Biomonitoring research dioxins eggs backyard chicken Beringen, Belgium 2022

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Client: Stadsbestuur Beringen
Thanks to hobby chicken keepers in Beringen
Leefbaar Tervant for the initial recommendation for the biomonitoring study in Beringen

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Acronyms

APCD	Air Pollution Control Devices
BAT	Best Available Techniques
BEP	Best Environmental Practice
BEQ	Bioanalytical EQuivalents
BFR	Brominated Flame Retardants = Gebromeerde vlamvertragers
BMI	Body Mass Index
BREF	Best Available Techniques (BAT) Reference Document for Waste Incineration
BBT	Best Beschikbare Technieken
dl-PCB	Dioxin-Like Polychlorinated Biphenyls
DR CALUX®	Dioxin Responsive Chemical-Activated LUciferase gene eXpression
EFSA	European Food and Safety Authority
GC-MS	Gas Chromatography Mass Spectrometry GC-MS
GenX	Group of fluorochemicals related to of hexafluoropropylene oxide dimer acid (HFPO-DA)
i-PCB	Indicator Polychlorinated Biphenyl
LB	Lower Bound; GC-MS-waarden onder de detectielimiet (LOD) worden op nul gezet
LOD	Limit of Detection
LOQ	Limit of Quantification
MB	Medium Bound; GC-MS-waarden onder de detectielimiet (LOD) worden op 50% van de detectielimiet gezet
MWI	Medical Waste Incineration
MSWI	Municipal Solid Waste Incineration
ndl-PCB	Non-Dioxin-Like Polychlorinated Biphenyl (Non-Dioxin-Like PCB)
ng	Nanogram; 10^{-9} gram
OTNOC	Other Than Normal Operating Conditions
PAH	Polycyclic Aromatic Hydrocarbons, NL: Polycyclische Aromatische Koolwaterstoffen (PAK)
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated Dibenzodioxins
PCDF	Polychlorinated Dibenzofurans
PBDD/F	Polybrominated-dibenzodioxinen/furanen
pg	Picogram; 10^{-12} gram
POP	Persistent Organic Pollutants
SVHC	Substances of Very High Concern
TCDD	2,3,7,8-tetrachloordibenzo-*p*-dioxine
TDI	Tolerable Daily Intake = Aanvaardbare Dagelijkse Inname
TEF	Toxic Equivalency Factor
TEQ	Toxic Equivalents
TW	ToxicoWatch
TWI	Tolerable Weekly Intake = Aanvaardbare Wekelijkse Inname
UB	Upper Bound (UB), GC-MS: waarden onder de detectielimiet (LOD) worden berekend met de waarde van de detectielimiet i.t.t. lowerbound (LB) waarbij waardes onder de detectielimiet als nul worden genoteerd.
UPOP	Unintentional POP (Persistent Organic Polutants)
µg	Microgram 10^{-3} gram
WtE	Waste to Energy (waste incinerator), WtE afvalverbrander
ZZS	Zeer Zorgwekkende Stoffen

Acronyms	Dioxins, furans (PCDD/F), dioxin-like PCBs (dl-PCB)	Toxic Equivalentie Factor
	Congeners	TEF
Dioxins (n=7)		
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1
PCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1
HxCDD1	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0,1
HxCDD2	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0,1
HxCDD3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0,1
HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0,01
OCDD	Octachlorodibenzo-p-dioxin	0,0003
Furans (n=10)		
TCDF	2,3,7,8-Tetrachlorodibenzofuran	0,1
PCDF1	1,2,3,7,8-Pentachlorodibenzofuran	0,03
PCDF2	2,3,4,7,8-Pentachlorodibenzofuran	0,3
HxCDF1	1,2,3,4,7,8-Hexachlorodibenzofuran	0,1
HxCDF2	1,2,3,6,7,8-Hexachlorodibenzofuran	0,1
HxCDF3	1,2,3,7,8,9-Hexachlorodibenzofuran	0,1
HxCDF4	2,3,4,6,7,8-Hexachlorodibenzofuran	0,1
HPCDF1	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0,01
HPCDF2	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0,01
OCDF	Octachlorodibenzofuran	0,0003
Polychlorinated biphenyl (n=12)		
PCB77	3,3',4,4'-Tetrachlorobiphenyl (#77)	0,0001
PCB81	3,4,4',5-Tetrachlorobiphenyl (#81)	0,0003
PCB126	3,3',4,4',5-Pentachlorobiphenyl (#126)	0,1
PCB169	3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	0,03
PCB105	2,3,3',4,4'-Pentachlorobiphenyl (#105)	0,00003
PCB114	2,3,4,4',5-Pentachlorobiphenyl (#114)	0,00003
PCB118	2,3',4,4',5-Pentachlorobiphenyl (#118)	0,00003
PCB123	2,3,4,4',5-Pentachlorobiphenyl (#123)	0,00003
PCB156	2,3,3',4,4',5-Hexachlorobiphenyl (#156)	0,00003
PCB157	2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	0,00003
PCB167	2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	0,00003
PCB189	2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	0,00003

Colour codes

EU limit analyse resultaten dioxinen & TW indicatieve schalen

EU Limiet GC-MS	
GC-MS (MB)	
PCDD/F	≥ 1.75
PCDD/F	≥ 2.5
dl-PCB	≥ 1.75
PCDD/F/dl-PCB	≥ 5.0

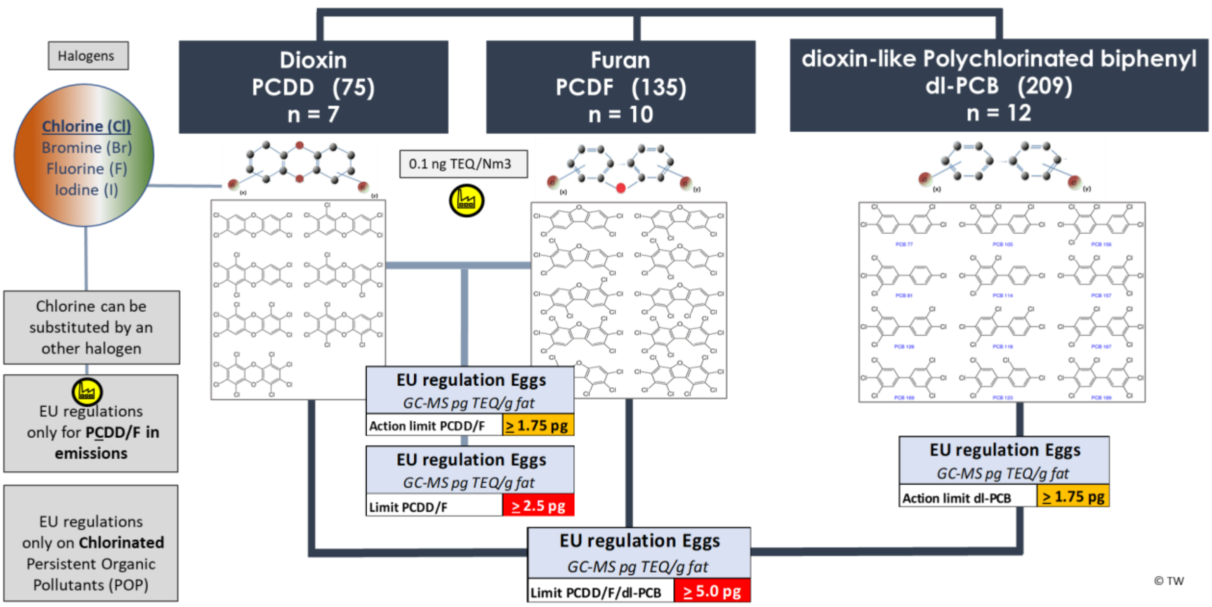
TW Indicatieve schaal voor eieren (GC-MS)	
pg TEQ /g fat	
PCDD/F/dl-PCB	**PCDD/F**
≥ 15.0	≥ 7.5
≥ 10.0	≥ 5.0
≥ 5.0	≥ 2.5
< 5.0	< 2.5

TW Indicatieve schaal
Verhoging %
≥ 500 %
≥ 300 %
≥ 200 %
≥ 100 %
< 100 %

EU Limiet bioassay DR CALUX	
DR CALUX	
PCDD/F	≥ 1.7
dl-PCB	
PCDD/F/dl-PCB	≥ 3.3

TW Indicatieve schaal voor eieren (DR CALUX)	
pg BEQ /g fat	
PCDD/F/dl-PCB	**PCDD/F**
≥ 10	≥ 6.6
≥ 6.6	≥ 3.3
≥ 3.3	≥ 1.7
< 3.3	< 1.7

EU regulations for dioxins (PCDD/F/dl-PCB)



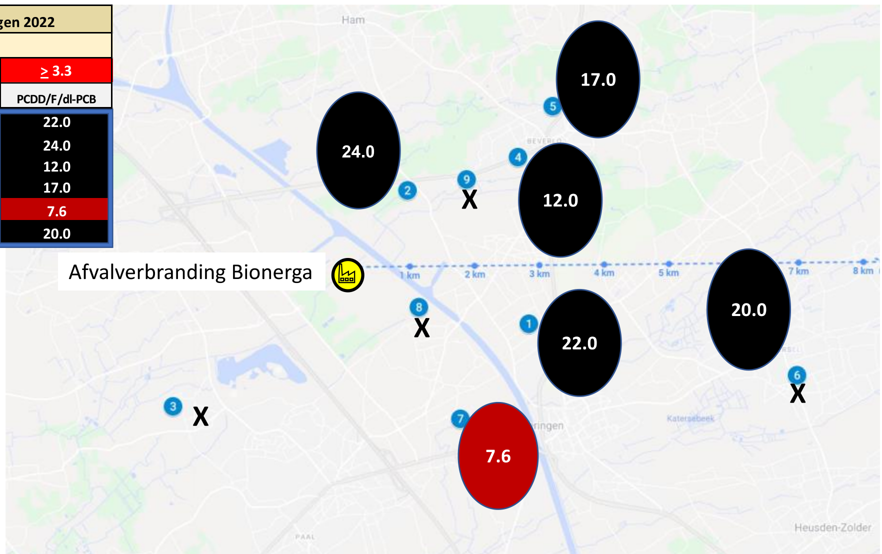
Results of biomonitoring research Beringen 2022

The TW Biomonitoring survey in chicken eggs in Beringen, 2022 shows significant elevations of dioxins (PCDD/F) and dioxin-like PCBs (dl-PCB), Figure 1. This study is the third year of the biomonitoring programme in Beringen. It started in 2019 before the WtE waste incinerator Biostoom/Bionerga went into production. In 2022, a broad spectrum of elevated dioxin congeners is observed at all sites.

- All six (6) chicken egg sites measure elevated dioxins (PCDD/F/dl-PCB), with both DR CALUX bioassay analysis and chemical (GC-MS) analysis.
- One hundred per cent (100%) of chicken eggs do not meet the EU dioxin standard with the DR CALUX analysis.
- Analyses by DR CALUX show 50% of sites have very high dioxin values of >20 pg BEQ/g fat.
- Chemical analysis of dioxins shows 5 out of 6 eggs above the EU standard of 5 pg TEQ/g.
- One site, most near, shows a strong increase of 756% Heptachlorodibenzofuran (HpCDF1), a typical combustion-related congener and also identified in the flue gases of Bionerga.

Resultaten DR CALUX dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen, 2022

Resultaten dioxinen Kippeneieren, Beringen 2022			
DR CALUX			
EU limiet	≥ 1.7		≥ 3.3
locaties	PCDD/F	dl-PCB	PCDD/F/dl-PCB
BE-1	15.0	7.0	22.0
BE-2	15.0	9.0	24.0
BE-4	8.5	3.5	12.0
BE-5	13.0	4.0	17.0
BE-7	5.2	2.4	7.6
BE-10	15.0	5.0	20.0



TW Indicative scale for Eggs (DR CALUX)	
pg BEQ /g fat	
PCDD/F/dl-PCB	PCDD/F
≥ 10	≥ 6.6
≥ 6.6	≥ 3.3
≥ 3.3	≥ 1.7

Figure 1: Resultaten dioxinen (PCDD/F/dl-PCB) in eieren 2022

Introduction

The complexity of the chemical composition of household and industrial waste today poses a challenge to convert it into applicable renewable energy for (WtE) waste incinerators, among others. However, the inevitable emissions of toxic substances of very high concern (PHS) from waste incinerators with deposition into the environment is an intensive research field. This biomonitoring study focuses on dioxins (PCDD/D/dl-PCB) deposition into the environment at a waste incineration plant.

There is public concern about the potentially toxic effects of dioxins on human health and the environment, especially where people live near waste incinerators and industries. The concern is justified as the health risks, and short- and long-term exposure from emissions of dioxins are well-founded given the many studies in this field. Dioxins are highly toxic substances with risks of serious damage to human health, biodiversity, and the environment. These toxic substances cause a wide range of human diseases such as chloracne, various cancers, diseases related to endocrine disruption, impairment of the nervous system and impairment of the immune system. Dioxins are generated as by-products in many industrial processes, during thermal treatment (burning) of chlorinated and brominated materials, plastics, impregnated wood, or pesticides.

Bionerga NV, Beringen processes 200,000 tonnes a year of non-hazardous and non-recyclable waste, Figure 2. This includes household, industrial as well as non-hazardous hospital waste. The plant can burn biomass, biomass waste, uncontaminated treated wood waste, other non-hazardous waste, and non-hazardous sludge in limited quantities. The plant is operational 24/7.

The first measurements of the TW biomonitoring study with chicken eggs took place in October 2019, before the Bionerga waste incinerator was operational, a so-called baseline measurement. In this first biomonitoring study, high levels of dioxins had already been detected at several sample locations. This report presents the survey results of the 2022 biomonitoring survey.

Figure 2: Waste incinerator Biostoom Beringen, Belgium, source: biostoomberingen.be

Methods of analysis

Bioassay DR CALUX®

The bioassay DR CALUX® (Dioxin Responsive Chemical Activated LUciferase gene eXpression) is used for the quantification of dioxins/furans (PCDD/F) and dioxin-like PCBs (dl-PCBs). The results in this study using DR CALUX® for analyses of dioxins (PCDD/F/dl-PCBs) in eggs are expressed in Bioassay Equivalent, BEQ (pg BEQ/g fat). The term "BEQ" is used for food elements to distinguish Toxic Equivalence (TEQ) derived from chemical analyses (gas chromatography-mass spectrometry GC-MS, pg TEQ/g fat). For non-food biomatrices, such as vegetation like mosses or pine needles, the results are expressed with the DR CALUX abbreviated as TCDD eq./g product. TCDD stands for 2,3,7,8-Tetrachlorodibenzo-p-dioxin, the most toxic dioxin congener, see Figure 5, page 10.

COMMISSION REGULATION (EU) 2017/644 of 5 April 2017, on methods of sampling and analysis for the monitoring of levels of dioxins, dioxin-like PCBs, and non-dioxin-like PCBs in certain foodstuffs, is the latest EU Regulation 1881/2006 in force. The regulation sets maximum levels for dioxins (PCDD/F/dl-PCB) in foodstuffs. Recommendations 2013/711/EU, update 2017/644, set the cut-off values of the DR CALUX analysis. If the bioassay analysis for PCDD/F exceeds 1.7 pg BEQ/g fat and for the sum of dioxins PCDD/F/dl-PCB 3.3 pg BEQ/g fat, a GC-MS analysis of the egg sample should be performed to establish the results, as stated in EU 1881/2006.

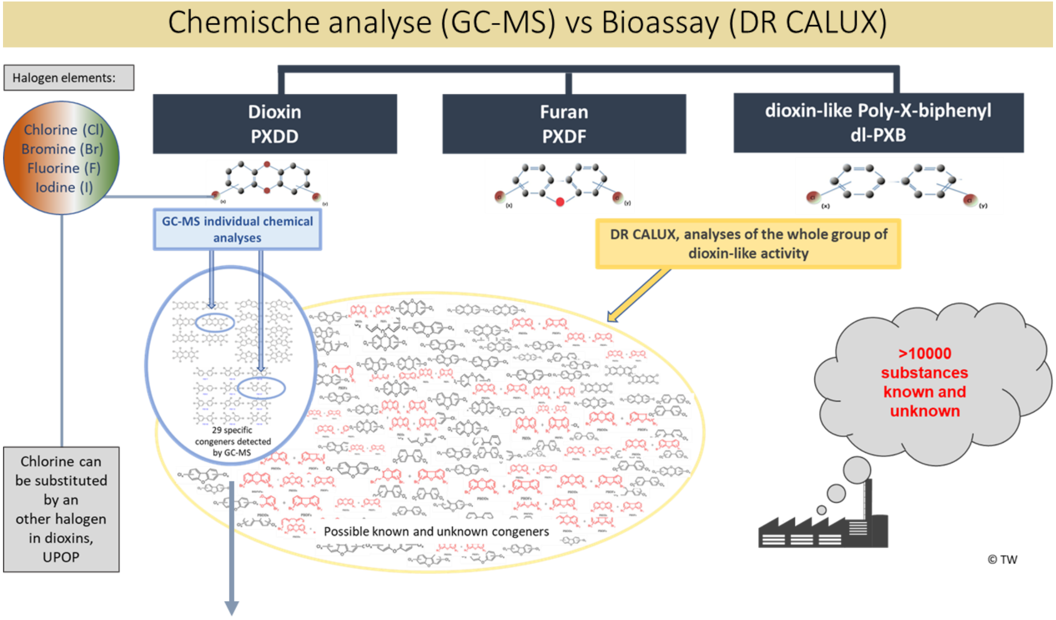
Chemical analysis, GC-MS

The limits for eggs with GC-MS chemical analyses are expressed in pg TEQ/g. Seven dioxins (PCDDs), 10 furans (PCDFs) and 12 dioxin-like polychlorinated biphenyls (dl-PCBs) will be analysed, page 10. The concentration results of the chemical analyses of dioxins (PCDD/F/dl-PCBs) will be calculated with a specific toxic equivalency factor (TEF) to a TEQ value (see page 5 of Abbreviation and TEF for dioxins and dl-PCBs). The limit for dioxins in eggs is 2.5 pg TEQ/g fat for PCDD/F and for the sum of dioxins and dioxin-like PCBs (PCDD/F/dl-PCBs), the limit is set at 5 pg TEQ/gram fat. When these GC-MS limits are exceeded, chicken eggs may not be placed on the market (see Figure 2, p.6).

2013/711/EU contains the GC-MS action thresholds for both dioxins (PCDD/F) and dioxin-like PCBs (dl-PCBs) in chicken eggs, set at 1.75 pg TEQ/g fat. These action thresholds are a tool for competent authorities and operators to identify cases where it is appropriate to identify a source of contamination and take measures to reduce or eliminate it.

EU and regulatory dioxins and chicken eggs

Figures 3 and 4 below explain the bioassay (DR CALUX)) and GC-MS chemical analyses for dioxins (PCDD/F/dl-PCB) related to the EU regulation on dioxins in eggs.



Congeners of chlorinated compounds (chemical GC-MS analysis)

Dioxins, furans (PCDD/F) and dioxin-like PCBs		
Abbreviation	Congeners	TEF
Dioxins (n=7)		
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1
PCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1
HxCDD1	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0,1
HxCDD2	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0,1
HxCDD3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0,1
HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0,01
OCDD	Octachlorodibenzo-p-dioxin	0,0003

Furans (n=10)		
TCDF	2,3,7,8-Tetrachlorodibenzofuran	0,1
PCDF1	1,2,3,7,8-Pentachlorodibenzofuran	0,03
PCDF2	2,3,4,7,8-Pentachlorodibenzofuran	0,3
HxCDF1	1,2,3,4,7,8-Hexachlorodibenzofuran	0,1
HxCDF2	1,2,3,6,7,8-Hexachlorodibenzofuran	0,1
HxCDF3	1,2,3,7,8,9-Hexachlorodibenzofuran	0,1
HxCDF4	2,3,4,6,7,8-Hexachlorodibenzofuran	0,1
HPCDF1	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0,01
HPCDF2	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0,01
OCDF	Octachlorodibenzofuran	0,0003

Polychlorinated biphenyl (n=12)		
PCB77	3,3',4,4'-Tetrachlorobiphenyl (#77)	0,0001
PCB81	3,4,4',5-Tetrachlorobiphenyl (#81)	0,0003
PCB126	3,3',4,4',5-Pentachlorobiphenyl (#126)	0,1
PCB169	3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	0,03
PCB105	2,3,3',4,4'-Pentachlorobiphenyl (#105)	0,00003
PCB114	2,3,4,4',5-Pentachlorobiphenyl (#114)	0,00003
PCB118	2,3',4,4',5-Pentachlorobiphenyl (#118)	0,00003
PCB123	2,3,4,4',5-Pentachlorobiphenyl (#123)	0,00003
PCB156	2,3,3',4,4',5-Hexachlorobiphenyl (#156)	0,00003
PCB157	2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	0,00003
PCB167	2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	0,00003
PCB189	2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	0,00003

Figure 4: Chemical analysis (GC-MS) vs bioassay (DR CALUX)

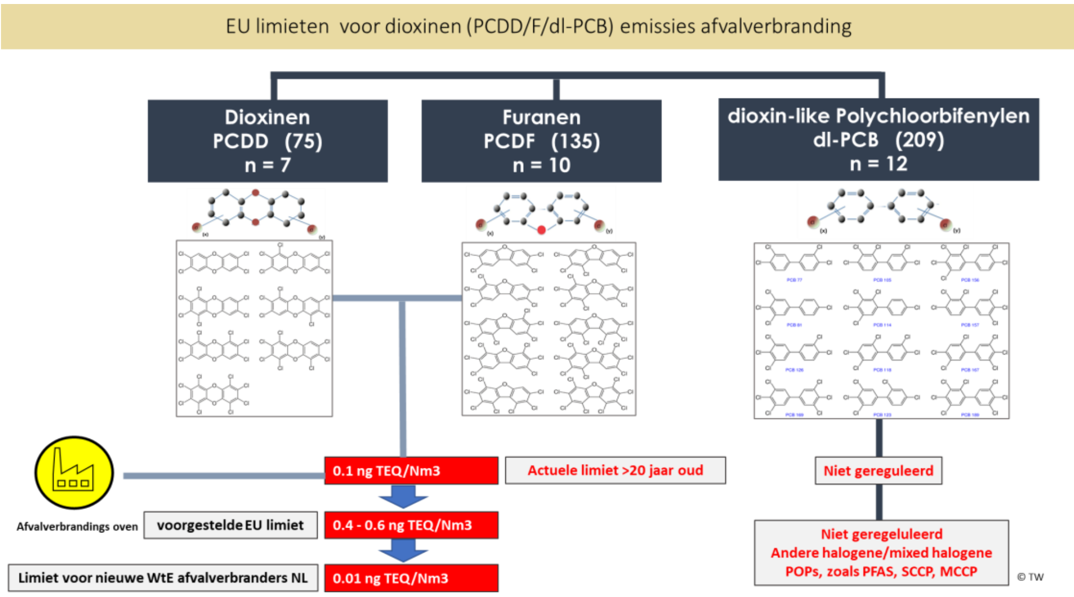


Figure 3: EU limits for dioxin (PCDD/F/dl-PCB) emissions in waste incineration

Acceptable tolerable intake of dioxins

In 2018, the European Food and Food Safety Authority (EFSA) recommended lowering the acceptable intake for dioxins by a factor of seven, see Figure 5. This recommendation is based on an extensive review of scientific literature. It also recommended more testing for dioxins in food. However, the EU decided not to adopt this advice, so the already >10-year-old limits for dioxins are continued (2011), see figure 6. It shows governments, industry, and the agricultural sector cannot or do not want to reduce dioxins. However, an adjustment of a stricter standard for dioxins in food, will put tension on the food industry.

