PCCD / Fs from incineration medical care waste in east Algeria

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Abstract: The incineration of waste from medical care waste , pharmaceutical and DASRI: (wastes infectious Risk Care Activities) is just beginning to develop in Algeria and the pollution by this toxic waste is caused by PCDD / F which must be monitored and quantified because these pollutants cause a great controversy on the treatment of our hospital waste by our incinerators. Knowing that Algeria does not have high-tech incinerators for the treatment of incineration gases and does not have much experience in this waste treatment technique.

This study presents firstly a qualitative and quantitative analysis of semi-volatile organic compounds (PCDD and PCDF), their concentrations were evaluated by monitoring the emissions of an industrial waste incinerator (Société ECFERAL). PCDD / F was collected by active sampling using an isokinetic sampler in the incinerator stack gas release. Following treatment A1, a high level was recorded for OCDD of 2,987 ng / m^3 of gaz emission DASRI .We have studied afterwards the exact location of PCDD / F formation in the incinerator, in order to better control technology, which led us to install another treatment(gas adsorption column)in parallel with the old, to reduce these pollutants at the exit of the chimney, there is had a decrease of more than 40%following treatment B2.

Keywords: Industrial waste incinerator (IWI), pharmaceutical wastes and DASRI: wastes infectious Risk Care Activities , Gas Chromatography/High Resolution Mass Spectrometry (HRGC/HRMS), volatile polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), incineration, toxic equivalent quantity (TEQ).

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1. Introduction

In the recent years, waste management in Algeria has become one of the major scientist and government concerns. According to the Ministry of Territorial Planning and Environment (MATE),

the total amount of industrial waste is 2.6 million tons per year, with 325,000 tons of hazardous waste. To these amounts is added to a stored volume of 4,500,000 tones (MATE report, 2003 [1]), and large quantities of persist pollutants (POPs), such as pesticides and other waste operators, are stored in the country and waiting for to be eliminated.

For the management of medical care waste, Algeria has opted for incinerators, knowing that they are very toxic and their incineration must be advanced and very monitored.

Medical waste may consist of infectious, radioactive, toxic substances from hospitals, laboratories and clinics, including sharp objects (syringes and needles), blood products, human tissues, body parts, pharmaceuticals, cytotoxins, in addition to the general purpose element such as paper, food, plastics, etc. According to the WHO (World Health Organization), waste produced by hospitals carries a higher potential for infections and injuries than any other type of waste [2]. Hospital waste is considered hazardous because it can have pathogens and can cause adverse effects on human health and the environment [3]. It is necessary that all medical waste be disposed of in a which is less harmful to human beings. Medical waste management is of high environmental priority in developing countries [2] because the mismanagement of these wastes causes environmental pollution and health problems in terms of the proliferation of diseases by viruses and micro-organisms, as well as the contamination of groundwater by non-medical waste treated in landfills [4].

Improper disposal of infectious waste can pose a significant threat to public health and the environment [5]. Careless disposal of some recovered and reused waste can lead to the induction of hepatitis B, hepatitis C, HIV and other possible infectious diseases for the exposed population [6].Of the main methods available for good medical waste management, the incineration and disposal of ashes resulting from land filling is the most widely used method [7]. The main advantages of incineration are the destruction of pathogens and the reduction of the volume and weight of waste [8].However, incineration produces residues that are enriched by toxic chemicals, such as heavy metals [9].

In this case, the continuous control of emissions from incinerators is necessary to assess the level of air pollutants, especially those well-known to be very dangerous, such as poly-chlorodibenzodioxins (PCCDs), dibenzofurans (PCBs), polychlorinated biphenyls, mono and poly-aromatic hydro-carbons [10,11].

Persistent organic pollutants, such as PCDDs and PCDFs, are known by their toxicity and properties in environmental media. They are emitted from combustion (water, soils, and sediments), and are transported to distant locations through atmospheric or aquatic pathways. However, they are also bioaccumulated through the food web, and pose a risk of causing harmful effects to human health [12- 15]. The food consumption is the most important way for human exposure to these contaminants. In addition to their presence in outdoor air, PCDD / Fs have been found in different indoor environments [16-18].

PCDD / Fs are formed by two main ways, such as the novo synthesis [19, 20]. Several parameters are involved and have impacts on PCDD / Fs level emissions, such as temperature [21, 22], oxygen and chlorine content [23, 24], and the waste nature and composition [25] .Mainly the chlorine presence in the waste is until today controversed by several researchers; [26, 27] .

PCDD / F analyzes were conducted in 2014 following the incineration of drug waste at an El Harrach incinerator in northern Algeria. These analyzes found concentrations ranging from 21 to 774 pg TEQ m^{-3}. [28], but no analysis has been made up to today in Algeria on the releases of DASRI in PCDD / F, knowing that these wastes are very toxic and their incineration requires a lot of precautions.

The goal of this study is to first determine the PCDD / Fs levels at the emissions stack of the waste for hospitals by monitoring following two A1and B2 treatments.

For this purpose, an isokinetic sampler for active sampling in the vicinity of the IWI Company, located at SI Mustapha, were used. Then understanding of places of formation of these pollutants by the analysis at different points of the incinerator. This paper adds to the current literature to increase the PCDD / Fs atmospheric measurement data of industrial areas in east Algeria.

2. Materials and Methods

2.1 Site sampling

Sampling was carried out at the stack emission of an IWI company (IWI, ECFERAL SPA) located at Si Mustapha, 45 km east of Algiers (Fig 1).

The incineration of the various pharmaceutical and DASRI (wastes infectious Risk Care Activities) wastes .DASRI come from Zmirli Hospital were carried out at the station of the company ECFERAL , the pilot station of the incinerator (S1 Nar 3000) equipped with a scrubber and neutralization gaz : (Treatment A1)(fig2).

Incineration of waste drugs was performed at 950 ° C, while that of DASRI was performed at 1100 ° C.

After having obtained very high PCDD / F analysis values far exceeding the norm, we proposed to the company ECFERAL to add another treatment at the Si Mustapha station consisting of active coal adsorption column. placed after the neutralization gases (fig 3), in order to adsorb the pollutants coming out of the chimney: treatment B2 (washing of the gases and neutralization with the soda and adsorption an active carbon (AC)).

This Incineration Station is subject to the Algerian regulations relating to classified installations: Executive Decree No. 7-144 of 19/05/07.

The sampling of PCDD/Fs sampling, an isokinetic sampler at the stack emission was used, The PCDD/F samplings were taken following incineration pharmaceutical and DASRI wastes (Infectious Risk Care Activities).

