



CO₂ from the use of soda ash

CRF 2A4

Anna-Karin Nyström, SCB

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Summary

Emissions of CO₂ from the use of soda ash shall be reported to the UNFCCC according to the IPCC Guidelines. In earlier Submissions, Sweden has only reported emissions from the use of soda ash within glass manufacture. In this project contact has been made and data has been collected from several other users of soda ash, for instance moist snuff producers and producers of detergents. Data has also been collected from companies that reported use of soda ash in the trading survey sent by SEPA and SMED in January, and from the Swedish Chemicals Inspectorates (KemI). New calculations of CO₂ from the use of soda ash were made for the time series 1990-2003 based on data from KemI for all sectors except from glass manufacturers, where the data already available from earlier submissions were used. The new time series show a lot higher emissions than in Submission 2004, but still CO₂ emissions from the use of soda ash is only about 1 % of the total CO₂ emissions in the Industrial Process sector.

1. Introduction

According to the IPCC Guidelines¹ and the Good Practice Guidance,² emissions of CO₂ from the use and production of soda ash - sodium carbonate, Na₂CO₃ - should be reported in the CRF table 2A4. According to the guidelines, some of the major uses of soda ash include glass manufacture, chemicals, soaps, detergents and flue gas desulphurisation. In Sweden's Submission 2004 to the UNFCCC, emissions of CO₂ from the use of soda ash were only included in glass manufacturing.

1.1 Aim of study

The aim of this study was to get an overview of the use of soda ash in Sweden within the production of detergents, snuff and within water treatment. The aim was also to collect data of soda ash use from companies that reported emissions of CO₂ from soda ash use in the CO₂ trade system survey in January 2004, for instance from flue gas desulphurisation. Finally data should be collected from companies within SNI 24 500 - production of detergents and toilet articles - that report fuel consumption data to the Energy Statistic Department at Statistics Sweden. The collected data should cover the whole time series from 1990-2003. Based on the collected data, calculations of emitted CO₂ should be made and be reported in the UNFCCC Submission 2005.

CRF 2A4 should also include emissions of CO₂ from the production of soda ash, however this is not applicable for Sweden since soda ash production does not exist.³

1.2 Facts about soda ash

Soda ash with chemical formula Na₂CO₃ is a grey-white powder, soluble in water, which gives an alkaline solution, but is insoluble in organic solvents. Soda ash has been used for a long time and was produced at home by soaking of wood ash or plants, e.g. seaweed to be used for washing. The old name 'soda' comes from an Arabic word sawwada, which stands for the plants from whose ashes it was extracted. The substance is nowadays manufactured synthetically from limestone and salt (calcium carbonate and sodium chloride) by the Solvay process. Soda is also won from mining localities in USA and Kenya, either from the mineral trona or from salt lakes. In the year 2000, about 30 million tons of soda ash was manufactured globally and it is thus one of the most utilized chemicals.

The substance is used as a sodium source in many industrial processes. Largest is the use in glass melts, where about 5-15% soda is melted together with sand and chalk. More than 90% of all glass is manufactured with soda ash as a main ingredient. Another large consumer of soda ash is as a sodium source for manufacture of sodium silicates and sodium phosphates.⁴

¹ Revised 1996 IPCC Guidelines for National Greenhouse Gas inventories: Reference Manual 2.6.

² IPCC NGGIP. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 15 June 2001

^{3,4} www.kemi.se. 2004-06-07.

2. Method of analysis

To get an overview of what soda ash is used for, who uses it and how much is used, three organisations were contacted; National Institute of Public Health, the Swedish Water & Waste Water Association and the Swedish Chemical Inspectorate (KemI). The results from these contacts are described in the following chapters. Contact was also made directly with a number of companies producing detergents and tobacco, also described below.

