EVALUATION OF THE EFFECT OF SOLID WASTE BURNING AT MOULAY ISMAIL HOSPITAL OF MEKNES CITY ON THE SOIL

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Abstract

The management of the hospital waste constitutes one of the main challenges with which our societies are confronted; but unfortunately, only few researches has been conducted with regards to the management of hospital waste. Most establishments of health especially in the private sector throw their waste in the garbage dumps, which can provoke the contamination of grounds and ground-water sheets. Thus, the sanitary establishments which make the treatment of their waste are rare. A more practiced treatment is the incineration process, of which the consequences are very fatal on the environment if it is made without appropriate filtering: discharge of smokes which is a toxic waste, if not polluting the atmosphere (US EPA: USA–.Environment Protection Agency, 2006).

This work is realized on the ground of the Moulay Ismail hospital in Meknes. Before 2006, the waste of this hospital was always treated in open-air burned. This practice which does not correspond to the international standards leads to the formation of the dioxins which are toxic matter, and are harmful to the human health and to the environment.

These substances constitute a group including 210 chlorinated tricyclic organic compounds which include dioxins (PCDDs [Polychlorinated dibenzodioxins] / PCDFs [Polychlorinated dibenzofurans]). Thus, we took

analyses of the ground of Moulay Ismail hospital in Meknes to look for these substances.
In this work, we made use of chromatography in gaseous phase connected to the mass spectrometry (GC/MS); it is the method of choice to identify and quantify PCDD / Fs to the state of tracks in the complex matrices (Eppe *et al*., 2006). Therefore, the dosage demonstrated the absence of any organic polluting substances.

Keywords: Hospital waste, Incineration, environment, Dioxins/Furans, GC/MS

Introduction

The World Health Organization (WHO) (OMS, 2005a) considers that the waste of medical care is all the waste produced by the medical institutions (public or private sector), by a research establishment or a laboratory. The waste of medical care has a direct and indirect impact on the human health, as they have a direct impact on the environment, the fauna and the flora. In this frame, the WHO considers that more than 20 million of infections which include hepatitis B, hepatitis C and HIV were recorded every year due to the practice of reusing non-sterilized syringes and needles injections (OMS, 2005b).

Morocco instituted law number 28-00 relating to the management of waste and their elimination promulgated in 2006 (Bulletin officiel [BO], 2006). However, the classification and fixing of the list of the dangerous waste on one hand and management of the medical and pharmaceutical waste on the other hand would be respectively governed by the decree number 2-07-253 of July 18th, 2008 (BO, 2008) and the decree number 2-09-139 of May 21st, 2009 (BO, 2009).

Besides the absence of technical resources, the insufficiency of the necessary funds and the lack of sensitization in most of the developing countries represent the major obstacles to the realization and execution of a global regulation plan on the subject (Nations Unies [NU], 2011).

Thus, all of these led the Moulay Ismail hospital to burn its medical waste in open-air, before 2006. This type of practice could engender a release of harmful gases, of which the most dangerous is PSDDs/Fs. These substances can accumulate in the food chain and have a toxic effect (OMS In Visez, 2005). They are classified among the persistent organic pollutants (POP) because they are not biodegradable. (PNUE [=UNEP : United Nations Environment Programme], 2001; UNEP et OMS, 2005; UNEP, 2005). Dioxins damage the air quality; moreover, the rejection of these toxic substances in the air means that they can be transported through a very long distances. So they arrive at the level of soils via precipitation, and could

contaminate human beings through the food chain (CEAEQ [Centre d'expertise en analyse environnementale du Québec], 2006).

Morocco signed the convention of Stockholm in 2003 and ratified it in 2004. So, it made a commitment to reduce emissions of dioxins and furans. 3,9 % of these emissions were caused by the incineration of waste (Ministre de l'Aménagement du Territoire, de l'Eau et de l'Environnement [MATEE] et Programme des Nations Unies pour le Développement [PNUD], 2005).

Dioxins are very persistent in soil (about 10 years for 2, 3, 7, 8 – TCDD) and concentrate in 10 cm situated under the surface. Indeed, their vertical migration is very weak (Eppe *et al*., 2006).