Figure 1 .Sampling Site Location on Si-Mustapha Satellite Map

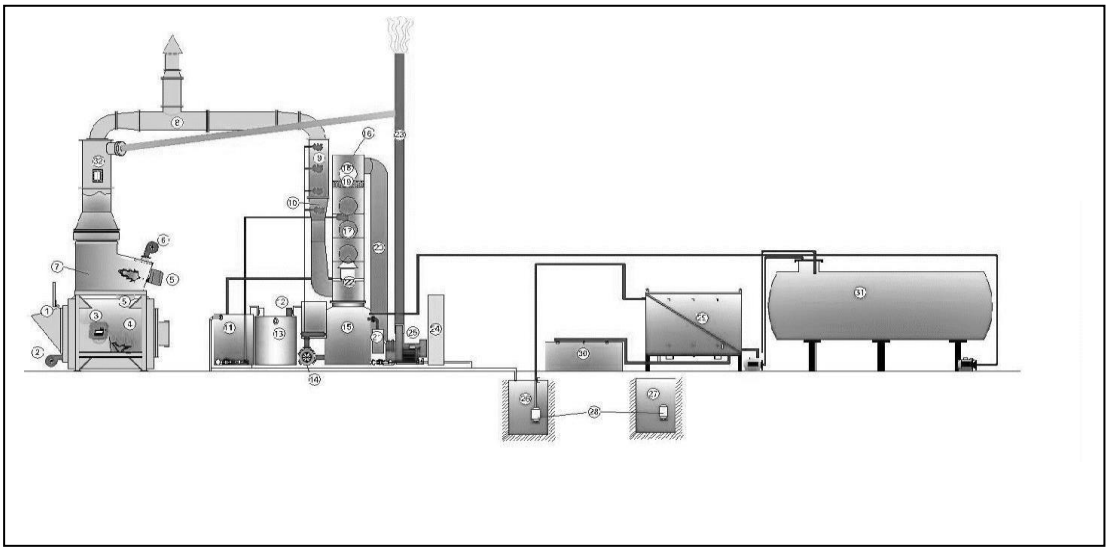


Figure 2. Schematic diagram of the industrial waste incinerator, model Nar3000":Treatment A1

1 - Charging system
2 - Primary Fan
3 - Burner combustion chamber
4 - Combustor
5 - Burner afterburner
6 - Secondary air fan
7 - Bedroom afterburner
8 - Junction equipped with a safety register
9 - Quench
10 - Venturi
11 - Neutralization tank water purge
12 - Metering pump
13 - Tank saturated aqueous solution of caustic soda
14 - A circulation pump of the washing waters
15 - Washwater tank
16 - Plate column
17 - Trays absorption acid gas
18 - Inspection door
19 - Devisiculor
20 - Sheath connecting
21 - Overflow
22 - Chinese heat
23 - Fireplace
24 - Control panel
25 - Induced draft fan
26 - Pit rainwater drain
27 - Fose collection of filtered water
28 - Submersible pump
29 - Decanter water purge
30 - Sand filter
31 - Water reservoir
32 - Heat exchange

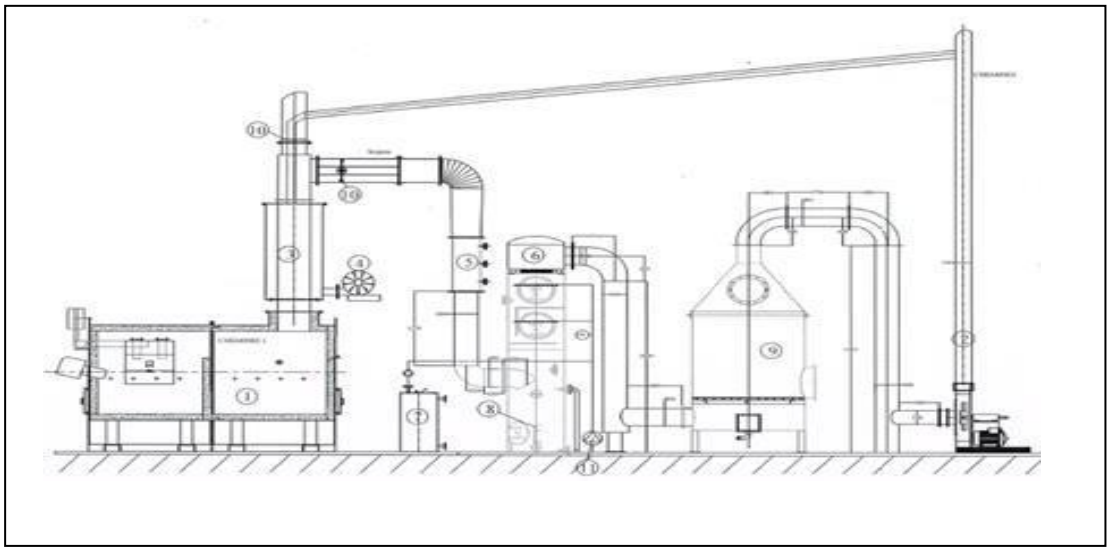


Figure 3 . Schematic diagram of theindustrial was teincinerator, model Nar3000

:Treatment B2.

11- Pump. 10- Non-return valve. 09- Activated carbon filter. 08- Level Incinerator- 07-Sodium Tray. 06- Smoke Washer. 05- Quench. 04- Turine. 03- Heat Exchanger. 02-Chimney. - 01-IncieratorNar3000.

2.2. Samples taken

For the study of PCDD / F from health care waste (DASRI), the samples were taken from Si Mustapha industrial site: First, at the level of the chimney at the exit of the fumes: In order to evaluate the emission of the pollutants in the air coming from the incinerator; Sampling was carried out following two types of treatment: the first (treatmentA1) with washing and neutralization of the gases, the second with washing and neutralization of the gases coupled with adsorption with activated carbon (treatmentB2).

Then various iso-kinetic samples were taken at different points of the incinerator (NAR 3000) to evaluate the amounts of dioxin / furan and to understand the effect of temperature on the formation of these gaseous pollutants at different points (Fig 4).This part of study was carried out following pharmaceutical was teincineration.

