 20 µg/kg bw/day as a reasonable worst-case value.

The main target organs for repeated doses of SCCPs seem to be the liver, kidney and thyroid. SCCPs show neoplastic effects in the liver of mice and rats, however the relevance of this evidence for humans is uncertain.

In 1996, WHO recommended that daily doses of SCCPs for the general population should not exceed 11 µg/kg bw for neoplastic effects (tumor formation).

Long-range transboundary atmospheric transport is an important aspect of the global distribution of SCCPs and is responsible for their occurrence in remote areas. The EU risk assessment report concludes that there is no significant risk to man exposed to SCCPs via the environment. However, the EU worst-case human uptake estimate is greater than the guideline value established by WHO.”

Europeans may therefore be exposed to concentrations of SCCPs in excess of the WHO human health guideline.

Very high concentrations of SCCPs have been found in the blubber of belugas, ringed seals and walrus from areas remote from point sources of (100-770 µg/kg) (Draft 1 SCCP Dossier, p.6). Aboriginal peoples living in the Arctic consume these animals as food, and therefore may be exposed to SCCPs at concentrations greater than the WHO health guideline.

The purpose of the UNECE ad hoc Expert Group on POPs dossier on SCCPs is to...
provide information on substances not included in the Protocol, but may be candidate substances in the future. Whether or not a substance is added to the UNECE POPs Protocol will be negotiated by Parties to the Protocol after it enters into force.

10. SOCIO-ECONOMIC FACTORS (PART II, C)

*Euro Chlor:* PARCOM [Paris Commission] Decision 95/1 and the future amendment to EU Directive 76/769/EEC, mentioned by several countries, are somewhat contradictory. The ban in PARCOM goes much further than in the EU Directive. Euro Chlor believes that only the EU Directive should be taken into consideration, because it is based on a full-fledged scientifically-based Risk Assessment. The science in this Risk Assessment is more recent than for the PARCOM decision, based in part on the precautionary principle.

RESPONSE: The text of next draft SCCP dossier will be amended to reflect these comments.

*Euro Chlor:* The text mentions that SCCPs are often contaminants in MCCPs and LCCPs. This might be true to an extent of less than 1% in MCCPs, but it is certainly not true for LCCPs.

RESPONSE: This error will be corrected in the next draft of the SCCP Dossier.

C. COMMENTS RECEIVED FROM THE NETHERLANDS

*Page 5:* Homologue patterns in southern Ontario are discussed in the second paragraph. For the UNECE framework it is more logical to discuss these patterns – if possible with quantitative data - in Alert (and compare to the technical mixtures).

RESPONSE: Response pending.

*Page 9:* What is the relevance of calculating a NOEC\textsubscript{benthic}? 

RESPONSE: The NOEC (No Observed Effects Concentration) is calculated to estimate the toxicity of SCCPs to sediment-dwelling organisms, since no toxicity data was available for sediment-dwelling invertebrates. The European Technical Guidance Document gives a formula for converting a pelagic Predicted No Effect Concentration (PNEC) to a benthic PNEC. The formula used by Environment Canada could have been used with a Lowest Observed Effects Concentration (LOEC) or other Critical Toxicity Value as well, if one existed.

*Page 10:* What is the BCF (or BAF) used in the EU Risk Assessment Report (e.g. in the secondary poisoning scenario) as in this report an evaluation is made of all studies mentioned and a most reliable or preferred value determined?
RESPONSE:
The EU Risk Assessment Report (RAR) (European Communities 2000) does not choose a single BCF value as being the most reliable, but describes a variety of studies measuring high BCFs in fish and molluscs. High bioconcentration factors (ranging from 1,000 to 50,000 for whole body, with high values for individual tissues) have been reported with a variety of freshwater and marine organisms (European Communities 2000).

Among the bioaccumulation studies, European Communities (2000) mentions the mussel study conducted by Madeley et al. (1983), which determined whole mussel BCFs to be 40,900 and 24,800 at the low and high exposure concentrations respectively. Accumulation of the chlorinated paraffin was found to be greatest in the digestive gland, with BCFs being measured as 226,400 and 104,000 at the low and high exposure concentrations respectively.

Page 17: The paragraphs on “Abiotic transformation” and “Biotic Transformation” should be moved and integrated with section 3 of the Risk Profile.

RESPONSE:
This modification will be made in the next draft of the SCCP Dossier.

Page 18: Can section B on environmental levels more focus on monitoring data in remote areas?

RESPONSE:
Below is additional information from the EU Risk Assessment on environmental levels of SCCPs in areas remote from sources that could be included in the report. If available, new information on environmental levels in remote areas will be included in the next draft of the SCCP Dossier.

Information taken from European Communities (2000):

Concentrations in Water

Short chain length chlorinated paraffins are likely to adsorb strongly onto suspended sediments. When interpreting the measured levels of chlorinated paraffins in water it is important to try to distinguish between levels that refer to chlorinated paraffins in the dissolved phase and those that refer to chlorinated paraffin adsorbed onto suspended matter. In most cases, little or no information is given about the sampling method used and so it is assumed that these levels refer to the ‘total’ concentration (i.e. dissolved + adsorbed) in water.

