PRESENCE OF PCDD/Fs IN THE SOILS OF THE PROVINCE OF TRENTO

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SUMMARY: The aim of this paper includes the presentation of an overview on a provincial scale with particular reference to PCDD/Fs in soils, detected in several measurement campaigns carried out over a period of ten years (from 2002 to 2012). This in order to obtaine a comparison between the results found in the Borgo Valsugana and surroundings and those relating to other provincial realities. In particular, in the year 2002 and followed in the years 2005 to 2010 there have been some measurement campaigns aimed at obtaining a background reference in terms of micropollutants in view of the possible construction of the MSW incinerator of Trento. In 2009, also, a measurement campaign was carried out, by the Provincial Agency of Environment Protection, to achieve the environmental characterization of the Valsugana, as well as in the city of Trento and its surroundings, in order to contribute to the assessment of the impact of the steel making plant of Borgo. In 2012, finally, a campaign of monitoring of soil was carried out by the Department of Civil and Environmental Engineering of Trento, with the aim of monitoring the area around the steel making plant in Borgo Valsugana.

1. INTRODUCTION

Adverse health effects of exposure to Persistent Organic Pollutants (POPs) have been object of great public, scientific and regulatory concern in the last years (European Commission, 1999). POPs reach the human body through multiple pathways, such as airways, contact and ingestion (ATSDR, 2011). POPs are subjected to atmospheric transport and deposition into water and soil, but also bioaccumulation represents an important way of contamination (Thron, 1996). Furthermore, the ultimate uptake to receptor organs and systems in the human body are complex (Thron, 1996). Hence, both direct and indirect exposure assume great relevance for the health risk assessment.

For this reason, the environmental optimization related to human exposure has become the new frontier. In this scenario, dioxins and furans (PCDD/Fs) are considered the most toxic and diffuse family of POPs. The exposure risks from PCDD/F are not related to acute toxicity, but the primary health risk derives from chronic, long term exposure at much lower levels.

A total of 210 congeners are known between PCDD (75 congeners) and PCDF (135 congeners) correlated to characteristics and toxicity. Only 17, seven PCDDs and ten PCDFs, are considered extremely toxic for humans and animals (Rada and Ragazzi, 2008).

For years PCDD/F inventories have pointed out the significant role of Municipal Solid Waste (MSW) incinerators in the overall/national balances (Rada et al., 2006). Recently, thanks to new regulations on PCDD/F emissions, in a few countries this scenario is changed or bettering (Rada et al., 2006). The European Directive 2000/76/EC on the incineration of waste has forced the existing

and new plants to adopt more efficient emission control and abatement systems (EU, 2000). As a consequence, nowadays the available technology is able to ensure the respect of PCDD/F emission limits (European Commission, 2010), which, in many cases, are more stringent than those requested for a few productive activities.

PCDD/Fs are a group of organic pollutants produced as by-products in combustion and industrial processes. Although the main sources of PCDD/Fs are industrial combustions (i.e., oil refineries, power plants, etc.), natural combustions (i.e., forest fires, agricultural waste burning, etc.) may occasionally disguise the low PCDD/F ambient levels typical of rural areas. Once emitted to the atmosphere and due to their hydrophobic properties, PCDD/Fs accumulate in matrices with high organic contents such as herbage and soils (Domingo et al., 2002). PCDD/F concentrations in soils derive mainly from atmospheric deposition (Schuhmacher et al., 2002; Martinez et al., 2006). Thus, high levels of PCDD/Fs in air would be linked to elevated concentrations of PCDD/Fs in soils (Mari et al., 2009).

To contribute to a better understanding of the PCDD/F's exposure in Trento's province some monitoring campaign were carried out in order to characterize the presence of these pollutants in soils. A first characterization concerned the years 2002 and 2003 in the area of the town of Trento (DIIAR, 2003). During winter 2006 and 2007 two soil monitoring campaigns were carried out with the aim of increasing the level of knowledge concerning the environmental quality of the town of Trento with a view to the possible construction of a MSW incinerator plant (DICA, 2006; DICA, 2007). Furthermore the presence of the A22 highway was considered in order to check a potential correlation between the concentrations of PCDD/Fs and the distance from the highway. Indeed, recent studies show that the combustion of diesel vehicles can represent an important source of PCDD/F (Caserini, 2002).