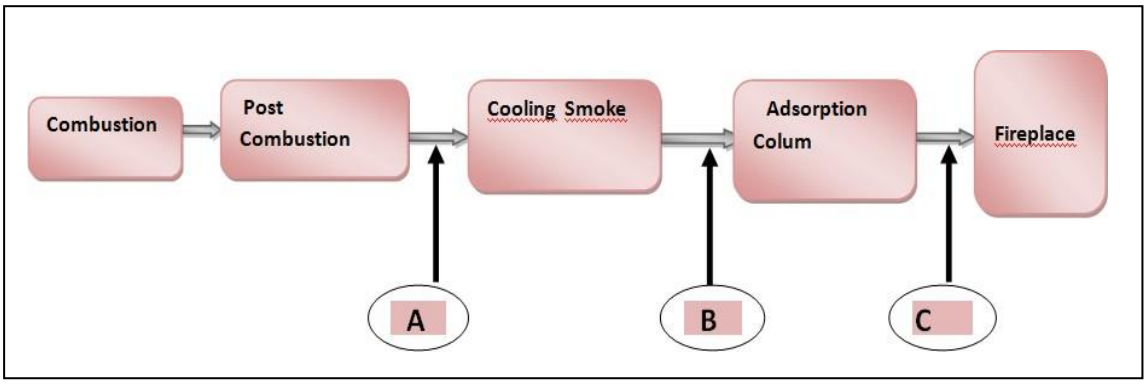


Figure 4. PCDD/F sampling at different levels of the incinerator

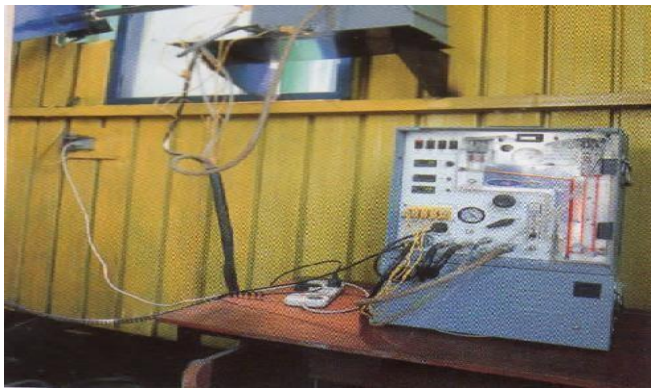
A: Exit post combustion B: Cooling fumes

C: After adsorption on activated charcoal

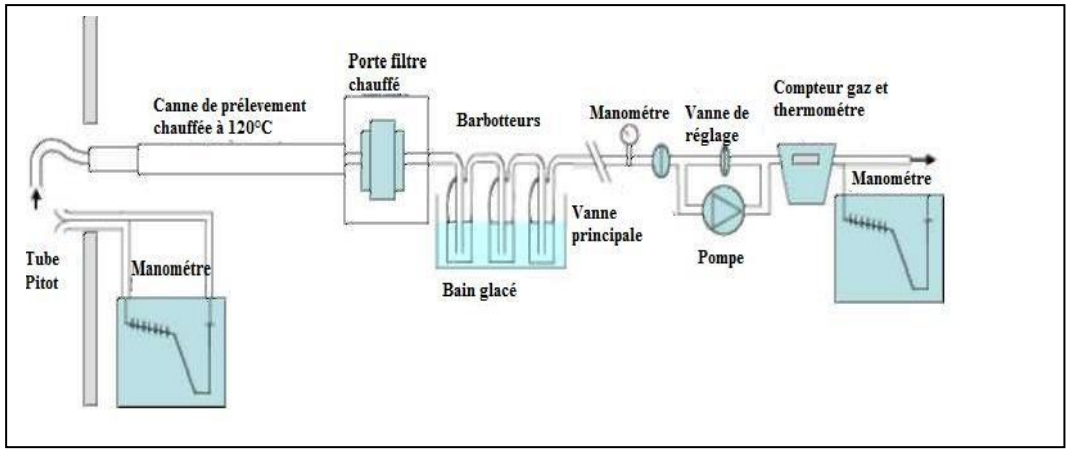
2.3 PCDD/FsSampling methods

The particle sampling was performed by means of an isokinetic sampler (Clean Air Engineering, Marseille, France) (Fig.5) operating at an average flow of 40 L min^{-1}. Two m^3 of air were drawn by a Whatman glass micro-fiber filter (110 mm diameter) where atmospheric particles >0.1 lm in diameter were trapped (grade GF/F, Whatman, purchased from Fourni-Labo, Versailles, France).

The particles-loaded filters (fig 6) were directly maintained in methylene chloride to prevent any degradation, and, then stored at 4 °C before analysis. The sampling was carried out at the stack emission of an IWI company.



(a)



(b)

Figure 5. (a) and (b). Diagram of the isokinetic sampler Clean Air Engineering

Figure6. Examples of filters taken for PCDD / F analysis

2.3 Chemicals and reagents

Helium (99.99%) was purchased from Air products (Vilvoorde, Belgium). The internal standard solution of the 17 2, 3, 7,8-chloro-substitued $^{13}C_{12}$ congeners labeled PCDD/Fs (EDF-4144), the calibration standard solution (EDF-4143), and the syringe (recovery) standard (EDF-4145) were purchased from Cambridge Isotope Laboratory (Cambridge Isotope Laboratories, Andover, MA, USA). For PCDDs and PCDFs, a mixture of [$^{13}C_6$]1,2,3,4-TeCDD, and [^{13}C]1,2,3,4,7,8,9-HpCDF was used as the recovery standard (EDF-4145).

2.4 Extraction and analysis

The glass microfiber filters were Soxhlet-extracted with toluene during 16 h. The extract was then evaporated at 250 ml with precision, using a rotary evaporator. An aliquot portion (one tenth) of the extract was transferred into a bottom balloon for the analysis. Few nonane droplets were added as keeper and 10 µl of the internal standard containing the 17 $^{13}C_{12}$-labeled PCDD/Fs specified as (EDF-4144) were dropped to the aliquot. The toluene was then evaporated with a rotary evaporator.

The extract in hexane was then subjected to an acid/base clean-up, followed by a clean-up on a silica gel column (modified with silver nitrate). The extract was evaporated at 10 ml and transferred into a 50-ml tube for a Zymark additional evaporation down to 500 µl, with a turbovap(Turbo Vap® II). The last clean-up was carried out with 200 mg sulphuric acid (44%, v/v) of silica gel in a Pasteur pipette column. The purified extract was then

transferred into a GC flask and concentrated to10 µl in nonane. Finally, the extract was enriched with 5 µl of recovery standard (EDF-4145) before HRGC– HRMS analysis to determine the achieved recovery rates for the $^{13}C_{12}$-labeled internal standards which were 83 ± 11 for PCDFs and 77 ± 10 for PCDDs.

3. Results

3.1 Analysis PCDD /F of Drug C Following Treatment A1.

The study of the analysis of PCDD and PCDF gases resulting from the incineration of cyclo 3 (C) following treatment A1. The results are summarized in Table 1 according to the two standards I TEF (NATO) and I TEF (WHO).