2.1 Soda ash reported in the CO₂ trading survey

In the Swedish CO₂ emission trading survey conducted by SMED on behalf of the Swedish EPA in January 2004,⁴ four plants reported use of soda ash. Of these four, two were glass manufacturer that Statistics Sweden has already collected data from and reported in CRF 2A4 in Submission 2004. Data from 1998-2002 from the trading survey were compared with data reported earlier directly to Statistics Sweden (SCB) and they were almost identical.

The other two companies were Göteborgs Energi AB Sävenäsverket and Saint-Gobain Isover AB (mineral wool producer) and these two were contacted to receive data for 1990-1997 and 2003. Göteborg Energi reported that they actually use bicarbonate and not soda ash, even though CO₂ is emitted when using bicarbonate as well. They did not start to use bicarbonate until the year 2000, so they could only report new data for 2003.⁵

Isover use soda ash when producing glass that is used for glass wool production. Data was provided from 1990-1997 and 2003.⁶ Soda ash use has decreased since 1990 since more and more glass has been recovered and hence less glass has to be produced. In data from KemI soda ash used by Isover is not included in the glass sector since Isover is mainly a glass wool producer.

2.2 Detergents

The use of soda ash as filler in detergents and other cleaning agents is important. In hard water, soda ash complexes calcium ions and thus hinders deposition of insoluble calcium on washing goods. By its alkalinity it contributes to the dirt-removing ability of the washing powder. Its complexing and pH-adjusting properties are also utilised in water treatment.

All 22 companies within SNI 245 - production of detergents and toilet articles - that report fuel consumption to Statistics Sweden were contacted. One company within SNI 24130, that was primary contacted to collect data on limestone use, also reported that they use soda ash.

Among the 23 companies approached, 18 responded and the remaining five did not respond or was not possible to get in contact with despite several attempts by telephone and e-mail. Only five of the companies that responded reported data on

⁴ Ivarsson, Kumlin, Lidén, Olsson. 2004-02-12. SMED- report: Datarapport - Dataunderlag för Sveriges nationella fördelningsplan i EU:s system för handel med utsläppsrätter

⁵ Mats Nilsson, 2004-05-24, mats.nilsson@goteborgenergi.se.

⁶ Lindvall, Per, 2004-06-07, per.lindvall@saint-gobain.com.

soda ash consumption. In total they use 8000 to 40 000 ton of soda ash per year. The remaining companies responded that they were producing cosmetics, shampoos, cleaning towels etc., without using soda ash.

2.3 Moist snuff

Soda ash is used in the production of moist snuff (Swedish tobacco, "snus"). It is added to adjust the pH value and keep the qualities of the snuff.⁷ Swedish match is the main producer of moist snuff in Sweden, and has about 98 % of the Swedish market.⁸ Swedish Match was contacted and provided data on soda ash use from 1998 to 2003. The consumption in 1990 was estimated by Swedish match,⁹ and the remaining years has been estimated based on data in 1990 and 1998-2003.

Except for Swedish Match, contact has also been made with smaller companies producing snuff, like Gotlandssnus, SnusAB, Snusfabriken and Bengt Sändhs Snusfabrique,¹⁰ but their consumption of soda ash only amounts to a maximum of 60 kg per year. Gallaher Sweden AB and Skruf have a bit higher snuff production, but they have not responded on our request. To maintain the total amount of soda ash used within snuff production, the Swedish Match market share of 98 % has been used to calculate the total consumption of soda ash. However, these data has not been used in the final calculations, but only as verification data for the data from KemI, see chapter 2.5.

2.4 Water purification

In the cleaning process in water plants, soda ash is added to raise the alkalinity. Instead of soda ash, limestone or other alkaline products may be used. The main part of the carbon in the soda ash added, will remain in the water as hydrogen carbonate (HCO_3) and only a minor part will be emitted as CO_2 .¹¹ According to KemI, a total of 164 tons of soda ash was used in 2002 within sectors that might include water purification, which is a minor part of the whole Swedish consumption.¹² No specific data on soda ash use within water purification has been collected; instead data from KemI has been used (chapter 2.5).