During 2009's summer a comparative study to carry on the characterization of environmental background of Trento surroundings was conducted with the aim to draw the present situation (DICA, 2010).

During winter 2009, the Provincial Agency of Environmental Protection conducted an environmental control campaign, in order to monitor the input of pollutants by the industrial plant emissions in Valsugana valley and in Trento surroundigs.

Lastly, during spring 2012 some soil samples in the Valsugana valley were collected, in order to evaluate the contribution of the local steel making plant to PCDD/F deposition in soils.

2. MATHERIALS AND METHODS

During the monitoring campaign 2002/2003 soil samples were carried out at three sites representative of the local context and emissivity (Cadine, urban and peripheral urban area of Trento, sites chosen depending on the expected impact of the proposed MSW incinerator plant) and in two periods of time representative of the meteorological regime in winter and summer in the area of Trento (DIIAR, 2003).

During the 2006's measurement campaign some points were identified for a representative soil sampling of the interested area:

- Trento Nord (and similarly in Trento Sud): two points of sampling at a distance of 50 and 700 meters by the motorway axis (A22), in order to verify the PCDD/F's contribution due to the presence of a major thoroughfare.
- Trento Nord and Trento Sud: samples located at the same distance from the motorway (350 meters).
- Sampling at the two air quality stations located in Gardolo and S. Chiara Park.
- Sampling by two city parks, by the Fersina river and by Solteri area.

The characterization of particularly sensitive sites was investigated by sampling in correspondence of public parks, where, in relation to age of the population, it is more likely to occur

ingestion of soil (DICA, 2006).

During the 2007 field monitoring campaign further investigation of PCDD/Fs in soils was carried out in the same sampling sites of 2006 measurement campaign (DICA, 2007). Furthermore other sites located in surroundings of the "Ischia Podetti" site were considered: protected areas denominated "Stagni della Vela" and "Foci dell'Avisio", and also two sites located in Cadine (playground and parking) and one site located in "Sorasass" area, where the point of maximum fallout of pollutants by the models used in the Environmental Impact Study of the proposed MSW incineration plant of Ischia Podetti was predicted (DICA, 2002).

During summer 2009 some sites that presented an over fifteen years pollutant deposition history without alterations were carried out: a public park in Lavis, a public park in Terlago and the primary school of Zambana. Furthermore, other three sites were carried out as well as protected natural areas denominated "Foci dell'Avisio", "Terlago", "Laghi e abisso di Lamar", liable to 92/43/CEE directive (DICA, 2010).

The 2009 and 2012 monitoring campaigns were carried out both in proximity to a steel making plant both far from the steel making plant in Borgo Valsugana, in order to carachterize the plant contribution to PCDD/F deposition in soils during the last years.

Particular care was adopted for all the sampling campaigns in order to obtain a representative sample for each site.

3. RESULTS AND DISCUSSION

During field monitoring campaigns low PCDD/F's values were found. Italian Legislative Decree 152/2006 concerning the remediation of contaminated soils for PCDD/Fs provides a limit of 10 $ng_{I\text{-}TEQ}$ kg^{-1} for residential and green land and 100 $ng_{I\text{-}TEQ}$ kg^{-1} for commercial and industrial land: results of all field monitoring campaign show values below these limits (in particular below the first one).

In the 2002-2003 Environmental Impact Study for the proposed MSW incinerator plant of Trento n.7 characterizations of soil were carried out, obtaining values of PCDD/Fs in the range from 0.09 to 1 ngI-TEQ/kg (DIIAR, 2003).