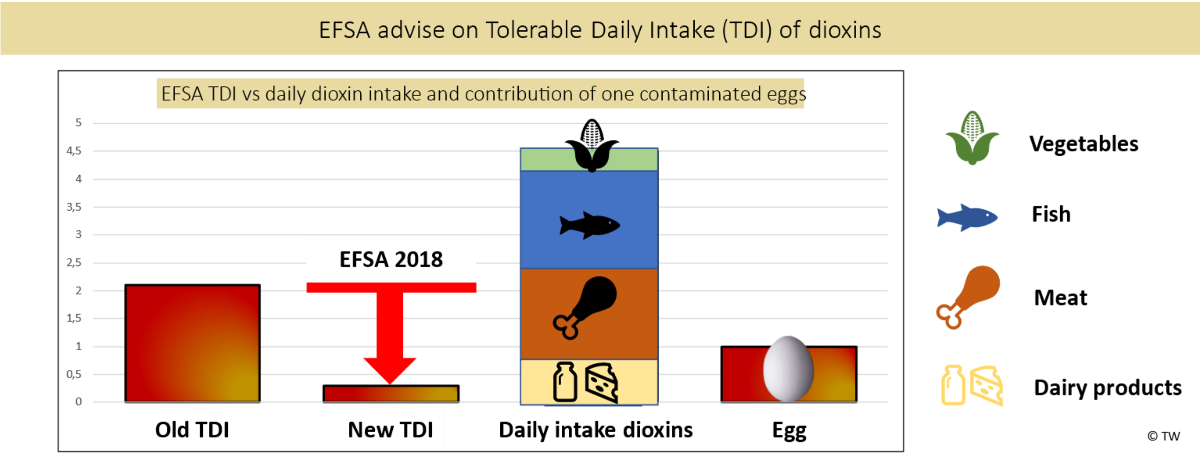


Figure 6: EFSA recommended acceptable daily intake of dioxins (ADI)

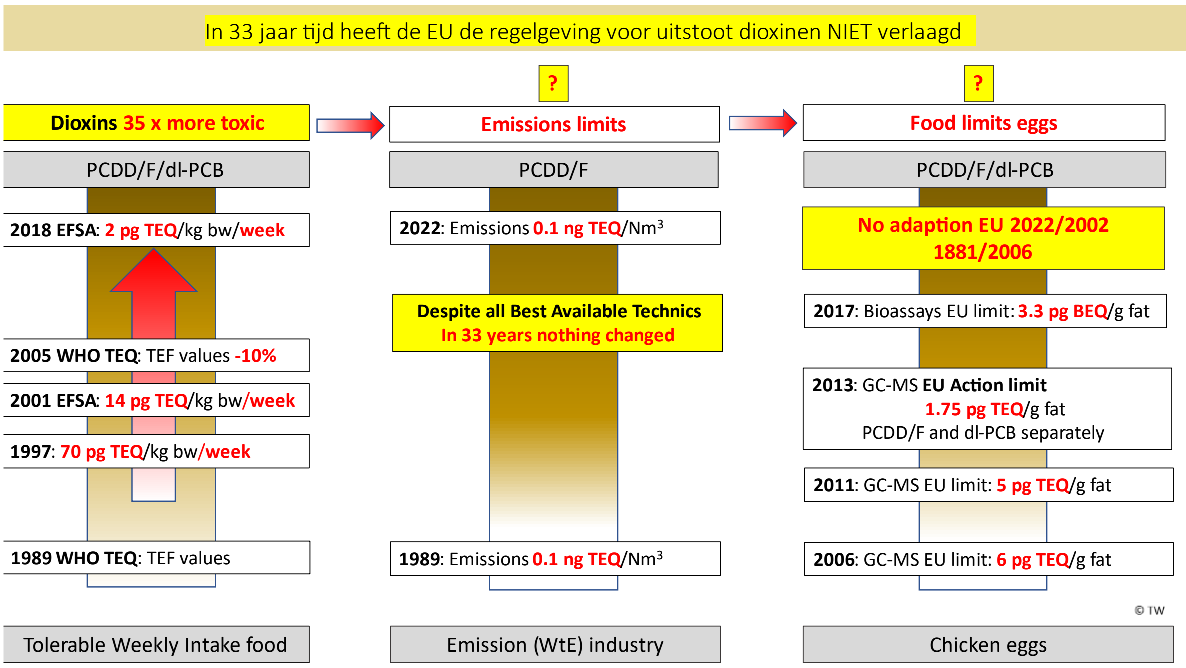


Figure 5: EFSA advice and EU regulations over the years

Sampling chicken eggs, Beringen, 2022

Sampling of hobby chicken eggs took place on 17 and 18 October 2022 at six (6) sites, Figure 7. Three 2019 and 2021 sites (BE-3, BE-6, BE-9) and one 2021 site (BE-8) could not participate in this biomonitoring study, for reasons that either the hens were no longer laying eggs, or the hens were still too young, and one site had stopped raising chickens. TW found one more location (BE-10) in Koersel willing to participate in this study. This location BE-10 has also visited TW in 2019 for possible participation in this multi-year study, replacing location BE-6 in Koersel in 2022. Some limited changes with the previous year occurred at the other sites. The questionnaire answered by hobby chicken keepers can be seen in Annex 1.

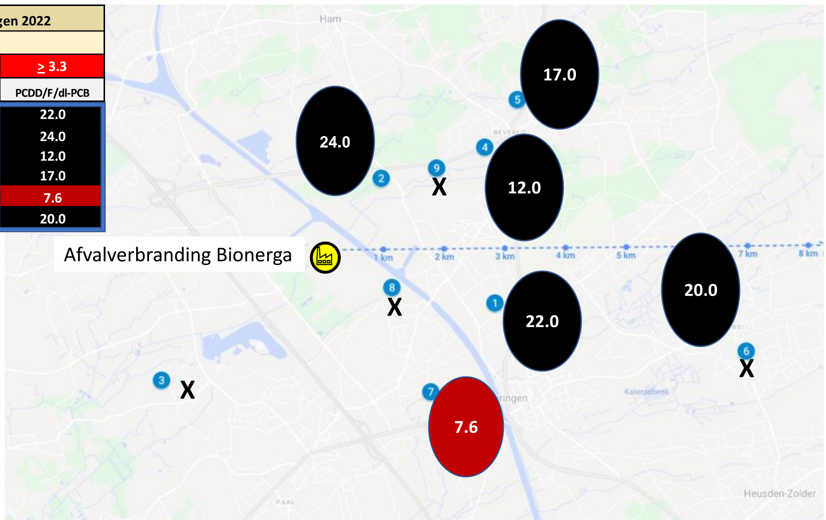
Figure 7: Sampling map eggs of backyard chickens on private properties, Beringen 2022

Dioxin analysis results DR CALUX chicken eggs

The results of dioxin values from the DR CALUX® bioassay analyses are shown in Figures 8 and 9. All six (6) have values above the action level of 3.3 pg BEQ/g fat for the sum of dioxins (PCDD/F/dl-PCB). In the figures, the degree of exceeding the EU limit is indicated with a TW indicative colour coding. When the action limit is exceeded by a factor of 2.3, this is indicated by red, dark red and black, respectively. See page 6 for the colour-coding table. In 2022, all sites exceed the EU limit by a factor of 2 to even 7 times the permitted EU limit for the sum of dioxins (PCDD/F/dl-PCB). These elevated values give cause - according to EU 709/2014 regulations - to carry out verification with a GC-MS analysis.

Resultaten DR CALUX dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen, 2022

Resultaten dioxinen Kippeneieren, Beringen 2022			
DR CALUX			
EU limiet	≥ 1.7		≥ 3.3
locaties	PCDD/F	dl-PCB	PCDD/F/dl-PCB
BE-1	15.0	7.0	22.0
BE-2	15.0	9.0	24.0
BE-4	8.5	3.5	12.0
BE-5	13.0	4.0	17.0
BE-7	5.2	2.4	7.6
BE-10	15.0	5.0	20.0

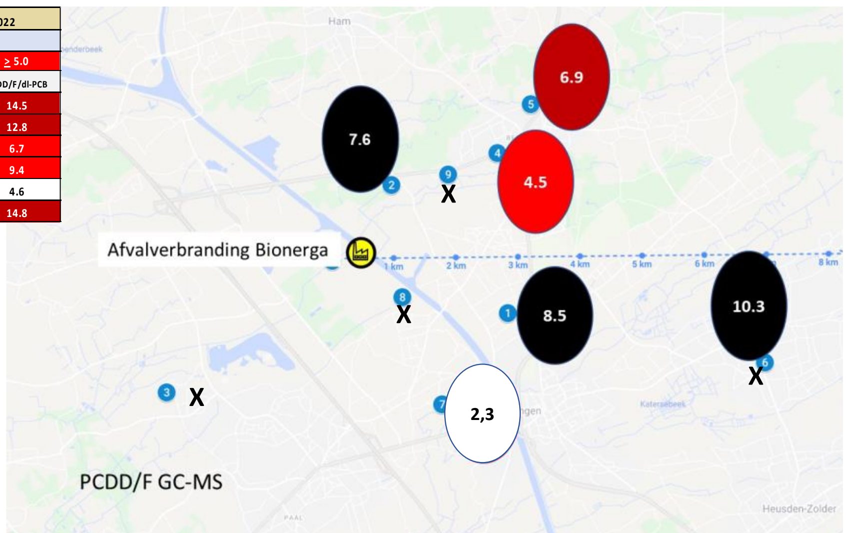


TW Indicative scale for Eggs (DR CALUX)	
pg BEQ /g fat	
PCDD/F/dl-PCB	PCDD/F
≥ 10	≥ 6.6
≥ 6.6	≥ 3.3
≥ 3.3	≥ 1.7

Figure 9: DR CALUX results for sum of dioxins (PCDD/F/dl-PCB) DR CALUX chicken eggs, Beringen - 2022

Resultaten GC-MS analyse dioxinen (PCDD/F) in kippeneieren, Beringen, 2022

Resultaten dioxinen Kippeneieren, Beringen 2022			
GC-MS			
EU limiet	≥ 2.5	≥ 1.75	≥ 5.0
locaties	PCDD/F	dl-PCB	PCDD/F/dl-PCB
BE-1	8.5	6.0	14.5
BE-2	7.6	5.2	12.8
BE-4	4.5	2.2	6.7
BE-5	6.9	2.5	9.4
BE-7	2.3	2.3	4.6
BE-10	10.3	4.5	14.8



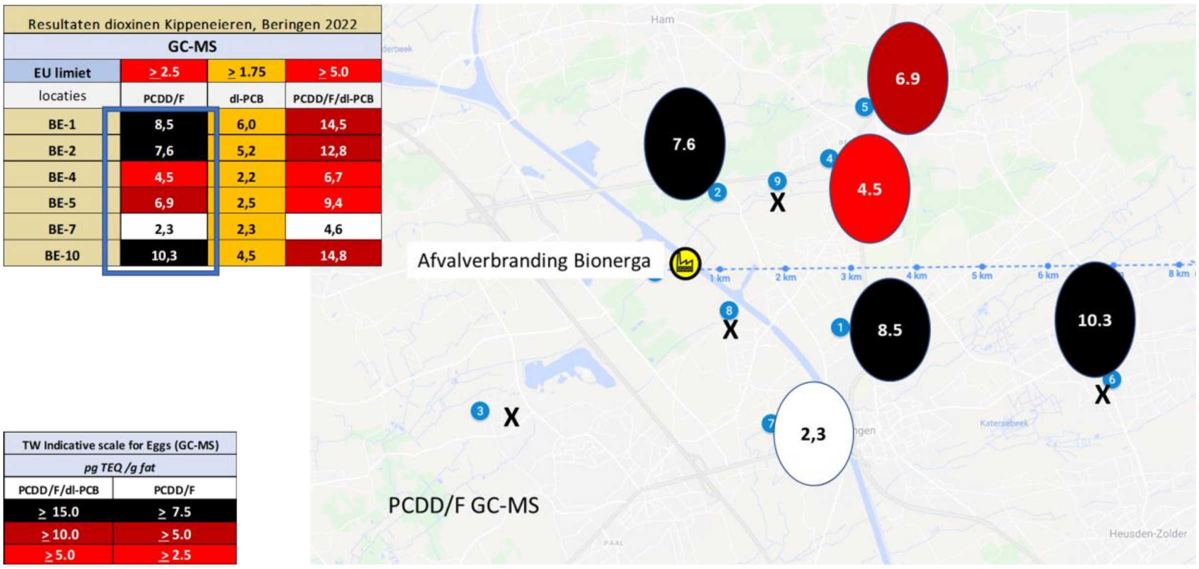
TW Indicative scale for Eggs (GC-MS)	
pg TEQ /g fat	
PCDD/F/dl-PCB	PCDD/F
≥ 15.0	≥ 7.5
≥ 10.0	≥ 5.0
≥ 5.0	≥ 2.5

Figure 8: Results DR CALUX for sum of dioxins (PCDD/F) DR CALUX chicken eggs, Beringen - 2022

Results of chemical dioxin analysis (GC-MS) chicken eggs

The chemical analyses with the GC-MS show values above the limit of 5 pg TEQ/g fat at 5 sites, as set by the European directives No 1259/2011 , see figure 10. One site meets the EU standard, although this only has a minimal margin of 0.4 pg TEQ.

Resultaten GC-MS analyse dioxinen (PCDD/F) in kippeneieren, Beringen, 2022



Resultaten dioxinen Kippeneieren, Beringen 2022			
	GC-MS		
EU limiet	≥ 2.5	≥ 1.75	≥ 5.0
locaties	PCDD/F	dl-PCB	PCDD/F/dl-PCB
BE-1	8,5	6,0	14,5
BE-2	7,6	5,2	12,8
BE-4	4,5	2,2	6,7
BE-5	6,9	2,5	9,4
BE-7	2,3	2,3	4,6
BE-10	10,3	4,5	14,8

TW Indicative scale for Eggs (GC-MS)	
pg TEQ /g fat	
PCDD/F/dl-PCB	PCDD/F
≥ 15.0	≥ 7.5
≥ 10.0	≥ 5.0
≥ 5.0	≥ 2.5

Figure 10: Results sum of dioxins (PCDD/F/dl-PCB) GC-MS analysis chicken eggs 2022

All 6 chicken egg sites are above the action level of 1.75 pg TEQ for PCDD/F and of dl-PCB. For the commercial circuit, specific measures apply to reduce dioxins in eggs with substantial measures (2011/516/EU). For the private circuit, it is up to the local authorities to act on this or not.

All sites have values above the GC-MS action level of 1.75 pg TEQ for dioxin-like PCB (dl-PCB). This implies that measures should be taken to trace the source of this toxic substance to reduce or eliminate dioxin-like PCB (dl-PCB) in eggs (2011/516/EU), Figure 11.

Figure 11: Results PCDD/F and dioxin-like PCB (dl-PCB) GC-MS analysis chicken eggs 2022

Increase and decrease of dioxins

Figure 12 below shows the relative increases and decreases of dioxins in Beringen in per cent. In the overview of 2022 compared to 2021, it can be seen, that all locations found elevated dioxin concentrations. In the overview compared to 2019, the difference is more pronounced mainly due to the increased dioxin results at site BE-2.

Toe- en afname dioxinen (PCDD/F/dl-PCB) in kippeneieren) , Beringen 2022

CALUX	BE-01	BE-02	BE-04	BE-05	BE-06/10	BE-07
Resultaten 2022 vs 2021						
PCDD/F	25%	36%	183%	63%	70%	68%
dl-PCB	133%	50%	133%	0%	-4%	20%
PCDD/F/dl-PCB	47%	41%	167%	42%	43%	49%
Resultaten 2022 vs 2019						
PCDD/F	36%	213%	-15%	-7%	178%	-27%
dl-PCB	133%	1186%		0%	213%	41%
PCDD/F/dl-PCB	57%	336%	20%	-6%	186%	-14%

GC-MS (MB)	BE-01	BE-02	BE-04	BE-05	BE-06/10	BE-07
Resultaten 2022 vs 2021						
PCDD/F	46%	17%	139%	73%	102%	21%
dl-PCB	28%	2%	56%	-24%	-23%	20%
PCDD/F/dl-PCB	38%	10%	104%	29%	35%	20%
Resultaten 2022 vs 2019						
PCDD/F	45%	274%	16%	-2%	198%	-43%
dl-PCB	43%	384%	-5%	-45%	71%	1%
PCDD/F/dl-PCB	45%	312%	8%	-19%	143%	-28%

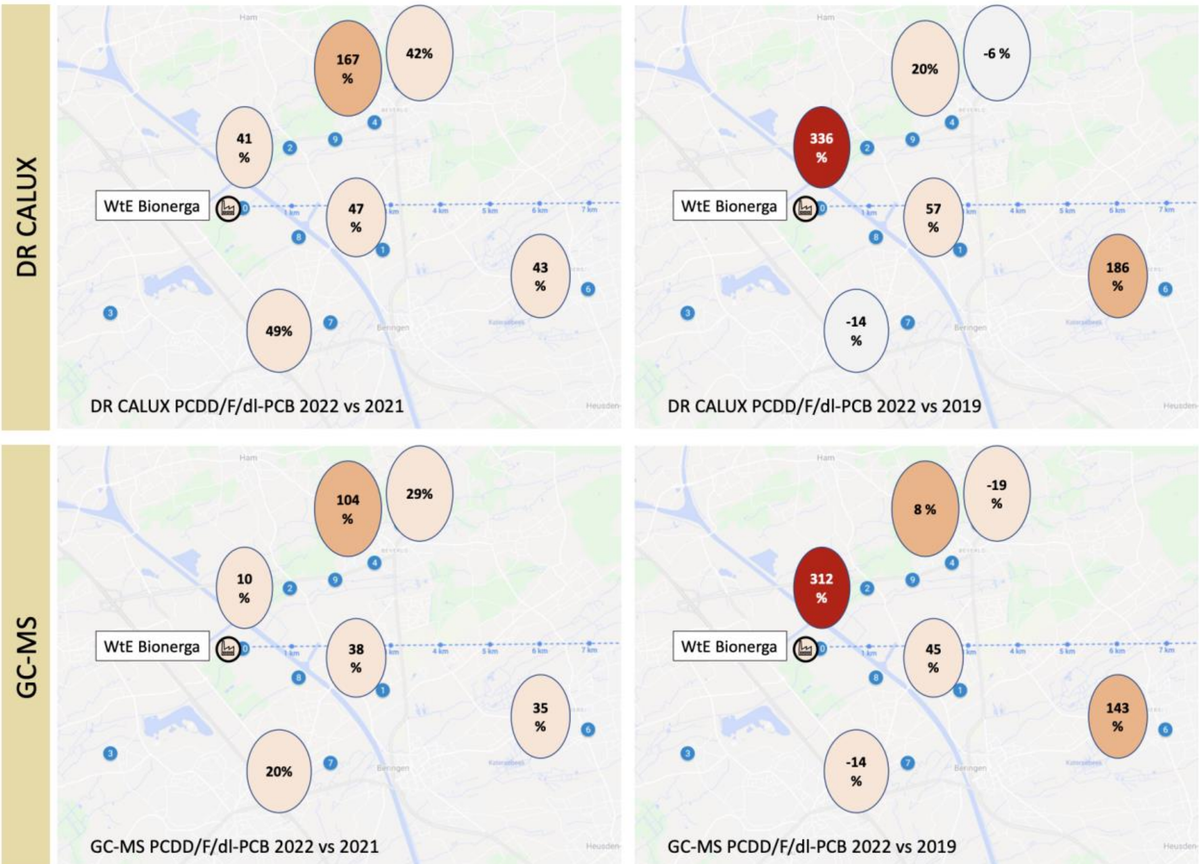


Figure 12: Increase and decrease in dioxins 2022.

Relative increases and decreases of dioxin congeners

Tables 1 and 2 below are given the increase and decrease in specific dioxin congeners per site in the different years. Compared to 2021, the results at sites BE-2, BE-6 and BE-10 are prominent. In 2022, at site BE-4, there is a strong increase of 329% of 2,3,7,8-Tetrachlorodibenzofuran and of 533% of 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin. In 2019, the launch of the Beringen biomonitoring study started here. And at this very site, after the reduction of dioxins in 2021, a remarkable increase was observed in 2022. Site BE-10 also stands out here, although no baseline measurements were taken here in 2019. Compared to the baseline measurement, site BE-2 has significantly increased by 318% - 569% of tetra- and penta- dioxins and furans. Site BE-1 shows an increase of 756% of 1,2,3,4,6,7,8-Heptachlorodibenzofuran. Noteworthy is the trend of increases in dioxins in 2022 compared to 2021.