Table1. Analysis of PCDD / Fs in C gas incineration emissions following treatment A1 (1 I-TEQ NATO, 2 I-TEQ WHO)

	I TEF NATO	I TEF OMS	C
2,3,7,8-TCDD	1	1	0,012

1,2,3,7,8-PCDD	0,5	0,5	0.042
1,2,3,4,7,8-HxCDD	0,1	0,1	0.055
1,2,3,6,7,8-HxCDD	0,1	0,1	0.076
1,2,3,7,8,9-HxCDD	0,1	0,1	0.057
1,2,3,4,6,7,8-HpCDD	0,01	0,01	0.664
OCDD	0,001	0,001	2. 257
Furanes			
2,3,7,8-TCDF	0,1	0,1	0.079
1,2,3,7,8-PCDF	0,05	0,03	0.343
2,3,4,7,8-PCDF	0,5	0,3	0.399
1,2,3,4,7,8-HxCDF	0,1	0,1	0.555
1,2,3,6,7,8-HxCDF	0,1	0,1	0.602
2,3,4,6,7,8-HxCDF	0,1	0,1	0.760
1,2,3,7,8,9-HxCDF	0,1	0,1	0.111
1,2,3,4,6,7,8-HpCDF	0,01	0,01	2.110
1,2,3,4,7,8,9-HpCDF	0,01	0,01	0.557
OCDF	0,001	0,001	2.144
Somme PCDD/Fs (ng			10.82
ngI-TEQm-^{3}(PCDD/Fs)1			0.516
ngI-TEQm-^{3}(PCDD/Fs)^{2}			0.447

C: represents the waste of Cyclo 3

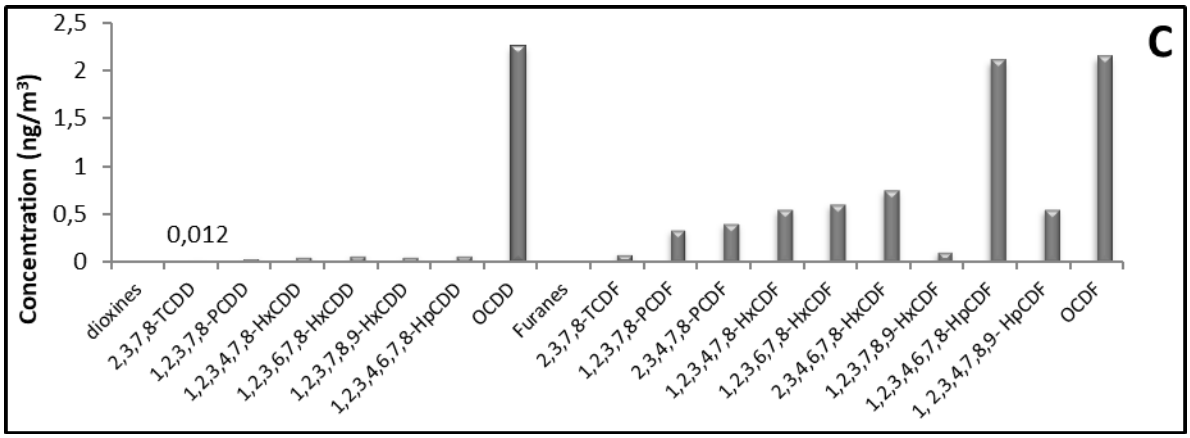


Figure7. Assessment of PCDD / F concentration of C following treatment A1

The concentration of PCDD / Fs with treatment A1 is 10.82 ng m^{-3} (Table 1). Figure 7 shows that for the sample C filter, the profile is dominated by OCDD (21%), followed by OCDF (20%), then 1,2,3,4,7,8,9-HpCDF (20%), and finally, 2,3,4,6,7,8-HxCDF (7%). The contents of TEQ for PCDD / F according to NATO and WHO I-TEF are, respectively, 0.551 and 0.447 ng I-TEQ m^{-3}. The TEQ content of the PCDD / Fs measured in gas stack emissions in this study exceeded the maximum PCDD / F limit given by European Union legislation setting the 100 µg m^{-3} I-TEQ limit threshold. PCDD / PCDF and this for the drug cyclo 3.

3.2 Analysis Dioxin / Furan of Drug C Following Treatment B2.

This analysis after the adsorption column makes it possible to quantify PCDD / F pollutants resulting from the incineration of the drug C, the PCDD / F formed adsorb on activated carbon. The different concentrations are grouped together in (Table 2).

Table2. PCDD / Fs Analysis of Drug Emissions from Treatment B2 (1 I-TEQ NATO, 2 I-TEQ WHO)

	I TEF NATO	ITEF OMS	C
Dioxines			
2,3,7,8-TCDD	1	1	0,005
1,2,3,7,8-PCD	0,5	0,5	0.015
1,2,3,4,7,8-HxCDD	0,1	0,1	0.021
1,2,3,6,7,8-HxCDD	0,1	0,1	0.034
1,2,3,7,8,9-HxCDD	0,1	0,1	0.037
1,2,3,4,6,7,8-HpCDD	0,01	0,01	0.352

OCDD	0,001	0,001	1.057
Furanes			
2,3,7,8-TCDF	0,1	0,1	0.041
1,2,3,7,8-PCDF	0,05	0,03	0.215
2,3,4,7,8-PCDF	0,5	0,3	0.120
1,2,3,4,7,8-HxCDF	0,1	0,1	0.276
1,2,3,6,7,8-HxCDF	0,1	0,1	0.215
2,3,4,6,7,8-HxCDF	0,1	0,1	0.281
1,2,3,7,8,9-HxCDF	0,1	0,1	0.111
1,2,3,4,6,7,8-HpCDF	0,01	0,01	1.021
1,2,3,4,7,8,9- HpCDF	0,01	0,01	0.216
OCDF	0,001	0,001	1.006
Somme PCDD/Fs (ng m^{-3})			5.023
ng I-TEQ m^{-3}(PCDD/Fs)1			0.202
ng I-TEQ m^{-3} (PCDD/Fs)^2			0.174