2.5 Soda ash according to KemI

At the Swedish Chemicals Inspectorates homepage¹³ the flow of soda ash in Sweden in 2001 is shown, see figure 1. It shows that the main use in Sweden is within glass and chemical production. KemI was directly contacted to collect data from other years. Data on soda ash are stored at a database at KemI called the Products register.

KemI annually collects data on the total amount of soda ash imported and manufactured in Sweden.

⁷ <http://www.snusfabriken.com/snusfiler/fakta.htm>, 2004-04-26.

⁸ Paul Nordgren at the National Institute of Public Health. 2004-04-28. E-mail: paul.nordgren@fhi.se.

⁹ Bertil Runström, Swedish Match, 2004-05-04. E-mail: bertil.runstrom@swedishmatch.se.

¹⁰ Gotlandssnus: henrik.jakobsson@gotlandssnus.com, Snus AB: Peter Nilsson: info@snusab.se, Snusfabriken: aimo@snusfabriken.com, Bengt Sändhs snusfabrique: bengt.sandh@aanc.se.

¹¹ Gullvy Hedenberg, The Swedish water & waste water association. 2004-04-28. gullvy.hedenberg@svensktvatten.se.

¹² Eva Ljung, KemI, 2004-06-07. E-mail: eva.ljung@kemi.se, phone number 08- 51941228.

¹³ the Swedish chemicals inspectorates homepage: www.kemi.se, 2004-05-15.

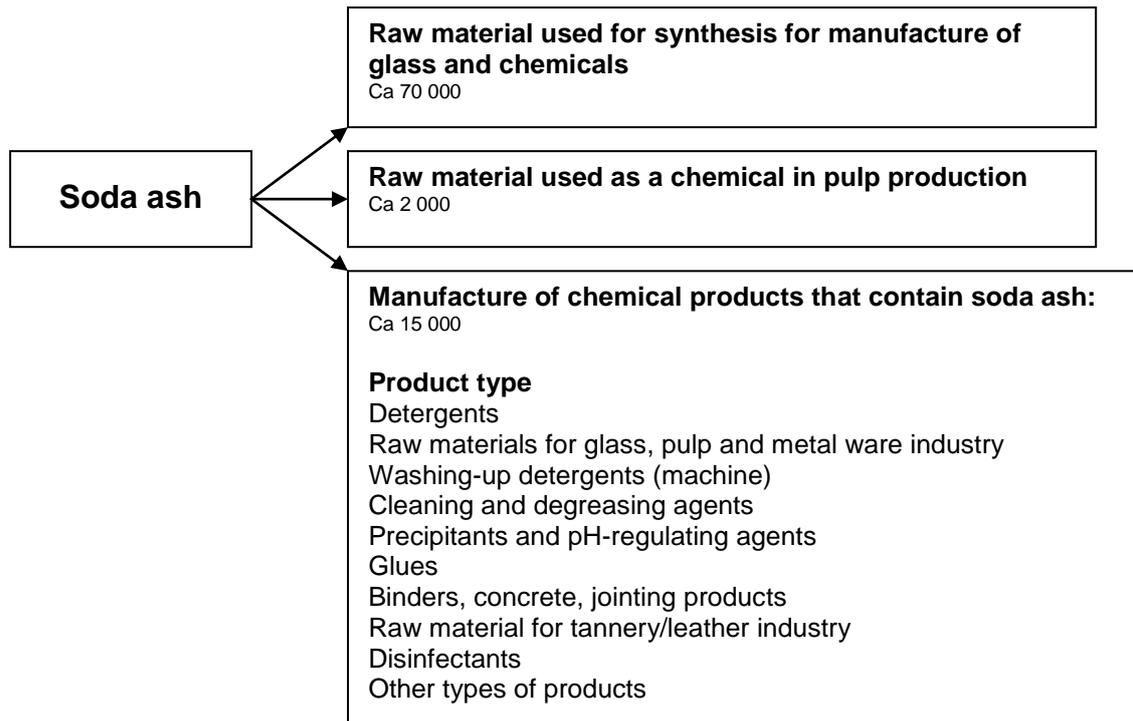


Figure 1. Substance flow of soda ash in 2001 (www.kemi.se).

