Accessory publication

Sources of antimony in an urban area

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Uncertainty calculations

Data have been allotted subjective uncertainty intervals in accordance with Hedbrant and Sörme.[33] Uncertainty calculations for each product group and total follow the suggestions by the same authors.

Table A1. Uncertainty levels with sources of information and with examples, used in the Stockholm study of Hedbrant and Sörme[33]

Level	Source of information	Example
Interval ×/1.1	Official statistics at a local level	Number of households, cars, apartments, small houses
	Information from authorities, construction and production agencies	Cr content in steel for a specific application
Interval ×/1.33	Official statistics at (local), regional and national levels	Percentage of leather shoes among shoes
	Information from authorities, construction and production agencies	Amount of Pb and Cu in power cables; Cr content in leather
		Thickness of Ni and Cr layer on plating; paint per area
Interval ×/2	Official statistics at national levels downscaled to local level	Share of Volvo cars among all cars
	Information on request from authorities, construction and production agencies	Annual use of stainless steel on roofs and walls (or cladding)
Interval ×/4	Information on request from authorities, construction and production agencies	Weight of catalytic converters
Interval ×/10		Cd content in Zn in a type of goods, e.g. galvanised goods

Accumulators

Inflow = Number of batteries × Battery weight × Share of battery consisting of Pb × Sb concentration in Pb

Stock = Number of batteries × Battery weight × Share of battery consisting of Pb × Sb concentration in Pb

Number of batteries = ×/1.33 (official statistics at local levels)

Battery weight = ×/1.33 (information on request from authorities, construction and production agencies)

Share of battery consisting of Pb = ×/1.33 (information from authorities, construction and production agencies)

Sb concentration in Pb = ×/1.33 (information from authorities, construction and production agencies)

$$1+\sqrt{(1.33-1)^2+(1.33-1)^2+(1.33-1)^2+(1.33-1)^2}=1.66 \quad (1)$$

Waste = Number of batteries × Battery weight × Share of battery consisting of Pb × Sb concentration in Pb × Share of total amount of batteries that go to waste

Recycling = Number of batteries × Battery weight × Share of battery consisting of Pb × Sb concentration in Pb × Share of total amount of batteries that go to recycling

Number of batteries = ×/1.33 (official statistics at local levels)

Battery weight = ×/1.33 (information on request from authorities, construction and production agencies)

Share of battery consisting of Pb = ×/1.33 (information from authorities, construction and production agencies)

Sb concentration in lead = ×/1.33 (information from authorities, construction and production agencies)

Share of total amount of battery that goes to recycling and waste = ×/1.33 (official statistics at regional levels)

$$1+\sqrt{(1.33-1)^2+(1.33-1)^2+(1.33-1)^2+(1.33-1)^2+(1.1-1)^2}=1.67 \quad (2)$$

Ammunition

Inflow = Inflow of Pb in ammunition × Concentration of Sb in Pb

Inflow of Pb in ammunition ×/4 (information on request from authorities, construction and production agencies)

Concentration of Sb in Pb ×/10 (information on request from authorities, construction and production agencies)

$$1+\sqrt{(4-1)^2+(10-1)^2}=10.49 \quad (3)$$

Emission = Emission of lead in ammunition × Concentration of Sb in Pb

Emission of Pb from ammunition ×/4 (information on request from authorities /construction/ production)

Concentration of Sb in Pb ×/10 (information on request from authorities, construction and production agencies)

$$1+\sqrt{(4-1)^2+(10-1)^2}=10.49 \quad (4)$$

Cables, shielding

Stock = Stock of Pb in cables × Concentration of Sb in Pb

Stock of Pb in cables ×/1.45 (information from authorities, construction and production agencies)

Concentration of Sb in Pb ×/10

$$1+\sqrt{(1.45-1)^2+(10-1)^2}=10.01 \quad (5)$$

Flame retardant

Inflow = Amount of plastic inflow × Share of plastic containing Sb as flame retardant × Concentration of Sb flame-retarded plastic

