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ASSESSMENT OF THE EMISSIONS OF POLYCHLORINATED BIPHENYLS IN BULGARIA

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ABSTRACT

A comparison of polychlorinated biphenyls (PCBs) emissions in Bulgaria within the period 1990 – 2004 is done. The trends in the different emission categories for 2004 are studied.

For the calculation of the PCBs emissions a methodology approved by the Ministry of Environment and Water of Bulgaria (article 25, paragraph 6 from the Clean Air Act) was applied. The methodology was developed according to the CORINAIR-94, SNAP-94 manual, adjusted to the conditions of Bulgaria.

Keywords: polychlorinated biphenyls, emissions, emission categories.

INTRODUCTION

The Stockholm convention on Persistent Organic Pollutants (POPs) is accepted and opened for signing in Stockholm, Sweden, in 22-23th May, 2001. The Republic of Bulgaria signed this convention on 23th May, 2001. On the 30th September 2004 the convention was ratified with by an act of the National Assembly law and was effective in Bulgaria since 20th March, 2005. The aim of the convention is to protect the human health and the environment from the POPs. In order to be assessed the available capacity worldwide and the necessity of building up equipment for POPs analysis in the developing countries, the Global Environment Facility (GEF) together with several donor countries approved the project of the Environment Programme (UNEP Chemicals). This global project for developing "National plans on persistent organic pollutants management" started at the end of 2002. Bulgaria is one of the 12 countries included in it . One of the first steps in developing such plans is making an inventory of some POPs like aldrin, dieldrin, DDT, dioxins, endrin, mirex, polychlorinated biphenyls, toxaphen, furans, hexachlorbenzene, heptachlor and chlordane [1-5].

The aim of the inventory presented in this paper is to study the PCBs emissions trends in Bulgaria for the period 1990 – 2004, as well as to determine the contribution to the air pollution of the industrial processes from each production category in 2004.

METHODOLOGY

The Stockholm Convention calls upon governments to report regularly on effort to implement the treaty and the Conference of the Parties will evaluate the effectiveness of the measures undertaken. Governments are encouraged to undertake research on POPs, monitor health effects, and exchange information [6].

In Bulgaria there is no monitoring system for measurement the PCBs concentrations. To calculate the emissions a methodology approved by the Ministry of Environment and Water of Bulgaria (article 25, para-

graph 6 from the Clean Air Act) is applied. Our methodology is developed according to the CORINAIR-94, SNAP-94 manual and is adjusted to the conditions of Bulgaria. The national specifics concerning the activities, technologies, equipment and row material used as well as the operative atmospheric air legislation are taken into consideration in the methodology. In the CORINAIR-94, SNAP-94 manual the pollutants are divided in three groups. The third group includes the persistent organic pollutants. The PCBs emissions are calculated according to the following equation [7]:

$$E = EF \times Q \quad (1)$$

where: E - the PCBs emissions expressed in a corresponding quantity;
EF - the emission factor - the emission referred to unit of quantitative characteristics of a given industrial activity;
Q - quantitative characteristic.

In the inventory done the emission quantities of PCBs are calculated on the base of emission factors that correspond to the level of the technologies through the relevant years.

RESULTS AND DISCUSSION

In Fig. 1 are shown the emission quantities of polychlorinated biphenyls for the years 1990 and 1995-2004. As it is seen, except 1995 when the concentrations are 382.3 kg y^{-1}, the emitted quantities through the years until 2001 are similar - from 261.7 kg y^{-1} in 1996 to 211.7 kg y^{-1} in 2001.

The alteration trend of the emitted quantities through these years is descending except 1998 when the emission level grows with 11.9 % compared to the previous year. In 2002 a light growing trend of the emitted PCBs starts, which keeps so till the end of the period in hand (2004). The emissions in 2003 are by 4.2 % higher compared to 2002 and the 2004 emissions growth towards the previous year is 3.7 %.

The percentage share of PCBs emissions by production categories in 2004 are visualized in Fig. 2. The data show that in 2004 the production sectors with highest quantities of PCBs emitted in Bulgaria are "Combustion in commercial, institutions, residential and agricultural sectors" - 63.8 % of the total year emissions of the country, "Combustion in energy production and transfer" - 16.7 % and "Road transport" - 15.6 %. That is why it could be considered that just the process emissions from these groups of the production sectors define the trends of the PCBs emissions through the years. Since through the last three years (2002-2004) the trends are ascending, for this period it is studied the trend in the biggest three emission categories (Fig. 3).

The data analysis shows the following:

• In the production sector "Combustion in commercial, institutions, residential and agricultural sectors" the 2003 emissions are by 5 % higher compared to those in 2002, and the raise in the 2004 emissions is by 4.9 % compared to 2003. The raise of the emitted quantities is mainly due to the heating installations in the domestic sector which are the source of nearly 100 % of the emissions.