Levels of total short and intermediate chain length chlorinated paraffins have been measured in marine and fresh waters remote from industry in the United Kingdom (Campbell and McConnell, 1980). As these levels refer to total chlorinated paraffin in the C10-20 range, it is not possible to say anything definite about the likely amounts of C10-13 chlorinated paraffins present. However, analysing the results reported in Table 3.6, it can be seen that the C10-13 chlorinated paraffins make up around 1/4 to 1/3 of the
combined total for short and intermediate chain length chlorinated paraffins in those samples. Therefore, if the same approximate distribution applies to these data, the likely concentrations of the short chain length chlorinated paraffins in these samples can be inferred. [Note: above Table numbers refer to those found in European Communities (2000)].

The measured levels of \( C_{10-20} \) CPs at 18 marine locations (18 samples) in the U.K. ranged from non-detect to 4.0 µg/L (Campbell and McConnell 1980), with an average concentration of 0.56 µg/L. The detection limit (DL) was 0.5 µg/L. The measured levels of \( C_{10-20} \) CPs at 12 freshwater locations (12 samples) in the U.K. remote from industry ranged from non-detect to 1.0 µg/L (Campbell and McConnell 1980), with an arithmetic average concentration of 0.29 µg/L. The DL was 0.5 µg/L, except for two of the non-detect results, the DL was 1.0 µg/L.

The concentration of \( C_{10-20} \) chlorinated paraffins in marine waters are in the range 0.5-4 µg/l. Around half the samples contained detectable amounts of chlorinated paraffins. By inference, the levels of the short chain length chlorinated paraffins are probably in the range 0.1-1 µg/l (EC 2000).

In the fresh and other non-marine water samples from areas remote from industry, the \( C_{10-20} \) chlorinated paraffins were detected in just under half the samples in the range 0.5 - 1 µg/l. This corresponds to probable short chain length chlorinated paraffin concentrations of 0.1- 0.3 µg/l (EC 2000).

Concentrations in Sediment

Information taken from EC (2000):

The levels of combined short and intermediate chain length chlorinated paraffins have been measured in several types of sediment, often from the same areas where the levels in water were measured (Campbell and McConnell, 1980). The DL was 50 µg/kg, which is approximately 100 times the DL for the water samples (0.5 µg/L). Marine sediments were sampled at seventeen locations in the U.K. (seventeen samples). All but four of the samples were non detect. The remaining samples had concentrations ranging from 50 to 500 µg/kg. Freshwater sediments remote from industry were measured at 5 locations in the U.K and at five drinking water reservoirs in the Manchester area. Two of the samples had detectable levels of CPs at concentrations of 300 µg/kg and 1000 µg/kg. The drinking water reservoir samples were ND at a DL of 250 µg/kg.

Levels in Aquatic Organisms (from EC 2000)

Levels of combined short and intermediate chain length chlorinated paraffins (i.e. \( C_{10-20} \)) have been measured in seal, marine shellfish and salt and freshwater fish from around the
United Kingdom (Campbell and McConnell, 1980). The results of the analyses are shown in Table 1.

**Table 1** Concentration of combined short and intermediate chain length chlorinated paraffins (C\textsubscript{10-20}) in aquatic organisms (Campbell and McConnell, 1980)

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of specimens</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean (ug/kg)</td>
</tr>
<tr>
<td>Plaice (Pleuronectes platessa)</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Pouting (Trisopterus luscus)</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>Mussel (Mytilus edulis)</td>
<td>9</td>
<td>3,250</td>
</tr>
<tr>
<td>Pike (Esox lucius)</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>Grey seal (liver and blubber) (Halichoerus grypus)</td>
<td>4</td>
<td>75</td>
</tr>
</tbody>
</table>

ND = not detected (detection limit = 50 µg/kg)

Bio-accumulation (from European Communities 2000):

Little information appears to be available on the levels of short chain length chlorinated paraffins alone in aquatic organisms. The levels of C10-20 chlorinated paraffins measured in fish range between <50-200 µg/kg. Mussels from the Wyre Estuary, which was thought to receive chlorinated paraffin plant effluent at the time of the survey, contain around 1,000 µg/kg of C10-20 chlorinated paraffin in general and 6,000-12,000 µg/kg close to the effluent discharge.

The levels measured in the organisms are generally close to those in sediments below the water in which they live. However, the levels in sediments are approximately 100-1,000 times those in water, indicating that bioconcentration in biota appears to be taking place. Although it is not possible to say what fraction the C10-13 chlorinated paraffins make to the total C10-20 levels measured in this study, it is known that the C10-13 chlorinated paraffins are more bioaccumulative than the longer chain chlorinated paraffins (Willis et al., 1994) and so may make up the major fraction of these measured levels.

Levels of total (C10-C24) chlorinated paraffins in food, fish and marine animals have recently been reported (Greenpeace, 1995). The levels measured (on a fat weight basis) were 271 µg/kg in mackerel, 62 µg/kg in fish oil (herring), 98 µg/kg in margarine containing fish oil, 16-114 µg/kg in common porpoise, 963 µg/kg in fin whale, 69 µg/kg in pork, 74 µg/kg in cows milk and 45 µg/kg in human breast milk. The average chlorine content of the chlorinated paraffins detected was thought to be around 33%. Short chain length chlorinated paraffins were thought to make up a very small percentage of the total.
in mackerel, fish oil, porpoise and fin whale, around 7% in human milk, 11.5% in margarine, 21% in cows milk and 30% in pork.