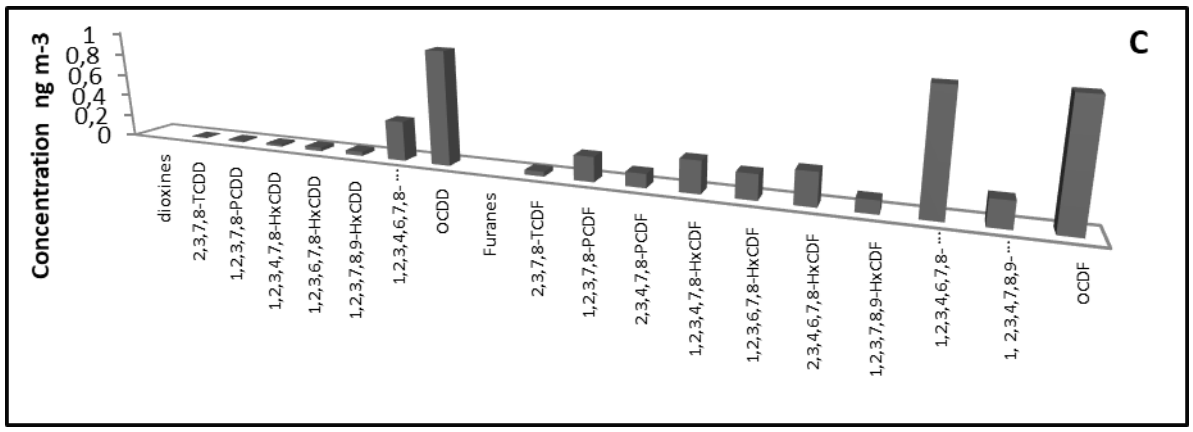


Figure 8. Assessment of PCDD / F concentration of C following treatment B2

The concentration of PCDD / Fs with treatment B2 is 5.023 ng m^{-3}(Table 2). For the sample C filter (Fig 8), the profile is dominated by OCDD (21.04%), followed by OCDF (20.02%), and then 1,2,3,4,7,8,9-HpCDF (20.32%), and finally, 2,3,4,6,7,8-HxCDF (5.6%). The contents of TEQ for PCDD / F in the sample according to NATO and WHO I-TEF are, respectively,

0.516 and 0.447 ng I-TEQ m^{-3}. After treatment the reduction was calculated at 39% PCDD / F, with concentrations of 0.202 ng I-TEQ m^{-3} and 0.174 ng I-TEQ m^{-3} respectively according to NATO and WHO I-TEF. The treatment of PCDD / F on a column at the AC proves effective.

3.3 Dioxin / furan analysis of DASRI following treatment

We analyzed the PCDD /F from the incineration of DASRI to quantify the release of these toxic pollutants into the air, this study was carried out without (treatment A1) and with adsorption on AC(treatment B2). (Table 3 and Table 4).

3.3-1 Dioxin / furan analysis of DASRI following treatment A

The PCDD / F profiles of emissions from treatment A are shown in Table 3.

Table 3. Analysis of PCDD / Fs in DASRI gas emissions following treatment A1.[1] I-TEQ NATO; [2] I-TEQ OMS

	I TEF NATO	I TEF OMS	D
Dioxins			
2,3,7,8-TCDD	1	1	0,091
1,2,3,7,8-PCDD	0,5	0,5	0.042
1,2,3,4,7,8-HxCDD	0,1	0,1	0.055
1,2,3,6,7,8-HxCDD	0,1	0,1	0.076
1,2,3,7,8,9-HxCDD	0,1	0,1	0.057
1,2,3,4,6,7,8-HpCDD	0,01	0,01	1.364
OCDD	0,001	0,001	2.987
Furans			
2,3,7,8-TCDF	0,1	0,1	0.179
1,2,3,7,8-PCDF	0,05	0,03	1.873
2,3,4,7,8-PCDF	0,5	0,3	0.399
1,2,3,4,7,8-HxCDF	0,1	0,1	1.985
1,2,3,6,7,8-HxCDF	0,1	0,1	1.002

2,3,4,6,7,8-HxCDF	0,1	0,1	1.969
1,2,3,7,8,9-HxCDF	0,1	0,1	0.988
1,2,3,4,6,7,8-HpCDF	0,01	0,01	2.110
1,2,3,4,7,8,9- HpCDF	0,01	0,01	1.377
OCDF	0,001	0,001	2.208
Somme PCDD/Fs (ng m^{-3})			18.582
ng I-TEQ m^{-3}(PCDD/Fs)[1]			1.089
ng I-TEQ m^{-3} (PCDD/Fs)[2]			0.972

D: represents the waste of DASRI

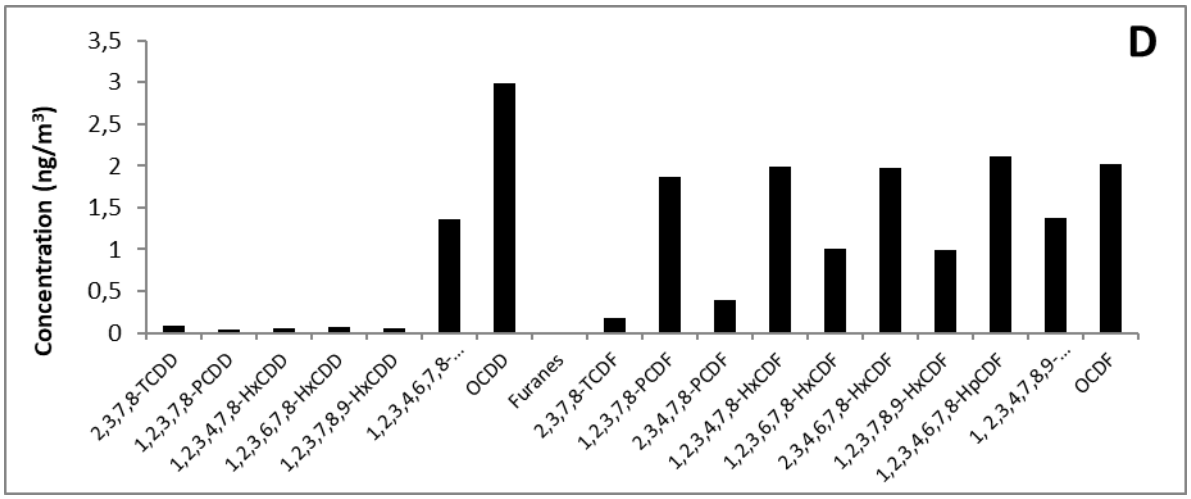


Figure 9. Evaluation of PCDD / F concentration of DASRI following treatment A1

The concentration of PCDD / Fs is 18.582 ng m^{-3}(Table 3) .

Fig 9 shows, for the filter of the DASRI sample following treatment A1, the profile is dominated by OCDD

(16.07%), followed by OCDF (10.91%) and then, 1,2,3,4,7, 8-HxCDF (10.68%) and finally 1,2,3,6,7,8, HxCDF (5.39%). The TEQ contents for PCDD / F of the DASRI sample prior to adsorption according to NATO and WHO I-TEF are, respectively, 1.089 and 0.972 ng I-TEQ m^{-3}.