2.5.1 Data collection of soda ash from the Products register

KemI has collected data from 1992-2002 from companies that sell and import soda ash. Data on the total amount reported to KemI and the five largest consumers each year were provided Statistics Sweden within this project.

To verify this data, it was compared with data collected within this project from snuff producers, producers of detergents and with available data from glass manufacturers. The total amount of soda ash consumed according to collected data by Statistics Sweden and data from KemI is shown in figure 2. As can be seen data is missing for 1990, 1991 and 2003 from KemI. What is interesting to notice is the great variation between single years in data from KemI.

Total soda ash , ton

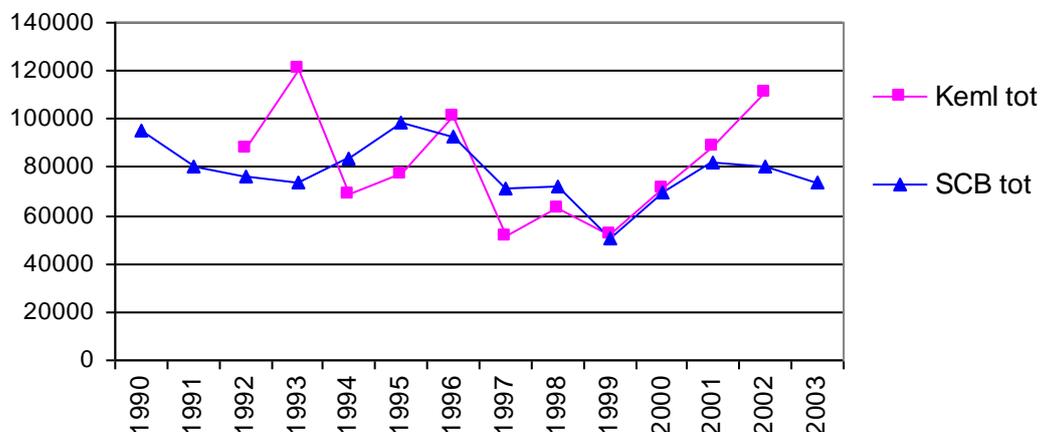


Figure 2. Total use of soda ash according to KemI and data sent to SCB within this project.

Data from Statistics Sweden contain information from five companies within SNI 245, detergent producers, glass manufacturers, one energy producer, one stone wool producer and the total consumption in snuff production, all described in the chapters above. Consumption is quite steady with some exceptions: the dip in 1999 is caused by a drift stop in the production at one of the glass manufacturer and the annual fluctuations is caused by variation in consumption at one company within SNI 245 and one glass manufacturer.

Data from KemI are fluctuating in a much more complex way. In figure 3 below, data from four different sectors are presented, which summarized show the total amount reported. Note that for some years, for instance basic chemicals in 1994 and 1997, no data are reported because the sector was not on the top five list that year and hence separate data has not been provided by KemI. Despite of that, data seem to be unrealistically high some years and it was agreed¹⁴ that this data should not exclusively be used as a base to calculate CO₂ emissions from this sector without any adjustments.

