Conacyt-Semarnat Project (2002-C01-0463): Evaluation of the Presence of Persistent Organic Pollutants (POP's: DIOXINS [PCDD] and FURANS [PCDF]) in Mexican Lacustrine Ecosystems (Dam included); (in progress).

Zarate del Valle Pedro F.[1], Deysi J. Venegas Garcia[1], Carmen A. Barajas Martinez[1]

[1]Universidad De Guadalajara

INTRODUCTION

Mexico belongs to the environmental region named "North America" (2nd region of UNEP: Environmental Program of the United Nations) that also includes Canada and the United States of America . Mexico lags behind in the study of pollution by POPs. POPs are organic halogenated compounds that resist photolytic, biological and chemical degradation; also they are characterized by both low hydrosolubility and high liposolubility, which facilitates their bioaccumulation. High POPs concentrations provoke harmful effects in the reproduction, development and immunological function of organisms.

POPs or “dirty dozen" considered by the Convention of Stockholm are:

- Pesticides (9): Aldrin, Dieldrin, Endrin, Chlordane, Heptachlor, Dichlorodiphenyl-trichloroethane (DDT), Toxaphene, Mirex and Hexachlorobenzene (HCB);
- Manufactured compounds (1): Polychlorinated biphenyls (PCBs);
- Non Intentional by-products (2): Polychlorinated dibenzo-dioxins (dioxins or PCDD) and polychlorinated dibenzo-furans (furans or PCDF)**.**

Because of their semivolatility and repetitive processes of suspension-transport-deposition ("grasshopper effect"), POPs can travel long distances in troposphere (1,500 m - 12,000 m), having being detected in the ice of the poles. These substances evaporate in regions with high temperatures and deposit in regions with low temperatures.

GOAL.

The major goal of the project is the chemical (GC-HRMS) and radiometric (^{137}Cs & ^{210}Pb) research of sediments of two Mexican sites capable of registering the historical pollution by POPs, particularly dioxins and furans.

METHODS.

The methodology applied during the first stage of our project to select the sites of deposit of dioxin and furans. The major components that are considered of the environmental problem in Mexico concerning POP’s are organized in a data bank: emission factors[1], release vectors (Mexican wind vectors and watersheds) and sites of deposit (lakes and dams) which are included in a Geographic Information System (GIS).

DISCUSSION.

POPs Emission Factors (EFs).

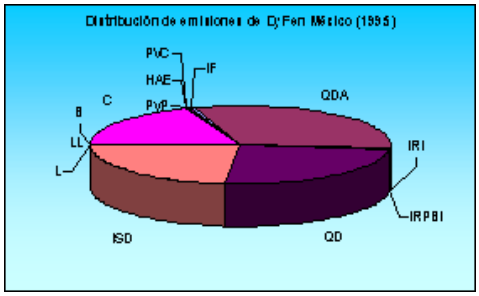
The following EFs[1] are included: a) generation of energy, foundries, combustion in cement kilns; b) production of: asphalt, glass windows, paper mills, petrochemicals; c) zones sprayed with pesticides; d) incineration of: hospital residues, dangerous residues and domestic tailing; e) smelting of secondary steel; f) production of copper and secondary aluminium; g) extraction of magnesium; h) production of chlorine; i) plants of flesh and paper whitened based on chlorine; j) production of vinyl chloride and PVC; k) agricultural burning areas, and l) forest fires.

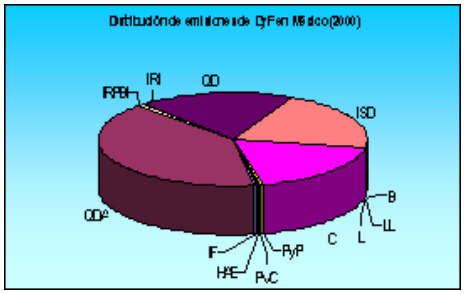
During years 1995 and 2000[2] the release rates[1,3,4] as annual mass flow rates of PCDD/PCDF for major EFs are shown in Table 1 and Pie diagram 1. The major EF was the burning area with agricultural purposes (QDA; Table 1; Pie diagram 1 & Figure 1).

ACRO-NYMS	EMISSION FACTORS	1995 (mg TEQ y^{-1})	2000 (mg TEQ y^{-1})
IF	Forest fires	3.545	1.853
QDA	Burning area with agricultural purposes	221.830	221.830
ADOIRPBI	Incinerators of hospital residues	3.103	5.271
IRI	Incineration of dangerous residues	0.015	0.840
QD	Incineration of domestic tailing	177.134	103.774
ISD	Fires in sites of disposition	166.505	115.473
B	Burning biogas	0.091	0.091
LL	Rims	0.058	0.058
L	Brickyards	0.460	0.460
C	Cement	132.100	102.500
PyP	Plants of flesh and paper whitened based on chlorine	0.576	0.774
PVC	Production of chloride of vinyl chloride and PVC	1.908	2.428
HAE	Ovens, electrical arc	0.697	0.805

Table 1.

Release rates of PCDD&PCDF, mg Toxic Equivalents by year (TEQ y^{-1}) during years 1995 and 2000[2].





Pie diagram 1.

Distribution by EFs of PCDD/PCDF release during years 1995 and 2000[2]. For acronyms identification see Table 1.

Fig. 1.

Annual burning areas for agricultural purposes (QDA in Table 1 and Pies diagram 1). Green sectors: burning during March; green squares: burning during April; blue squares: burning during May; violet vertical lines burning during June (Tabasco State); Black boundary sectors: burning during July[5].

Release Vector.

We are considering basically two kind of release vectors: wind vector and water vector.

Wind Vector: In Mexico[6] during approximately 8 months of the year the predominant direction of the wind in the troposphere is Northeast and in the remaining months it is inverted going to the South-west (Fig. 1).