A high level was recorded for OCDD of 2,987 ng / m^3. The TEQ content of the PCDD / Fs measured in gas stack emissions in this study exceeded the maximum PCDD / F limit given by European Union legislation setting the 100 µg m^{-3} I-TEQ limit threshold. PCDD / PCDF and this for DASRI.

These high PCDD / F results following the incineration of DASRI waste with only gas neutralization treatment are expected, given the toxicity and complexity of this waste.

3.3-2 Dioxin / furan analysis of DASRI following treatment B2

The PCDD / F profiles of emissions from treatment B2are shown in Table 4

Table4. Analysis of PCDD/Fs in DASRI gas emissions following treatment B2.[1] I-TEQ NATO; [2] I-TEQ OMS

	I TEF NATO	I TEF OMS	D
Dioxines			
2,3,7,8-TCDD	1	1	0,041
1,2,3,7,8-PCDD	0,5	0,5	0.032
1,2,3,4,7,8-HxCDD	0,1	0,1	0.055
1,2,3,6,7,8-HxCDD	0,1	0,1	0.046
1,2,3,7,8,9-HxCDD	0,1	0,1	0.023
1,2,3,4,6,7,8-HpCDD	0,01	0,01	0.664
OCDD	0,001	0,001	1.787
Furanes			
2,3,7,8-TCDF	0,1	0,1	0.079
1,2,3,7,8-PCDF	0,05	0,03	0.563
2,3,4,7,8-PCDF	0,5	0,3	0.099
1,2,3,4,7,8-HxCDF	0,1	0,1	0599
1,2,3,6,7,8-HxCDF	0,1	0,1	0.703
2,3,4,6,7,8-HxCDF	0,1	0,1	0.654

1,2,3,7,8,9-HxCDF	0,1	0,1	0.523
1,2,3,4,6,7,8-HpCDF	0,01	0,01	1.065
1, 2,3,4,7,8,9-HpCDF	0,01	0,01	0.265
OCDF	0,001	0,001	1.801
Somme PCDD/Fs (ng m-^{3})			8.999
ng I-TEQ m-3(PCDD/Fs)[1]			0.427
ng I-TEQ m-^{3} (PCDD/Fs)[2]			0.396

D: represents the waste of DASRI

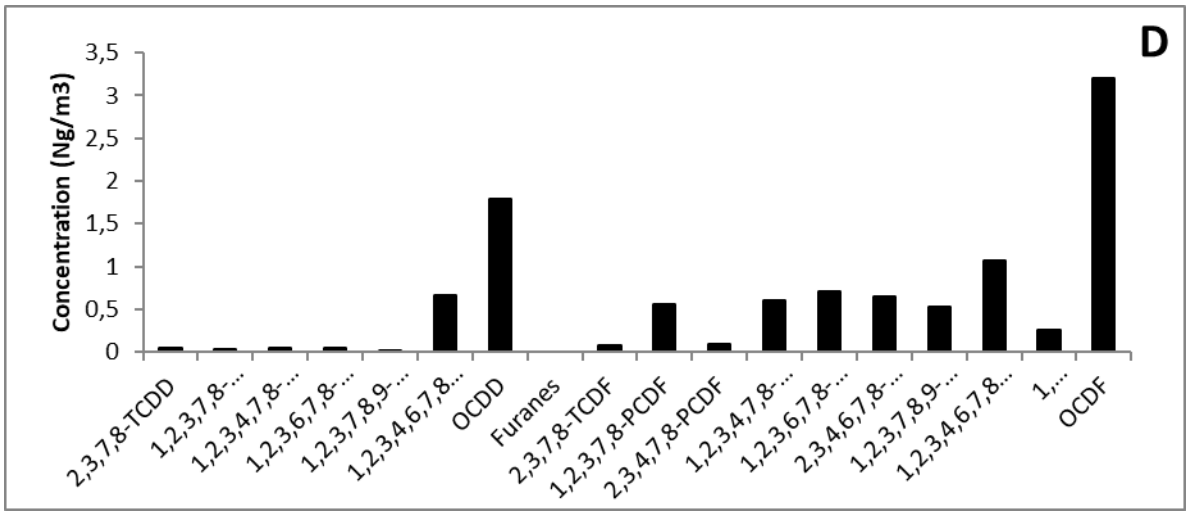


Figure10. Evaluation of PCDD / F concentration of DASRI following treatment B2

The PCDD / Fs concentration ranges from 0.023 to 1.801 ng m^{-3} (Table 4).

Fig 10 shows that for the filter of the DASRI sample following treatment B2 the profile is dominated by OCDF (20%), followed by OCDD (19.85%) and then 1,2,3,4,6 , 7.8, HPCDF (11.83%) and finally 1,2,3,6,7,8, HxCDF (7.81%).

The contents of TEQ for PCDD / F of the DASRI sample for adsorption according to NATO and WHO I-TEF are, respectively 0.427 and 0.396 ng I-TEQ m-^{3}.

In conclusion, the incineration of DASRIs with a flue-gas treatment at the CA did not allow the lowering of the PCDD / Fs to below the norm of 0.1 ng I-TEQ m^{-3}, but there is had a decrease of more than 40%.

3.4. Study of dioxins / furans in different incinerator formation zones: Effect of temperature

We will study the effect of temperature on the appearance of PCDD / F, for this we will analyze at different points of the incinerator these emissions.

To do this, we incinerated a pharmaceutical waste (C) followed by a complete treatment (treatment B2) (Figure 11).

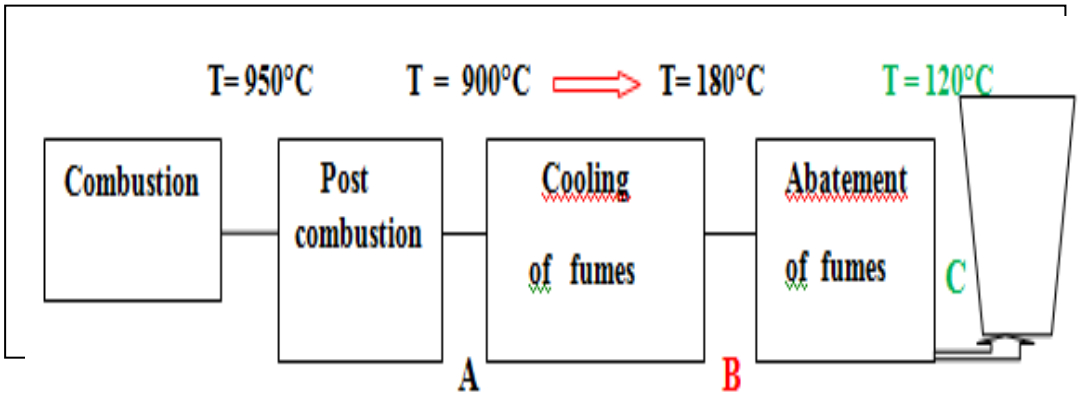


Figure11. Removal of PCDD / F at different levels of the incinerator

A: Output of the c post combustion

B: Fume cooling

C: After treatment of fumes by adsorption

The different results obtained from the analysis of PCDD / F emissions at different points of incinerator A, B, C are summarized in Table 5.