During 2007's campaign in Trento South sample a higher value (4.86 ngI-TEQ/kg) was measured, as found in the 2006 measurement campaign at the same site (4.39 ngI-TEQ/kg): such data could be linked to a specificity of sampling point. During the same campaign the soil samples were carried out considering the distance from the highway axis: however a correlation between the distance from highway and the value of equivalent toxicity found in soils wasn't detected. Comparing the I-TEQ concentrations detected in soils for sampling points made during 2006's and 2007's study, it can be seen that there was an increase for all sites considered except for the site called Trento Sud Ravina. The ratio PCDD/PCDF has not been significantly variable, while the relationship between PCDD/F and I-TEQ (PCDD-F/I-TEQ) decreased at all sites except for Trento Sud Ravina, that decreases; for the sites of Trento Nord the reduction of this parameter is more pronounced. This shows a general increase in toxicity in the samples analyzed in 2007 compared to 2006, and in particular in the North of Trento (DICA, 2007). Compared to the characterization in 2006 it must be highlighted that on 28 July 2006 there was the burning of the "Ricicla Trentino 2" of Lavis, a "green deck" where the transfer and the selection of multi-material waste resulting from the collection of the whole province took place. The plant treats packaging materials such as plastic, glass, aluminum and steel. As we can't exclude a contribution of such event to the increase in concentrations of PCDD/F, as it's observed in the complex modest values detected during monitoring campaigns 2006 and 2007. The values resulting from sampling are placed well below the values set by the Italian Legislative Decree 152/2006 (DICA, 2007).

The 2009 monitoring campaign was conducted near the city of Trento during summer: PCDD/F

soils concentrations are almost in line with each other and show values between 41.5 and 83.85 ng kg_{dw}^{-1}. It's notice how there is more than a match of values measured by geographical area compared to the type of place. The value of PCDD/F in the Zambana sample (83.85 ng kg_{dw}^{-1}) is higher than the measurements of the Lavis samples, as well as Biotope "Laghi e abisso di Lamar" has a value of 65.92 ng kg_{dw}^{-1} higher than the values measured in the locality of Terlago. PCDD/F's values found in soils during the monitoring campaign are shown in Tab.1a, Tab.1b and Tab.1c (DIIAR 2003, DICA, 2006; DICA, 2007; DICA, 2010).