Levels of SCCPs in other biota (from European Communities 2000)

Levels of combined short and intermediate chain length chlorinated paraffins (C10-20) have been measured in several parts of the food chain in the United Kingdom (Campbell and McConnell, 1980). The results of the analyses are shown in Tables 2 to 4. As can be seen from Tables 2 to 4, short and intermediate chain length chlorinated paraffins have been detected in birds, eggs and human foodstuffs in the United Kingdom. Although it is not possible to say what fraction the C10-13 chlorinated paraffins make to the total C10-20 levels reported, it is known that the C10-13 chlorinated paraffins are more bioaccumulative than the longer chain chlorinated paraffins (Willis et al., 1994) and so may make up the major fraction of these measured levels.

Table 2 Concentration of combined short and intermediate chain length chlorinated paraffins (C10-20) in seabirds’ eggs (Campbell and McConnell, 1980)

<table>
<thead>
<tr>
<th>Concentration (µg/kg)</th>
<th>No of eggs containing C10-20 chlorinated paraffins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not detected (&lt;50 µg/kg)</td>
<td>7</td>
</tr>
<tr>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td>200</td>
<td>5</td>
</tr>
<tr>
<td>300</td>
<td>1</td>
</tr>
<tr>
<td>400</td>
<td>2</td>
</tr>
<tr>
<td>600</td>
<td>1</td>
</tr>
<tr>
<td>&gt;600 (=2,000 µg/kg)</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3 Concentration of combined short and intermediate chain length chlorinated paraffins (C10-20) in birds (Campbell and McConnell, 1980)

<table>
<thead>
<tr>
<th>Species</th>
<th>Organ</th>
<th>Concentration of C10-20 chlorinated paraffins (µg/kg wet weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heron (Ardea cinerea)</td>
<td>Liver</td>
<td>100-1,200</td>
</tr>
<tr>
<td>Guillemot (Uria aalge)</td>
<td>Liver</td>
<td>100-1,100</td>
</tr>
<tr>
<td>Herring gull (Larus argentatus)</td>
<td>Liver</td>
<td>200-900</td>
</tr>
</tbody>
</table>
Table 4 Concentration of combined short and intermediate chain length chlorinated paraffins (C10-20) in human foodstuff (Campbell and McConnell, 1980)

<table>
<thead>
<tr>
<th>Foodstuff class</th>
<th>No of samples analysed</th>
<th>Average concentration of C10-20 chlorinated paraffins (µg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy products</td>
<td>13</td>
<td>300</td>
</tr>
<tr>
<td>Vegetable oils and derivatives</td>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>Fruit and vegetables</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Beverages</td>
<td>6</td>
<td>ND</td>
</tr>
</tbody>
</table>

ND = not detected (detection limit = 50 µg/kg)
*Detected in approximately 70% of samples analysed

Page 24: What are the actions taken by the USA on SCCPs? Can the – since this is the most important decision in the EU to reduce emissions of SCCPs – EU Directive 76/769/EEC be more specified (e.g. what is the expected reduction in use?)?

RESPONSE:
Information provided by US Experts regarding SCCP actions is contained in the Summary of Country responses to UNECE POPS Questionnaire, Part 4 (Environment Canada 2002), which is attached to the Draft 1 SCCP Dossier. Highlights of US actions:

- Substances not listed on US EPAs Toxic Substances Control Act (TSCA) Inventory cannot be used or manufactured. Three SCCP related substances are listed on the Inventory and two of these have been reported as being both manufactured and imported in 1997:
  I) Alkanes, chloro; chloroparaffins (CAS 61788-76-9);
  II) Par waxes and h/c waxes, chlorinated (CAS 63449-39-8); and
  III) Alkanes, C6-18, chloro (CAS 68920-70-7);
- USA SCCP production is 20,000 metric tonnes / year, imports are 5,500 metric tonnes / year; and uses are 25,500 metric tonnes / year;
- Disposal of SCCPs in hazardous waste are subject to stringent regulations to ensure disposal occurs in an environmentally safe manner and only in specifically designed landfills;
- SCCPs are not otherwise subject to regulatory control actions, however, for substances not on the TSCA Inventory of chemicals, any intended industrial chemical-type use would require 90-day advance premanufacture notification (PMN) (See 40 CFR 720 for the USEPA PMN regulations). The required notification would provide EPA with the opportunity to review the substance for potential unreasonable risks and to take action, where appropriate, to control those risks before they can occur.

Note - Please see Summary (Environment Canada 2002) for additional details on US and other country production, use, disposal and actions on SCCPs.


approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (4) was amended as follows:

In Annex I to Directive 76/769/EEC the following point shall be added:
Alkanes, C10-C13, chloro (short-chain chlorinated paraffins)
1. May not be placed on the market for use as substances or as constituents of other substances or preparations in concentrations higher than 1 %:
— in metalworking;
— for fat liquoring of leather.

2. Before 1 January 2003, all remaining uses of SCCPs will be reviewed by the European Commission, in cooperation with the Member States and the OSPAR Commission, in the light of any relevant new scientific data on risks posed by SCCPs to health and the environment. The European Parliament will be informed of the outcome of this review.

Article 2
1. Member States shall adopt and publish, not later than 6 of July 2003, the laws, regulations and administrative provisions necessary to comply with this Directive. They shall forthwith inform the Commission thereof.