This objective of this study is to assess the rate of organic pollution of the ground which is caused by the treatment of hospital waste by open-air burning.

Experimental details

We worked on the ground of Moulay Ismail hospital in Meknes (Figure 1), more exactly the place where the open-air singeing was made, to look at this level for polluting substances such as organic toxic substances, dioxins and furans.

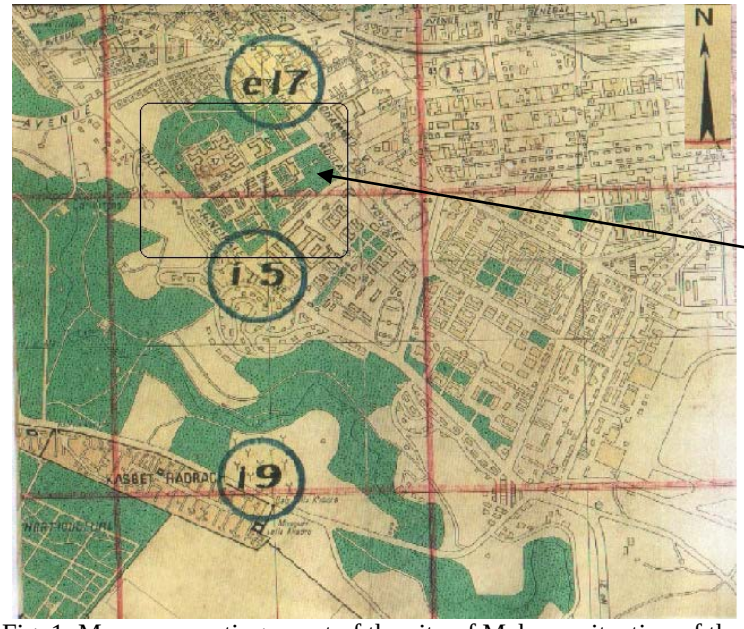

Fig. 1: Map representing a part of the city of Meknes: situation of the Moulay Ismail hospital

We made a composite sampling and we took the sample (300 grams) at the level of the layer of the ground going from 0 to 10 cm (CEAEQ,

2010a); by scraping, eliminating the elements of the surface and discarding any foreign objects.

Sub-samples were blended and preserved in a clear glassy bottle encircled with aluminum foil to shelter it from light (CEAEQ, 2010b). The PCDDs / PCDFs are organic micro pollutants, so we avoided the use of any plastic bottle (Jeannot *et al*., 2001).

Then, we preserved the sample in approximately 4 °C in a hermetic glass flask shielded from the light.

We proceeded to the sieving of the sample. The size grading is fixed at 2 mm (US EPA, 1997). The human or ecological receivers are exposed to a fine fraction (CEAEQ, 2010a); then we dried the product in a drying oven at a temperature of 40°C for three days. The rate of humidity of the sample is 20,74 %. After the sieving, we grind this sample finely to homogenize it.

There are several techniques of extraction. Hence, soxhlet extraction technique was used as a reference method for the extraction of numerous organic compounds (Calvet *et al*., 2005). The dry weight of the treated ground is 84,67 grams, and the toluene is the most effective solvent for the extraction of PCDD / PCDF, which are strongly adsorbed on the ground (Eppe *et al*., 2006). Furthermore, we allowed it to flow back during 18 hours and a half for total exhaustion of the sample (weight 2 = 68,21 g).

Other co-extracted organic compounds can interfere during the dosage of dioxins and furans; for this reason, it is necessary to eliminate them by purification. Thus, we subjected our extract to the rotary evaporator, then we treated the remainder by diverse solvents on patches of (TLC). It has been revealed that the trichlorométhane conveys fine substances contained in the extract, and so we subjected it afterward to the solution of a chromatography on column containing the silica gel by using this solvent as mobile phase. We collected the product on twenty test tubes of 10 mL each, which we subjected again to the TLC.