Soda ash KemI, ton

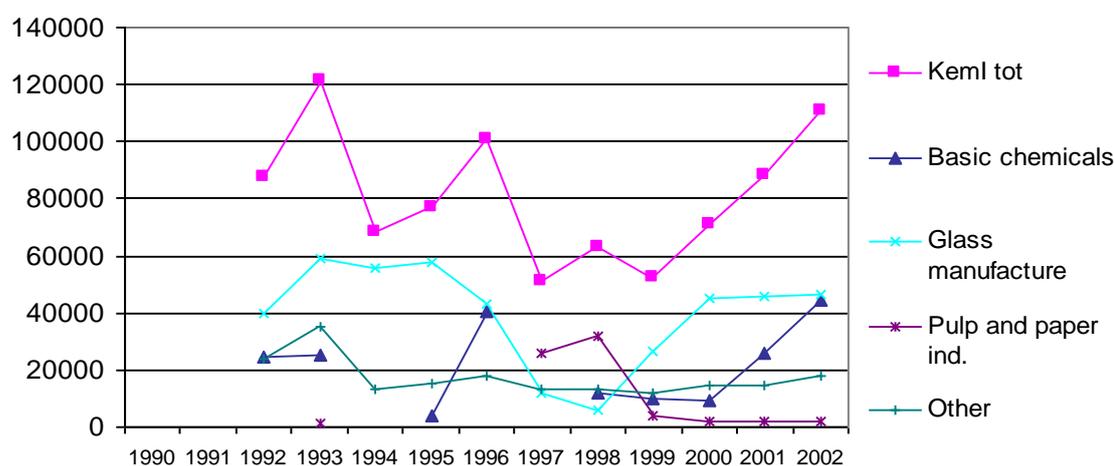


Figure 3. Use of soda ash in different sectors (KemI).

A separate comparison was made between data used within glass manufacturing reported to Statistics Sweden and to KemI, see figure 4. Data reported to Statistics Sweden are believed to be accurate since they are collected by directly contacting the companies involved and these data are protected by secrecy by law. Data might be somewhat underestimated in case there are smaller glass manufacturers unknown to Statistics Sweden. In case this assumption is true, these manufacturers must be very small and will not be included in the CO₂ trading system. Since data reported to Statistics are correct, data from KemI cannot be fully complete for all years, and hence should not be used for the sector glass manufacture.

¹⁴ Agreed by Anna-Karin Nyström, Maria Lidén and Karin Kindbom (SMED) and David Mjureke (SEPA).

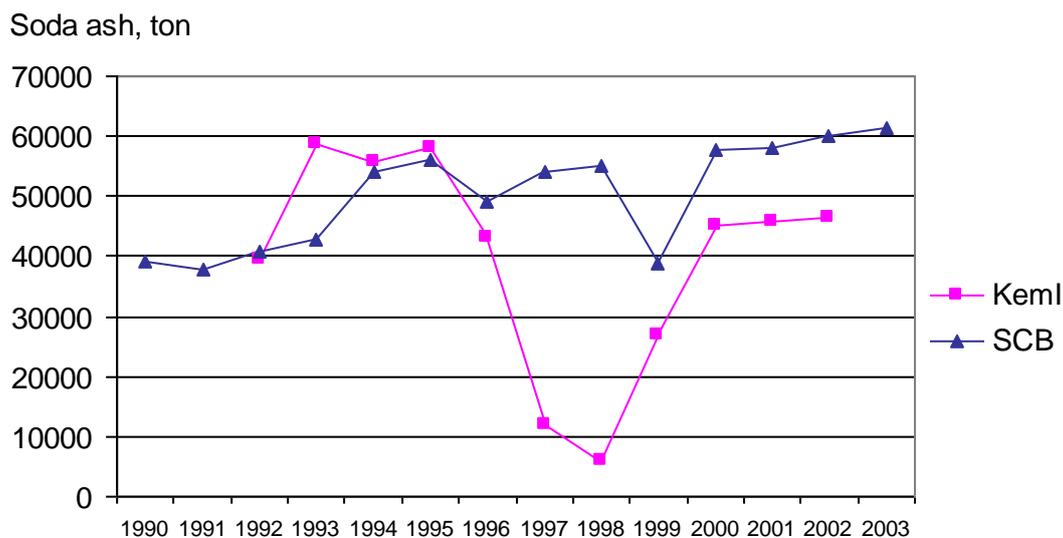


Figure 4. Use of soda ash in glass manufacture reported by KemI and to Statistics Sweden.

