

NILU OR: 19/88

NILU OR : 19/88
REFERENCE: O-8663
DATE : MARCH 1988
ISBN : 82-7247-910-9

ATMOSPHERIC LEAD EMISSIONS IN EUROPE IN 1985

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SUMMARY

The atmospheric emissions of lead from various anthropogenic sources in Europe are estimated for 1985. The estimates are partly based on the Pb emission survey for 1982, assuming that changes in Pb emissions in Europe between 1982 and 1985 are mainly related to the changes of the Pb emissions from gasoline combustion during the period. The use of leaded and unleaded gasoline in all European countries in 1985 is presented. Major decrease of the Pb emissions from gasoline combustion between 1982 and 1985 has been noted for Denmark (60%), Norway (50%), Greece (45%), Italy (40%), Finland (30%), and Spain (20%). The total emission of Pb from gasoline combustion in Europe in 1985 was only 6% lower than in 1982, as there was some increase in gasoline consumption in this period as well. Although the changes of the Pb emissions in Europe between 1982 and 1985 are not significant it is difficult to extend this for 1986. Lead-free gasoline was introduced in 1986 in many countries in Europe, and in some countries a limit of 0.15 g/l was introduced instead of 0.4 g/l in both regular and high-octane super gasoline. The spatial distribution of the Pb emissions in Europe within the EMEP grid of 150 km x 150 km is given.

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ATMOSPHERIC LEAD EMISSIONS IN EUROPE IN 1985

1 INTRODUCTION

This report presents the emissions of lead (Pb) from various anthropogenic sources in Europe in 1985. The estimates are partly based on the Pb emission survey for 1982 (Pacyna and Münch, 1988). The statistical data for the production of industrial goods and the consumption of fossil fuels for 1982 and 1985 vary within 10% for individual European countries. No indication of a major change in production technology was found for 1982 and 1985 in the expansion plans of all major smelters in Europe. The modernisation of environmental protection installations concerned mainly the construction of new acid plants. Considering the above findings, it was assumed here, that if there are changes in Pb emission in Europe between 1982 and 1985, they should be mainly related to the changes of the Pb emissions from gasoline combustion during the period.

2 USE OF LEAD IN GASOLINE

The use of the Pb additives in gasoline in Europe in 1985 is discussed separately for various countries.

No information exists on the use of Pb additives in Albania. A limit of 0.4 g/l gasoline was assumed in this work.

In Austria, lead-free regular gasoline and high-octane super gasoline with a Pb content of 0.15 g/l is available but after 1985. For 1985, a factor of 0.4 g/l can be used. The same factor is valid for Belgium, where a limit of 0.15 g/l was introduced in January 1987. The same factor of 0.4 g/l is also applicable for Bulgaria and Czechoslovakia. The latter country has introduced one type of lead-free gasoline since April 1986.

In Denmark a limit of 0.15 g/l has been introduced for regular gasoline in July 1982 and for premium-gasoline in July 1984. In 1985 all gasoline contained 0.15 g/l. Unleaded gasoline has been introduced in December 1985 and today unleaded gasoline contributes more than 30% to the total amount.

Regular gasoline with 0.15 g Pb/l is used in Finland from 1985 contributing 40% to the total amount already in 1985. The rest was high-octane super gasoline with 0.4 g Pb/l. Thus, the Pb emission factor for gasoline combustion in Finland in 1985 is 0.3 g/l.

In France, Pb content is limited since 1981 to 0.4 g/l. Lead-free gasoline is available but after 1985.

A limit of 0.15 g/l has been introduced in the Federal Republic of Germany already in 1976. However, lead-free gasoline contributed only 1% to the total consumption of gasoline in 1985.

No information exists on the use of Pb in German Democratic Republic. It was assumed that high-octane gasoline in this country contains 0.4 g/l. The same limit was used in 1985 in Hungary, Iceland, Ireland, Italy, Luxembourg and the Netherlands. A limit of 0.15 g/l was introduced in the two latter countries in 1986. Italy, Luxemburg and the Netherlands have recently introduced lead-free gasoline. In Hungary, lead-free gasoline is available for foreign currency.

In Norway, the whole amount of gasoline in 1985 contained 0.15 g/l. Unleaded gasoline was introduced in 1986.

In Poland, a content of Pb in gasoline varies from 0.3 to 0.56 g/l. Most of gasoline in 1985 contained 0.4 g/l. An introduction of lead-free gasoline is planned but only for foreign currency.

A limit of 0.4 g/l was also used in 1985 in Portugal, Romania and Spain.

In Sweden and Switzerland the whole amounts of gasoline is used in 1985 contained 0.15 g/l. Lead-free gasoline was introduced in these countries in 1986.

In the United Kingdom, a content of Pb in gasoline was limited to 0.4 g/l in 1985. A limit of 0.15 g/l was introduced from January 1986. A lead-free gasoline is now available.