They shall apply those measures from 6 January 2004 at the latest.

Page 26: What is the conclusion on alternatives for SCCPs considering that also MCCPs and LCCPs are probably POPs?

RESPONSE:
Currently, there is no conclusive evidence that MCCPs and LCCPs are POPs, as defined by the UNECE POPs Protocol. For example, MCCPs meet some of the criteria listed in the Convention (i.e. Toxicity, vapour pressure, lack of biodegradation, Kow>5), but the BCF was only 1,087 and no evidence was given in the U.K. draft risk assessment report (U.K. Environment 2002) that MCCPs undergo long-range atmospheric transport. The atmospheric half-life was estimated to be 2 days using EUSES (U.K 2002).

Environment Canada is currently reviewing available information on MCCPs and LCCPs, to update a risk assessment, and a report is expected to be available in 2003.

NON-CHLORINATED PARAFFIN ALTERNATIVES TO SCCPS

Leather Processing
The U.K. Department of the Environment commissioned a report that discusses alternatives to SCCPs used in leather processing (RPA 1997a). This report provides the following information about alternatives to SCCPs in leather processing:

SCCPs are used as inexpensive additives to fatliquors to provide greater product volume (i.e. they are bulking agents). Fatliquors replace oils that are lost during the
The tanning process, however, it appears that no fatliquoring properties are conferred by the use of SCCPs. The only benefits that they offer over alternatives appear to be their odour-free nature and their reasonable price. However, no tanner has indicated that the use of alternatives (any of a range of animal, vegetable or mineral oils) would alter the quality of end-products. Although alternatives are around 15% more expensive than SCCPs, this is equivalent to only 0.075% of turnover arising from SCCP-treated hide for a small tanner (i.e. a tanner with <50 employees). The environmental risks posed by alternatives appear to be less than those posed by SCCPs.

Alternatives to SCCPs have been listed as MCCPs and longer chain length chlorinated paraffins, and any natural animal, vegetable or mineral oils, such as: animal oils which are usually derived from beef tallow; vegetable oils such as corn, soya, palm, and to some extent rapeseed. The consensus is that MCCPs pose lower risks to the environment and human health than SCCPs. Given the nature of other alternatives, this is likely to be the case for these also.

Therefore, the use of alternatives to SCCPs in leather processing appears to be practical, both from a technical feasibility, environmental and economic standpoint.

**Metalworking**

The U.K. Department of the Environment commissioned a report that discusses alternatives to SCCPs used in metalworking (RPA 1997b). This report provides the following information about alternatives to SCCPs in metalworking:

**Feasibility and Costs of Alternatives to SCCPs**

Historically, due to their availability and thus cheap supply, SCCPs have been added to a wide range of metalworking fluids. As many processes have now grown accustomed to SCCP-based fluids, it is difficult to determine which processes require the use of SCCPs. Consultation suggests that these are broaching, precision gear cutting, grinding, and some forms of milling and reaming; however, there appears to be no consensus on this issue within the industry.

The low dependence of Germany on the use of SCCPs results from legislation which has increased the costs of disposal for chlorinated waste oils. As a result, users have replaced SCCP-based fluids with chlorine-free alternatives.

Across the Member States, there is a general expectation that the use of SCCPs in metalworking fluids will be restricted through legislation as a result of the PARCOM (Paris Commission) Decision (95/1) to phase out their use. In response to this, and pressures from specific legislation in countries such as Germany, formulators are involved in research and development into chlorine-free alternatives.

Implementation of a total ban on the use of SCCPs in all fluids is expected to result in
increased annual costs of around £4 million across the UK as a result of higher fluid prices alone. It is estimated that these costs would be spread over roughly 26,000 UK metalworking companies. These companies could also face additional costs associated with reduced tool life, increased machine down-time or reduced quality finished pieces which may add significant costs to this estimate. As indicated above, these and additional costs could be of an equal magnitude to the increase in fluid prices. Operators in other countries have also reported reduced levels of output associated with the adoption of chlorine-free alternatives.

The report notes that cost increases would be reduced if the alternative chosen was MCCPs:

Again, for a medium sized user of metalworking fluids, the marginal increase in costs associated with higher fluid prices is estimated at around £450 per annum. Where MCCP-based emulsions are adopted, a medium sized company may incur costs of only around £80 per annum stemming from increased fluid prices.

Toxicity of Alternatives

The toxicities of alternatives to SCCPs for use in metalworking are tabulated in Annex 3 and Annex 4 of RPA 1997b. The least toxic of the alternatives with respect to human health effects is trixylyl phosphate, has an LD50 of >5 g/kg (rat) and causes no skin or eye irritation. This compares with LD50s of >4 g/kg for SCCP compounds, which cause slight skin and eye irritation (RPA 1997b).

With respect to environmental effects, the effects of long-term exposure to many of the alternatives to SCCPs, including trixylyl phosphate has not been evaluated. MCCPs do not appear to be mutagenic, as are SCCPs, or genotoxic (RPA 1997b). However, MCCPs do not biodegrade. The following information on the health and environmental effects of alternatives to SCCPs in metalworking is given in RPA1997b:

MCCPs

MCCPs are considered to be less toxic and less persistent than SCCPs. MCCPs are, however, already present in higher concentrations in the environment than SCCPs and the effects of increasing the MCCP load is not known. It is not possible to make a clear statement as to the costs and benefits of replacing SCCPs with MCCPs, therefore, but current information indicates that there would be net benefits to the environment associated with a move to MCCPs.