Congeneren CS-MS analyse dioxinen in kippeneieren, Beringen, 2022

PCDD/F/dl-PCB congeneren in kippeneieren, Beringen – 2022 - 2021						
	BE-01	BE-02	BE-04	BE-05	BE-06/10	BE-07
TCDD	245%	4%			189%	
PCDD	173%	110%	194%	100%	227%	108%
HxCDD1	7%	-60%	211%	8%	86%	76%
HxCDD2	-31%	-15%	176%	75%	150%	121%
HxCDD3	-16%	-15%	533%	43%	374%	-17%
HpCDD	29%	25%	69%	228%	770%	257%
OCDD	-32%	-51%	68%	164%	381%	16%
TCDF	140%	130%	329%	74%	53%	100%
PCDF1	52%	27%	123%	77%	79%	43%
PCDF2	15%	88%	155%	63%	6%	-19%
HxCDF1	15%	-36%	64%	173%	28%	93%
HxCDF2	-24%	-71%	0%	16%	-12%	-60%
HxCDF3						
HxCDF4	-34%	-32%	264%	58%	190%	9%
HPCDF1	15%	-79%	-65%	9%	-41%	-47%
HPCDF2		34%	-80%	253%	168%	-85%
OCDF	41%	-63%	-6%	283%	241%	47%

PCDD/F/dl-PCB congeneren in kippeneieren, Beringen – 2022 - 2019						
	BE-01	BE-02	BE-04	BE-05	BE-06/10	BE-07
TCDD	26%	318%	129%		119%	
PCDD	69%	375%	-15%	-4%	246%	-50%
HxCDD1	29%	60%	-33%	-27%	285%	-33%
HxCDD2	41%	99%	166%	-6%	387%	5%
HxCDD3	16%	115%	83%	23%	498%	-45%
HpCDD	46%	27%	3%	115%	512%	-66%
OCDD	95%	33%	120%	164%	540%	-64%
TCDF	4%	545%	0%	-40%	79%	-11%
PCDF1	19%	493%	16%	9%	182%	-18%
PCDF2	8%	569%	-9%	-13%	118%	-57%
HxCDF1	35%	95%	-30%	73%	81%	-35%
HxCDF2	118%	142%	-5%	39%	131%	-48%
HxCDF3						
HxCDF4	16%	90%	46%	41%	375%	-47%
HPCDF1	756%	62%	30%	68%	164%	-65%
HPCDF2		338%	-43%	108%	278%	-69%
OCDF	76%	26%	-13%	125%	564%	-76%

Table 1: PCDD/F congeners 2022 (colour coding see page 6)

For comparison, here are last year's results compared to 2019 where the waste incinerator was not yet operational.

PCDD/F congeneren in kippeneieren, Beringen – 2021 - 2019								
	BE-01	BE-02	BE-03	BE-04	BE-05	BE-06	BE-07	BE-08/09
TCDD	-64%	302%				-24%		-82%
PCDD	-38%	126%	39%	-71%	-52%	6%	-76%	-94%
HxCDD1	21%	304%	49%	-78%	-33%	107%	-62%	-80%
HxCDD2	105%	134%	168%	-3%	-46%	95%	-53%	-63%
HxCDD3	38%	153%	69%	-71%	-14%	26%	-34%	-81%
HpCDD	14%	2%	98%	-39%	-35%	-30%	-90%	-66%
OCDD	186%	169%	115%	31%	0%	33%	-69%	31%
TCDF	-57%	180%	73%	-77%	-66%	17%	-55%	-66%
PCDF1	-21%	368%	358%	-48%	-38%	58%	-43%	-63%
PCDF2	-6%	256%	93%	-64%	-47%	106%	-47%	-58%
HxCDF1	17%	205%	149%	-57%	-37%	42%	-66%	-48%
HxCDF2	187%	722%	154%	-5%	20%	163%	30%	23%
HxCDF3								
HxCDF4	77%	180%	254%	-60%	-10%	64%	-51%	-34%
HPCDF1	643%	668%	458%	267%	54%	349%	-34%	59%
HPCDF2	60%	227%		184%	-41%	41%	105%	-51%
OCDF	25%	243%		-8%	-41%	95%	-83%	-73%

Table 2: PCDD/F congeneren 2021 - 2019

Biomonitoring by site

BE-1 (Beringen)

In the centre of Beringen, next to the old site of the Beringen town hall, the first chicken site is situated. This is a parcel with a small piece of forest and a vegetable garden for their own use. The chickens can freely forage in an area of around 800 square metres. Further information about this site can be found in the Annex.

Locatie BE-1: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

BE-01							
		2019	2021	2022	21 vs 19	22 vs 19	22 vs 21
GC-MS (MB)							
PCDD/F / **EU-Actiewaarde**	**≥ 1.75**						
PCDD/F / **EU-Limiet**	**≥ 2.5**	**5,8**	**5,8**	**8,5**	**0%**	**45%**	**46%**
dl-PCB / **EU-Actiewaarde**	**≥ 1.75**	**4,2**	**4,7**	**6,0**	**12%**	**43%**	**28%**
PCDD/F/dl-PCB / **EU-Limiet**	**≥ 5.0**	**10,0**	**10,5**	**14,5**	**5%**	**45%**	**38%**
DR CALUX							
PCDD/F / **EU-Limiet**	**≥ 1.7**	**11,0**	**12,0**	**15,0**	**9%**	**36%**	**25%**
dl-PCB		**3,0**	**3,0**	**7,0**	**0%**	**133%**	**133%**
PCDD/F/dl-PCB / **EU-Limiet**	**≥ 3.3**	**14,0**	**15,0**	**22,0**	**7%**	**57%**	**47%**

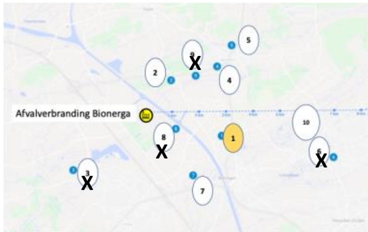


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Figure 13: Location BE-1: Dioxins (PCDD/F) in chicken eggs, Beringen - 2022

Figure 14 plots the results by year. The graph shows the EU limits for commercial chicken eggs for PCDD/F and the sum of PCDD/F/dl-PCB. The dioxins (PCDD/F) account for the majority of these exceedances.

Locatie BE-1: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

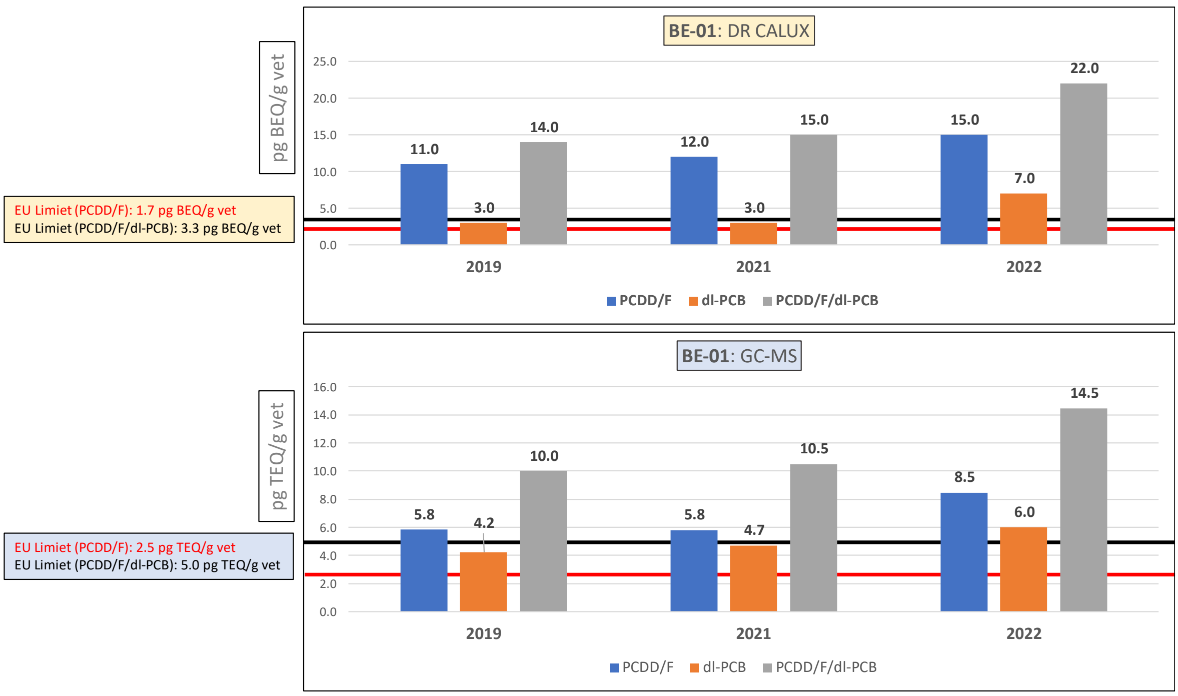

Figure 14: Location BE-1: Dioxins (PCDD/F/dl-PCB) in chicken eggs, Beringen - Beringen - 2022

At the congener level, there is a remarkable increase of 2,3,7,8-Tetrachlorodibenzo-p-dioxin, 1,2,3,7,8-Pentachlorodibenzo-p-dioxin and 2,3,7,8-Tetrachlorodibenzofuran compared to 2021, see Figure 15. Compared to 2019, the sharp increase of 1,2,3,4,6,7,8-heptachlorodibenzofuran by 634% - 756% is especially remarkable.

	BE-01					
Congeneren concentraties	**2019**	**2021**	**2022**	19 vs 21	19 vs 22	21 vs 22
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.61	0.22	0.76	-64%	26%	245%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.78	1.10	3.00	-38%	69%	173%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.16	1.40	1.50	21%	29%	7%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	4.40	9.00	6.20	105%	41%	-31%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.38	1.90	1.60	38%	16%	-16%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	12.30	14.00	18.00	14%	46%	29%
Octachlorodibenzo-p-dioxin	31.80	91.00	62.00	186%	95%	-32%
2,3,7,8-Tetrachlorodibenzofuran	5.79	2.50	6.00	-57%	4%	140%
1,2,3,7,8-Pentachlorodibenzofuran	3.18	2.50	3.80	-21%	19%	52%
2,3,4,7,8-Pentachlorodibenzofuran	4.15	3.90	4.50	-6%	8%	15%
1,2,3,4,7,8-Hexachlorodibenzofuran	2.30	2.70	3.10	17%	35%	15%
1,2,3,6,7,8-Hexachlorodibenzofuran	2.02	5.80	4.40	187%	118%	-24%
1,2,3,7,8,9-Hexachlorodibenzofuran	0.07	0.20	0.10			
2,3,4,6,7,8-Hexachlorodibenzofuran	1.81	3.20	2.10	77%	16%	-34%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	6.19	46.00	53.00	643%	756%	15%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.29	0.46	0.10	60%		
Octachlorodibenzofuran	2.73	3.40	4.80	25%	76%	41%

TW indicatieve legenda Verhoging %	
	> 500 %
	> 300 %
	> 200 %
	> 100 %
	< 100 %

below limit of detection (LOD)

Figure 15: Location BE-1, dioxins (PCDD/F) concentration values, Beringen 2022

Figure 16 compares the dioxin-like PCB (dl-PCB) values of 2022 at site BE-1 with the dl-PCB values at this site in 2019 and 2021. Noteworthy is the continuous increase of PCB 126, which is a major contributor in the total dioxin toxicity at this site. In 2022, 5.6 pg TEQ/g fat.

Locatie BE-01: dl-PCB in kippeneieren, Beringen - 2022

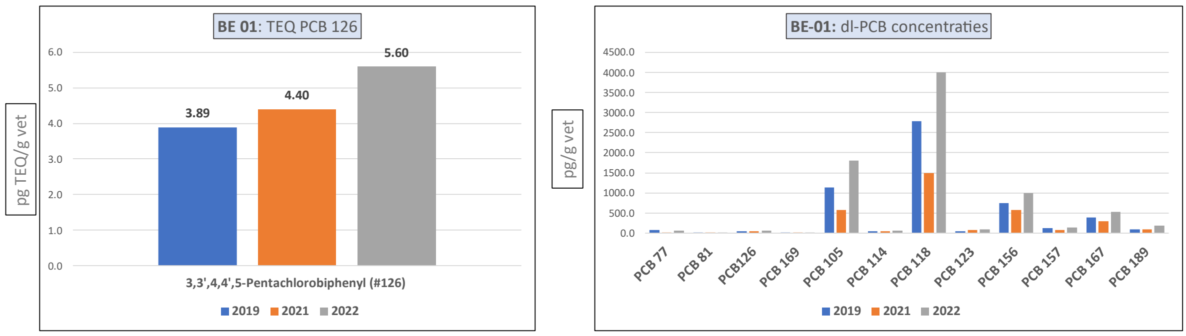

Figure 16: Location BE-1, dl-PCB values chicken eggs, Beringen 2022

BE-2 (Ham)

Site 2 (Ham)/BE-2 is located 1790 metres northeast of the Bionerga waste incinerator. The site is secluded by a forest edge. There are 7 laying hens and 5 geese present at this site. The area is over 200 m2 of space, consisting of grass and a pond. It is located next to agricultural land, on which maize is grown, figure 17. The results of analyses show an increasing concentration of dioxins, both in the bioassay DR CALUX and in the chemical analysis with the GC-MS

Locatie BE-2: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

		BE-02					
		2019	2021	2022	21 vs 19	22 vs 19	22 vs 21
GC-MS (MB)							
PCDD/F / **EU-Actiewaarde**	≥ 1.75						
PCDD/F / **EU-Limiet**	≥ 2.5	2,0	6,5	7,6	219%	274%	17%
dl-PCB / **EU-Actiewaarde**	≥ 1.75	1,1	5,1	5,2	377%	384%	2%
PCDD/F/dl-PCB / **EU-Limiet**	≥ 5.0	3,1	11,6	12,8	273%	312%	10%
DR CALUX							
PCDD/F / **EU-Limiet**	≥ 1.7	4,8	11,0	15,0	129%	213%	36%
dl-PCB		0,7	6,0	9,0	757%	1186%	50%
PCDD/F/dl-PCB / **EU-Limiet**	≥ 3.3	5,5	17,0	24,0	209%	336%	41%

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Figure 17: Location BE-2 chicken egg samples, Beringen 2022

Figure 18 below shows, that in the 2019 baseline measurement, site BE-1 met EU standards in GC-MS measurement, only to exceed them by 273% and 312% in 2021 and 2022, respectively. No changes have taken place at this site, which could lead to this high contamination.

Locatie BE-2: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

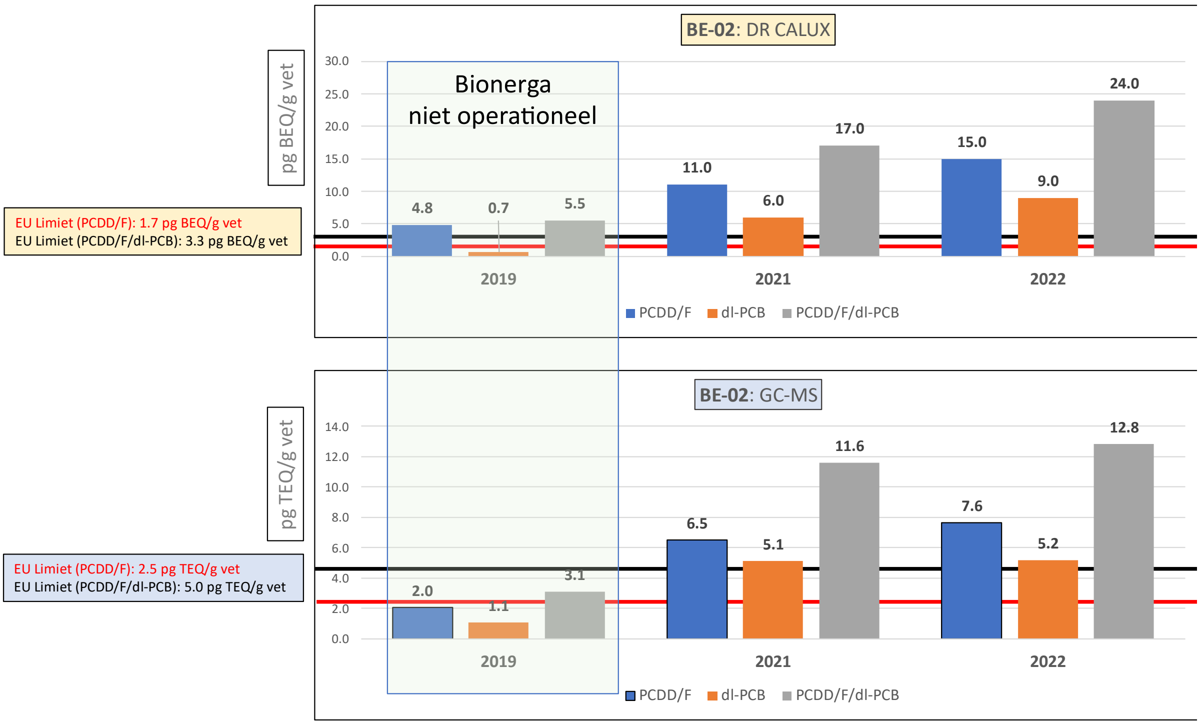

Figure 17: Location BE-2: Dioxins (PCDD/F/dl-PCB) in chicken egg samples, Beringen 2022

In 2021, the dominant presence of 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF1) was notable. This could have been emitted by Bionerga, as according to (summary) data of Bionerga, this congener is also dominantly present in the Bionerga emission pattern. The 2022 results show a slight increase compared to 2021. Compared to 2019, this HpCDF1 is even more pronounced. In addition, the increase in tetra- and penta-furans is a prominent observation in this congener pattern (Figure 19).

Locatie BE-2: Dioxinen (PCDD/F) in kippeneieren, Beringen - 2022

	BE-02					
Congeneren concentraties	**2019**	**2021**	**2022**	21 vs 19	22 vs 19	22 vs 21
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.12	0.49	0.51	302%	318%	4%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.44	1.00	2.10	126%	375%	110%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.52	2.10	0.83	304%	60%	-60%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2.61	6.10	5.20	134%	99%	-15%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.79	2.00	1.70	153%	115%	-15%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	19.70	20.00	25.00	2%	27%	25%
Octachlorodibenzo-p-dioxin	32.30	87.00	43.00	169%	33%	-51%
2,3,7,8-Tetrachlorodibenzofuran	1.07	3.00	6.90	180%	545%	130%
1,2,3,7,8-Pentachlorodibenzofuran	0.88	4.10	5.20	368%	493%	27%
2,3,4,7,8-Pentachlorodibenzofuran	1.18	4.20	7.90	256%	569%	88%
1,2,3,4,7,8-Hexachlorodibenzofuran	1.18	3.60	2.30	205%	95%	-36%
1,2,3,6,7,8-Hexachlorodibenzofuran	0.95	7.80	2.30	722%	142%	-71%
1,2,3,7,8,9-Hexachlorodibenzofuran	0.07	1.00	0.15			
2,3,4,6,7,8-Hexachlorodibenzofuran	0.89	2.50	1.70	180%	90%	-32%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	7.42	57.00	12.00	668%	62%	-79%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.21	0.68	0.91	227%	338%	34%
Octachlorodibenzofuran	1.75	6.00	2.20	243%	26%	-63%

Figure 18: Location BE-2: Dioxins (PCDD/F) concentration and relative increase and decrease congeners, Beringen 2022

The dl-PCB congeners were increased BE- 1 at this site in 2021 and perpetuated in 2022 (Figure 20). The presence of 4.7 pg TEQ is exceedingly high for such a site. The presence of dl-PCBs in this area has also been confirmed by the results in the jars (last year (see biomonitoring report 2021).

