OPEN BURNING OF WASTES AT LANDFILLS AS SOURCE OF DIOXINS

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Abstract

Releases of Dioxins/Furans (PCDD/PCDF) in case of low-temperature open waste burning at dumps pose a threat for population of Armenia, as periodically occurring spontaneous waste ignition and smoldering result in PCDD/PCDF releases. The study was performed to assess PCDD/PCDF releases into air, water, soil and residues with the use of UNEPToolkit proposed coefficients of toxic equivalent (TEQ): 300 mcg TEQ/ton for air and 600 mcg TEQ/ton for residue and soil. Monitoring study revealed that open burning of wastes caused PCDD/PCDF releases of 0.3 g TEQ/year (to air) and 0.6 g TEQ/year (to residue and soil). The population of Armenia used to dispose domestic and sometimes non-toxic industrial waste to open-air dumps (iron boxes) in yards/streets. As a rule, such places were located near plants and animals and not always at the leeward side of the inhabited massif. For elimination the waste was exposed to open-air burning that had random character. Burnt waste (ash, noncombustible components of refuse) was actually thrown to the surface. Therefore, in case of uncontrolled waste burning citizens were exposed to potential threat of toxic exposure, smoke and oppressive smells.

Introduction

Dumps are considered to be areas with visual (evident) pollution and, thus, present threat for human and environmental health. Solutions (filtrates) are released from the area of dumps polluting ground waters and soils of surrounding lands.

During a period of time some part of population of the Republic of Armenia for reasons of convenience or due to local customs, eliminated domestic, in-yard, and sometimes even non-toxic industrial wastes to open-air landfills, open iron boxes or waste dumps in yards and streets where rubbish is heaped and then burnt in order to dispose. This is still observed especially in location void of attention of local authorities. Waste burning bears discretionary character.

In case of open waste burning population is exposed to oppressive, heavy smells and there is a potential hazard of toxic exposure as open waste burning is always accompanied by smoke and persistent foul smell. In fact, burnt wastes (ashes, noncombustible components of refuse) are spread over the soil surface. As a rule, sites of open waste burning are localized in the vicinity of plants and animals and not always at the leeward side of the inhabited massif.

The content of waste to be burnt depends on housekeeping (urban or rural type). Usually, such wastes are composed of in-yard sweepings, plastics, glass, ceramics, clothing, leather, packaging of soft drinks, tin and aluminum cans, paper, cardboard, polymer composites of packing material of domestic appliances, aerosol containers, organic substances, such as food remains, safe wastes from shops, canteens, etc., debris of construction wastes , cleansing/washing detergents, paints and dies, solvents, organic and inorganic chlorine-containing compounds (e.g. polyvinyl chloride).

Material and Methods

Our study revealed that at the territory of the Republic of Armenia there function 474 dumps of domestic wastes. Solid domestic waste dumps function in 46 of 53 inhabited settlements. Forty-four of these dumps mismatch to appropriate Sanitary Hygienic Requirements. In 892 rural settlements, there are 448 dumps, of which 377 do not correspond to the requirements of sanitary hygienic safety.

The study involved 22 waste dumps of rural settlements and towns. Thirteen dumps were chosen for sampling. When choosing, the peculiarities of inhabited area were taken into consideration; this latter conditioned the type of domestic wastes and the degree of pollution.

For laboratory analyses, samples were taken from the chosen dumps of domestic wastes. Sampling was performed at the dumps and adjoining area from the surface soil layer at the depth of 15 cm.

The quantitative evaluation of Dioxins/Furans emissions in the Republic of Armenia was done by calculation according to Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases" prepared by UNEP Chemicals[1]. Additionally Dioxin Emission factors proposed by IPEN were also used for comparison and interpretation of data obtained[2].

Results and Discussion

Waste dumps are located at a distance varying from some few to 15-20 km. Natural cavities also serve as dumps. The dumps are not surrounded by fences (there are no preventive sanitary hygienic zones); waste dumps are covered by soil.