Location	Site 1	Site 2		Site 3		Site 4		Trento Nord A22		Trento Nord Via B.Todesca		Trento Sud cabina di rifornimento Trenta		Trento Sud Cabina Eca		Trento Sud Ravina	
Distance from A22 (m)	-	-		-		-		10		760		240		60		700	
Year	2002	Summer 2002	Winter 2002/2003	Summer 2002	Winter 2002	Autumn 2002	Winter 2002	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Units	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$
2378-TCDF	0.33	0.42	0.25	0.04	0.20	0.05	0.56	0.77	0.66	0.37	0.69	5.31	7.34	0.54	1.42	< 0.3	0.39
12378-PeCDF	0.26	0.39	0.24	0.05	0.27	0.03	0.42	0.72	< 0.41	0.32	< 0.42	5.42	6.19	0.29	1.16	0.5	< 0.42
23478-PeCDF	0.34	0.65	0.32	0.09	0.28	0.05	0.64	0.55	0.64	0.32	0.58	3.6	4.34	0.21	0.84	0.59	< 0.42
123478-HxCDF	0.60	0.78	0.46	0.16	0.58	0.08	0.76	0.97	0.73	0.82	0.61	4.65	4.58	0.68	1.07	0.5	0.41
123678-HxCDF	0.44	0.59	0.23	0.11	0.41	0.05	0.44	0.56	0.43	0.3	< 0.39	1.22	1.17	0.26	< 0.40	0.49	< 0.39
123789-HxCDF	0.49	0.94	0.39	0.25	0.54	0.07	0.62	< 0.24	< 0.47	< 0.24	< 0.39	< 0.24	< 0.72	< 0.19	< 0.40	< 0.2	< 0.39
234678-HxCDF	0.17	0.15	0.09	0.04	0.13	0.02	0.16	0.67	0.9	0.43	0.46	1.59	1.72	0.35	0.48	0.4	< 0.39
1234678-HpCDF	3.66	3.41	1.46	0.74	2.90	0.25	2.96	2.6	2.57	2.02	1.93	6.87	6.53	1.89	2.23	2.27	1.32
1234789-HpCDF	0.39	0.27	0.15	0.10	0.29	0.03	0.28	< 1.57	0.51	< 1.59	< 0.37	< 1.61	0.82	< 1.28	< 0.38	< 1.31	< 0.37
OCDF	8.13	2.72	2.58	0.86	3.18	0.35	4.65	5.03	12.3	4.22	3.95	11.1	9.64	7.66	5.77	6.21	3.14
2378-TCDD	<0.02	<0.02	<0.02	<0.002	<0.02	<0.005	<0.07	< 0.08	< 0.17	< 0.08	< 0.18	0.11	< 0.18	< 0.22	< 0.18	< 0.14	< 0.18
12378-PeCDD	0.03	0.24	0.05	0.02	0.03	0.01	0.17	< 0.12	< 0.23	< 0.12	< 0.24	0.24	< 0.24	< 0.13	< 0.24	0.14	< 0.24
123478-HxCDD	0.56	0.20	0.09	0.02	0.09	0.01	0.19	< 0.24	< 0.46	< 0.24	< 0.47	0.27	< 0.48	< 0.19	< 0.48	< 0.2	< 0.47
123678-HxCDD	0.23	0.45	0.19	0.03	0.19	0.04	0.39	< 0.24	< 0.46	< 0.24	< 0.47	0.99	0.71	0.27	< 0.48	< 0.2	< 0.47
123789-HxCDD	0.28	0.45	0.11	0.02	0.13	0.02	0.25	0.25	< 0.46	< 0.24	< 0.47	0.62	0.6	0.2	< 0.48	0.35	< 0.47
1234678-HpCDD	2.91	6.69	2.42	0.35	1.95	1.36	9.56	6.92	4.62	2.13	1.99	26.6	23.7	3.63	7.42	3.58	2.56
OCDD	16.79	40.18	17.64	1.08	9.84	6.65	72.84	71.8	32.7	13.2	12.2	261	242	21.7	51.6	19.7	16.8
I-TEQ (NATO/CCMS) (NR=LR/2)	**0.62**	**1.02**	**0.45**	**0.14**	**0.47**	**0.09**	**1.00**	**0.92**	**0.96**	**0.55**	**0.79**	**4.39**	**4.86**	**0.6**	**1.19**	**0.77**	**0.54**
ΣPCDD/F	35.62	58.54	26.68	3.96	21.02	9.07	94.93	92.09	57.39	25.51	24.11	330.52	310.15	36.69	73.51	35.91	26.73
PCDD/F/I-TEQ	58.15	57.44	59.48	28.43	44.73	99.26	94.59	100.21	59.83	46.13	30.4	75.24	63.77	64.27	61.63	46.63	49.94
PCDD/PCDF	1.41	4.67	3.32	0.62	1.39	8.26	7.26	6.21	1.99	1.63	1.68	7.12	6.27	2.07	4.42	2.03	3.14
Dry matter (%)	-	-	-	-	-	-	-	81.7	78.2	74.5	74.3	78.7	77	80.5	76.6	76.2	73.8

Tab.1a: PCDD/F's soils concentrations in monitoring campaigns.