Locatie BE-02: dl-PCB in kippeneieren, Beringen - 2022

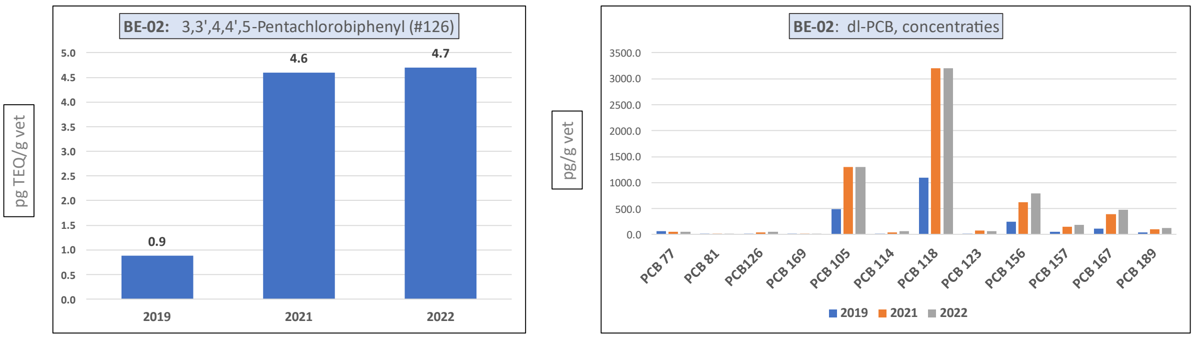

Figure 19: Location BE-2, dl-PCB values chicken eggs location 2, Beringen 2022

BE-3 (Paal)

For completeness, the results from Site BE-3 in Paal, in 2021 west of Beringen. Unfortunately, it was not possible to allow eggs to be collected here, as the hens were already off-laying by October. It is 3700 metres away from the Bionerga waste incinerator and located in the prevailing wind direction southwest of Beringen region, Figure 21. Like Site BE-02, in 2019 this site complied with the EU regulations on dioxins (PCDD/F) and dioxin-like PCB (dl-PCB) in chicken eggs. In 2021, both the GC-MS action standard for PCDD/F and dl-PCB is exceeded, The increase of the different dioxin congeners was notable with 1,2,3,4,6,7,8-Heptachlorodibenzofuran and 2,3,4,7,8-Pentachlorodibenzofuran as notable outliers with measured increases of resp. 458% and 358%, respectively, see Figure 22. This region should be monitored to understand the source load of these highly toxic persistent substances

Locatie BE-3: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

BE-03				
GC-MS (MB)		**2019**	**2021**	21 vs 19
PCDD/F / **EU-Actiewaarde**	≥ 1.75			
PCDD/F / **EU-Limiet**	≥ 2.5	0.7	1.6	115%
dl-PCB / **EU-Actiewaarde**	≥ 1.75	0.9	1.9	122%
PCDD/F/dl-PCB / **EU-Limiet**	≥ 5.0	1.6	3.5	119%
DR CALUX				
PCDD/F / **EU-Limiet**	≥ 1.7	3.1	5.5	77%
dl-PCB		0.7	3.5	400%
PCDD/F/dl-PCB / **EU-Limiet**	≥ 3.3	3.8	8.0	111%

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Figure 20: Location BE-3: Dioxins (PCDD/F) in chicken eggs, Beringen 2022

Locatie **BE-3**: Dioxinen (PCDD/F) in kippeneieren, Beringen - 2021

	BE-03		
Congeneren concentraties	**2019**	**2021**	19 vs 21
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.025	0.10	
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.165	0.23	39%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.275	0.41	49%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.559	1.50	168%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.213	0.36	69%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	2.17	4.30	98%
Octachlorodibenzo-p-dioxin	3.77	8.10	115%
2,3,7,8-Tetrachlorodibenzofuran	0.637	1.10	73%
1,2,3,7,8-Pentachlorodibenzofuran	0.24	1.10	358%
2,3,4,7,8-Pentachlorodibenzofuran	0.57	1.10	93%
1,2,3,4,7,8-Hexachlorodibenzofuran	0.562	1.40	149%
1,2,3,6,7,8-Hexachlorodibenzofuran	0.551	1.40	154%
1,2,3,7,8,9-Hexachlorodibenzofuran	0.065	1.00	
2,3,4,6,7,8-Hexachlorodibenzofuran	0.311	1.10	254%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.825	4.60	458%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.05	1.00	
Octachlorodibenzofuran	0.065	0.37	

Figure 21: Location BE-3: Dioxins (PCDD/F) congeners in chicken eggs, Beringen 2022

BE-4 (Beverlo)

Site BE-4 is the location where the 2019 start of the study was published by the local media. At this site, a remarkable reduction in dioxins, furans (PCDD/F) and dioxin-like PCB (dl-PCB) had been measured in 2021. However, this was completely reversed in 2022. In 2019, the chicken run and night shelter had been moved from debris waste (see left photo in Figure 50) to a clean site. The results show a decrease in dioxins (PCDD/F/dl-PCB) in 2021, but in 2022 the dioxin level is higher than in 2019. This site showed the highest increase in dioxins and dioxin-like PCBs, Figure 23.

Locatie BE-4: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

BE-04							
		2019	2021	2022	21 vs 19	22 vs 19	22 vs 21
GC-MS (MB)							
PCDD/F / **EU-Actiewaarde**	≥ 1.75						
PCDD/F / **EU-Limiet**	≥ 2.5	3,9	1,9	4,5	-52%	16%	139%
dl-PCB / **EU-Actiewaarde**	≥ 1.75	2,3	1,4	2,2	-39%	-5%	56%
PCDD/F/dl-PCB / **EU-Limiet**	≥ 5.0	6,2	3,3	6,7	-47%	8%	104%
DR CALUX							
PCDD/F / **EU-Limiet**	≥ 1.7	10,0	3,0	8,5	-70%	-15%	183%
dl-PCB		0,0	1,5	3,5	5900%	13900%	133%
PCDD/F/dl-PCB / **EU-Limiet**	≥ 3.3	10,0	4,5	12,0	-55%	20%	167%

Voor de DR CALUX dl-PCB calculatie is gebruik gemaakt van de mediumbound (MB) waarde van 0.025 pg BEQ/g vet (Limit of Detection /LOD = 0.05 pg BEQ/g vet).

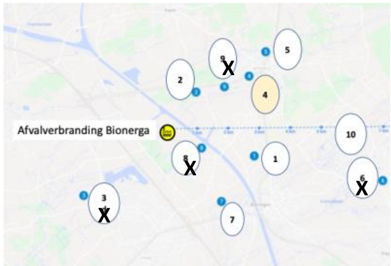

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Figure 22: Location BE-4: Dioxins (PCDD/F) in chicken eggs, Beringen 2022

Figure 24 shows the course of biomonitoring at this site and the exceedances of the bioassay and chemical limits.

Locatie BE-4: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen- 2022

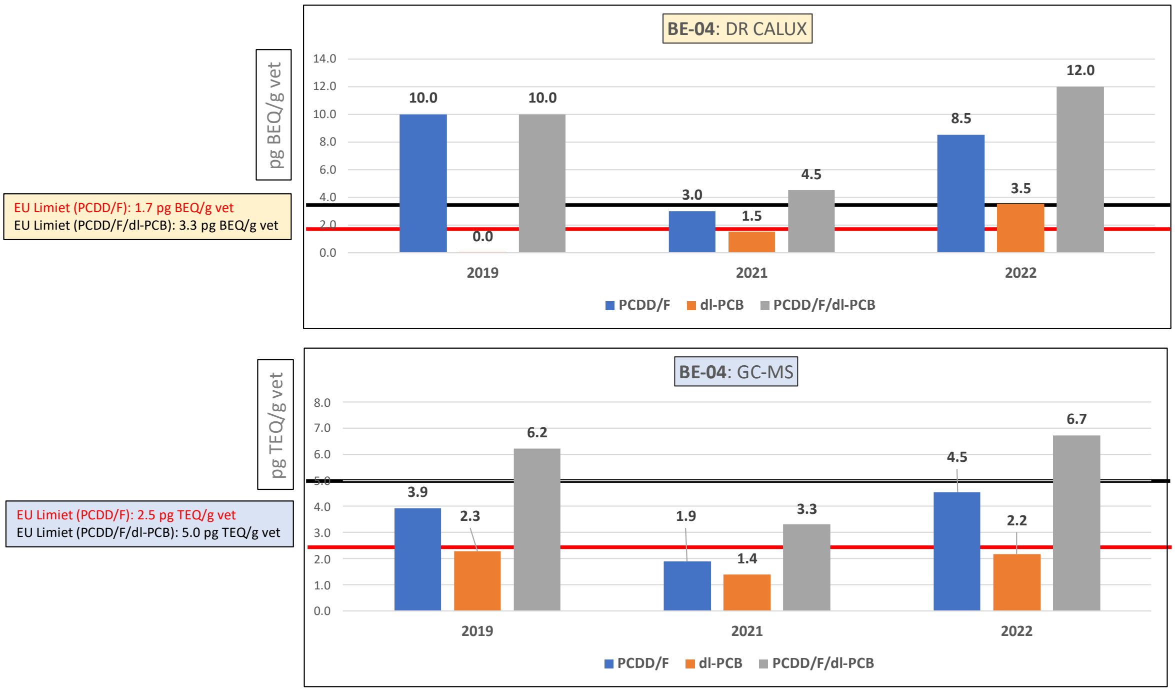

Figure 23: Location BE-4: Dioxins (PCDD/F) in chicken eggs, Beringen 2022

In Figure 25, of the dioxin congeners below shows that compared to 2021, major changes have taken place. 2,3,7,8-Tetrachlorodibenzo-p-dioxin is calculated with the medium bound (MB) value of 0.10. This gives a relative increase of the highly and most toxic TCDD of 530 %. The increase of 2,3,7,8-Tetrachlorodibenzofuran is 329%. Also noteworthy is the increase of 2,3,4,6,7,8-Hexachlorodibenzofuran, see also the summary table below.

Locatie BE-04: Dioxinen (PCDD/F) in kippeneieren, Beringen - 2022

	BE-04					
Congeneren concentraties	**2019**	**2021**	**2022**	19 vs 21	19 vs 22	21 vs 22
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.275	0.10	0.63		129%	
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.07	0.31	0.91	-71%	-15%	194%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.835	0.18	0.56	-78%	-33%	211%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2.59	2.50	6.90	-3%	166%	176%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.04	0.30	1.90	-71%	83%	533%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	10.7	6.50	11.00	-39%	3%	69%
Octachlorodibenzo-p-dioxin	21.4	28.00	47.00	31%	120%	68%
2,3,7,8-Tetrachlorodibenzofuran	3.01	0.70	3.00	-77%	0%	329%
1,2,3,7,8-Pentachlorodibenzofuran	2.5	1.30	2.90	-48%	16%	123%
2,3,4,7,8-Pentachlorodibenzofuran	3.08	1.10	2.80	-64%	-9%	155%
1,2,3,4,7,8-Hexachlorodibenzofuran	2.56	1.10	1.80	-57%	-30%	64%
1,2,3,6,7,8-Hexachlorodibenzofuran	2.32	2.20	2.20	-5%	-5%	0%
1,2,3,7,8,9-Hexachlorodibenzofuran	0.084	1.00	0.20			
2,3,4,6,7,8-Hexachlorodibenzofuran	1.64	0.66	2.40	-60%	46%	264%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	4.09	15.00	5.30	267%	30%	-65%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.352	1.00	0.20	184%	-43%	-80%
Octachlorodibenzofuran	1.96	1.80	1.70	-8%	-13%	-6%

below limit of detection (LOD)

Figure 24: Site BE-4: Dioxins (PCDD/F) congeners in chicken eggs, Beringen 2022

The dl-PCB congener pattern shows a decrease in PCB 105 and PCB 118. In contrast, PCB 126, 3,3',4,4',5-Pentachlorobiphenyl (#126) is increased and contributes substantially to the total TEQ load on this location (Figure 26).

Locatie BE-04: dl-PCB in kippeneieren, Beringen - 2022

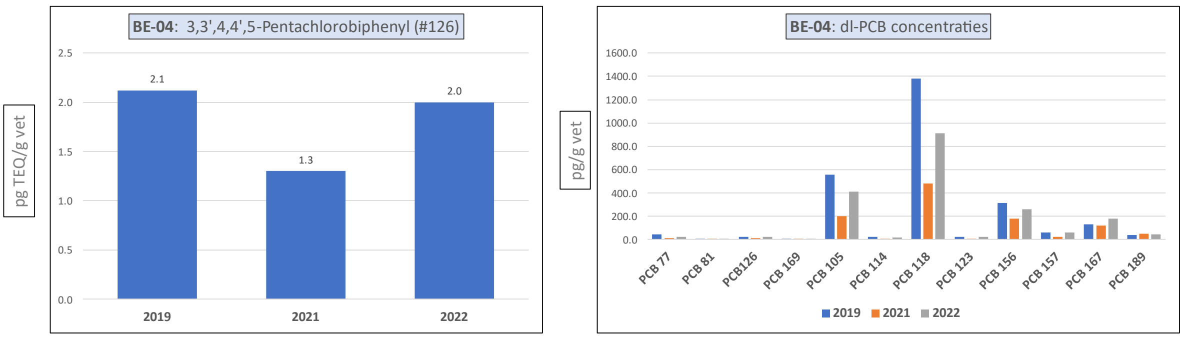

Figure 25: Site BE-4: dl-PCB in chicken eggs, Beringen 2022

BE-5 (Beverlo)

Site BE-5 is located in the sub-commune of Beverlo, 4040 metres northeast of Bionerga. To protect against birds of prey and martens, the chickens' outdoor enclosure was covered with nylon cords and the stakes of the outdoor coop were covered with barbed rope. In 2021, one of the hens turned into a "rooster", started crowing and stopped laying eggs. How this is related to the high found levels of dioxins at this location would require further investigation. Dioxins can act as endocrine disruptors.

Locatie BE-5: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

		BE-05					
GC-MS (MB)		**2019**	**2021**	**2022**	21 vs 19	22 vs 19	22 vs 21
PCDD/F / **EU-Actiewaarde**	**≥ 1.75**						
PCDD/F / **EU-Limiet**	**≥ 2.5**	**7,0**	**4,0**	**6,9**	**-43%**	**-2%**	**73%**
dl-PCB / **EU-Actiewaarde**	**≥ 1.75**	**4,6**	**3,3**	**2,5**	**-27%**	**-45%**	**-24%**
PCDD/F/dl-PCB / **EU-Limiet**	**≥ 5.0**	**11,6**	**7,3**	**9,4**	**-37%**	**-19%**	**29%**
DR CALUX							
PCDD/F / **EU-Limiet**	**≥ 1.7**	**14,0**	**8,0**	**13,0**	**-43%**	**-7%**	**63%**
dl-PCB		**4,0**	**4,0**	**4,0**	**0%**	**0%**	**0%**
PCDD/F/dl-PCB / **EU-Limiet**	**≥ 3.3**	**18,0**	**12,0**	**17,0**	**-33%**	**-6%**	**42%**

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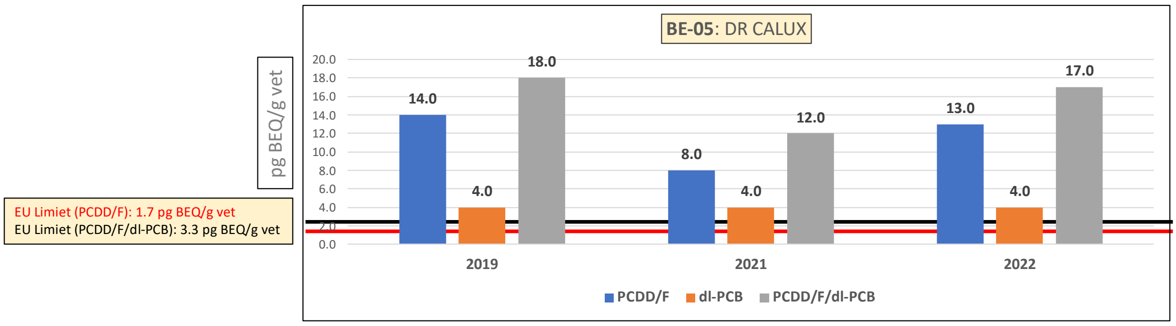
Figure 26: Site BE-5: Dioxins (PCDD/F/dl-PCB) in chicken eggs, Beringen 2022

Two new laying hens have arrived since 2021. In 2019, the highest dioxin level of the first Beringen biomonitoring study was measured at this site: 18 pg BEQ/g fat. In 2022, this level was almost reached again with 17.0 pg TEQ in the DR CALUX bioassay. The large difference with the GC-MS analysis result of 9.4 pg TEQ/g shows, that other POPs may be present as brominated dioxins, Figure 27

Remarkable is the reduction of dl-PCB in the GC-MS analysis (12 congeners), while this measurement in the DR CALUX bioassay remains at the same level all years, Figure 28.

Locatie BE-5: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen- 2022



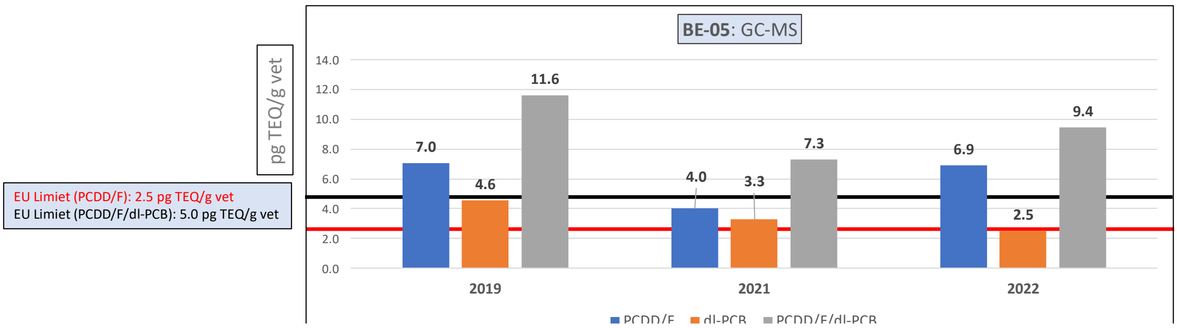


Figure 27: Site BE-5: Dioxins (PCDD/F/dl-PCB) in chicken eggs, Beringen 2019 - 2022

Interestingly, no TCDD above the detection limit is measured at this site. In contrast, a sharp increase in hepta- and octachloro congeners is measured in 2022 compared to 2021: 1,2,3,4,7,8,9-Heptachlorodibenzofuran, Octachlorodibenzofuran, 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin and Octachlorodibenzo-p-dioxin, respectively, with relative concentration increases of 253%, 283%, 228% and 164%, Figure 29.

Locatie BE-5: Dioxinen (PCDD/F) in kippeneieren, Beringen - 2022

	BE-05					
Congeneren concentraties	**2019**	**2021**	**2022**	19 vs 21	19 vs 22	21 vs 22
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.52	0.10	0.20			
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.08	1.00	2.00	-52%	-4%	100%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.78	1.20	1.30	-33%	-27%	8%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3.71	2.00	3.50	-46%	-6%	75%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.62	1.40	2.00	-14%	23%	43%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	9.32	6.10	20.00	-35%	115%	228%
Octachlorodibenzo-p-dioxin	14.00	14.00	37.00	0%	164%	164%
2,3,7,8-Tetrachlorodibenzofuran	5.52	1.90	3.30	-66%	-40%	74%
1,2,3,7,8-Pentachlorodibenzofuran	5.04	3.10	5.50	-38%	9%	77%
2,3,4,7,8-Pentachlorodibenzofuran	5.63	3.00	4.90	-47%	-13%	63%
1,2,3,4,7,8-Hexachlorodibenzofuran	4.74	3.00	8.20	-37%	73%	173%
1,2,3,6,7,8-Hexachlorodibenzofuran	3.67	4.40	5.10	20%	39%	16%
1,2,3,7,8,9-Hexachlorodibenzofuran	0.22	0.31	0.20			
2,3,4,6,7,8-Hexachlorodibenzofuran	2.90	2.60	4.10	-10%	41%	58%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.83	9.00	9.80	54%	68%	9%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.58	0.34	1.20	-41%	108%	253%
Octachlorodibenzofuran	2.04	1.20	4.60	-41%	125%	283%

Figure 28: Site BE-5: Dioxins (PCDD/F) in chicken eggs, Beringen 2022

In contrast to the other sampling locations, a reduction of PCB 126 is observable at this site, Figure 30.

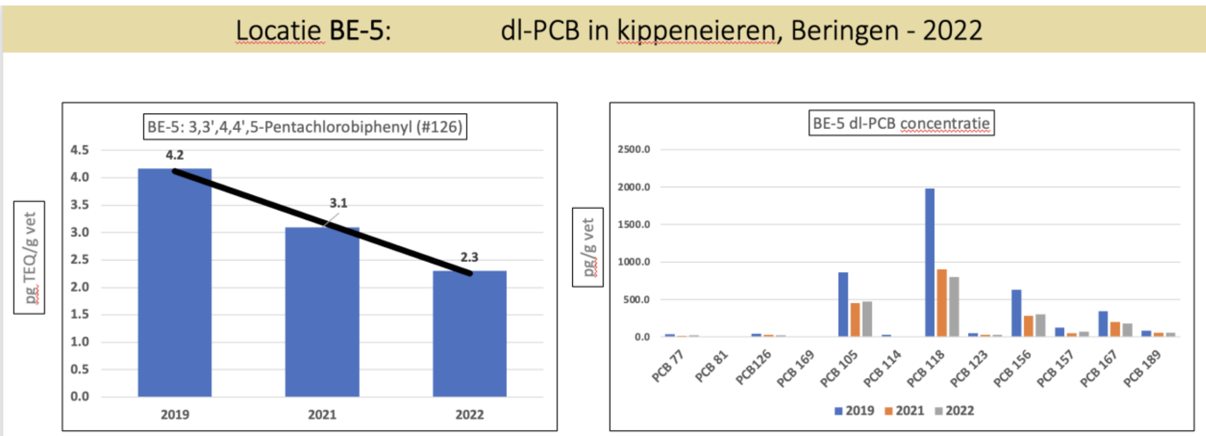


Figure 29: Locatie BE-5, dl-PCB waarden kippeneieren, Beringen 2019-2021

BE-6/BE10 (Koersel)

Site 6, a reference site, ceased keeping chickens. A site (BE-10) was chosen as a replacement, 8900 m away from the Bionerga waste incinerator and 2180 m away from site BE-6. The chickens at site BE-10 can forage freely in vegetation-rich garden area. The results of the bioassay DR CALUX and chemical analyses (GC-MS) in the eggs of hobby chickens at this site are 20 pg BEQ/g fat in the bioassay and 14.8 pg TEQ/g fat in the chemical analysis, see Figure 31. These are extremely high dioxin values. In 2022, 102% and 198% increases in PCDD/F are measured compared to 2021 and 2019, respectively. At site BE-10, even higher values for dioxins are found than previously at site BE-06

Locatie BE-6/10: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

BE-06/10							
		BE-06	BE-06	BE-10	BE-06	BE10/06	BE-10/06
GC-MS (MB)		2019	2021	2022	21 vs 19	22 vs 19	22 vs 21
PCDD/F / EU-Actiewaarde	≥ 1.75						
PCDD/F / EU-Limiet	≥ 2.5	3,5	5,1	10,3	48%	198%	102%
dl-PCB / EU-Actiewaarde	≥ 1.75	2,7	5,9	4,5	122%	71%	-23%
PCDD/F/dl-PCB / EU-Limiet	≥ 5.0	6,1	11,0	14,8	80%	143%	35%
DR CALUX							
PCDD/F / EU-Limiet	≥ 1.7	5,4	8,8	15,0	63%	178%	70%
dl-PCB		1,6	5,2	5,0	225%	213%	-4%
PCDD/F/dl-PCB / EU-Limiet	≥ 3.3	7,0	14,0	20,0	100%	186%	43%

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Figure 30: Site BE-6/10: Dioxins (PCDD/F/dl-PCB) in chicken eggs, Beringen 2022

Figure 32 below compares the results of BE-6 in 2019 and 2021 with the results of BE-10 in 2022. This may introduce a bias, but a strong load of dioxins can be observed in Koersel. And this finding is at odds with the site inspection, which cannot find any illegalities. The amount of 20 pg BEQ in the DR CALUX bioassay is found in heavily polluted areas, but not in forested natural environments.