With respect to human health, while there is contention over whether SCCPs or MCCPs pose lower risks, there does appear to be a general consensus that a move to MCCPs would be beneficial.
Chlorine-Free Extreme Pressure Additives

In general terms, movement to sulphur-based products could result in slight reductions in aquatic risk, as most formulations appear to be slightly less toxic than SCCPs. However, some formulations appear to be more toxic, and it is perhaps safest to say that there will be no net change in risks to the aquatic environment associated with the increased use of sulphur-based products.

Movement to phosphorus additives may either reduce or increase risks to the aquatic environment, depending on the nature and quality of the receiving waters. Thus, where phosphorus-based products are the most likely and most efficacious replacements for SCCPs for a given process, it may be worthwhile considering these processes as candidates for a derogation until other alternatives are developed.

With respect to human health, the change in benefits associated with a move to sulphur and phosphorus are unclear. The use of certain formulations may actually increase the impacts on human health.

D. Comments from the United States

(received in e-mail from Henning Wuester, May 29, 2002)

USA: The [Executive Summary] table listing the POP criteria includes the author’s judgment as to whether each criterion is met. However, the basis for the author’s conclusion is absent.

RESPONSE:
In the next draft of the SCCP Dossier, the Table listing the POPs criteria will be designed for consistency with the tabular format in the July 2002 Report by the Chair of the UNECE ad hoc Expert Group to the UNECE Working Group and Strategies and Review. The basis for Canada’s judgment will be further expanded in the “Remarks” column of the table, and will be explained in greater detail in Part III (Summary and Conclusions) of the next draft of the SCCP Dossier.

USA: It would be helpful to report the measured or predicted values, or range of values associated with each of the 4 criteria. For example, for “potential for long-range atmospheric transport,” it is important to provide the values for vapor pressure and the estimated half-life in air to facilitate comparison with the established criteria/guidelines. Also, the comments/remarks column could be supplemented with a characterization of
the authors’ confidence in the quality and adequacy of the supporting evidence. For example, does the author believe that the weight of evidence is strong, adequate, incomplete or inconclusive. Such characterization would be worthwhile, as it would help provide a more complete picture of the supporting evidence.

A summary of how SCCPs meet the criteria for addition to the Protocol on POPs has been provided in “Part III. Summary and Conclusions” of the Draft 1 SCCP dossier. This section will be expanded and improved in the next draft of the SCCP Dossier.

USA: On long-range transport the dossier relies heavily on modeled results for the half-life, which is around 2 days, but does not further inform this assessment through multimedia modeling. This further assessment is warranted for SCCPs because of their low volatility, and the relationship of long range transport to the octanol-carbon partition coefficient and Henry’s law constant.

RESPONSE:
Environment Canada does not plan to undertake multimedia modeling at this time.

USA: For bioaccumulation and levels in biota, table 3 is problematic due to the apparent inconsistency in the data. The SCCP levels are surprisingly constant across regions, and do not increase in St. Lawrence beluga whales, although other POPs concentrations are at extreme levels. Could this inconsistency be the result of a data error in the table, or there could be a problem with laboratory techniques in use (a previous concern with the difficulty in measuring this heterogeneous chemical group)? This apparent inconsistency needs to be explained.

RESPONSE:
See Section B.5. of this document.

USA: The dossier also needs to be compared to the conclusions of the UK SIDS (Screening Assessment Data Set) document and the U.S. EPA RM2 (Risk Management) process, both of which concluded that SCCPs conferred a local risk (deemed “regional” 200 km range in the UK context). These conclusions were based on predicted effect concentration/predicted no effect concentration procedures, and it would be valuable to detail and compare these processes in the current assessment. A comparison of environmental levels vis-a-vis toxicity levels would be informative.

RESPONSE:
The most sensitive species according to the EU Risk Assessment Report (European Communities 2000) were:

- The most sensitive freshwater NOEC was for Daphnia magna from a 21 day multi-generational study using C10-12 (Thompson and Madeley 1983d), where NOEC = 5 ug/L. The European RAR applies an application factor of 10 to the above value, giving a Predicted No Effect Concentration (PNEC) of 0.5 ug/L.
- The most sensitive marine NOEC was 7 ug/L for mysid shrimp (Thompson and
Using an application factor of 10, the PNEC was determined to be 0.7 µg/L.

These values are comparable or above values which have been found in the environment and wildlife:

Concentrations of CPs measured in marine and fresh waters remote from industry in the U.K (from EU RAR): The concentration of C10-20 chlorinated paraffins in marine waters are in the range 0.5-4 µg/l. Around half the samples contained detectable amounts of chlorinated paraffins. By inference, the levels of the short chain length chlorinated paraffins are probably in the range 0.1-1 µg/l (EC 2000). In the fresh and other non-marine water samples from areas remote from industry, the C10-20 chlorinated paraffins were detected in just under half the samples in the range 0.5 - 1 µg/l. This corresponds to probable short chain length chlorinated paraffin concentrations of 0.1- 0.3 µg/l (EC 2000).