The PCDD / F emission profiles at different points of the incinerator are shown in Table 5.

Table 5.Analysis of PCDD / Fs at different points of the incinerator

	I TEF NATO	I TEF OMS	A	B	C
Dioxins					
2,3,7,8-TCDD	1	1	0.003	0.041	0.005
1,2,3,7,8-PCDD	0,5	0,5	0.045	0.092	0 .015
1,2,3,4,7,8-HxCDD	0,1	0,1	0.01	0.055	0.021

1,2,3,6,7,8-HxCDD	0,1	0,1	0.025	0.086	0.0034
1,2,3,7,8,9-HxCDD	0,1	0,1	0.021	0.085	0.037
1,2,3,4,6,7,8-HpCDD	0,01	0,01	0.082	0.664	0.352
OCDD	0,001	0,001	0 .098	1.787	1.057
Furans					
2,3,7,8-TCDF	0,1	0,1	0.012	0.079	0.041
1,2,3,7,8-PCDF	0,05	0,03	0.091	0.563	0.215
2,3,4,7,8-PCDF	0,5	0,3	0 .078	0.456	0.12
1,2,3,4,7,8-HxCDF	0,1	0,1	0.083	0.599	0.276
1,2,3,6,7,8-HxCDF	0,1	0,1	0.097	0.703	0.215
2,3,4,6,7,8-HxCDF	0,1	0,1	0.091	0.654	0.281
1,2,3,7,8,9-HxCDF	0,1	0,1	0.054	0.523	0.111
1,2,3,4,6,7,8-HpCDF	0,01	0,01	0.067	1.892	1.021
1,2,3,4,7,8,9- HpCDF	0,01	0,01	0.096	0.765	0.216
OCDF	0,001	0,001	0.09	2 .321	1.006
Somme PCDD/Fs (ng m-^{3})			1.404	11.365	5.00
ng I-TEQ m-^{3}(PCDD/Fs)^{1}			0.022	0.66	0.202
ng I-TEQ m-^{3}(PCDD/Fs)^{2}			0.093	0.55	0.174

3. 4. 1. Study of PCDD / F afterPost-combustion (point A)

In this part the incineration temperature is still high (T = 950 ° C), it is expected according to the literature to find a negligible amount of PCDD / F pollutants because at this temperature the dioxin is virtually destroyed.

The total concentration of PCDD / Fs at this point is estimated at 1.404 ng m^{-3}, the profile is dominated by OCDD and 1,2,3,6,7,8-HxCDF at (7%), followed by (1 , 2,3,4,7,8,9-HpCDF (6., 83%), and finally, 2,3,4,6,7,8-HxCDF and 1,2,3,7,8-PCDF (6.48%).

The contents of TEQ for PCDD / F at this point according to NATO and WHO I-TEF are, respectively, 0.022 and 0.093 ng I-TEQ m^{-3} (Fig 12).

3. 4. 2. Study of PCDD / F after flue gas cooling (point B)

At point B, following the cooling of the fumes, the gases pass through a peak temperature range between

200°C and 400 ° C, that is the range favoring the formation of PCDD / F. The total concentration of PCDD / Fs at this point is estimated at 11.365 ng m^{-3}, the profile is dominated by OCDF at 20%, followed by 1,2,3,4, 6,7,8- HpCDF andOCDD at 17%. % and 16% and finally 1, 2,3,4,7,8,9- HpCDF at 7%.

A very high level of TEQ content for PCDD / F at this point according to NATO and WHO I-TEF which are respectively, 0.66 and 0.55 ng I-TEQ m^{-3}. This shows the need for treatment systems. (Fig 13).

3.4.3. Study of PCDD / F following fume treatment (point C)

At this point the temperatures are at low T= 120 ° C, the concentration of PCDD / F has halved, with a total concentration of 5 ng m^{-3}, the profile is dominated by the following congeners OCDF, 1,2 , 3,4,6,7,8-HpCDF and 20% OCDD each.

The effect of temperature is of paramount importance for the formation or destruction of PCDD / F, as shown in the bibliographic section so the maximum is reached at a temperature of 350 ° C. To minimize their formation, an effective cooling system is required to cool these gases in a very short time. (Fig 14).