Locatie BE-6/10: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

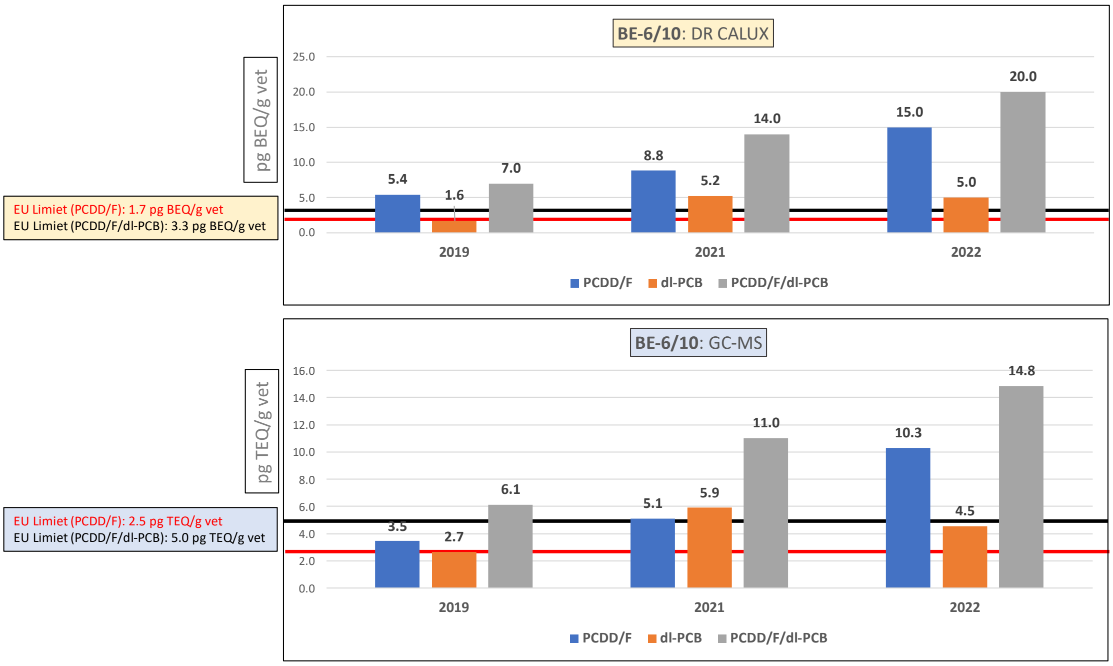

Figure 31: Site BE-6/10: Dioxins (PCDD/F/dl-PCB) in chicken eggs, Beringen 2022

Figure 33 shows a strong increase in several PCDD/F congeners, however, these are two different sites (BE-6 and BE-10). Site BE-6 stopped keeping chickens in 2022. This gives a bias, but is in line with the observed increase in dioxins in 2021 in this area. It indicates that there is a problem with both dioxins and dioxin-like PCBs in Koersel. The question arises, whether in and near Koersel there are also measurements and/or reports of nearby military activities, which could potentially release dioxin emissions. A possible correlation with emissions from the waste incinerator cannot be excluded. The literature describes the so-called 'grasshopper effect' in relation to dioxin depositions. To investigate this, more data is needed from the emission characteristics of, among others, waste incinerator Bionerga.

Locatie BE-6/10: Dioxinen (PCDD/F) in kippeneieren, Beringen - 2022

	BE-06		BE-10	BE-06	BE-06/10	
Congeneren concentraties	2019	2021	2022	21 vs 19	22 vs 19	22 vs 21
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.37	0.28	0.81	-24%	119%	189%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.93	0.98	3.20	6%	246%	227%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.68	1.40	2.60	107%	285%	86%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2.26	4.40	11.00	95%	387%	150%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.77	0.97	4.60	26%	498%	374%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	9.81	6.90	60.00	-30%	512%	770%
Octachlorodibenzo-p-dioxin	20.30	27.00	130.00	33%	540%	381%
2,3,7,8-Tetrachlorodibenzofuran	3.24	3.80	5.80	17%	79%	53%
1,2,3,7,8-Pentachlorodibenzofuran	1.77	2.80	5.00	58%	182%	79%
2,3,4,7,8-Pentachlorodibenzofuran	2.38	4.90	5.20	106%	118%	6%
1,2,3,4,7,8-Hexachlorodibenzofuran	2.54	3.60	4.60	42%	81%	28%
1,2,3,6,7,8-Hexachlorodibenzofuran	1.56	4.10	3.60	163%	131%	-12%
1,2,3,7,8,9-Hexachlorodibenzofuran	0.06	1.00	0.20			
2,3,4,6,7,8-Hexachlorodibenzofuran	1.22	2.00	5.80	64%	375%	190%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	3.79	17.00	10.00	349%	164%	-41%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.40	0.56	1.50	41%	278%	168%
Octachlorodibenzofuran	1.13	2.20	7.50	95%	564%	241%

Figure 32: Site BE-6, dioxins (PCDD/F) concentration values, Beringen 2022

Figure 34 shows the dominant presence of PCB 126. Large concentrations of dl-PCBs were found at site BE-6 in 2021 as PCB 118 and PCB 105, which were not present in 2019 and not present in 2022 at site BE-10.

Locatie BE-6/10: dl-PCB in kippeneieren, Beringen - 2022

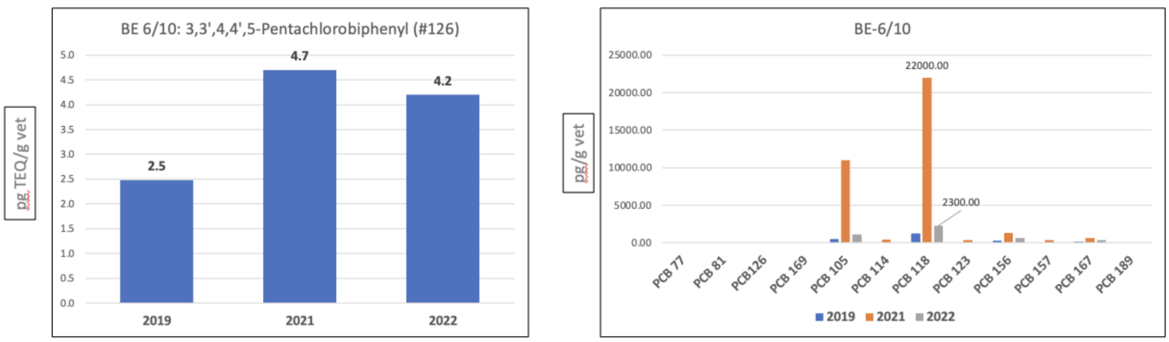

Figure 33: Site BE-6, dl-PCB values chicken eggs, Beringen 2019-2021

BE-7 (Tervant-Zuid)

Site BE-7 is located in Tervant sub-municipality, 2700 m south-east of Bionerga. The site measures 42% fewer dioxins in DR CALUX and 40% in GC-MS in 2021. In 2022, it measures 49% more dioxins in the DR CALUX bioassay and 20% in the GC-MS, Figure 35. In the DR CALUX, there is an exceedance of more than 300% of the 1.7 pg BEQ/g fat limit. The GC-MS measurement falls at 4.6 pg TEQ, just within the safe margin. However, European regulations are seriously behind EFSA's scientific health recommendations. Based on the EFSA recommendations, further research would also be desirable at this location to investigate the origin of this contamination with dioxins.

Locatie BE-07: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

		BE-07					
GC-MS (MB)		**2019**	**2021**	**2022**	21 vs 19	22 vs 19	22 vs 21
PCDD/F / **EU-Actiewaarde**	≥ 1.75						
PCDD/F / **EU-Limiet**	≥ 2.5	4,1	1,9	2,3	-53%	-43%	21%
dl-PCB / **EU-Actiewaarde**	≥ 1.75	2,3	1,9	2,3	-16%	1%	20%
PCDD/F/dl-PCB / **EU-Limiet**	≥ 5.0	6,3	3,8	4,6	-40%	-28%	20%
DR CALUX							
PCDD/F / **EU-Limiet**	≥ 1.7	7,1	3,1	5,2	-56%	-27%	68%
dl-PCB		1,7	2,0	2,4	18%	41%	20%
PCDD/F/dl-PCB / **EU-Limiet**	≥ 3.3	8,8	5,1	7,6	-42%	-14%	49%

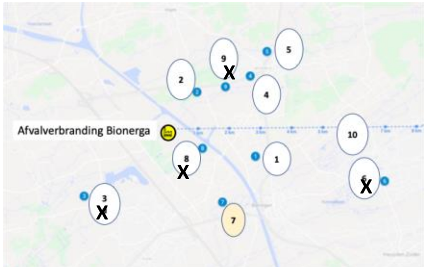

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Figure 34: Site BE-7: Dioxins (PCDD/F/dl-PCB) in chicken eggs, Beringen 2022

Figure 36 shows the trend of dioxins from 2019 to 2022. After a sharp decrease in 2021, the values of dioxins and PCBs in both bioassay and chemical measurements increased slightly in 2022.

Locatie BE-07: Dioxinen (PCDD/F/dl-PCB) in kippeneieren, Beringen - 2022

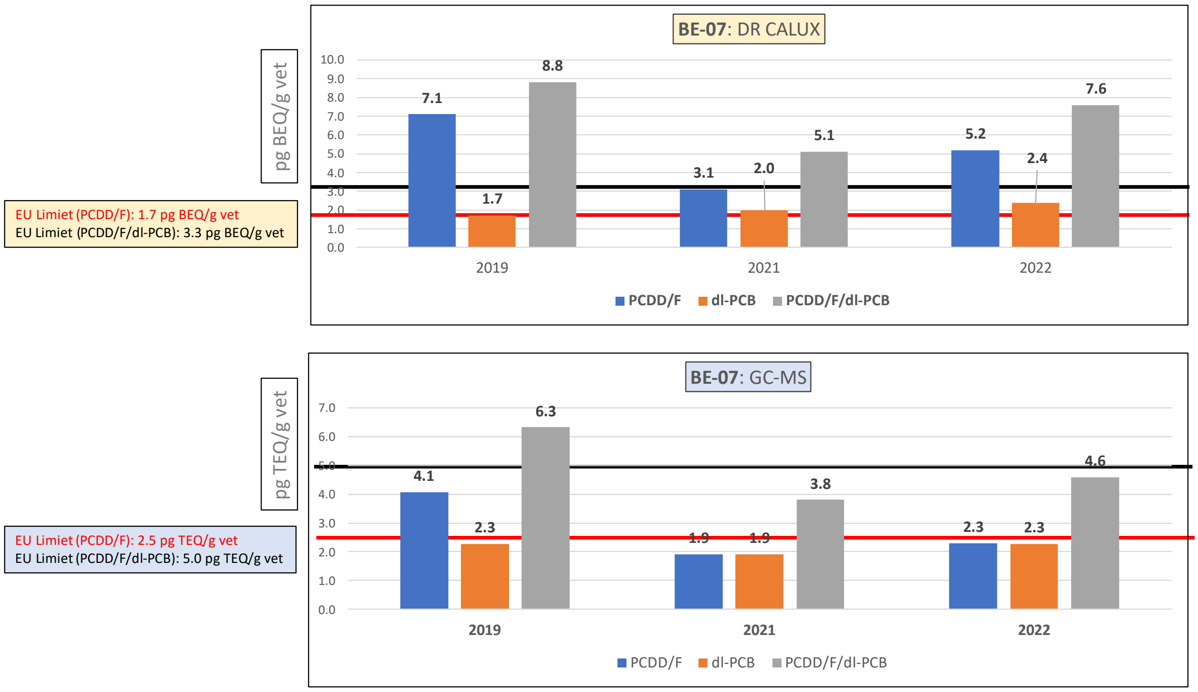


Figure 35: Site BE-7, Dioxins (PCDD/F/dl-PCB) in chicken eggs, Beringen 2022

Increases of three (3) PCDD congeners of more than 100%, as 2,3,7,8-Tetrachlorodibenzo-p-dioxin, 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin and 257% for 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin 2,3,7,8-Tetrachlorodibenzofuran is 100% increased from 2021, Figure 37.

Locatie BE-7: Dioxinen (PCDD/F) in kippeneieren, Beringen - 2022

	BE-07					
Congeneren concentraties	2019	2021	2022	19 vs 21	19 vs 22	21 vs 22
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.29	0.10	0.15			
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.00	0.24	0.50	-76%	-50%	108%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.86	0.33	0.58	-62%	-33%	76%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	2.96	1.40	3.10	-53%	5%	121%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.99	0.65	0.54	-34%	-45%	-17%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	24.10	2.30	8.20	-90%	-66%	257%
Octachlorodibenzo-p-dioxin	60.60	19.00	22.00	-69%	-64%	16%
2,3,7,8-Tetrachlorodibenzofuran	3.14	1.40	2.80	-55%	-11%	100%
1,2,3,7,8-Pentachlorodibenzofuran	2.44	1.40	2.00	-43%	-18%	43%
2,3,4,7,8-Pentachlorodibenzofuran	3.01	1.60	1.30	-47%	-57%	-19%
1,2,3,4,7,8-Hexachlorodibenzofuran	2.46	0.83	1.60	-66%	-35%	93%
1,2,3,6,7,8-Hexachlorodibenzofuran	1.92	2.50	1.00	30%	-48%	-60%
1,2,3,7,8,9-Hexachlorodibenzofuran	0.06	1.00	0.15			
2,3,4,6,7,8-Hexachlorodibenzofuran	1.80	0.88	0.96	-51%	-47%	9%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	10.00	6.60	3.50	-34%	-65%	-47%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.49	1.00	0.15	105%	-69%	-85%
Octachlorodibenzofuran	4.51	0.75	1.10	-83%	-76%	47%

Figure 36: Site BE-7: Dioxins (PCDD/F) congeners in chicken eggs, Beringen 2022

Elevations of some dl-PCB congeners are observed in 2022, including PCB 105, PCB 118, PCB 156, and PCB 189. PCB 126 is also dominant at this site, Figure 38.

Locatie BE-7: dl-PCB in kippeneieren, Beringen - 2022

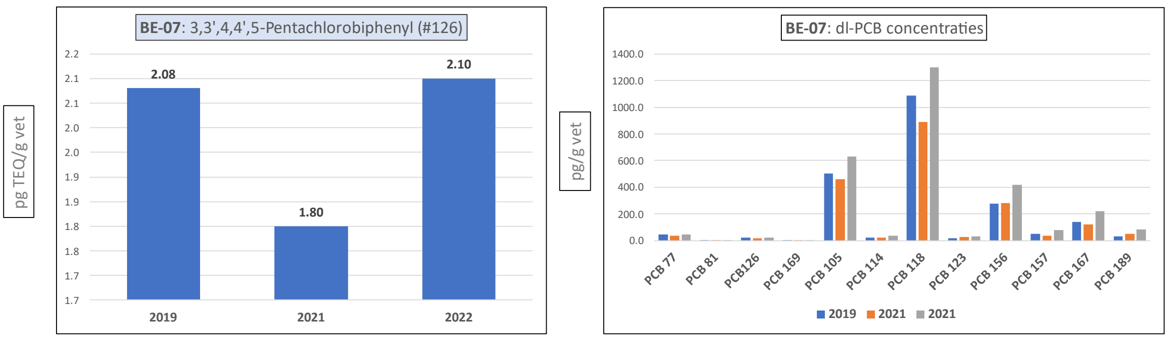
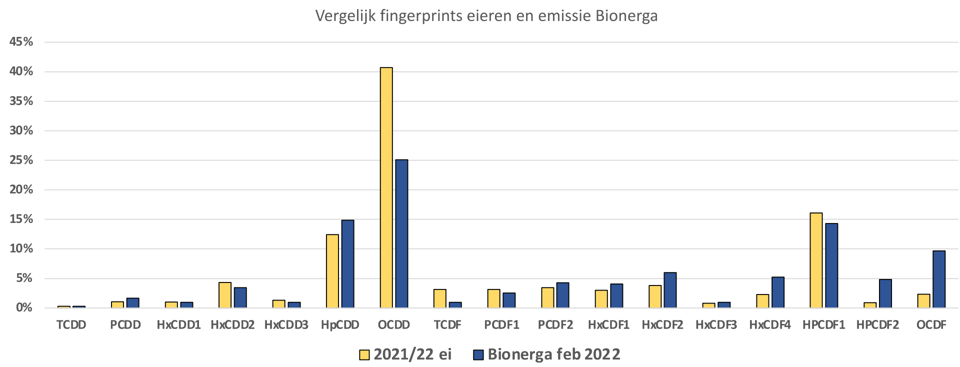


Figure 37: Location BE-7, dl-PCB values chicken eggs, Beringen 2019-2021

Emission data WtE incinerator Bionerga

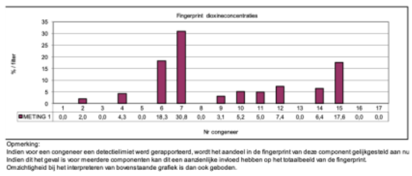
Monitoring with Bergerhoff jars was used for a limited period and was not continued in 2022. A comprehensive analysis of the data was provided in the Beringen 2021 TW report. No feedback was given on ToxicoWatch results and recommendations to continue these measurements with multiple measurement points around the Bionerga waste incinerator and the various Seveso companies in the Beringen region. ToxicoWatch has received one measurement of semi-continuous measurements of 09/02/2022 to 23/02/2022 with the dioxin congeners analysed and one page with the results of one-year semi-continuous measurements. Not received are detailed data from semi-continuous measurements of dioxin emissions Bionerga, with additional data of the control room of OTNOC.[1,2] In the figure below the comparison is made between the fingerprint of Bionerga with the dioxins found in the eggs.

Vergelijking patroon eieren 2021/2022 met emissie Bionerga Febr 2022 (Medium Bound)



TW biomonitoring kippeneieren
Eieren gemiddeld 2021 (n=9) - 2022 (n=6) in totaal n=15

Bionerga emissie uitstoot
09/02/22 - 23/02/22, 13d 22u 11m



Figuur 4: Fingerprints eieren vs Bionerga, percentuele bijdrage

[1] *Tauw, Belgie NV. Ref. L040-1475681GMS-V01-BE, resultaten dioxinebemonstering nr. 40, 09/02/2022 tem 23/02/2022.*
[2] *Olfascan (2022), resultaten continue dioxine-metingen 12 augustus 2020 en 1 december 2021*
, 2022_WO_000033_VL

Log files of the interrupted events are important to have insight into the operation functionality of the waste incinerator during conditions referred to as Other Than Normal Operating Conditions (OTNOC). These are conditions with non-optimal combustion and reduced capability for cleaning the flue gases. These situations need to be analysed, evaluated, and communicated and must be reported to comply with EU-166/2005._[3] In Harlingen (REC), analyses of semi-continuous measurements lead to improvements to the waste incinerator to reduce dioxin emissions. [4]

A Regional Environmental Permitting Commission (GOVC) document dated 29 June 2022 regarding BAT conclusions for Bionerga describes that measurements under OTNOC were not carried out.[5] It is unclear why Biostoom/Bionerga did not carry out these measurements and why the obligation of these measurements was not included in the permit. Monitoring functionality in the initial phase is essential for optimal production with minimal emissions. A Bionerga management plan of Best Available Techniques (BAT) is not expected until December 2023 (page 21 of the GOVC report). The high dioxin values found in this study with a progressive trend around the Bionerga waste incinerator is a reason for the accelerated realisation of Best Available Techniques (BAT) management plans.

It is in the public health interest to obtain data from the semi-continuous measurements as soon as possible. Accompanying documentation, minute data, from the control room of the waste incinerator is also needed for a more complete analysis. According to EU-166/2005 and the drafted BREV 2019, these documents should be handed over transparently to local authorities, as described in the document. For this TW biomonitoring study, these data are important to determine what share of Bionerga emissions could account for the observed increase in dioxin contamination in Beringen. In addition, it is important to request the emission data of the Seveso companies to obtain more clarity on the source of dioxins.

In 2019 is as part of the permit monitoring of depositions by emissions of Bergerhoff gauges. Monitoring instances done using “Bergerhoff gauges” – a monitoring instrument to measure for dust deposition on-site – show high levels of dioxins during the start-up and elevated levels in the operational phases of the Bionerga waste incinerator. See Annex 4.

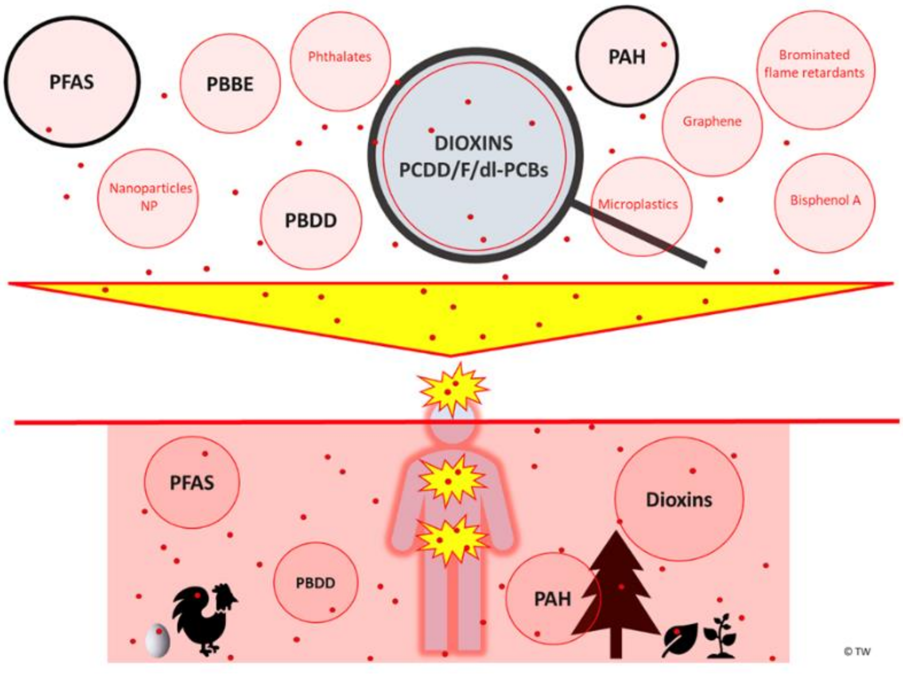
[3] *https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R0166-20200101*
[4] *https://www.infomil.nl/onderwerpen/lucht-water/stookinstallaties/dioxine/reguliere-dioxine/#:~:text=Tegengaan%20van%20dioxine%2Demissies&text=Toch%20is%20het%20mogelijk%20een,moet%20in%20het%20milieumanagementsysteem%20komen.*
[5] GOVC BE.VL.000000551 Bionerga - Beringen.pdf

It is not just an 'Egg' problem

There is no safe level of exposure to dioxins. The precautionary principle should be applied as a matter of principle to keep persistent organic pollutants such as dioxins out of our living environment. Incineration of (household) waste inevitably leads to the production of dioxins. The waste industry has to comply with EU regulations to reduce dioxin emissions, but the limits have not changed since 1989, more than 30 years now. TW's biomonitoring studies in Europe show increasing levels of dioxins in the environment around waste incinerators, such as in Beringen.