• In the production sector "Combustion in energy production and transfer" in 2003 are emitted 6.81

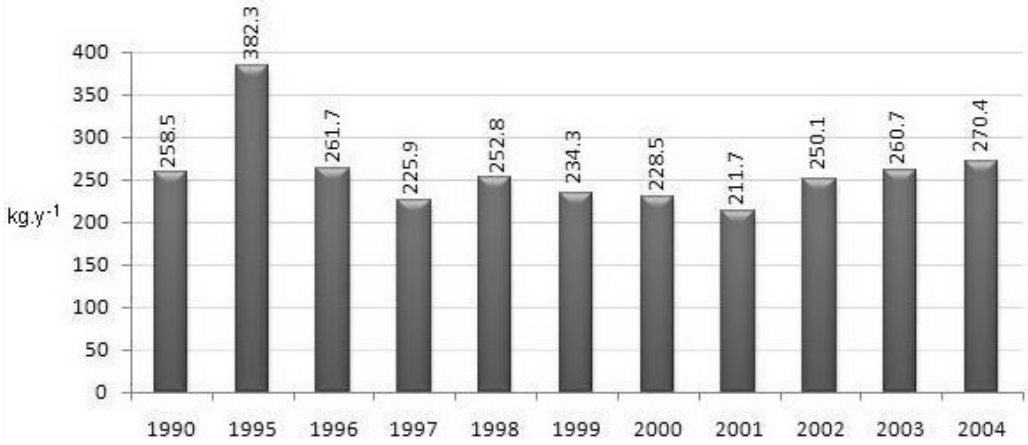

Fig. 1. Emissions of polychlorinated biphenyls by years.

Table 1. PCBs emissions from the category "Combustion in commercial, institutions, residential and agricultural sectors".

Sources from the production category	Emitted quantities of PCBs for 2004	
	$kg.y^{-1}$	%
Thermal power plants in commercial and institutions	0.034	0.02
Thermal power plants in residential	0.005	0.003
Household heating installations	172.59	99.977
Total	172.629	100

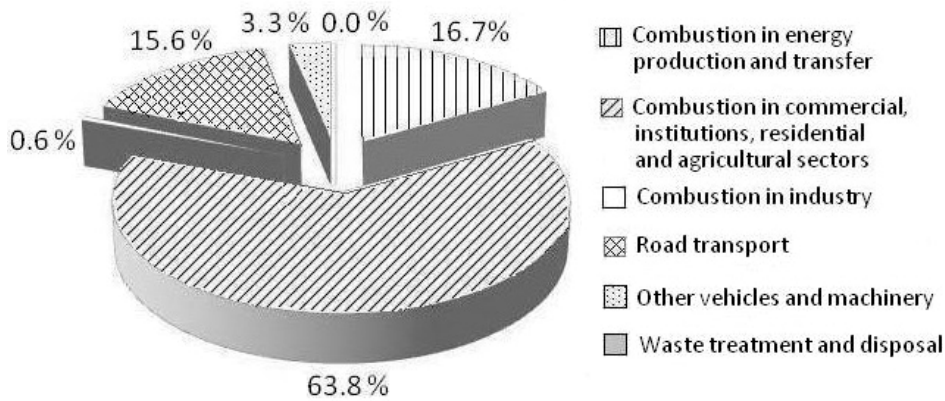

Fig. 2. Percentage share of the PCBs emissions by production categories in 2004.

kg more compared to the previous year which equals to growth of 17.3 %. There is a slight decrease of the emissions in 2004 by 2.3 %.

• The data on the production sector "Road transport" for 2003 and 2004 show that the one year emissions growth is by 13.6 %.

Three production sectors which are sources of most PCBs emissions for the last three years keep the ascending trend of the total PCBs emission for the same years as illustrated in Fig.3.

The other production sectors, emitted PCBs in 2004, are as follows: "Other vehicles and machinery"- 3.27 %, "Combustion in industry"- 0.64 %, "Waste treatment and disposal"- 0.01 %.

Data in Table 1 present the emissions of PCBs from the category "Combustion in commercial, institutions, residential and agricultural sectors". The biggest share from the emissions is due to the household heating installations, which constitute 99.98 % from the overall emissions in this category.

Table 2 presents the data for the PCBs emissions in the sector "Combustion in energy production and transfer". The highest contribution belongs to the Thermal Power Plants (TPP) with power of 100 to 300 MW

Table 2. Emitted quantities and percentage share of PCBs emissions from the production category for "Combustion in energy production and transfer" in 2004.