Unlike rural dumps, at the urban/town dumps there prevail articles ("goods") of polymer synthetic materials, rubber or containers/packages made of various materials, as well as other types of goods. Collection and transportation of industrial wastes is non-regulated in Armenia. As a result, very frequently the industrial wastes are spontaneously piled at the domestic waste-dumps and at the adjoining area.

In the majority of cases wastes are burnt at the dumps at comparatively low temperature; this latter stimulates environmental pollution, resulting from persistent organic pollutants, dioxins, furans, polychlorinated biphenyls, etc.

The study revealed that empty containers of organochlorine pesticides and packaging materials of domestic chemical goods also cumulate at the dumps.

The research findings indicate that non-controlled open-air burning of wastes occurs at almost all dump-sites of Armenia annually; only minor part (10 % and lesser) remains. Some part of generated waste was treated and destructed at the premises of industrial entities by intended open-air burning of piled domestic and other types of wastes.

Based on data for 1999-2004 we used the proposed method applying:

- UNEP Toolkit coefficients: 100 mcg TEQ/ton for air (1) and
- coefficients proposed by Par Costner: 34.5 mcg TEQ/ton for air and 145 mcg TEQ/ton for soil (3)

to calculate the emissions of dioxins to air and their discharge to soils as a result of waste burning/ignition at dumps (Table 2 and Figure 1).

As 86-96 % of wastes exposed to open burning "belongs" to Yerevan, the capital of Armenia, greater part of PCDD/PCDF generation and emissions also occurs here. Dioxins emissions to atmosphere and discharge to soil were calculated for Yerevan landfill, moreover that up to 435 of in-country wastes cumulates here and 86-96% of wastes exposed to open burning also belongs to Yerevan (Table 2; Figure 2).

Table 1. Uncontrolled burning of domestic wastes in the Republic of Armenia, *ton*

Year	Waste burning	Emission, *mg TEQ/year*		
		Air	Soil	Residue
2000	72244.3	21673.29	43346.58	43346.58
2001	1391.4	417.42	834.84	834.84
2002	873.8	262.14	524.28	524.28
2003	330.6	99.18	198.36	198.36
2004	1000.8	300.24	600.48	600.48
Incl. Yerevan				
2000	72181.7	21654.51	43309.02	43309.02
2001	1293.0	368.790	737.580	737.580
2002	811.0	243.30	486.60	486.60
2003	284.0	85.20	170.40	170.40
2004	963.2	288.96	577.92	577.92

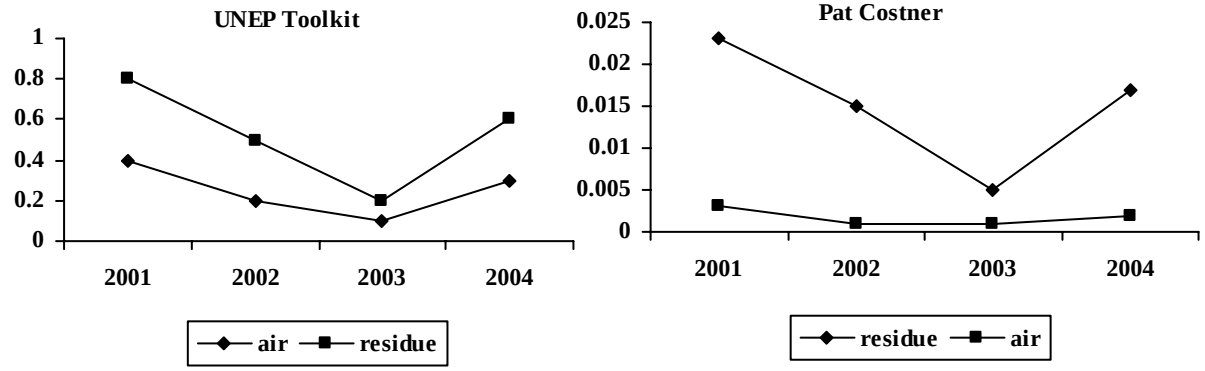

Figure 1. Dioxins emissions into air and residues as a result of open burning of domestic wastes (*g TEQ/year*).