Location	TN Nord Interbrennero	Gardolo	Parco S.Chiara	Torrente Fersina	Solteri	Trento Nord Biotopo Foci dell'Avisio		Trento Nord Roncafort	Biotopo Stagni della Vela	Cadine Parco Giochi	Cadine Parcheggio	Zona Sorasass	Zambana	Lavis	Terlago	Biotopo "Terlago"	Biotopo "Laghi e abisso di Lamar"
Distance from A22 (m)	400	1500	1200	1250	1250	140		80	500	-	-	-	-	-	-	-	-
Year	2006	2006	2006	2006	2006	2007	2009	2007	2007	2007	2007	2007	2009	2009	2009	2009	2009
Units	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$
2378-TCDF	< 0.36	0.72	1.66	0.56	0.95	0.61	< 0.54	0.64	0.87	0.6	< 0.32	1.41	0.46	< 0.53	0.45	0.32	1
12378-PeCDF	0.18	0.56	1.46	0.45	0.83	0.49	< 0.74	0.43	0.72	< 0.44	< 0.43	0.6	< 0.44	< 0.73	< 0.45	< 0.43	0.59
23478-PeCDF	< 0.16	0.53	1.54	0.35	0.6	0.69	< 0.74	0.62	1.15	0.5	< 0.43	0.91	0.47	< 0.73	< 0.45	< 0.43	0.85
123478-HxCDF	< 0.39	0.85	1.98	0.88	1.07	1.22	< 0.67	0.74	1.5	0.64	0.44	1.19	< 0.40	< 0.67	0.51	0.42	1.37
123678-HxCDF	< 0.32	0.53	0.97	0.42	0.56	0.62	< 0.67	< 0.38	0.97	0.47	< 0.4	0.7	< 0.40	< 0.67	< 0.41	< 0.39	0.84
123789-HxCDF	< 0.24	< 0.24	< 0.20	< 0.20	< 0.24	< 0.37	< 0.67	< 0.38	< 0.45	< 0.41	< 0.4	0.4	< 0.40	< 0.67	< 0.41	< 0.39	< 0.39
234678-HxCDF	< 0.24	0.66	1.52	0.34	0.6	1.11	< 0.67	0.65	1.69	0.83	< 0.4	0.94	0.46	< 0.67	< 0.41	< 0.39	1.05
1234678-HpCDF	< 1.60	2.39	4.41	1.41	3.21	4.4	1.41	2.62	6.44	4.48	2.23	5.37	1.48	1.41	2.69	2.77	7.55
1234789-HpCDF	< 1.60	< 1.60	< 1.35	< 1.31	< 1.59	0.55	< 0.64	< 0.36	0.8	0.54	< 0.38	0.57	< 0.38	< 0.63	< 0.39	< 0.37	0.99
OCDF	< 4.00	4.29	7.17	4.18	6.33	6.25	3.04	7.36	9.09	16.1	5.95	13.8	2.81	2.6	6.62	6.52	19.2
2378-TCDD	< 0.08	< 0.08	< 0.07	< 0.07	< 0.08	< 0.17	< 0.30	< 0.17	< 0.18	< 0.18	< 0.18	0.29	< 0.18	< 0.30	< 0.18	< 0.18	< 0.18
12378-PeCDD	< 0.12	< 0.12	0.19	< 0.10	< 0.12	< 0.22	< 0.40	< 0.23	0.26	< 0.24	< 0.24	0.24	< 0.24	< 0.40	< 0.24	< 0.23	< 0.24
123478-HxCDD	< 0.24	< 0.24	0.3	< 0.20	< 0.24	< 0.45	< 0.81	< 0.46	< 0.48	< 0.49	< 0.48	0.48	< 0.48	< 0.80	< 0.49	< 0.47	< 0.47
123678-HxCDD	< 0.24	0.25	0.43	< 0.20	< 0.24	< 0.45	< 0.81	< 0.46	< 0.48	0.67	< 0.48	0.48	< 0.48	< 0.80	< 0.49	< 0.47	< 0.47
123789-HxCDD	< 0.24	0.28	0.24	< 0.20	< 0.24	0.56	< 0.81	< 0.46	0.6	0.67	< 0.48	0.86	< 0.48	< 0.80	< 0.49	< 0.47	< 0.47
1234678-HpCDD	< 1.60	4.34	12.1	3.78	4.4	7.46	< 6.73	6.77	5.09	25.9	2.4	9.27	10	< 6.65	4.13	< 3.91	< 7.53
OCDD	< 4.00	29.4	132	29.8	30.5	50.4	< 94.30	51.1	16.6	275	13.7	44.4	66.3	< 93.10	63	< 54.80	< 55.20
I-TEQ (NATO/CCMS) (NR=LR/2)	**0.26**	**0.82**	**2**	**0.61**	**0.9**	**1.17**	**0.84**	**0.94**	**1.61**	**1.44**	**0.53**	**1.75**	**0.69**	**0.83**	**0.64**	**0.55**	**1.29**
ΣPCDD/F	7.9	45.94	166.78	43.31	50.43	75.19	59.2	72.38	46.58	327.28	27.03	81.91	83.85	58.09	79.61	41.5	65.92
PCDD/F/I-TEQ	30.31	55.69	83.22	71.01	56.13	64.5	70.72	77.15	28.87	226.6	51.18	46.77	121.38	69.91	123.51	75.2	51.08
PCDD/PCDF	0.7	3.01	6.76	3.63	2.35	3.66	7.31	4.31	0.99	12.31	1.7	2.16	11.67	7.72	5.9	2.7	0.96
Dry matter (%)	88.7	86.1	81.4	86.1	83.9	85.3	80.34	74.9	77.3	79.4	76.9	62.6	96.18	88.78	89.32	80.55	96.18

Tab.1b: PCDD/F's soils concentrations in monitoring campaigns.