Sources from the production category	Emitted quantities of PCBs for 2004	
	$kg.y^{-1}$	%
Thermal power plants = 300 MW	11.664	25.86
Thermal power plants = 100 < 300 MW	30.903	68.53
Central heating plants = 100 < 300 MW	0.286	0.63
Central heating plants = 50 < 300 MW	2.019	4.48
Central heating plants < 50 MW	0.026	0.06
Thermal plants in petroleum industry = 100 < 300 MW	0.160	0.08
Thermal plants in petroleum industry < 50 MW	0.001	0.002
Crude oil heating	0.035	0.36
Total	45.094	100.00

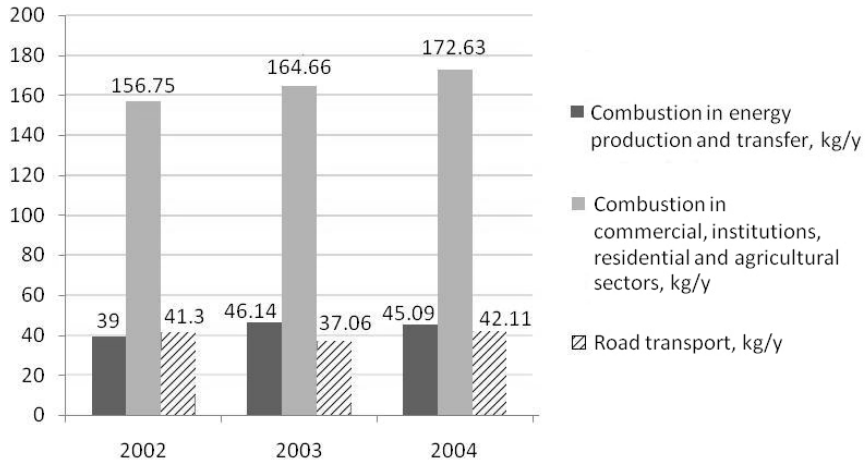

Fig. 3. Comparison of the PCBs emissions from production categories, which are the biggest sources in 2002-2004.

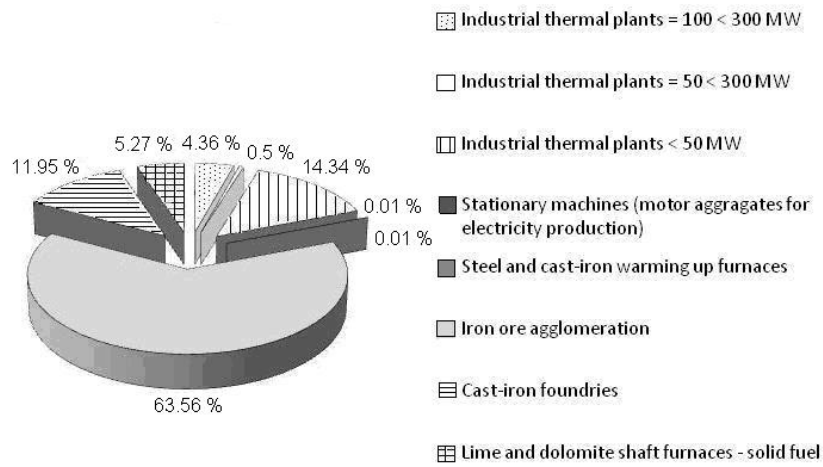

Fig. 4. Percentage share of the PCBs emissions in the air from the category "Combustion in industry".

(68.53 %). On the second place with 25.86 % are the emissions from TPP with power of 300 MW and on the third place with share of 4.48 % are the emissions due to Central Heating Plants (CHP) with power of 50 to 300 MW. The remaining 1.13 % are distributed to: TPP with power of 100 to 300 MW (0.63 %), CHP with power of less than 50 MW (0.06 %), Thermal plants in petroleum industry with power of 100 to 300 MW (0.08 %), Thermal plants in petroleum industry with power of less than 50 MW (0.002 %) and crude oil heating (0.36 %).

Fig. 4 shows the percentage share of the emitted PCBs quantities from the production category for "Combustion in industry" in 2004. 63.56 % of the emissions in this category come from iron-ore agglomeration, 14.34 % of the emissions are due to the thermal stations with power of less than 50 MW. The cast-iron foundries are the source of 11.95 % of the PCBs emissions. The next ones are the lime and dolomite shaft furnaces with 5.27 % of the total, the industry thermal stations with power of 100 to 300 MW - 4.36 %, the industry thermal stations with power of 50 to 300 MW - 0.5 %, stationary machinery (motor aggregates for electricity production) and the furnaces for warming up steel and cast-iron - 0.01 %.

CONCLUSIONS

During the period under study (1990-2001, except 1995), the quantities of the different emitted polychlorinated biphenyls are very close as there are some slight deviations registered through the years - both ascending and descending.

In the production category "Combustion in commercial, institutions, residential and agricultural sectors" the growth of 7.99 kg (4.9%) in 2004 compared to the previous year is mainly due to the increased air pollution from the residential heating systems.

In the production category "Combustion in energy production and transfer" more than 68.53 % of the emissions are due to the thermal-electrical stations with power of 100 to 300 MW and 25.86 % are emitted from thermal-electrical stations with power of 300 MW.

In the production category "Combustion in industry" the biggest source of PCBs emissions is the iron-ore agglomeration.

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