Tomy et al. (2000) reported SCCPs in the blubber of ringed seal (Phoca hispida) from Eureka, Nunavut, Canada, southwest Ellesmere Island, beluga whales (Delphinapterus leucas) from northwest Greenland and the Mackenzie Delta, Northwest Territories, Canada, and walrus (Odobenus rosmarus) from northwest Greenland at concentrations ranging from 110 to 770 ng/g wet weight (Draft 1 SCCP Dossier, Section B on Biota / Table 3).

Stern et al. (1998) reported mean SCCP concentrations of 0.63, 0.20, 0.32 and 0.46 µg/g in blubber from male beluga collected in Hendrickson Island (Southern Beaufort Sea near the Mackenzie River delta), Arviat (western Hudson Bay), Saniklauq (Belcher Island area in southern Hudson Bay) and Pangnirtung (south eastern Baffin Island), Canada, respectively (Draft 1 SCCP Dossier, Section B on Biota).

USA: It would be informative to provide a description of the actions mandated in the EU assessment on SCCPs and subsequently implemented, along with their costs, benefits and impacts. Similarly, a review of the Canadian TSMP action would be helpful. Comments submitted by the SCCP industry point to the importance of SCCPs as extreme pressure agents, which is the dispersive use considered most environmentally problematic. The alternatives proposed in the dossier - their toxicity and applicability to specific SCCP uses - therefore need to be elaborated.

RESPONSE:
Reports reviewing the alternatives to SCCPs for use in metalworking and leather processing have been prepared by the U.K. (RPA 1997 a,b). Information on costs and environmental/health impacts are summarized in Section C of this document.

Canada completed an environmental and human health risk assessment of chlorinated
paraffins in 1993 (Government of Canada 1993a). Short-chain chlorinated paraffins (SCCPs) were declared “toxic” to human health under Paragraph 11(c) of the *Canadian Environmental Protection Act (CEPA 1988)* and slated for “virtual elimination” under the Toxic Substances Management Policy (TSMP) because of their persistence and bioaccumulation. As indicated in the Introduction, Environment Canada is currently preparing a domestic follow-up report on short-, medium- and long-chain chlorinated paraffins for the Canadian Priority Substances Assessment Program. This follow-up report is expected to be available in 2003.
REFERENCES


APPENDIX 3C

COMMENTS RECEIVED ON RESPONSE TO COMMENTS DOCUMENT
(APPENDIX 3B)

Comments received by:
1. Chlorinated Paraffins Sector Group, Euro Chlor
2. United States
3. Chlorinated Paraffins Industry Association
1. Comments from the Chlorinated Paraffins Sector Group, Euro Chlor

1. Calculation of NOEC for benthic organisms (Part I, Section 2)

The calculation of PNEC\textsubscript{sed} given in the EC Response Document contains an error. The TGD calculation of K\textsubscript{susp-water} should be calculated using the K\textsubscript{p} (Foc × Koc) in units of litres/kg (not m\textsuperscript{3}/kg). Then, using the TGD default values:

\[
K\textsubscript{susp-water} = 0.9 + 0.1(0.1 \times 199500 \text{ l/kg})/1000 \times 2500 \text{ kg/m}^3
= 4988 \text{ m}^3/\text{m}^3
\]

Note that the Foc value (0.1) used by the TGD is that for “suspended matter” not “sediment”. It is therefore not appropriate to substitute a different (i.e. Canadian) Foc for sediment, since the TGD calculation would then employ different values for the fraction of water, the fraction of solid and the wet density (RHO value). It is more appropriate to adjust the final sediment PNEC (or NOEC) in proportion to the relative Koc values.

The above K\textsubscript{susp-water} value is given in Appendix C of the EU Risk assessment Report (2000) which shows the PNEC\textsubscript{sed} calculated from the (then) new Koc value (199,526 l/kg), using the current TGD equations:

\[
PNEC\textsubscript{sed} = 1.92 \text{ mg/kg (wet sediment)}
\]

The EC Response document refers to equations numbers from the draft revision of the TGD (not yet adopted) which includes a small amendment (to use RHO\textsubscript{susp} rather than RHO\textsubscript{sed}) to the PNEC\textsubscript{sed} calculation. Using this revised method (as also described in the EU Risk Assessment, Appendix C):

\[
PNEC\textsubscript{sed} = 4988 \times 5 \times 10^{-4} \text{ mg/L} \times 1000
= 2.17 \text{ mg/kg (wet sediment)}
\]

Note that the PNEC\textsubscript{sed} is calculated using the aquatic (pelagic) PNEC which, in this case, is the aquatic NOEC divided by an assessment factor of 10. Therefore, to convert back to a NOEC for sediment:

\[
\text{NOEC}_{\text{benthic}} \text{ (TGD characteristics)} = \text{PNEC}_{\text{sed}} \times 10 = 21.7 \text{ mg/kg (wet sediment)}
\]