Location	Borgo V. 1	Borgo V. 2	Borgo V. 3	Borgo V. 4	Borgo V. 5	Borgo V. 6	Borgo V. 7	Borgo V. 8	Borgo V. 9	Borgo V. 10
Year	2012	2012	2012	2012	2012	2012	2012	2012	2012	2012
Units	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$	ng $kg_{d.w.}^{-1}$
2378-TCDF	2.3	0.8	0.3	0.5	1,4	0.05	0.4	0.7	0.05	0.6
12378-PeCDF	1.5	0.25	0.25	0.25	1,1	0.6	0.25	0.25	0.25	0.25
23478-PeCDF	2	0.8	0.25	1.4	0,8	0.25	0.25	0.25	0.25	0.9
123478-HxCDF	1.3	1.4	1.1	1.3	1,1	1.2	1	0.7	0.25	0.9
123678-HxCDF	1.4	0.9	0.6	0.6	0,7	1.2	0.25	0.25	0.25	0.7
123789-HxCDF	0.7	0.5	0.25	0.8	1,2	1.5	0.25	0.25	0.25	0.6
234678-HxCDF	0.25	0.25	0.25	0.25	0,25	0.6	0.25	0.25	0.25	0.25
1234678-HpCDF	6.9	5.3	3.4	3.9	5,6	1.6	3.8	5.2	5.1	3.9
1234789-HpCDF	0.25	0.25	0.25	0.25	0,5	0.25	0.25	0.25	0.25	0.25
OCDF	10.3	5.7	4.4	3.2	6,7	2.4	6.3	6.9	8.3	5.3
2378-TCDD	0.05	0.05	0.05	0.05	0,05	0.05	0.05	0.05	0.05	0.05
12378-PeCDD	0.25	0.25	0.25	0.25	0,25	1.1	0.25	0.25	0.25	0.25
123478-HxCDD	0.25	0.25	0.25	0.25	0,25	0.8	0.25	0.25	0.25	0.25
123678-HxCDD	0.6	0.5	0.25	0.25	0,7	0.25	0.25	0.25	0.5	0.25
123789-HxCDD	0.25	0.25	0.25	0.25	0,8	0.7	0.25	0.25	0.25	0.25
1234678-HpCDD	6.8	2.9	1.8	3.8	7,3	1.4	5.7	2.8	4	5.1
OCDD	37	14.1	13.5	42	54	2.1	31	19.6	16.4	35
I-TEQ (NATO/CCMS) (NR=LR/2)	**2.14**	**1.18**	**0.71**	**1.43**	**1,47**	**1.42**	**0.74**	**0.71**	**0.64**	**1.15**
ΣPCDD/F	72.1	34.45	27.4	59.3	82.7	16.05	50.75	38.45	36.9	54.8
PCDD/F/I-TEQ	33.66	29.27	38.60	41.40	56.46	11.29	68.83	54.04	58.05	47.64
PCDD/PCDF	1.68	1.13	1.48	3.76	3.27	0.66	2.90	1.56	1.43	3.01
Dry matter (%)	63.9	75.6	82.9	75.5	74.9	80.9	67.2	66.6	75.4	78.1

Tab.1c: PCDD/F's soils concentrations in monitoring campaigns.