In the TW biomonitoring study, eggs from hobby chickens are used as biomarkers to monitor contamination in each area. Besides dioxins in eggs from hobby chickens, the results also show dioxins in pine needles and mosses. To summarise the dioxins found solely as an egg problem is too short-sighted. It is a denial of the fact, that the investigated environment is burdened with deposition of dioxins, observed in the eggs, but very likely also in the environment. Discouraging backyard consumption of chicken eggs is not the solution to the dioxin problem. A 2018 EFSA study shows that it is the dioxins in meat, fish, milk, butter, and cheese that pose a much greater threat to our health.

A chicken egg is extremely sensitive to monitoring dioxin contamination in the environment. Especially since hobby chickens can feed on a wide range of seeds, insects, worms, snails, vegetation, and soil and have direct contact with outdoor air. Eggs from hobby poultry should be healthier than chicken eggs from the massively reared chickens in covered houses from the bio-industry without the many toxic substances from agro-industry, such as e.g., Fipronil. If dioxins are found in hobby chicken eggs, the real cause should be found in an approach to reduce, or better eliminate, the source of the dioxins.



Figuur 38: Toxic environmental pollution is on our lips

Confounders

Other possible dioxin sources may be responsible for the current contamination of the chicken eggs in Beringen. Dioxins and dioxin-like substances can be produced and emitted by several sources. These sources are referred to as 'confounders', as this potentially distorts the biomonitoring study on the deposition of emissions from the Bionerga waste incinerator. It is also very important to be able to compare the congener-level results from the Bergerhoff jars used by Bionerga to measure emissions with the results of dioxins in the eggs in the TW biomonitoring studies at Beringen, as included in this study, see pages 35-37.

Dioxins can also be emitted by so-called 'Seveso companies'. The following Seveso companies can be found in the Beringen area: Borealis Polymers, Hercules Beringen and Neste Oil, in Tessenderlo, Tessenderlo Chemie, Chevron Phillips, Dow Belgium, Ecolab, Limburgse Vinyl Maatschappij and Primagaz, and in Heusden-Zolder, Rezinal and Umicore Oxyde. It is unclear what the state of these companies' emissions is. The database of the international E-PRTR, the electronic system of 'Pollution Registration and Transport Registration' offers very global outdated emission data and is not detailed at the congener level. It is recommended to obtain data from these companies to get more tools, to trace the source of pollution of dioxins and dioxin-like substances. Another recommendation is to install monitoring of Bergerhoff jars near these companies to evaluate the contribution of dioxins from these companies in the Beringen area.

There is one VMM (Flemish Environment Agency) monitoring station 14.7 km away from the Bionerga incinerator in Houthalen-Helchteren in an area with more than 8 'Seveso companies' in the Beringen-Ham-Tessenderlo area., The other two monitoring stations in Hasselt and Genk are located 18 and 28 km away from the Bionerga incinerator, respectively. Based on the modelling of these limited number of measurement points, the government concludes that the concentrations present for PM10 and NO2 are within the standards, with no measurements of dioxins nor the relevant parameter PM1.0. Seveso plants are under special industrial safety supervision according to EU directives, because of the risk of dioxin emissions during calamities. Given the very high values of dioxins in these biomonitoring studies, a comprehensive investigation of Seveso industry emissions in the Beringen area would be needed to clarify the origin of these high dioxin results.

As part of a reaction to the response of the management of the incinerator pointing to the contribution of wood burning by particulars, an answer is formulated in the Annex 4.

Conclusion Biomonitoring, Beringen 2022

In 2019, at the request of concerned residents, the mayor and deputy commissioners of the city of Beringen mandated ToxicoWatch (TW) to carry out a non-human biomonitoring study of dioxins (PCDD/F) and dioxin-like PCB (dl-PCB) in relation to the WtE Bionerga waste incinerator. This report includes the third measurement and concludes the multi-year biomonitoring study of dioxins in relation to the Bionerga waste incinerator. The first measurement series took place in October 2019, before WtE plant Bionerga was operational the last in October 2022.

As biomarkers of Substances of Very High Concern, chicken eggs from six locations were sampled in the Beringen region. These eggs were analysed for the presence of dioxins (PCDD/F) and dioxin-like PCB (dl-PCB). The results of the bioassay analysis method DR CALUX showed very high contamination of dioxins at all six (6) chicken egg sites. Chemical GC-MS analysis verified these high dioxin values at 5 sites, with one site showing values just below the EU limit. Both the GC-MS and bioassay DR CALUX results from 2022 show substantial increases in dioxins and dioxin-like PCBs (dl-PCBs) in chicken eggs compared to the baseline measurement in 2019. The DR CALUX bioassay measures higher values than the GC-MS analysis, indicating the presence of other persistent organic pollutants (POPs), such as brominated dioxins (PBDD/PBDF), which are so far outside the scope of mandatory EU regulation.

The DR CALUX shows 50% of the sites show very high dioxin values of 20 pg BEQ/g fat and even more. At site, BE-4, a strong elevation of dioxin congeners related to waste incineration was observed. This report mainly looked at toxic dl-PCB 126, which increased at almost all sites in 2022. Site BE-1 again as in 2021 shows a strong increase now of 756% Heptachlorodibenzofuran (HpCDF1) compared to 2019.

In Koersel, a second new site, chosen as a reference site, shows a high concentration of dioxins. Given the very high values of dioxins in these biomonitoring studies, an investigation of Seveso industry emissions in the Beringen area would be needed to clarify the origin of these high dioxin results. In addition, examination of the emission data from Bionerga is essential to exclude or not identify the contribution of the waste incinerator as the source of the extremely high dioxin contamination in Beringen and its surroundings.

The conclusion of the 3-years biomonitoring Beringen can be as followed:

- At all chicken egg sites, nu elevated dioxins (PCDD/F/dl-PCB) are found with both bioassay analysis DR CALUX and chemical analysis (GC-MS).
- None of the chicken eggs does meet the EU dioxin standard with the DR CALUX analysis.
- 50% of chicken egg sites exceed dioxin values of >20 pg BEQ/g fat.
- Chemical analysis of dioxins verifies 5 out of 6 eggs above the EU standard of 5 pg TEQ/g.
- Congener-specific patterns of incomplete combustion are found at sites nearby the incinerator.

The problem of dioxin pollution should not be reduced to an egg problem. The problem is much more comprehensive. Most importantly, the source of the dioxins must be identified. Dioxins are highly toxic substances, which can persist in the Beringen habitat for years and lead to serious health problems.
First and foremost is that an accurate study of Bionerga emission minute data of the semi-continuous measurements must be carried out. Secondly, emissions from the Seveso industry should be studied and structurally monitored with multiple stations. The environment is highly polluted, and this needs more research.

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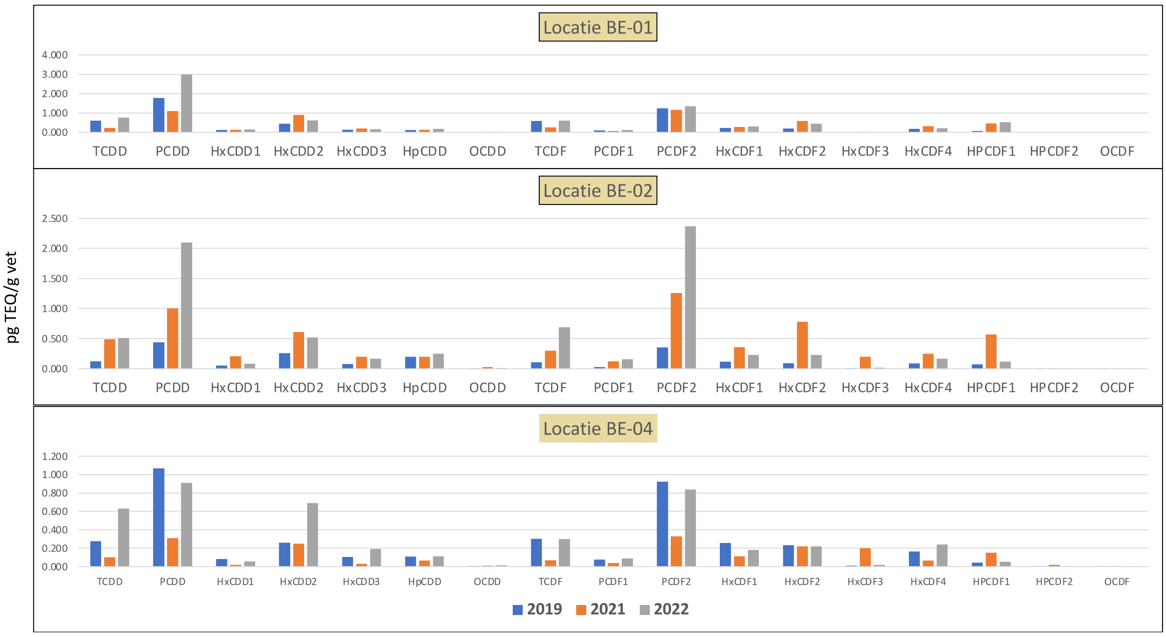
Annexes

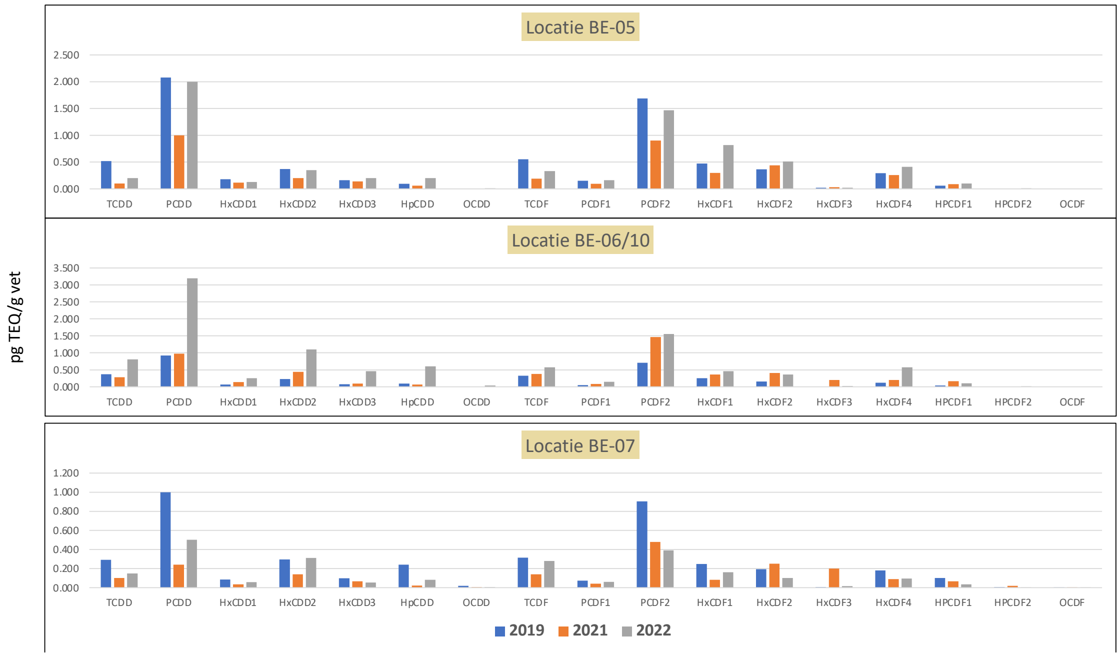
Annex 1: Questionnaire hobby chicken owners

TW-REF-NR	BE-1	BE-2	BE-4	BE-5	BE-10	BE-7
Afstand (m)	2900	1790	3180	4040	8900	2700
Leghennen (n)	4	7	4	2	5	3
Leeftijd (mnd)	18-36	24-36	24-36	12	24-36	12-36
Eieren/dag	4	6	4	2	4	3
Eieren/week	28	42	28	14	28	21
Eieren/maand	120	180	120	60	120	90
Buitenverblijf (m2)	800	200	25	120	1275	300
Binnenverblijf (m2)	12	10	3	1.2	1.9	1.5
Terrein	aarde	aarde	aarde	aarde	aarde	aarde
	gras	gras	hout(schors)	gras	hout(schors)	gras
	bos	vegetatie	takken	vegetatie	tuin	vegetatie
Voedsel	gem. graan	keukenafval	keukenafval	keukenafval	keukenafval	
	legkorrel	graanmix	graanmix	graanmix	graanmix	
			geen legkorrel			
Allesbrander buiten	nee	nee	nee	nee	nee	nee
Binnenverblijf	steen	steen	zaagsel	hout	hout	steen
	beton		beton		zaagsel	hout
Houtkachel	nee	nee	nee	nee	nee	nee
Pesticiden gebruik	nee	nee	nee	nee	nee	nee

Annex 2: Fingerprints congeneren in TEQ

Congeneer patronen TEQ, Beringen - 2022





Additional TW research reports Beringen, Belgium

June 2023

Annex 3

Dioxin measurements
Bergerhoff gauges, Beringen - Belgium

Measuring industrial deposition measurements of dioxins (PCDD/F/dl-PCB) is a challenge for governments and industries. The Dutch National Institute for Public Health and the Environment (RIVM) uses expensive active air sampling methodologies as in the air quality study around the REC waste incinerator in Harlingen (NL). A disadvantage in this type of study is that the required equipment can only be stationary in a large container at one location. This limitation of measurement methodology makes it difficult to make representative statements about the environmental burden in a specific region caused by dioxin emissions, particularly those that occur during Other Than Normal Operating Conditions (OTNOC) by incinerators.

A much cheaper methodology is to use passive sampling. Most used are metal hemispheres filled with polyurethane foam (PUF-scales) filled with a special resin, XAD-resin, to capture dioxins. This XAD-resin is a hydrophobic organic porous polymer, to dissolve lipophilic dioxins, which are extremely insoluble in water. PUF scales are used, for example, to measure POPs at distant locations such as the North Pole in the so-called Global Atmospheric Passive Sampling Project (GAPS).[6] POPs can be transported over long distances.

In Belgium, glass jars (Bergerhoff jugs) are used, see Figure 1 to monitor dioxin emissions from local industry. For four (4) weeks, air quality is measured by collecting dust in glass jars filled with water. Remarkable, given that dioxins are hydrophobic and this methodology of air emission for POPs measurements used jars filled with water. These jars are mounted on 1.5-metre piles, figure 1. The permit, granted to Bionerga to burn waste, states that deposition measurements of dioxins (PCDD/F/dl-PCBs) and PAHs will be made using this method for one (1) year.

Figure 39: Dioxin and PCB deposition measurements in the period May 2016 - May 2017 source: Flemish Environment Agency VMM

In Flanders, this method was applied in a study of dioxins (PCDD/F/dl-PCBs) and DDT in soil and chicken egg samples from Menen, Wevelgem and Wervik in a study of Colles. [7] However, the representativeness of the method is ambiguous, according to the Flemish Environment Agency (VMM). [8] VMM set an annual threshold value of 8.2 pg and 21 pg TEQ/m^2/day as a monthly average for dioxins (PCDD/F/dl-PCBs). These threshold values for dioxins (PCDD/F/dl-PCBs) are not included in Flemish legislation. Any measures in case of exceeding the limits are left to the enforcement authorities.

[6] *Environ. Sci. Technol. 2021, 55, 9479−9488*
[7] *Colle A., et all, Dioxinen, PCB's en DDT in bodem- en eistalen uit Menen, Wevelgem en Wervik (2014), 2014/MRG/R/72*
[8] *Desmedt, Marjory & Roekens, Edward & Fré, Raf & Swaans, Wendy & Vanermen, Guido. (2002). Methodological survey the dioxin deposition measurement with Bergerhoff gauges.*

The conversion to the much stricter established European Food Safety Authority (EFSA) food limit standard in 2018 still has not occurred (see Table 1).[9] If this EFSA opinion were to be implemented in policy, it would have major economic implications and is potentially a steering factor regarding whether political policy directions should anticipate it or not.

Table 1 shows the threshold values currently applied by the VMM. These are calculated assuming a permissible dietary dose of 14 pg TEQ/(kg/week). In late 2018, the European Scientific Committee on Food (EFSA) reduced this dose to 2 pg TEQ per kg body weight per week. Currently, the VMM has not yet had the thresholds recalculated. However, this reduction points to the high toxicity that science assigns to dioxins and PCBs.

Intake (EU)	Air quality (VMM)		
Acceptable intake via food defined by EU	Threshold annual average deposition	Threshold monthly average deposition	Where
14 pg TEQ/(kg bw/week)	8.2 pg TEQ/(m2.day)	21 pg TEQ/(m2/day)	agricultural areas residential areas

Table 3: Standards for dioxins and dioxin-like PCBs

Dioxin deposition measurements with the Bergerhoff flask near Bionerga were made at three locations, namely:

Location 1: at 1350 m northeast (NE) of Bionerga (blue)
Location 2(B): at 1790 m south-east (SE) of Bionerga on the Albert Canal (orange)
Location 3: at 0 m the site of WtE Bionerga (grey)

The process by which these limited three sampling locations were selected is not clear. The first measurement of four (4) weeks took place before the waste incinerator went into production on 19-9-2019. Then during start-up and four times during the period from 3-8-2020 to 19-10-2021. The result of the analysis is presented in pg TEQ/m2/day, figure 2.

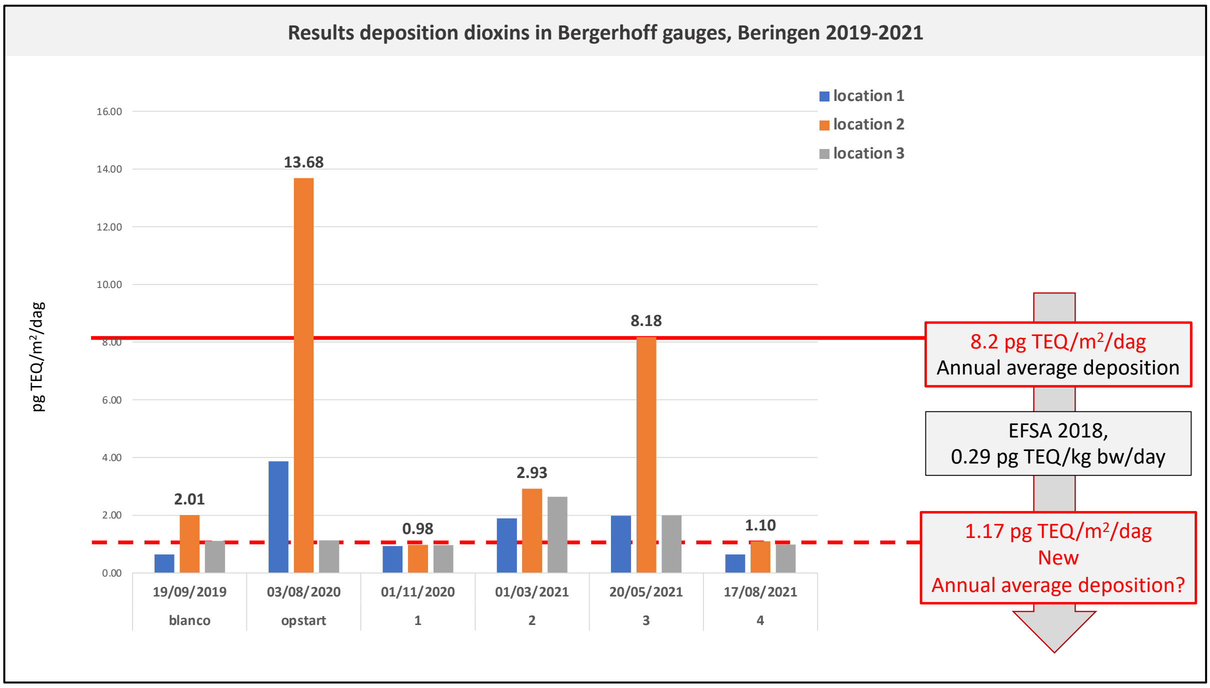


Figure 2: Resultaten dioxinen (PCDD/F/dl-PCB) in de Bergerhoff kruiken- metingen, Beringen 2019-2021

[9] *Vlaamse Milieumaatschappij (2020), Dioxine- en PCB-depositiemetingen in de periode juni 2019 – april 2020*

The graph in figure 3 shows the successive results in the Bergerhoff gauges. Concentrations of dioxins (PCDD/F/dl-PCB) were significantly elevated in the Bergerhoff jars during the first measurement of the start-up phase on 03-08-20 and 01-09-20The red line refers to the annual average deposition standards set by the VMM. The dotted line indicates the hypothetical limit after the calculation of the new EFSA standard for dioxins.