In the TGD, although calculated using the characteristics of suspended matter, the PNEC or NOEC is then deemed to be the concentration in sediment with different characteristics (Foc 0.05 and Wet/dry ratio 2.6). Thus, in terms of dry sediment, the above values should be multiplied by 2.6, giving:

\[
\text{PNEC}_{\text{sed}} = 5.64 \text{ mg/kg (dry sediment)}
\]

\[
\text{NOEC}_{\text{benthic}} = 56.4 \text{ mg/kg (dry sediment)}
\]
If the TGD default for organic carbon is applied to the original equation shown in the Draft Substance Dossier, a similar value is obtained:

$$NOEC_{benthic} = Foc \times Koc \times NOEC_{pelagic}$$

$$= 0.05 \times 199500 \times (5 \times 10^{-3})$$

$$= 49.9 \text{ mg/kg (dry sediment).}$$

**B.1. Vapour Pressure and Atmospheric Half-Lives**

EC RESPONSE: “Contrary to statements in the CPIA and EuroChlor comments, the major structures observed in environmental samples, such as C\textsubscript{10}H\textsubscript{17}Cl\textsubscript{5}, C\textsubscript{10}H\textsubscript{16}Cl\textsubscript{6}, C\textsubscript{10}H\textsubscript{15}Cl\textsubscript{7}, C\textsubscript{11}H\textsubscript{18}Cl\textsubscript{6}, C\textsubscript{11}H\textsubscript{17}Cl\textsubscript{7}, C\textsubscript{12}H\textsubscript{20}Cl\textsubscript{6}, C\textsubscript{12}H\textsubscript{19}Cl\textsubscript{7} all will have estimated atmospheric half-lives > 2 days.”

*Our comment was misunderstood. We stated that, from the relationship found by Drouillard et al (1998),*

$$\text{Log scl-VP} = -0.353(\text{No of C atoms}) - 0.654(\text{No of Cl atoms}) + 4.462$$

...all predicted half-lives greater than 2 days (in Dossier Table 1, AOPWIN OH-level) are associated with structures for which the scl-VP is less than 0.002 Pa for C\textsubscript{10} structures and less than 0.00003 Pa for C\textsubscript{13} structures. This was correct. For the structures mentioned in the above response (some of which are not given in Table 1):

<table>
<thead>
<tr>
<th>Structure</th>
<th>Atmospheric Half-life (days for [OH]=1.5 \times 10^6 \text{ mols/cm}^3 \text{ (from UNECE Dossier Table 1)}</th>
<th>Subcooled liquid vapour pressure (Pa) from Drouillard et al (1998)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C\textsubscript{10}H\textsubscript{17}Cl\textsubscript{5}</td>
<td>2.0</td>
<td>0.005093</td>
</tr>
<tr>
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Again, all vapour pressures are less than 0.002 for structures with a half-life >2 days. Such low vapour pressures indicate a low tendency to volatilise to the atmosphere and, more importantly, a rapid condensation and disposition close to sources.

In this context, we also stated:

“Van Pul et al (1998) modelled the atmospheric transport of SCCPs and their data should be added to the dossier. Taking into account wet and dry deposition processes, and using
a relatively long photochemical degradation half-life of 96 hours, they predicted atmospheric half-lives for SCCP of 23 hours over land, and 27 hours over the sea.”

We repeat the request that a full description of the Van Pul study be added to the dossier.

**EC RESPONSE:** New work has been produced since the Wania and Mackay (1996) paper regarding the vapour pressure value of <0.001Pa. This newer work emphasizes the importance of air-water and plant-air partitioning along with VP.

We would be grateful if full references to this work could be added to the revised draft dossier.

C. [Comments from the Netherlands] re Environmental monitoring data.
The additional information given in the EC Response Document, taken from European Communities (2000), is largely from Campbell and McConnell (1980). There are more recent data published for the UK environment (subsequent to the European Communities (2000) report) which indicates either that levels have declined considerably, or that the analytical methods used by Campbell and McConnell were not as specific or accurate as those currently available. In particular, the data of Nicholls et al (2001) shows levels in water below the detection limit in all but one sample, even in areas impacted by known sources of SCCP.

**Additional References (others as in Draft UNECE dossier)**
2. Comments from the United States

We appreciate the effort Mr. Greg Filyk has made in drafting the dossier and responding to comments, including those previously transmitted by the U.S. We are submitting the following very limited comments on the response to comments document, but may have additional comments at a later date.

Our comments are aimed at clarifying the dossier contents only, and are based upon available information. They do not attempt to support or reject short-chain chlorinated paraffins (SCCP) for consideration as a LRTAP POP.

- We support Canada’s ongoing effort to compile information on past exposures to SCCPs as the result of the use of the chemicals in the military when operating at remote locations in the Arctic (e.g., Alert).

- It should be noted in the dossier that analytical measurements of SCCPs are extremely difficult, and only a small number of laboratories in the world currently have the expertise to do so. While PCBs consist of 129 congeners and isomers, the number for SCCPs may number in the thousands. Therefore, instead of being able to resolve individual peaks corresponding to specific substances using analytical measurements, what is observed is an unresolved envelope of these substances. This, results in much more difficult detection of SCCPs through analytical methods.

Contact in the US EPA Office of Pollution Prevention and Toxics for additional information:

Dr. Robert L. Lipnick; Tel. 202-564-7632; lipnick.robert@epa.gov
3. **Comments from the Chlorinated Paraffins Industry Association**

See PDF file that was sent along with this Dossier.
APPENDIX 3D

CANADA’S RESPONSES TO COMMENTS RECEIVED ON RESPONSES DOCUMENT (APPENDIX 3C)

1. Comments from the Chlorinated Paraffins Sector Group, Euro Chlor

Calculation of NOEC for benthic organisms (Part I, Section 2)

This calculation has been corrected in the Dossier, in agreement with the comments received.