Regarding the relationship between PCDDs and PCDFs, PCDDs prevail to PCDFs in almost all sites, with a ratio ranging between 12.31 and 0.62. There are some differences: the area of Terlago (public park, biotope "Terlago") presents a ratio PCDD/PCDF between 3 and 6, which drops to 0.96 in the sample collected at the biotope "Laghi e abisso di Lamar", while for the zones of Lavis and Zambana values of the ratio PCDD/PCDF in the order of 8 - 11 are found. With regard to the soil collected at the playground of Cadine it presents a higher ratio, equal to 12.31, which is different from other sites. Also as regards the ratio PCDD/F and toxicity equivalent (PCDD-F/I-TEQ) there is an abnormality with regard to the site mentioned above for which this ratio is 226.60, then with a toxic content less consistent, while for the other sites it is between 11.29 and 123.51. As also confirmed by the analysis of congeners is deduced that this site is characterized by the presence of PCDD/F which is not comparable to that of other sites, such typicality can be traced to the use of land added recently (DICA, 2007).

The analysis of the toxic congeners and homologues shows how the profiles are similar for almost all sites, except the sample taken in the biotope "Laghi e abisso di Lamar". This sample is the only one with almost all the PCDF values above the detection threshold, and this can be the reason for a profile that differs substantially from the other samples that have modeled values, both for PCDD and PCDF, below the threshold of detection with the exception of the compounds 1,2,3,4,6,7,8-HpCDF and OCDF (DICA, 2010).

The results of the ten soils samples collected during spring 2012 in Borgo Valsugana show values in the same order of magnitude of the results obtained in the others characterized areas of Trento's province (as it can be seen in Tab.1c) and with the samples collected by the Provincial Agency of Environmental Protection in Valsugana valley and Trento surroundings during winter 2009 (the results of this monitoring campaign is shown in Tab.2 (APPA, 2010).

Location	I-TEQ (NATO/CCMS) (NR=LR/2) ng $kg_{d.w.}^{-1}$	ΣPCDD/F ng $kg_{d.w.}^{-1}$	PCDD/F/I-TEQ ng $kg_{d.w.}^{-1}$	PCDD/PCDF ng $kg_{d.w.}^{-1}$
1 – Borgo Valsugana	0.28	19.8	70.44	1.13
2– Borgo Valsugana	0.76	35.1	46.35	0.71
3 – Borgo Valsugana	2.12	84.3	39.79	0.79
4 – Borgo Valsugana	0.34	27.0	80.29	1.78
5 – Borgo Valsugana	0.61	29.7	48.95	0.49
6 – Borgo Valsugana	0.11	16.4	143.86	1.31
7 – Borgo Valsugana	0.29	30.2	105.37	1.72
8 – Borgo Valsugana*	-	-	-	-
9 – Borgo Valsugana	0.84	110.1	131.34	3.03
10 – Borgo Valsugana (Olle)	2.78	322.9	116.29	0.43
11 – Ronchi	1.78	68.9	38.72	1.03
12 – Torcegno	0.15	12.1	81.81	1.47
13 – Telve	0.28	30.1	108.08	0.93
14 – Telve*	-	-	-	-
15 – Castelnuovo	0.18	20.4	113.02	2.19
16 – Castelnuovo	0.14	21.1	154.81	1.51
17 – Villa Agnedo	4.01	258.3	64.43	0.27
18 – Ospedaletto	0.43	53.5	125.62	1.36
19 – Grigno	0.43	37.8	87.83	0.73

20 – Grigno	0.66	61.9	93.52	1.22
21 – Centa San Nicolò	2.02	135.6	67.06	1.51
22 - Roncegno	2.22	235.5	106.07	5.21
23 - Roncegno	1.24	133.1	107.32	0.43
24 – Levico	0.71	42.0	59.11	1.56
25 – Levico	0.68	47.6	70.00	1.02
26 – Pergine	0.76	30.6	40.54	1.23
27 – Pergine	0.34	20.6	60.95	0.93
28 – Trento	0.86	79.3	92.65	4.29
29 – Trento	0.58	54.0	93.17	1.19
*8 – 14: unreliable data				

Tab.2: PCDD/F's soils concentrations in APPA monitoring campaigns (APPA, 2010).

5. CONCLUSIONS

The monitoring campaigns carried out during the years (from 2002 to 2012) in the province of Trento show values of PCDD/F in soils relatively low, both in areas close to industrial plants (Borgo Valsugana, Lavis), both in the areas of environmental protection, such as natural habitats areas and in recreational facilities areas (public parks). No critical situation was found; the margins under the limit required by law for soils in residential areas are adequately high.

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