Amount of plastic inflow (year 2001) ×/2 (official statistics scaled to a local level)

Share of plastic containing Sb as flame retardant ×/1.33 (information from authorities, construction and production agencies)

Concentration of Sb flame-retarded plastic ×/4 (information on request from authorities, construction and production agencies)

$$1+\sqrt{(2-1)^2+(1.33-1)^2+(4-1)^2}=4.18 \quad (6)$$

Stock = Total amount of plastic × Share of plastic containing Sb as flame retardant × Concentration of Sb flame-retarded plastic

Total amount of plastic (counted as 11 years' inflow) ×/2 (official statistics scaled to a local level)

Share of plastic containing Sb as flame retardant ×/1.33 (information from authorities, construction and production agencies)

Concentration of Sb flame-retarded plastic ×/4 (information on request from authorities, construction and production agencies)

$$1+\sqrt{(2-1)^2+(1.33-1)^2+(4-1)^2}=4.18 \quad (7)$$

Glass

Inflow = Sb used in glass industries/year × Scaling factor to local level

Sb used in glass industries/year ×/1.33 (information from authorities, construction and production agencies)

Scaled to a local level ×/2

$$1+\sqrt{(1.33-1)^2+(2-1)^2}=2.05 \quad (8)$$

Stock = Sb used in glass industries/year × Number of years in use × Scaled to a local level

Sb used in glass industries/year × 1.33 (information from authorities, construction and production agencies)

Number of years in use × 1.1 (information from authorities, construction and production agencies)

Scaled to a local level × 2

$$1+\sqrt{(1.33-1)^2+(1.1-1)^2+(2-1)^2}=2.06 \quad (9)$$

PET in cars

Inflow and stock = Average amount of PET in cars × Concentration of Sb in PET plastic × Number of cars, scaled to a local level

Average amount of PET in cars ×/4

Concentration of Sb in PET plastic ×/1.37

Numbers of cars, scaled to a local level ×/2

$$1+\sqrt{(4-1)^2+(1.37-1)^2+(2-1)^2}=4.18 \quad (10)$$

PET in soft drink bottles

Inflow = Inflow of PET plastic × Concentration of Sb in PET plastic × Scaled factor to a local level

Inflow of PET plastic ×/1.1 (Information from authorities, construction and production agencies)

Concentration of Sb in PET plastic ×/1.18 (authors' measurements)

Scaled to a local level ×/2

$$1+\sqrt{(2-1)^2+(1.18-1)^2+(1.1-1)^2}=2.02 \quad (11)$$

Emission = Number of soft drink bottles scaled to local level × Water amount per bottle × Concentration of Sb in water

Number of soft drink bottles scaled to local level ×/2 (Information from authorities, construction and production agencies)

Water amount per bottle ×/1.33 (authors' estimate ~1 L)

Concentration of Sb in water ×/4 (refs [49,50])

$$1+\sqrt{(2-1)^2+(1.33-1)^2+(4-1)^2}=4.18 \quad (12)$$

Recycling and waste = Number of soft drink bottles × Concentration of Sb in PET plastic × Scaling to a local level × Share of the bottles that goes to recycling and waste

Number of soft drink bottles ×/1.1 (Information from authorities, construction and production agencies)

Concentration of Sb in PET plastic ×/1.18 (authors' measurements)

Scaled to a local level ×/2

Share of the bottles that goes to recycling and waste × 1.1 (information on request from authorities, construction and production agencies)

$$1+\sqrt{(2-1)^2+(1.18-1)^2+(1.1-1)^2+(1.1-1)^2}=2.03 \quad (13)$$

PET in textile

Inflow = Inflow of PET textile × Concentration of Sb in PET textile × Scaling to a local level

Inflow of PET textile ×/10 (information from authorities, construction and production agencies)

Concentration of Sb in PET textile ×/1.22 (authors' measurements)

Scaled to a local level ×/2

$$1+\sqrt{(2-1)^2+(1.22-1)^2+(10-1)^2}=10.06 \quad (14)$$

Emission = Inflow of PET textile × Amount leached × Scaled to a local level

Inflow of PET textile ×/10 (Information from authorities, construction and production agencies)