3. Calculations

To be able to make as correct calculations as possible data on soda ash use within glass manufacture collected by Statistics Sweden were used for all years to make sure that the same companies would be included. For the remaining use of soda ash it was decided to use data from KemI, since KemI has a better overview and because it was neither intended nor meaningful to try to collect every single use of soda ash within this project, since anyway emissions from soda ash use are relatively low. So to get the total amount of soda ash used, the soda ash used for glass manufacture was subtracted from the total amount of soda ash reported by KemI, and the remaining part was called ‘other consumption’.

The ‘other consumption’ part was meant to be added to the soda ash reported to Statistics Sweden from the glass manufacturers to make up a total amount of soda ash for Sweden. However, as shown in figure 5 below, ‘other consumption’ showed a very irregular pattern i.e. high annual variation in soda ash use. From the results of the comparison in the glass manufacture sector (figure 4), led to believe that these variations are probably not fully correct. This is in accordance with SMED: s earlier experience from the Products register having in mind that companies are obliged to report data to the products register, but are not reminded to do it, which means that all companies using soda ash may not report it every year.¹⁵

¹⁵ Karin Kindbom, IVL, 2004-06-09, telephone: 031-7256222.

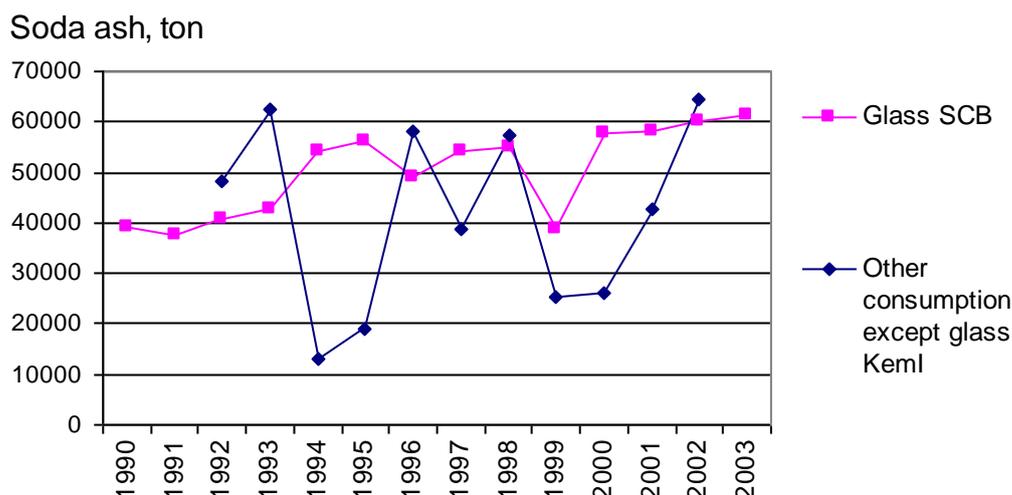


Figure 5. Data on soda ash reported by glass manufacturers to SCB and 'other consumption' reported to KemI.

Instead of directly adding the 'other consumption' part, a mean value of 'other consumption' was calculated for the years 1992-2002 based on all data from KemI except glass manufacture data. The mean value for 1992-2002 was 41 410 ton soda ash per year. This value was added to the value of consumption within glass manufacture according to data from Statistics Sweden, see table 1.

Year	Total KemI ton	Glass KemI ton	'Other' ton	Glass SCB ton	Mean value 'Other' ton	Total use ton
1990				39 276 +	41 410 =	80 686
1991				37 674 +	41 410 =	79 084
1992	87 613 -	39 499 =	48 114	40 852 +	41 410 =	82 262
1993	121 333 -	58 840 =	62 493	42 778 +	41 410 =	84 188
1994	68 620 -	55 626 =	12 994	54 154 +	41 410 =	95 564
1995	77 066 -	58 014 =	19 052	56 176 +	41 410 =	97 586
1996	101 139 -	43 017 =	58 122	49 184 +	41 410 =	90 594
1997	50 972 -	12 035 =	38 937	54 179 +	41 410 =	95 589
1998	63 167 -	5 956 =	57 211	55 059 +	41 410 =	96 469
1999	52 173 -	26 725 =	25 448	38 685 +	41 410 =	80 095
2000	71 223 -	45 076 =	26 147	57 656 +	41 410 =	99 066
2001	88 486 -	45 944 =	42 542	57 975 +	41 410 =	99 385
2002	110 788 -	46 336 =	64 452	60 168 +	41 410 =	101 578
2003				61 360 +	41 410 =	102 770
Mean value:			41 410 ton			

Table 1. Calculations of total use of soda ash in Sweden based on data from KemI and glass manufacturers.