TLC allows the following classification to be made:

- 20 mL of fraction F_1 containing a chemical compound;
- 180 mL of fraction F2 devoid of any substance;

Only the fraction 1 was submitted again to the evaporation of the solvent and the final residue is analyzed by chromatography in gas phase coupled with the mass spectrometry. The equipment in CPG-SM is constituted by the gaseous chromatography “Thermo Trace GC Ultra and mass spectrometer “Thermo Polaris Q”. Hence, the analytical conditions are shown (Table 1) below:

Table 1 : Analytical Conditions

	Time of analysis	Injected Volume
Fraction 1	56.02 min	1 µl

Results and discussion

The analysis by GC-MS was realized at the Fes Regional University of Interface. The injected volume was 1,00 µl, and the operation lasted for 56.02 min. it showed a complete absence of the PCDD / PCDF, but on the other hand, our sample is rich in hydrocarbons (figure 2).

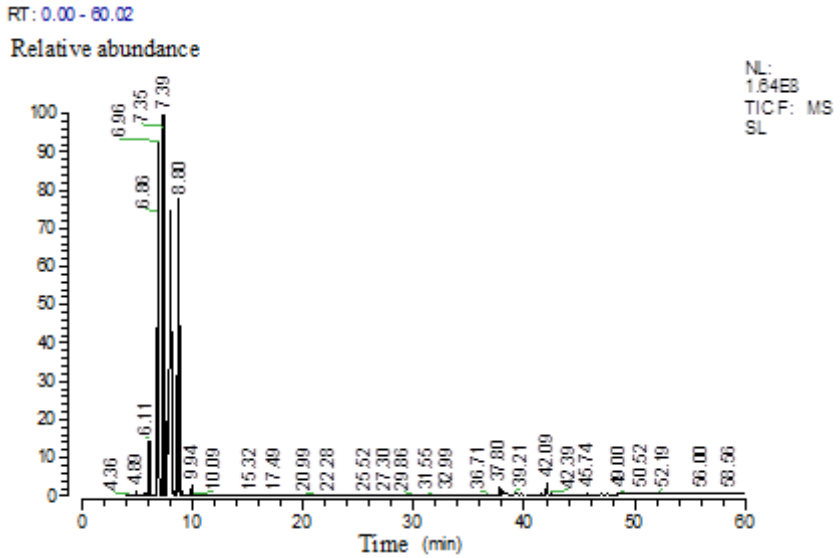

Fig. 2: Chromatogram of the sample of the soil (GC/MS)

The absence of the PCDD / PCDF could be interpreted in several ways, namely:

- Dioxins can be eliminated from the ground by plants (Blancato *et al*., 1994). According to certain authors, the transfer of the dioxins of the ground towards vegetables by root path seems very limited, apart from certain possible exceptions such as cucurbitaceae (Eppe *et al*., 2006). On our ground, we noticed the presence of certain herbaceous plants very close to our ground, if not on the ground itself; moreover, our sample was taken from a popular weeded zone of herbaceous plants ;
- In time, dioxins can form irreversible chemical links with the organic matter of the ground in a way that the analytical methods used at present are not able to detect them (Mc Lachlan *et al*., 1996). It seems that our ground is more or less rich in organic matter;
- The PCDD / PCDF is persistent in the environment and transfers can arise from the interaction between the circles, for example of the ground towards the water by flow. A lixiviation occurs when the rainwater has the

possibility to percolate through deposits of products badly conceived containing PCDD / PCDF, residues and\or waste. (PNUE, 2001) ;

However, the chromatographic column which served for purification purpose, and for lack of means, may not give satisfactory results. The purification aims at eliminating the interfering; the interfering most frequently met are the PCB, the PCB méthoxyled or hydroxyled, the PBDE, the chlorinated HAP as well as the chlorinated pesticides (Pichard *et al*., 2006). Therefore, none of these elements is present in our sample. Also, we added that the presence of small herbaceous plants on our ground could lead to herbicidal effects suppose that dioxins do not exist there any more, or if it exists only in a tiny quantity.

Conclusion

It should be noted that the absence of dioxins in our ground does not mean that our environment is healthy. All the conditions were favorable for the formation of this toxic matter in our environment. The atmosphere would be contaminated through smokes; which could be at the origin of the pollution of the other distant grounds. Therefore, the atmosphere is the main source of dioxins for grounds and the deposits are essentially made in the form of wet deposits (Schröder *et al*., 1997).

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