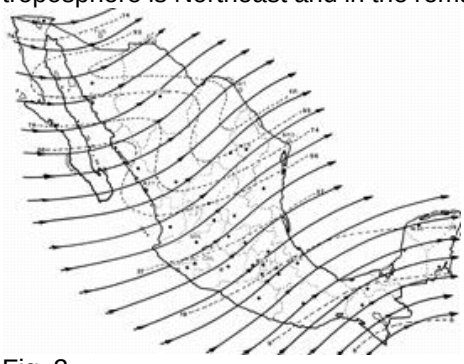


Fig. 2.

Wind vector (solid lines) in mexican troposphere during April[6]. Isotaches (dot lines) are in km/hr.

Water vector: Mexico has been divided in 37 watersheds by National Water Commission[7]. Because the major EFs are located in Central Mexico, the watershed to be selected must be located in Northern or Southern Mexico and must be characterized by the absence of EF aged of 30-40 years.

RESULTS

Sites of Deposit (Sinks): Sinks represent the long term storage and isolation of dioxin in undisturbed soil and sediment[8]. One site to be chosen will be located in the domineering directions of the wind in Mexico to track the airborne transport of dioxin vapor and dioxin contaminated particles. Preliminarily, this selected site is: Marte R. Gómez dam (18, Fig. 3). The other site to be chosen (lake or dam) will be located in a watershed with a minimum presence of EF to track the water transport of dioxin contaminated suspended particles.

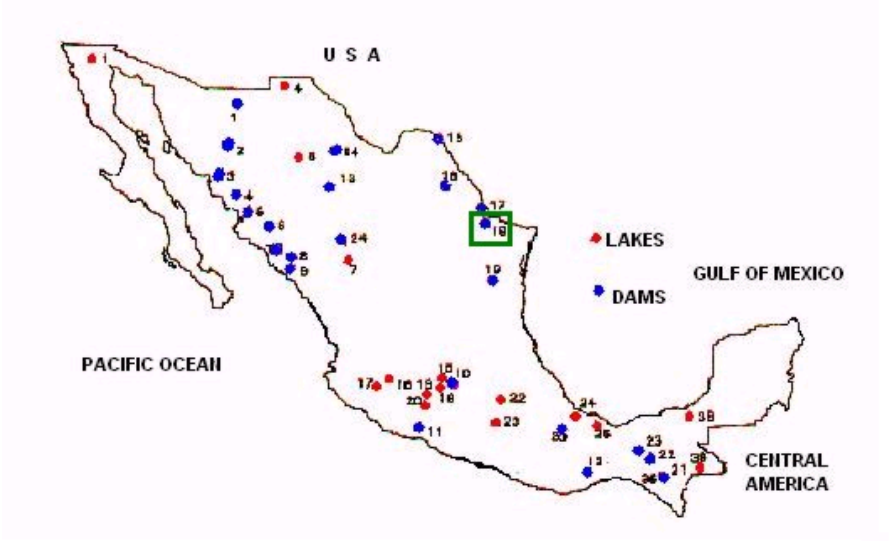


Fig. 3.

Principal lakes and dams in Mexico; green square shows the location of Marte R. Gómez dam[9].

CONCLUSIONS

Our conclusions from the data presented are:

(1) Mexico has an incipient research on historical record of dioxin and furan pollution.

(2) The major dioxin and furan emission factors to be considered in Mexico are: the burning for agricultural purposes; incineration of domestic tailings; fires in disposal sites and combustion in cement kilns.

(3) In Mexico the major release vectors for PCDD and PCDF are wind and water.

ACKNOWLEDGEMENT

The authors are deeply grateful to Metereology and Astronomy Institute of Universidad de Guadalajara, National Ecological Institute (INE) and Lerma-Santiago-Pacífico Management (CNA) authorities by have let us the access to unpublished reports. Also we are grateful to both Universidad de Guadalajara authorities and Conacyt-Semarnat Environmental Research Fund to facilitate our participation in the 25th International Symposium on Halogenated Environmental Organic Pollutants and POPs.

REFERENCES

1) UNEP. (United Nations Environment Program). 2003. Standardized Toolkit for Identification and Quantification of Dioxin and Furans Releases. UNEP Chemicals, Geneva, Switzerland.

2) García Gutiérrez A., Rosas Domínguez A., Velasco Saldaña HE, Gómez Perales J and Ramos Rodríguez GG. 2001. Informe de la situación y los conocimientos actuales sobre las principales fuentes y emisiones de dioxinas en México. National Center of Environmental Research and Training, Metropolitan Autonomous University (UAM), Iztapalapa campus. México, D.F. México. 2nd., unpublished report.

3) MCTMA (Science, Technology and Environment Ministery). 2000. Inventario Nacional de fuentes y liberaciones de dioxinas y furanos. Cuba

4) SMA (Secretary of Environment). 2002. Inventario Nacional de fuentes y liberaciones de dioxinas y furanos. Paraguay.

5) SEMARNAT (Secretary of Environment and Natural Resources) 2003. Site web : http://infoteca.semarnat.gob.mx/Website/Calendariodequemas/viewer.htm (visited April 12, 2004).

6) CPUJS (Civil Protection Unit of Jalisco State). 1985. Map for month of April of analysis of superior winds (whole troposphere). Unpublished report.

7) CNA (National Water Comission). 2004. Estadísticas del agua en México. 2004 ed.

8) USEPA (U. S. Environmental Protection Agency). 2004. Dioxin Exposure Initative. Site web: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=15239 (visited March 2004).

9) INEGI (National Institute of Statistics, Geography and Data System), 2005. Site web: www.inegi.gob.mx (visited April 8, 2005).