Amount leached (simple leaching test × 10) ×/10 (authors' measurements and estimation)

Scaled to a local level ×/2

$$1+\sqrt{(2-1)^2+(10-1)^2+(10-1)^2}=13.77 \quad (15)$$

Pewter

Stock = Average amount pewter per dwelling × Concentration of Sb in pewter × Number of dwellings

Average amount pewter per dwelling = ×/10 (rough estimate)

Concentration of Sb in pewter = ×/1.33 (information from authorities, construction and production agencies)

Number of dwellings in Stockholm = ×/1.1 (official statistics at local levels)

$$1+\sqrt{(1.33-1)^2+(10-1)^2+(1.1-1)^2}=10.00 \quad (16)$$

Pigment

Inflow = ∑Amount pigment × Concentration of Sb for each pigment

Sb concentration = Ni-Ti-pigment 10.5% ×/1.1428, Cr-Ti-pigment 11.25% ×/1.2444 (information from authorities, construction and production agencies)

Uncertainties for the amount of each pigment = ×/2 (official statistics scaled to a local level)

$$1+\sqrt{(1.1428-1)^2+(2.00-1)^2}=2.01 \quad (17)$$

$$1+\sqrt{(1.2444-1)^2+(2.00-1)^2}=2.03 \quad (18)$$

Uncertainty for the sum of the pigments 1.65 t + 3.85 t

$$1+\frac{\sqrt{[1.65*(2.01-1)]^2+[3.85*(2.03-1)]^2}}{5.5}=1.78 \quad (19)$$

Sinkers

Inflow = Inflow of Pb in sinkers × Concentration of Sb in Pb

Inflow of lead in sinkers ×/4 (information on request from authorities, construction and production agencies)

Concentration of Sb in Pb ×/10 (information on request from authorities, construction and production agencies)

$$1+\sqrt{(4-1)^2+(10-1)^2}=10.49 \quad (20)$$

Emission = Emission of Pb in sinkers × Concentration of Sb in Pb

Emission of lead in sinkers ×/4 (information on request from authorities, construction and production agencies)

Concentration of Sb in Pb ×/10 (information on request from authorities, construction and production agencies)

$$1+\sqrt{(4-1)^2+(10-1)^2}=10.49 \quad (21)$$

Tyres

Inflow and stock = Trade statistics for tyres including scaling to a local level × Share of the tyre that is rubber × Concentration of Sb in tyre rubber × Scaling to a local level

Trade statistics for tyres including scaling to a local level ×/2 (information from authorities, construction and production agencies)

Share of the tyre that is rubber ×/1.1 (information from authorities, construction and production agencies)

Concentration of Sb in tyre rubber ×/1.25 (from ref. [27])

$$1+\sqrt{(2-1)^2+(1.1-1)^2+(1.25-1)^2}=2.04 \quad (22)$$

Waste, recycling and emission = Statistics for tyres including scaling to a local level × Scaling from 1992 to 2005 × Share of the tyre that is rubber ×Concentration of Sb in tyre rubber × Scaling to a local level

Statistics for tyres including scaling to a local level ×/2 (information from authorities, construction and production agencies)

Scaling from 1992 to 2005 ×/2 (information from authorities, construction and production agencies)

Share of the tyre that is rubber ×/1.1 (information from authorities, construction and production agencies)

Concentration of Sb in tyre rubber ×/1.25 (from literature)

$$1+\sqrt{(2-1)^2+(2-1)^2+(1.1-1)^2+(1.25-1)^2}=2.44 \quad (23)$$

Total uncertainty

Uncertainties for the totals have been added in accordance with Hedbrant and Sörme.[33]

E.g. Total uncertainty for the stock:

$$1+\frac{\sqrt{\left[45000\times(1.33-1)\right]^2+\left[3000\times(10-1)\right]^2+\left[120000\times(10.01-1)\right]^2+\text{etc.}}}{430000}=3.92 \quad (24)$$