Conclusion

In Armenia, there is no plant for domestic wastes processing. Therefore, such wastes cumulate at the dumps. Despite the fact that special areas are allotted for dumps in rural inhabited locality, the wastes cumulate in different places; very frequently it occurs along the banks of the rivers and rivulets. The definite part of wastes from the dumps is then spread in the vicinity and on the roads to the dumps. During the last 3 years, the amounts of domestic wastes vary within the range of 1800-2200 thousand cubic meters, the main part of which make wastes generated in Yerevan.

Table 2. Dioxins emissions to atmosphere and soil as a result of open dump fires, Yerevan

Index	Quantity			
	2001	2002	2003	2004
Amounts of wastes disposed at dumps of Armenia, *tons*	2756.2	30583.7	42893.3	1762303.7
incl. Yerevan dump-site (*ton)* .	1148	1244	1380	3770
Emissions of Dioxins to air (*g TEQ/year*)				
a) according to UNEP Toolkit	1.148	1.244	1.38	3.77
b) according to Pat Costner	0.040	0.043	0.048	0.13
Dioxins discharge into soil (*g TEQ/year)*				
a) according to UNEP Toolkit	No coefficients determined			
b) according to Pat Costner	0.166	0.18	0.20	0.546

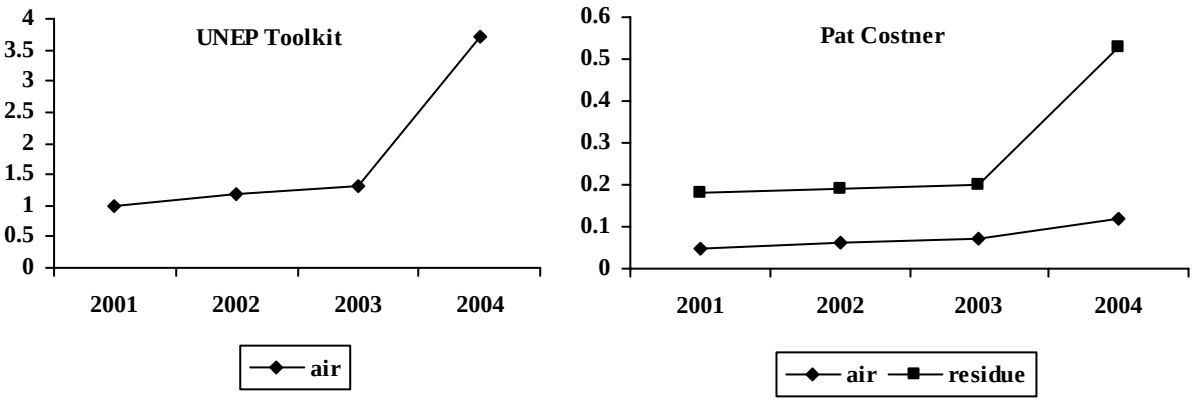

Figure 2. Dioxins emission to air and soil as a result of fires at dumps, *g TEQ/year* .

The study demonstrated that wastes cumulated at the dumps are of various types. In wastes of rural settlements, there was prevalence of wastes originating from cattle-breeding farms and wastes generated at construction sites. The following conclusions might be drawn in concern of town and village dumps. The activity on collection, transportation, processing, treatment, disposal of industrial and domestic wastes is performed insufficiently. No technologies are applied on wastes recycling. The state of domestic waste sites is unsatisfactory. Toxic and hazardous wastes management is not satisfactory.

At towns and rural settlements, the following tasks are considered of first priority:

- enhancement of the activity on wastes collection, transportation, processing, treatment and disposal of wastes; improvement of the sanitary state of functioning dumps,
- implementation of modern technologies on wastes processing/recycling.

References

1. Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases. UNEP Chemicals. Geneva, Switzerland. 2001. 180p.
2. Costner Pat. Estimating Releases and Prioritizing Sources in the Context of the Stockholm Convention. Dioxin Emission factors for Forest Fires, Grassland and Moor Fires, Open Burning of Agricultural Residues, Open Burning of domestic Waste, landfill and Dump Fires. International POPs Elimination project – IPEP. Mexico. December 2005. 40p.