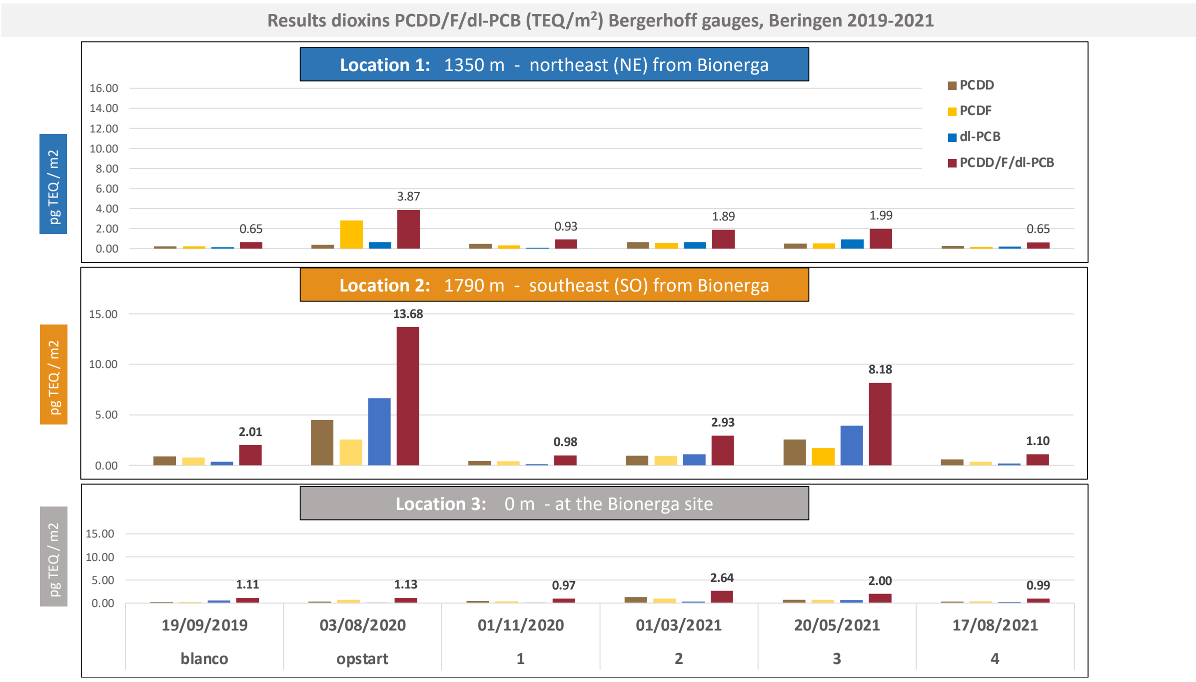


Figure 3: Results of dioxin emissions Bergerhoff gauges

Based on outdated threshold values, the situation has been assessed that the predetermined standards and guide values are not exceeded at any location and at any time. However, the Bergerhoff jars show increases in dioxin depositions. It is of interest to know how often Bionerga breaks down and thus the risk of increased dioxin emissions. Whether these results meet the VMM's new threshold value yet to be determined remains to be seen. Incorporating the new conclusions of the European Food and Safety Authority (EFSA) may mean that the dioxins found do not meet the EU standard. Leaving aside the fundamental question of whether a safe limit for dioxin emissions may be set.

There are some comments to be made about the results from the Bergerhoff jars. The results in the eggs contrast sharply with the values found in the jars. The question arises whether, with this limited number of jars, this method can be used for representative monitoring of the dioxin load of a waste industry. The large quantitative and qualitative differences in results between the jars raise several questions.

Figure 4 shows the differences in the dioxin congeners found by location. Site 1: 1350 metres northeast of the waste incinerator (blue) has more PCDF congeners, while at site 2 (orange): 1790 metres southeast predominantly PCDD congeners are found. Hexafuran HxCF3 and dioxin HxCC1 are particularly extremely elevated, 3954% and 3025%, respectively. Site 3 (grey), on the site of the Bionerga waste incinerator, seems to have a so-called 'umbrella effect'. Below the chimney, hardly any increase in dioxins is measured.

In order to explain these measured values, additional data from the waste incinerator would be needed as minute data from the semi-continuous dioxin measurements, in order to shed more light on the significantly different results in the Bergerhoff jars.

The question can be raised whether the Bergerhoff jars filled with water is the right measuring instrument to use for dioxins, which are by nature extremely poorly water-soluble, and attach themselves mainly to organic matter, for dioxin sampling.

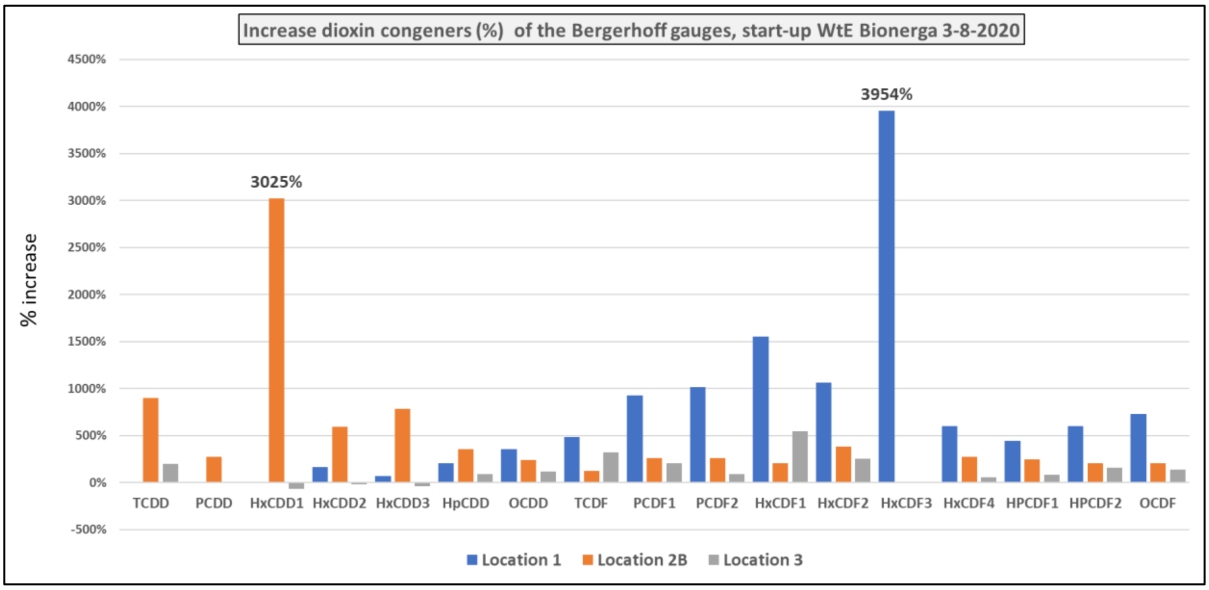
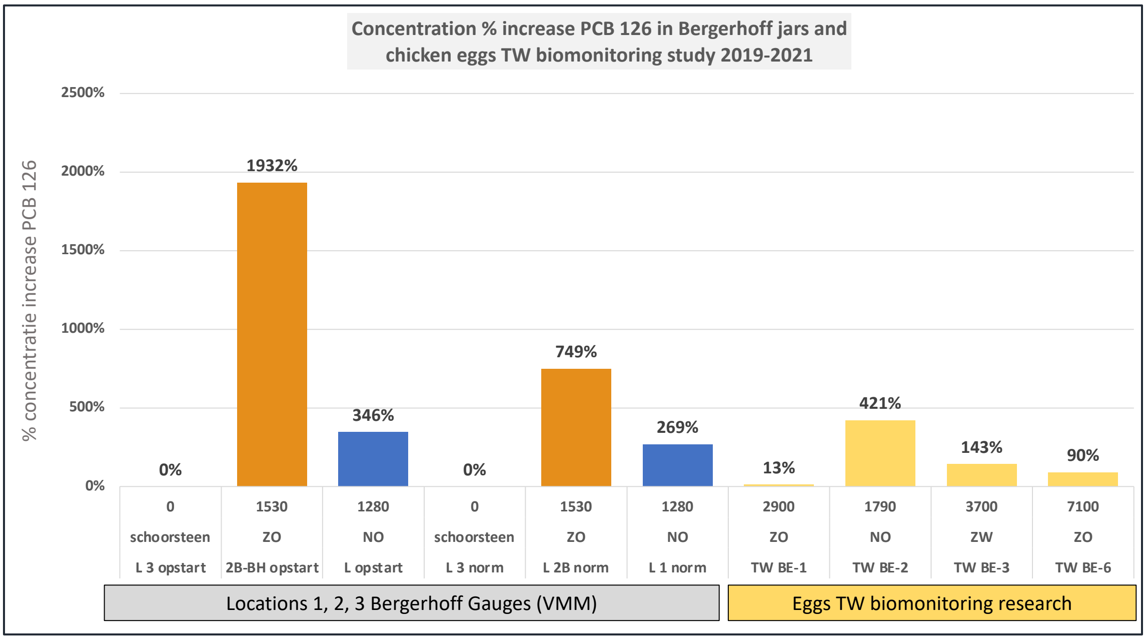


Figure 4: Congener increases during Bionerga start-up at the three sites.

PCB 126 is the most toxic dioxin-like PCB (dl-PCB), which is associated with de-novo synthesis in waste incineration. , This congener is dominant in the Bergerhoff jars during start-up. Also, on 20-5-2021 during normal incineration, a highly elevated PCB 126 concentration is found at jug site 2, towards the southeast. In the graph below, Figure 5, the results in the jars are related to the dl-PCB 126 found in the chicken eggs, TW biomonitoring survey 2019-2022. It indicates a possible relationship with the distance to the Bionerga waste incinerator site.



Figuur 5: Concentratie dl-PCB 126 in Bergerhoff kruiken en kippeneieren TW-biomonitoring 2019-2021

Dioxin measurements
Bergerhoff gauges, Beringen - Belgium

Conclusion

Calamities, and situations like Other Than Normal Operating Conditions (OTNOC) in waste incineration are explicitly mentioned to be monitored in the new European Directives (BREF). Dioxins (PCDD/F) and dioxin-like PCBs (dl-PCBs) are highly persistent substances, which degrade extremely slowly and persist in the environment and human body for years. Calamities and situations as Other Than Normal Operating Conditions (OTNOC) in waste incineration are explicitly mentioned to be monitored in the new European Directives (BREF). Dioxins (PCDD/F) and dioxin-like PCBs (dl-PCBs) are highly persistent substances, which degrade extremely slowly and persist in the environment and human body for years. The latest EFSA scientific insight clearly reveals the toxicity of dioxins to be far more serious than previously assumed. These EFSA findings should be the basis to define limits for dioxins in Industrial Emissions and Food Safety Standards and be implemented in both Flemish and EU standards.

ToxicoWatch, to derive data on dioxin deposition, chose the methodology of biomonitoring chicken eggs, as applied in the Beringen 2019-2022 study, for grounds such as:

- Monitoring a chicken egg involves monitoring a far broader area of the environment. A chicken interacts with compartments like soil, vegetation, seeds, and soil-dwelling animal organisms like insects, worms, snails, larvae, etc.
- The values of dioxins found in chicken eggs can be directly related to European food safety standards.
- The differences between the results of the dioxin measurements from the Bergerhoff flasks with those analysed in the chicken eggs are substantial and request closer observation.
- The qualitative and quantitative differences in the measurement results from the Bergerhoff gauges, also raise questions about the technique of this passive sampling technique.
- A chicken egg has a fat-related component (the egg yolk) and is also for this reason very suitable as a biomarker for measuring bioaccumulative dioxins, in contrast to gauges filled with water. Dioxins are extremely hydrophobic, and so do not stick to water. What is analysed in the Bergerhoff jars is undissolved dust in or on the water. This makes the Bergerhoff gauges in principle not suitable for measuring dioxin deposition.

Based only on the Bergerhoff jars, it is doubtful whether a waste incinerator meets the requirements for minimising dioxin emissions (minimisation obligation). The national safety standard has not been updated with the most recent EFSA limit for dioxins for the benefit of food safety and therefore public health. The use of just a few water-filled gauges as an instrument to monitor air quality in Beringen simply cannot be considered a representative measurement method for dioxins.

ToxicoWatch, June 2023

TOXICO WATCH

Annex 4

Dioxin emissions
Waste incineration and private woodburning

ToxicoWatch (TW) recently published a report with the results of a multi-year biomonitoring survey (2019-2022) in Beringen, Belgium. The results of this survey show significantly elevated dioxin levels in chicken eggs from private chicken farmers since the start of the TW biomonitoring survey in 2019 before the new Bionerga waste incinerator in Beringen started operating in 2020. The management of the waste incinerator disputes any involvement in the observed dioxin contamination in chicken eggs and points to people burning wood as the cause for the sharply increased dioxin levels in chicken eggs in recent years. Looking at emissions from the incinerator and wood burning in the local community, to what extent is this discussion of dioxin contamination in chicken eggs justified?

Private woodburning

The small-scale practice of burning wood by humans for daily necessities of food and heat supply has most likely been going on for hundreds of thousands of years.[10] The toxicological emissions of toxic substances such as PAH and dioxins are linked to how and what is burned. In the present setting, questions in this matter arise such as: what type of wood stove, yes/no/no filters, type and height of the chimney, soot, and ash removal, what types of wood (tree species) such as raw, glued/fabricated, and impregnated wood, purchased wood, what type of wood is burnt.

Excesses with toxic compounds of wood burning by private individuals occur, especially when impregnated wood is burnt. This produces smoke and odour pollution and should not be done these days. For pollution of the environment, a difference should be made between the incomplete burning of the thousands of tonnes of (toxic) chemical waste, which our household waste consists of nowadays (brominated flame retardants, PFAS, PVC, plastics, pesticides, etc.) and (basically clean) cleaved wood from (locally chopped) trees in a private wood stove. Then, according to a TNO emissions model, the share of burning wood in stoves and fireplaces in total emissions of particulate matter (PM_{10}) in the Netherlands is about 6%.[11] Its share of carbon dioxide (CO_2) emissions is 0.69% of the total emissions of 163 megatons of CO_2.[12] In addition, the trend of wood burning is declining due to the drastically decreasing share of fireplaces. From this perspective, the contribution of dioxins from wood fires to the environment will be low. In contrast, both in the media,[13,14] as well as in the scientific literature[15] seen a use of data that systematically underestimates dioxin emissions from waste incinerators. Several important observations should be brought to attention for greater clarity on how dioxins are measured and reported by the waste incineration industry.

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[10] *https://study.com/learn/lesson/discovery-fire-importance-facts.html#:~:text=Fire%20was%20used%20beginning%20approximately,Age%20into%20the%20Bronze%20Age.*
[11] *Ing. B.I. Jansen (2016) Vernieuwd Emissiemodel Houtkachels, TNO-rapport, TNO 2016 R10318*
[12] *https://stichting-nhk.nl/wp-content/uploads/2018/12/1812-CO2-document-houtstook.pdf*
[13] *https://www.nieuwsblad.be/cnt/dmf20230605_96774962*
[14] *https://www.tvl.be/nieuws/zorgden-houtkachels-voor-vervuilde-lucht-in-beringen-154403?fbclid=IwAR1ZEcx3W5Ngl_pRP4so8yza6UtO0uzhvw_7uqhzoDDQm-iuLBQsKXYcpps*
[15] *Lavric ET. Et all. (2006). Dioxin levels in wood combustion—a review, Biomass and Bioenergy 26 (2004) 115–145*

Emission and food safety limits

The limit requirement for emissions of dioxins from thermal treatment (waste incineration) was set at 0.1 ng TEQ/Nm3 in 1989 in several Western countries, as the Netherlands. In 2004, this was ratified globally with the Stockholm Convention (COPS BRS). Despite technical innovations and application of Best Available Techniques (BAT) in waste incinerators, the emission limit did not change until 2022. Only recently, new plants are required to meet a stricter standard of 0.06 ng TEQ/Nm3. However, old plants are still allowed to comply with the old emission requirement. Only the Netherlands, partly due to the moratorium imposed on waste plant,[16] introduced a 10x stricter limit requirement of 0.01 ng TEQ/Nm3 for the very last waste incinerator built.

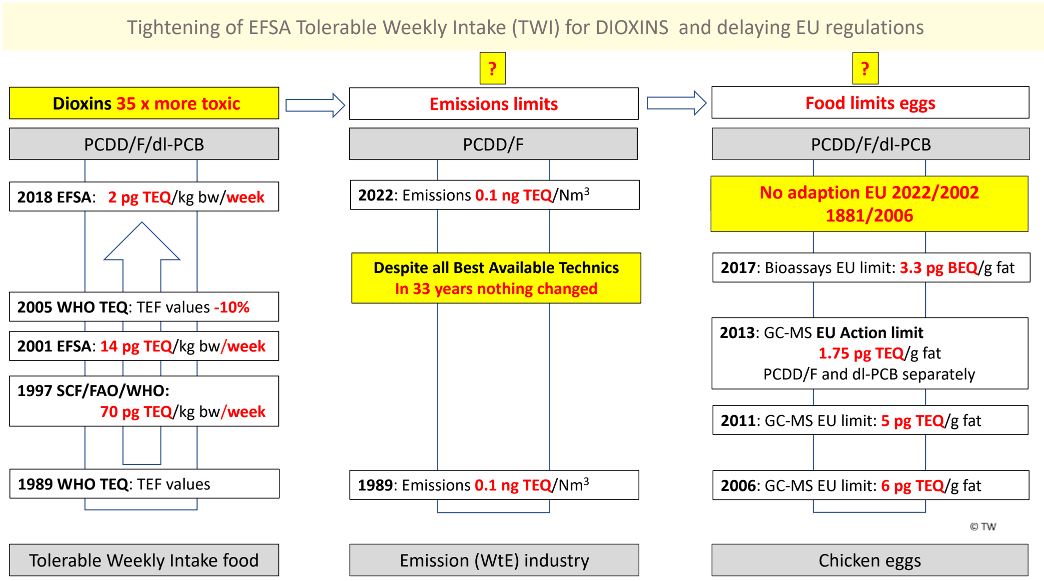

Figure 40: Discrepancy of required EU-norms dioxin-emissions of science and industry in time

However, advancing scientific understanding of dioxin toxicity is not keeping up with stricter standards for emission limits and food safety standards. In 2018, the EU's scientific advisory body EFSA upscaled the toxicity of dioxins by a factor of 35. However, neither the waste industry nor the food industry has incorporated these insights into stricter standards. On the contrary, after years the limits are still unchanged at the same level, see Figure 1. When the industry talks about the so-called stringent standards, that is an understatement.

[16] *https://lap3.nl/beleidskader/deel-b-afvalbeheer/b15/*

Short-term measurements

The vast majority of emission data from waste incinerators have been obtained since the 2004 mandatory emission measurements of 2 x 6 hours per year, pre-announced and set under optimal combustion conditions. Long-term sampling of emissions in flue gases has recently become mandatory for new plants, however, most waste incinerators still measure based on short-term measurements. As a result, the dataset of dioxin emissions is based on 0.15% of the 8000 hours in which waste is incinerated on average annually, which obviously cannot be considered representative. In a joint study by the Dutch government and ToxicoWatch (TW) at the REC waste incinerator, Harlingen NL, a discrepancy of a factor > 460 to > 1290 with the short-term measurements of 2x 6 hours was found in 2015 with simultaneous measurements, see figure 2. It shows, that short-term measurements cannot be used to measure representative dioxin emission values and therefore certainly not sufficient to calculate the contributions of dioxin emissions from waste incinerators.[17,18]

Short-term vs Long-term measurements REC/NL 2016/2017

Sampling dioxinen (PCDD/F) (ub)	Hours	ng TEQ/Nm3	Factor
Short-term, 30-03-2016	6	<0,00001	
Long-term, 26-03-2016 / 26-04-2016	**256**	**0,01290**	**> 1290**
Short-term, 08-03-2017	6	<0,00001	
Long-term, 07-03-2017 / 05-04-2017	**690**	**0,00460**	**>460**

ub: Upper bound

Below Limit of Detection (LOD): <0,00001

Sampling for **official monitoring dioxin emissions** must be **representative.**
Short-term sampling *underestimating* emission dioxin levels.

DioXin 2018
& 10th International PCB Workshop
26 – 31 August 2018, Kraków, Poland

Figure 41: Parallel short and long-term measurements 2016, 2017 REC, Harlingen, NL

Long-term measurements

Long-term sampling of flue gases gives a much more realistic picture of the extent of dioxin emissions. An important element in semi-continuous monitoring is the automatic recording of events, or events, in which measurement is not possible. Semi-continuous measurements are sensitive to disturbances in the various combustion conditions due to the required isokinetic condition for sampling. In case of malfunctions of the technical installation, referred to as OTNOC, Other Than Normal Operating Conditions, sampling of flue gases in the cartridge is stopped. A failure can be caused by non-optimal combustion conditions, or non-functioning or under-functioning air filtration systems, among others. These moments are prone to increased dioxin emissions. These moments of interruption of semi-continuous measurements should be evaluated for causality and measures/corrections should be taken to optimise the combustion and filtration process and thus the sampling measurement (EU-166/2005). The studies at the REC with the long-term sampling revealed numerous flaws in the plant. With a team

[17] *Arkenbout A, Esbensen KE, Olie K. (2018). Emission regimes of POPs of a Dutch incinerator: regulated, measured and hidden issues. Organohalogen Compounds Vol. 80, 413-416*

[18] *Arkenbout, A. (2018). Hidden Emissions: A story from the Netherlands, a case study, Zero Waste Europe, www.zerowasteeurope.eu*

of specialists from different technical committees, including TW, improvements for optimising reduction of dioxin emissions from the REC waste incinerator were realised at the time.[19]

Figure 3 below outlines the situation of a 5-hour stop at REC/NL in 2016 of semi-continuous measurements where 19 tonnes of waste were incompletely incinerated without a cloth filter, E-filter and no addition of activated carbon. A dioxin emission of 1.7 ng TEQ/Nm3 was measured. It resulted in an emission equivalent to that of 6 years of normal operation of a waste incinerator in a short period of time.[20] This example shows the importance of measurement, monitoring during firing and firing and OTNOC in general.