By using this method a much more consistent time series was obtained. The new total value was then used to calculate CO₂ emissions by using the IPCC default emission factor for soda ash: 44.01 g/mole CO₂/ 105.99 g/mole Na₂CO₃ =0.415,¹⁶ and using the equation:

¹⁶ Revised 1996 IPCC Guidelines for National Greenhouse Gas inventories: Reference Manual 2.6.2.

Ton CO₂: Total amount of soda ash (ton) * 0,415 ton CO₂/ ton soda ash

4. Results

The calculated time series is shown in figure 6 below. The dip in 1999 is caused by a three month long stop in the production at one of glass manufacturer, also shown in figure 2.

The emission levels in Submission 2004 and in Submission 2005 has increased with 67-107 % for different years, but still CO₂ emissions from the use of soda ash is only about 1 % of the total CO₂ emissions in the Industrial Process sector.

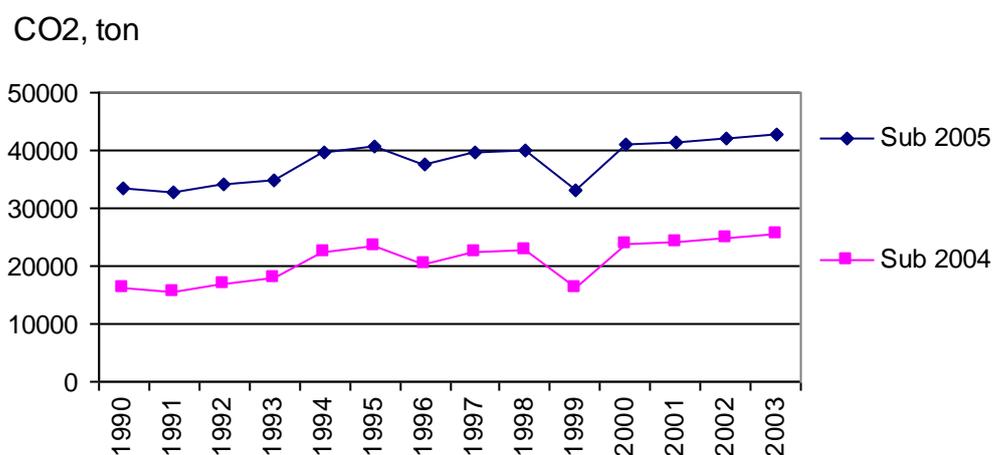


Figure 6. Calculated emissions of CO₂ based on Sweden's use of soda ash reported in Submission 2004 (only from glass manufacturers) and in Submission 2005 (total use including glass manufacturer and other consumption).

5. Discussion

Data from KemI on 'other consumption' was calculated as a mean value from the years 1992-2002, and then used for all years in the time series: 1990-2003. This mean value has a quite high uncertainty, but it was considered to be more accurate to use than the reported values for 1992-2002, since they were so irregular. It would be of great value if KemI could improve their statistics on soda ash use and revise their time series. This would make it possible for SMED to revise the time series for CO₂ and reduce the uncertainty.

If data from KemI will not be revised nor improved in the following year, there are some alternative ways to calculate data. The first option is to continue to use data directly from the glass manufacturers and add the same mean value for 'other consumption' as in Submission 2005. Another way would be to collect new data on 'other consumption' for the coming years and calculate a new mean value for 1990-2003 in Submission 2006. A third option would be to verify data from KemI by contacting the companies that has reported data to the Products register and ask them to send data for the whole time series.