It is very difficult to obtain the information on the use of Pb additives in the Soviet Union. The content of Pb in gasoline is now limited to 0.24 g/kg of fuel. The use of ethyleted gasoline containing lead additives is restricted in Moscow, Leningrad, Minsk, Kiev and a number of other cities. However, a factor of 0.4 g Pb/l seems to be appropriate for 1985. The same limit of 0.4 g/l was used in 1985 in Yugoslavia. Now, un- leaded gasoline is available in both countries.

3 ATMOSPHERIC EMISSIONS OF LEAD IN 1985

Lead emission estimates for gasoline combustion in Europe in 1985 are shown in Table 1. The amounts of Pb additives in gasoline are based on the reports presented by the European countries to the UN ECE Convention on Long-Range Transboundary Air Pollution (UN, 1987) and on the information obtained from CONCAWE, the Associated Octel Co. Ltd., The Norwegian Petroleum Institute, and from the environmental protection agencies in the Nordic countries: Statens forurensningstilsyn (SFT) in Norway, Naturvårdsverket in Sweden, Miljøstyrelsen in Denmark and Miljöministeriet in Finland.

The relevant information from the previous report (Pacyna and Münch, 1988) has also been used.

The data on the gasoline consumption in Table 1 are from the OECD (the OECD countries) and UN (other countries) statistics.

Major decrease of the Pb emissions from gasoline combustion between 1982 and 1985 has been noted for Denmark (60%), Norway (50%), Greece (45%), Italy (40%), Finland (30%) and Spain (20%). This decrease is related to the decrease of Pb content in gasoline.

The total emission of Pb from gasoline combustion in Europe in 1985 was only 6% lower than in 1982, as there was some increase in gasoline consumption in this period as well.

The Pb emissions from all sources in Europe in 1985 are shown in Table 2. Emissions from sources other than gasoline combustion were taken from Pacyna and Münch (1988). The spatial distribution of the Pb emissions in Europe within the EMEP grid of 150 km x 150 km is shown in Figure 1.

Although the changes of the Pb emissions in Europe between 1982 and 1985 are not significant it is difficult to extend this for 1986. Lead-free gasoline was introduced in 1986 in many countries in Europe, and in some countries a limit of 0.15 g/l was introduced instead of 0.4 g/l in both regular and high-octane super gasoline.

ACKNOWLEDGEMENTS

This work was funded by GKSS-Research Centre Geesthacht in the Federal Republic of Germany.

The author thanks Mr. W.Ch. Hopper of CONCAWE, Mr. R.J. Larbey of The Associated Octel Co. Ltd., Mr. J. Münch of Dornier-System GmbH, Mr. Olson of Naturvårdsverket, Mr. Iversen of Miljøstyrelsen and Mr. St. Larssen and Mr. R. Hillamo of NILU for providing the information of ~~the use of Pb in gasoline.~~

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Table 1: Lead emissions from gasoline combustion in Europe in 1985.

Country	Pb additives g/l	Gasoline consumption 10^3 t	Pb emission t
Albania	0.40	270	110
Austria	0.40	2 405	970
Belgium	0.40	2 501	1 010
Bulgaria	0.40	1 800	730
Czechoslovakia	0.40	1 778	720
Denmark	0.15	1 513	230
Finland	0.30	1 504	460
France	0.40	17 776	7 180
FRG	0.15	23 430	3 550
GDR	0.40	3 438	1 390
Greece	0.40	1 736	700
Hungary	0.40	1 271	510
Iceland	0.40	99	40
Ireland	0.40	841	340
Italy	0.40	11 103	4 490
Luxemburg	0.40	303	120
Netherlands	0.40	3 389	1 370
Norway	0.15	1 565	240
Poland	0.40	2 981	1 200
Portugal	0.40	854	350
Romania	0.40	2 186	880
Spain	0.40	5 894	2 380
Sweden	0.15	3 750	570
Switzerland	0.15	3 026	460
UK	0.40	20 403	8 240
USSR-Europe	0.40	60 500	24 440
Yugoslovakia	0.40	3 295	1 330
Total		179 611	64 010

Notes

- 1 The density of gasoline consumed is 0.74 kg/l.
- 2 Approximately 75% of the lead contained in the gasoline burned is emitted directly to the atmosphere.
- 3 About 89% of gasoline in the Soviet Union is used in the European part of the country.
- 4 The Pb emissions during the handling of gasoline are insignificant (ca. 0.5% of the total Pb emissions from gasoline combustion).

Table 2: Lead emissions in Europe in 1985 (in t/y).