B.1. Vapour Pressure and Atmospheric Half-Lives

Van Pul et al (1998) modelled the atmospheric transport of SCCPs. Taking into account wet and dry deposition processes, and using a relatively long photochemical degradation half-life of 96 hours, they predicted atmospheric half-lives for SCCP of 23 hours over land, and 27 hours over the sea. Unfortunately the physical property data used by Van Pul et al (1998) for SCCPs are not provided and their source is unclear. Their study predates the publication of VPs by Drouillard et al (1998) as well as other physical properties that apply to individual formula groups.

Two newer works on partitioning of SCCPs are discussed and referenced in the Dossier: van de Meent et al. (2000) and Peters et al. (2000).

C. [Comments from the Netherlands] re Environmental monitoring data.

Data from Nicholls et al. (2001) has been added to the Dossier.

2. Comments from the United States

The comments on analytical measurements have been added to the Dossier.

3. Comments from Chlorinated Paraffins Industry Association

Vapour Pressure

More scientific work contending that SCCPs are capable of undergoing long-range transport despite their low vapour pressures has been added to the Dossier. See the discussion of work by van de Meent et al. (2000) and Peters et al. (2000) in Part I.

Transport on Aerosols

Given that not enough empirical study has been conducted to prove or disprove this
conclusively, Canada contends that evidence of transport on aerosols of other chemicals with similar physiochemical characteristics as SCCPs (ie. vapour pressure, half-life in air) is sufficient to conclude that SCCPs will also be likely to be transported by aerosols.

Local Sources for SCCPs

The use of SCCPs in Arctic towns, at current or former military sites or mines/oil gas exploration is unlikely to account for the levels observed in biota because the quantities used, although unknown, are undoubtedly small compared to use in urban areas of Canada. To use the analogy with PCBs: a total of about 30 t of PCBs was estimated to have been imported into the Canadian Arctic for use in military radar stations which is a minor fraction of the 40,000 t imported into Canada. The population of the Canadian Arctic, Alaska north slope and Greenland is about 170,000 people in small communities spread over an area of 10 x10^6 km^2. The number of mining operations in this area is very small. Oil and gas exploration is significant but limited mainly to the Beaufort sea and well regulated in terms of emissions to the environment.

The results for Beluga whales, which are the only species for which we have some idea of geographical trends, show similar levels in both the western and eastern Canadian Arctic and in Hudson Bay (Tomy et al. 1998b). (Refer to Table 4 of the Dossier, which has been revised with an expanded data set.) There is also not a large amount of individual variation. All this is an indication that there are not significant point sources.

The data for PCBs in resident Arctic species such as ringed seals and polar bears, when examined from the point of view of broad geographical trends do not show any effect due to urban areas or old military sites. This has been discussed in the Canadian Arctic Assessment report (1997 and 2003) and in the Arctic monitoring and Assessment report on POPs (1998 and 2003).

Regarding the dumping of bilge water by ships as a possible source of SCCPs around Bermuda, Canada does not have any data on this subject which would show if ships are in fact a significant source of SCCPs to the water. We were unable to find the source for the seawater data cited in UNESC (2002) and have therefore omitted this reference from the Dossier. Canada suspects that ships are a minimal source of SCCPs to the water. This is because the main dispersive use of SCCPs is in metalworking, which is unlikely to be occurring on ships.
1. **Comments from the United States**

Agreed with Canada’s conclusion that it is only a subset of SCCPs that are subject to long-range transport (i.e., not all SCCPs).

Laboratory biodegradation data for SCCPs should be included in the Persistence section of the Dossier.

*Canada notes that available biodegradation data was included.*

2. **Comments from Norway**

Enquired about monitoring information for human breast milk.

Encouraged additional use of existing monitoring data for Svalbard, Norway, as well as for other international Arctic monitoring locations.

3. **Comments from the United Kingdom (England?)**

Noted that EU regulations have changed, which will lead to declining SCCP use in EU in coming years (A summary of the European Union legislation on SCCPs should be added to the Dossier (ie. Directive 2002/45/EC of the European Parliament and of the Council of 25 June 2002).

*This information is reflected in Exec Summary and in revised Draft II dossier.*

4. **Comments from The Netherlands/Holland**

The following information should be added to the Dossier:

- SCCPs are on the List of Substances of Possible Concern under OSPAR (The Convention of the Protection of the Marine Environment of the North-East Atlantic). These are substances that OSPAR has a goal of eliminating from the marine environment. SCCPs are also on the European Union First Priority List (Commission Regulation (EC) No. 1179 within the EU Existing Substances Regulation 793-93), with the U.K. having sponsored their risk assessment.

New health information may cast doubt on whether SCCPs are carcinogenic. The IPCS
(1996) assessment classified SCCPs as "possibly carcinogenic to humans", instead of "probably carcinogenic to humans" as was stated in the Canadian risk assessment of chlorinated paraffins (Government of Canada 1993a).

New information included in revised Draft II dossier.

5. EuroChlor

EuroChlor - i) noted that as per their recent set of comments, predicted vapour pressure and half-lifes for some SCCPs do not support dossier finding of mobility for long-range transport; ii) further EuroChlor comments will be forthcoming.

Reference