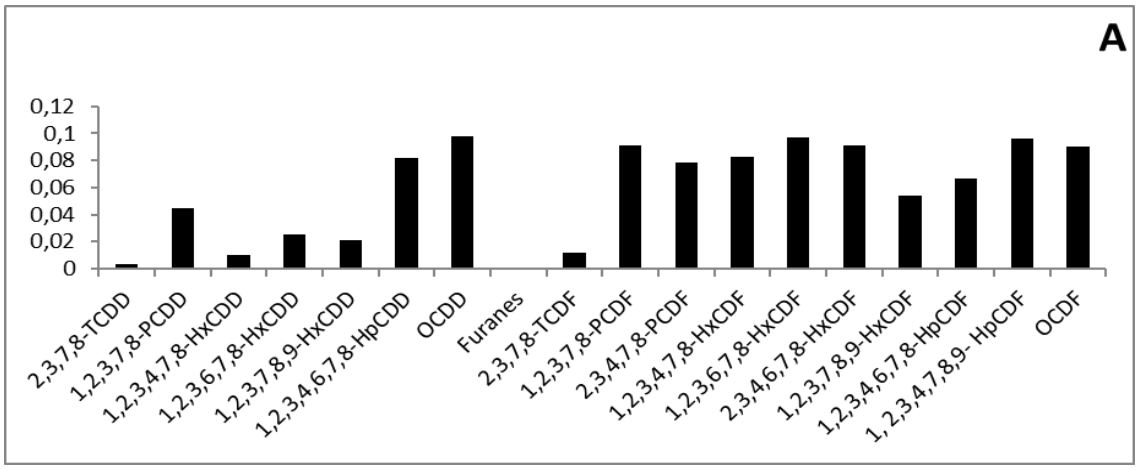


Figure12. Analysis of PCDD / F at point A

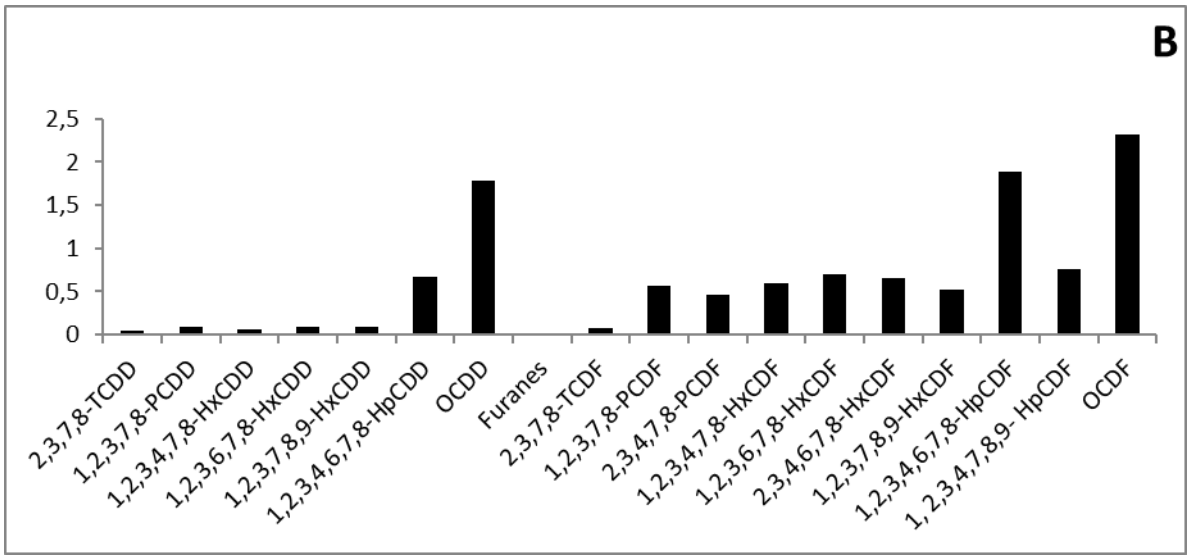


Figure13. Analysis of PCDD / F at point B

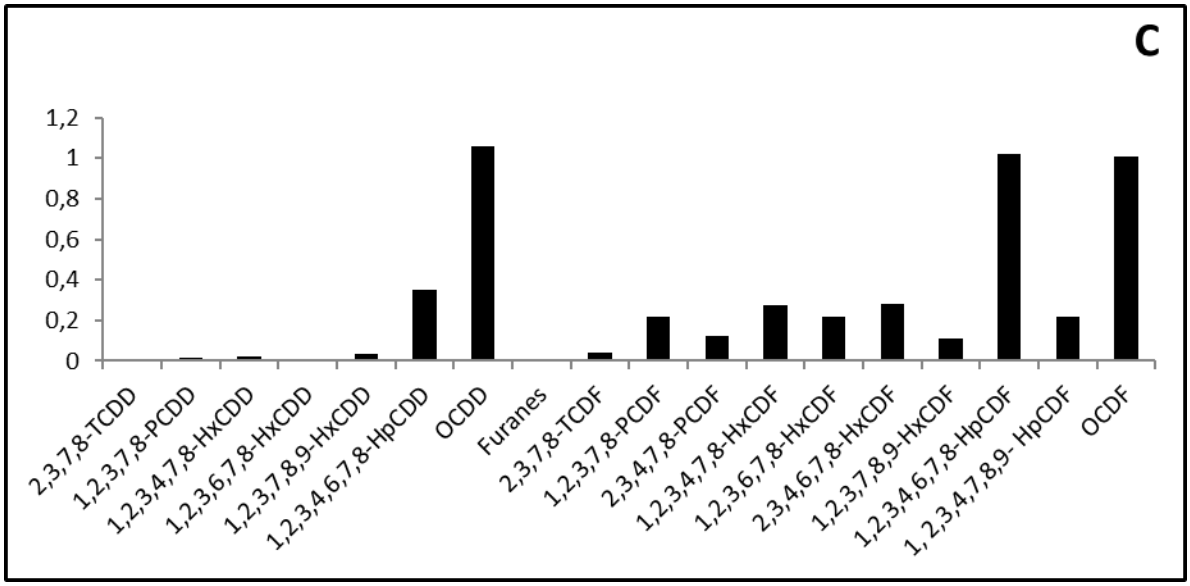


Figure14. Analysis of PCDD / F at point C

4. Conclusions

This work enabled us to analyze toxic and carcinogenic compounds even in the form of traces that

are PCDD / Fs on an incinerator in Algeria; The comparative study of the type of waste, an expired drug waste whose composition is not or potentially dangerous(may possibly contain traces of heavy metals) compared to DASRI whose composition is very toxic and dangerous

(heavy metals, chlorinated compounds, etc.) has led to then following results:

PCDD / Fs TEQ content measured in gas stacke missions as a result of simple gas scrubbing and

neutralization treatment exceeded the maximum PCDD /F limit given by European Union legislation setting it at100 pg m-3 I-TEQ for the drug Cyclo3.

The high value ofI-TEQ resulting from the emission of the incinerator gases during the combustion of this drug could be explained bythe presence of chlorine source since the combustion of this sample took place in the presence of the packaging polyvinyl chloride.

After treatment(B2), the reduction was calculated at 39% PCDD / F, with concentrations of 0.202 ng I-TEQ m-3 and 0.174 ng I-TEQ m-3 respectively according to NATO and WHO I-TEF. The treatment of PCDD / F on a column at the AC proves effective.

The incineration of DASRI with flue-gas treatment did not allow the lowering of PCDD / F to below the norm of 0.1 ng I-TEQ m-3, but there was a decrease by more than 40% for these pollutants after treatment B2. This shows the effectiveness of the active carbon treatment on PCDD / Fbut it still seems to be insufficient to be in the current standard, the company ECFERAL must add another treatment to be in the norm.

The study of the effect of temperature on the appearance of PCDD / F, by analyzing at different key points of the incinerator has shown that at (T = 950 ° C) anegligible amount of PCDD / F pollutants because at this temperature the dioxin is virtually destroyed.

The PCDD / Fs concentrations analyzed after cooling the fumes (temperatures ranging from 900 ° C to 180 ° C) are very high because the temperatures are gradually decreasing in this zone, the gases inevitably pass through a peak temperature range between 200 ° C and 400 ° C, that is the range favouring the formation of PCDD / F (according to bibliographical studies).

At the last point the temperatures are at low T =120 ° C, the concentration of PCDD / F has decreased by half. So there was no additional training of dioxins at this temperature (the decrease is due to the treatment that the gases have undergone).

The study of the effect of temperature on the appearance of PCDD / F has clearly shown that the formation of these compounds is located in the cooling zone. To minimize their formation, an effective cooling system is necessary in order to cool these gases in a very short time.

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