Country	Gasoline consumption	Emissions from other sources (accepted as in 1982)	Total
Albania	110	40	150
Austria	970	160	1 130
Belgium	1 010	1 020	2 030
Bulgaria	730	860	1 590
Czechoslovakia	720	450	1 170
Denmark	230	70	300
Finland	460	470	930
France	7 180	1 430	8 610
FRG	3 550	2 120	5 670
GDR	1 390	480	1 870
Greece	700	90	790
Hungary	510	160	670
Iceland	40	-	40
Ireland	340	50	390
Italy	4 490	1 000	5 490
Luxemburg	120	40	160
Netherlands	1 370	510	1 880
Norway	240	220	460
Poland	1 200	1 800	3 000
Portugal	350	40	390
Romania	880	540	1 420
Spain	2 380	1 240	3 620
Sweden	570	530	1 100
Switzerland	460	20	480
UK	8 240	1 100	9 340
USSR-Europe	24 440	6 060	30 500
Yugosllovakia	1 330	1 010	2 340
Total	64 010	21 510	85 520

Notes:

"Other sources" include: the production of ferrous and non-ferrous metals, the combustion of fossil fuels including fuel-wood and wastes, and the production of cement.

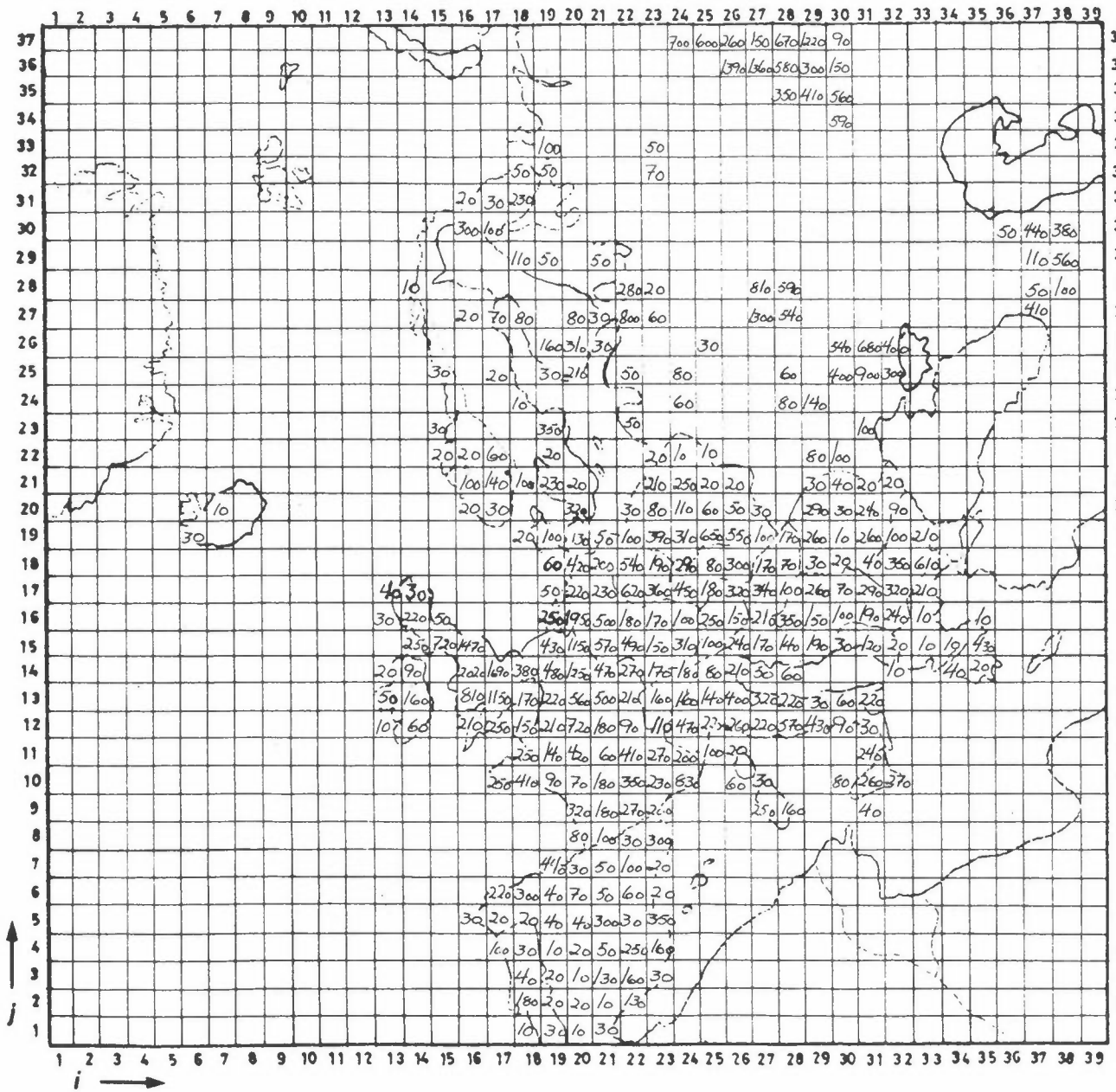


Figure 1: Spatial distribution of the Pb emission in Europe (in t/y) within the EMEP grid of 150 km x 150 km.