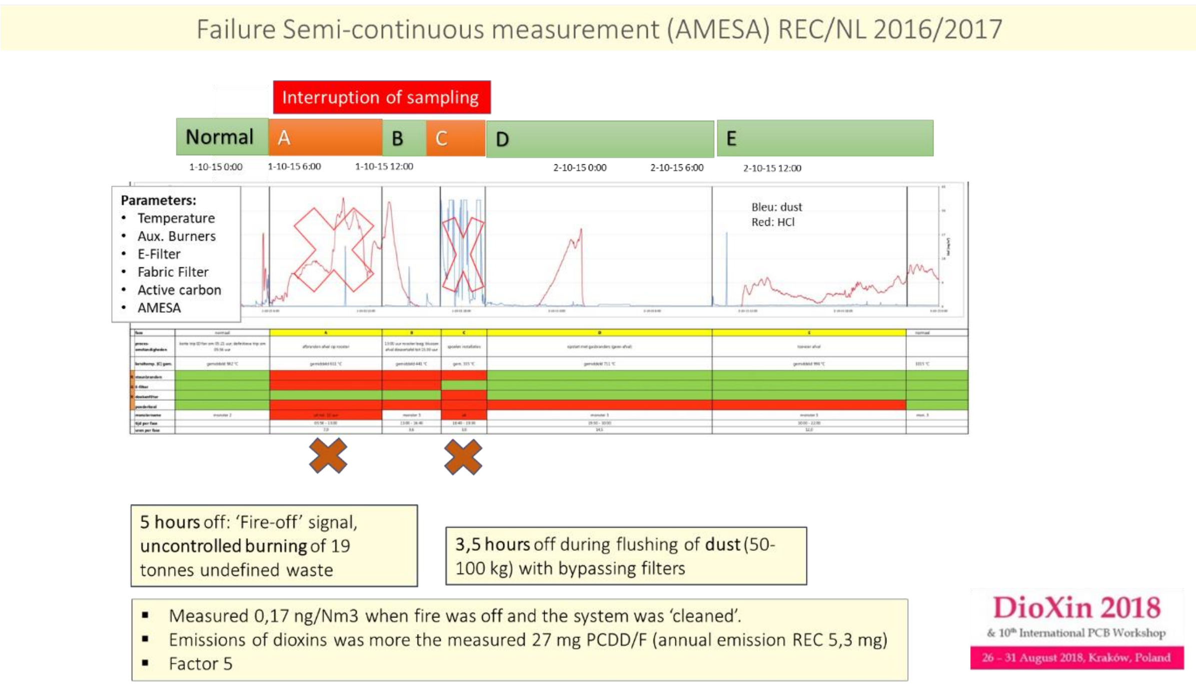

Figure 42: Data OTNOC Control room waste incinerator REC/NL (TW-presentation Dioxins Symposium Krakow 2018 [21])

Waste incinerator IVRY-PARIS XIII

IVRY-PARIS XIII is the largest waste treatment centre in the Paris region and is one of the largest waste incinerators in Europe with a treatment capacity of 700,000 tonnes/year. A soon-to-be-published ToxicoWatch study shows that 1,700 hours per year per incineration line (of which there are two) have no data from semi-continuous measurements because the equipment is switched off by OTNOC. OTNOC are precisely the periods with increased dioxin emissions. The latest update of European regulations on emissions from waste incinerators makes measurements during OTNOC mandatory according to European regulations. This TW report IVRY-PARIS XIII will soon be published to give management and authorities, among others, a better understanding that measures must be taken to reduce dioxin emissions to comply with the Stockholm Convention (COP BRS). A waste incinerator must be continuously monitored. At times when the semi-continuous measurements are not working, the log

[19] https://www.infomil.nl/onderwerpen/lucht-water/stookinstallaties/dioxine/reguliere-dioxine/#:~:text=Tegengaan%20van%20dioxine%2Demissies&text=Toch%20is%20het%20mogelijk%20een,moet%20in%20het%20milieumanagementsysteem%20komen.

[20] Arkenbout A, Esbensen KE, Olie K. (2018). Emission regimes of POPs of a Dutch incinerator: regulated, measured and hidden issues. Organohalogen Compounds Vol. 80, 413-416

[21] https://fbe9a7ef-5109-4c51-862c-8dc4e4e3c291.filesusr.com/ugd/8b2c54_1b8259f3600344c08c8825ee8e2dd974.pdf

data from the control room are extremely important to be able to carry out analyses and find out why the measuring equipment was blocked. For the safety of the public and the environment, OTNOC and therefore dioxin emissions must be eliminated or reduced. This also fulfils the obligations of the Stockholm Convention. In addition, the reporting of non-regular emissions, according to EU-166/2005, Article 5(2), should be reported.[22]

Dioxin congeners

The share of total dioxin emissions from waste incinerators is many times larger than shown in publications. The emissions reported to the European Pollutant Release and Transfer Register (E-PRTR)[23] relies on the data, which are incorrect, as explained above.

Figure 4 compares the fingerprint of dioxins (PCDD/F/dl-PCB) from the Bionerga waste incinerator (one measurement without additional data from the control room of the waste incinerator from 09/02/2022 till 23/02/2022[24]) with that of the dioxin congeners found in the chicken eggs of private chicken farmers in Beringen. The dioxin congeners in the flue gases with 7 or 8 chlorine atoms (HpCDD, OCDD, HPCDF1, HPCDF2, and OCDF) show similarities with the congeners found in the chicken eggs around Beringen. In particular, the equal contribution of heptafuran (HPCDF1) in the congener pattern is characteristic.

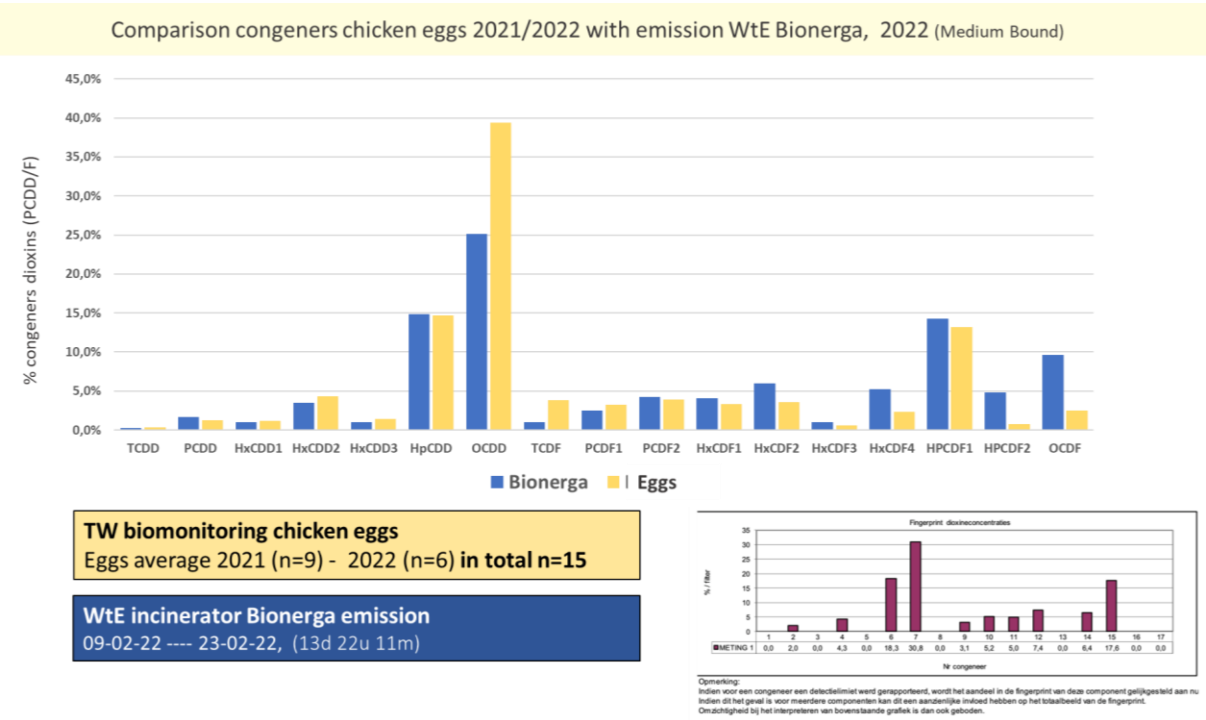

Figure 4: Fingerprints backyard chicken eggs vs Bionerga data 2022

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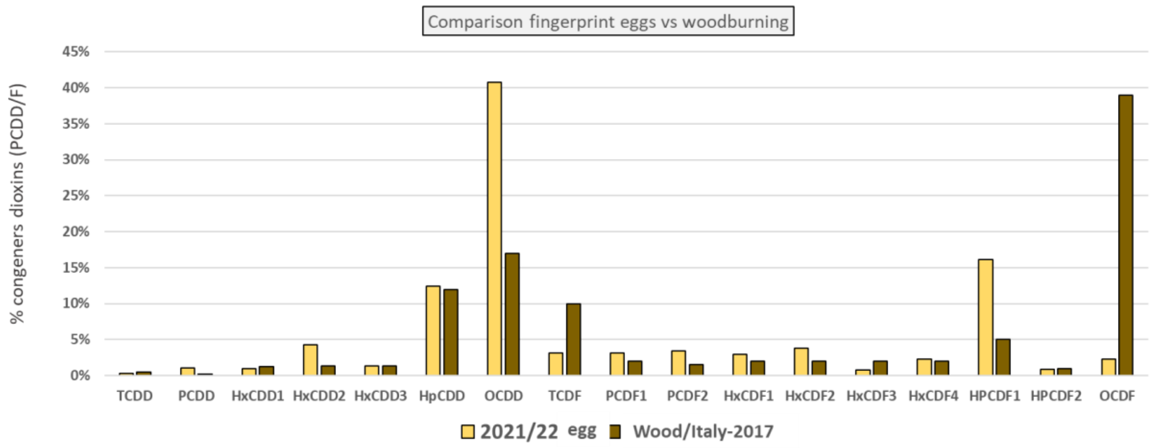
[22] *https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R0166-20200101*

[23] *European Environment Agency*

[24] *Tauw, Belgie NV. Ref. L040-1475681GMS-V01-BE, resultaten dioxinebemonstering nr. 40, 09/02/2022 tem 23/02/2022.*

The congener pattern of dioxins from pine wood of private firing was investigated in an Italian study (2017).[25] Three features stand out here: the relatively low contribution of octa-dioxins (OCDD) and heptafuran (HPCDF1) and the dominance of octafuran (OCDF). The latter congener is hardly detectable in the congener pattern of the chicken eggs in the TW study in Beringen (yellow bars in Figure 5).
This could be interpreted as a low input of dioxins by wood firing from individuals. The pattern from the waste furnace shows a greater similarity to that found in chicken eggs (see blue bars in Figure 4).

Comparison congeners chicken eggs BE-2021/2022 with emission wood burning (Medium Bound)



TW biomonitoring chicken eggs
Eggs average 2021 (n=9) - 2022 (n=6) **in total n=15**

Passamani G. et al (2018). PCDD/F emissions from virgin and treated wood combustion, Int. J. of Energy Prod. & Mgmt., Vol. 2, No. 1 (2017) 17-27

Figure 5: Fingerprints of dioxins in backyard chicken eggs and private wood burning, study Italy 2017

It would be more interesting to investigate the possible contribution of dioxins from the various Seveso industries to the environment of Beringen. Even though these industries have strict obligations such as the Brzo-2015/Seveso III directives, there seems to be a complete lack of information on possible dioxin emissions from this industrial sector. No emissions of dioxins are reported to the European Pollutant Release and Transfer Register (E-PRTR).[26] In contrast, the public health damage of dioxin emissions from industrial activities in Europe is significant. This fact too highlights the need to eliminate or reduce dioxins and strengthens regulation and enforcement.

[25] *Passamani G. et al (2018). PCDD/F emissions from virgin and treated wood combustion, Int. J. of Energy Prod. & Mgmt., Vol. 2, No. 1 (2017) 17-27*
[26] *European Environment Agency*

Dioxin emissions
Waste incineration and private woodburning

Conclusion

Dioxin emissions from the waste industry have been structurally under-recognised and underestimated for more than two (2) decades. This is because (still) only the results of short-term measurements of dioxins are used. These measurements are based on only twelve (12) hours per year, pre-announced and under ideal incineration conditions. Based on this very limited method of measurement, the actual annual dioxin emissions from a waste incinerator cannot be reflected. Long-term measurements with semi-continuous measurements give a much better representation of actual dioxin emissions. If this is supplemented by expert estimates of dioxin emissions during the period when the semi-continuous measurement equipment is out of service, a much more realistic understanding of the actual dioxin emissions from waste incinerators is obtained. Measuring and accounting for dioxin emissions during OTNOC is of great public health importance to recognise the real emissions of dioxin to the environment. Comparing these more realistic dioxin emissions with dioxin emissions from residential wood fires, the share of dioxin emissions from waste incinerators is substantially higher. The more realistic share of emissions from wood fires corresponds more closely to the share of particulate matter (PM10) emissions from wood fires, which are on the order of a few per cent.

The industry has a primary responsibility in keeping a clean environment safe and should do everything possible to eliminate or reduce dioxins in flue gases. Nonetheless, misfiring by private individuals is not a good thing and should not be allowed.

The waste industry should employ the best available techniques (BAT) to eliminate or reduce with utmost effort the emissions of the many toxic substances such as dioxins and heavy metals. Monitoring, sampling, and analysis should be carried out precisely during OTNOC, as 'start-ups' and other calamities. Crucially, the results of dioxin measurements should also be communicated transparently to the public. By this, we mean the raw measurement data and not just the average calculated data, as also agreed internationally in the "Aarhus Protocol" and laid down in EU-166/2005.

ToxicoWatch, June 29, 2023

Annex 5: Lab results

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Analysis report

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Authorized by:
Snezana Zeljkovic
Principle analyst

Date report (dd-mm-yyyy):
18-11-2022

Responsible person BDS:
Emiel Felzel
Head of Testing Laboratory

Information about report
The results of examination refer exclusively to the checked samples.
Results are given in table 1.
Sample characteristics are given in table 2.
The measurement uncertainty for CALUX method is typically below 30%. For the calculation a coverage factor of 1 is used.
If an analysis is accredited by ISO17025 (RvA L401) is indicated by a yes or a no
Date of the performance of the test: 18-11-2022

Table 1 sample analysis results

No.	Client code	Method	Parameter	Result	Conclusion	Cut off	Unit
1	TW22-BE-01-TN-eggs	DR CALUX	PCDD/PCDF (BEQ; semi)	15	suspected	1.7	pg BEQ / gram fat
2	TW22-BE-01-TN-eggs	DR CALUX	PCDD/PCDF and dl-PCBs (BEQ; semi)	22	suspected	3.3	pg BEQ / gram fat
3	TW22-BE-02-BP-eggs	DR CALUX	PCDD/PCDF (BEQ; semi)	15	suspected	1.7	pg BEQ / gram fat
4	TW22-BE-02-BP-eggs	DR CALUX	PCDD/PCDF and dl-PCBs (BEQ; semi)	24	suspected	3.3	pg BEQ / gram fat
5	TW22-BE-04-LJ-eggs	DR CALUX	PCDD/PCDF (BEQ; semi)	8.5	suspected	1.7	pg BEQ / gram fat
6	TW22-BE-04-LJ-eggs	DR CALUX	PCDD/PCDF and dl-PCBs (BEQ; semi)	12	suspected	3.3	pg BEQ / gram fat
7	TW22-BE-05-FH-eggs	DR CALUX	PCDD/PCDF (BEQ; semi)	13	suspected	1.7	pg BEQ / gram fat
8	TW22-BE-05-FH-eggs	DR CALUX	PCDD/PCDF and dl-PCBs (BEQ; semi)	17	suspected	3.3	pg BEQ / gram fat
9	TW22-BE-10-SB-eggs	DR CALUX	PCDD/PCDF (BEQ; semi)	15	suspected	1.7	pg BEQ / gram fat
10	TW22-BE-10-SB-eggs	DR CALUX	PCDD/PCDF and dl-PCBs (BEQ; semi)	20	suspected	3.3	pg BEQ / gram fat
11	TW22-BE-07-JF-eggs	DR CALUX	PCDD/PCDF (BEQ; semi)	5.2	suspected	1.7	pg BEQ / gram fat
12	TW22-BE-07-JF-eggs	DR CALUX	PCDD/PCDF and dl-PCBs (BEQ; semi)	7.6	suspected	3.3	pg BEQ / gram fat

For the suspected sample(s) to be non-compliant, the concentration has to be determined by a confirmatory method

Table 2 sample characteristics

No.	Client code	BDS code	Matrix	ISO17025 (RvAL401)	Date arrival	Sealed
1	TW22-BE-01-TN-eggs	44110	Food, egg(product)	yes	31-10-2022	
2	TW22-BE-01-TN-eggs	44110	Food, egg(product)	yes	31-10-2022	
3	TW22-BE-02-BP-eggs	44111	Food, egg(product)	yes	31-10-2022	
4	TW22-BE-02-BP-eggs	44111	Food, egg(product)	yes	31-10-2022	
5	TW22-BE-04-LJ-eggs	44112	Food, egg(product)	yes	31-10-2022	
6	TW22-BE-04-LJ-eggs	44112	Food, egg(product)	yes	31-10-2022	
7	TW22-BE-05-FH-eggs	44113	Food, egg(product)	yes	31-10-2022	
8	TW22-BE-05-FH-eggs	44113	Food, egg(product)	yes	31-10-2022	
9	TW22-BE-10-SB-eggs	44114	Food, egg(product)	yes	31-10-2022	
10	TW22-BE-10-SB-eggs	44114	Food, egg(product)	yes	31-10-2022	
11	TW22-BE-07-JF-eggs	44115	Food, egg(product)	yes	31-10-2022	
12	TW22-BE-07-JF-eggs	44115	Food, egg(product)	yes	31-10-2022	

For the method DR CALUX and the sum parameter PCDD/PCDF (BEQ; semi) the used method is shake extraction with organic solvents (hexane); the extracts are cleaned on an acid silica column. The cleaned extracts are dissolved in DMSO. The DR CALUX activity is determined (24h exposure). The response of the sample is corrected for the background and subsequently corrected for the apparent bioassay recovery with a reference sample at the level of interest. The evaluation was done on the maximum level for PCDD/F, from which a cut off value has been established (2/3 of maximum level) to determine if a sample is compliant or suspected. As a maximum level the level of the matrix as described in the table above is used. After the evaluation an estimation is given of the sample in the form of a BEQ outcome. The DR CALUX analysis is done according to p-bds-051.

For the method DR CALUX and the sum parameter PCDD/PCDF and dl-PCBs (BEQ; semi) the used method is shake extraction with organic solvents (hexane); the extracts are cleaned on an acid silica column. The cleaned extracts are dissolved in DMSO. The DR CALUX activity is determined (24h exposure). The response of the sample is corrected for the background and subsequently corrected for the apparent bioassay recovery with a reference sample at the level of interest. The evaluation was done on the maximum level for PCDD/F and dl-PCBs, from which a cut off value has

report number: 19682 version number: 1 *Page 1/2*

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Analysis report

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Authorized by:
Emiel Felzel

Date report (dd-mm-yyyy):
14-12-2022

Responsible person BDS:
Emiel Felzel
Head of Testing Laboratory

Information about report
The results of examination refer exclusively to the checked samples.
All analysis results comply with EU requirements as indicated in Commission Regulation (EU) 2017/644 of 5 April 2017 laying down methods of sampling and analysis for the control of levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in certain foodstuffs. Maximal levels according to COMMISSION REGULATION (EU) 2015/704 of 30 April 2015.
For the analyses on dioxins/furans/dl-PCBs/ndl-PCB the sample is extracted with organic solvents (hexane); the extracts are cleaned on an acid silica column/alumina/florisil/carbon. For recovery calculation all 13C labeled congeners are added. The concentrations are determined by GC-MS/MS.

Information about sample

BDS sample number	44340
Client identification	TW22-BE-01-TN-eggs
Sample recieved on	18-11-2022
Start of test	21-11-2022
End of test	29-11-2022
Matrix	Food, egg(product)

Judgement

Non-compliant for maximal level limit (expressed as WHO PCDD/F TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-01-TN-eggs is above the maximal level of 2.5 pg TEQ / gram fat.

Non-compliant for maximal level limit (expressed as WHO PCDD/F + dl-PCBs TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-01-TN-eggs is above the maximal level of 5 pg TEQ / gram fat.

Test results:

WHO sum parameters (accredited under RvA L401)

WHO PCDD/F TEQ lowerbound 2005	8.5	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ mediumbound 2005	8.5	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ upperbound 2005	8.5	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ lowerbound 2005	6	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ mediumbound 2005	6	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ upperbound 2005	6	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F/dl-PCBs TEQ lowerbound 2005	15	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ mediumbound 2005	15	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ upperbound 2005	15	pg TEQ / gram fat	U+/-	23%

Dioxins/furans (accredited under RvA L401)

2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.76	pg / gram fat	U+/-	44%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	3.0	pg / gram fat	U+/-	31%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.5	pg / gram fat	U+/-	44%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	6.2	pg / gram fat	U+/-	46%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.6	pg / gram fat	U+/-	41%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	18	pg / gram fat	U+/-	34%
Octachlorodibenzo-p-dioxin	62	pg / gram fat	U+/-	49%
2,3,7,8-Tetrachlorodibenzofuran	6.0	pg / gram fat	U+/-	27%
1,2,3,7,8-Pentachlorodibenzofuran	3.8	pg / gram fat	U+/-	31%

2,3,4,7,8-Pentachlorodibenzofuran	4.5	pg / gram fat	U+/-	29%
1,2,3,4,7,8-Hexachlorodibenzofuran	3.1	pg / gram fat	U+/-	37%
1,2,3,6,7,8-Hexachlorodibenzofuran	4.4	pg / gram fat	U+/-	25%
1,2,3,7,8,9-Hexachlorodibenzofuran	LOQ (<0.2)	pg / gram fat	U+/-	41%
2,3,4,6,7,8-Hexachlorodibenzofuran	2.1	pg / gram fat	U+/-	32%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	53	pg / gram fat	U+/-	25%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	LOQ (<0.2)	pg / gram fat	U+/-	28%
Octachlorodibenzofuran	4.8	pg / gram fat	U+/-	37%

dl-PCBs (accredited under RvA L401)

3,3',4,4'-Tetrachlorobiphenyl (#77)	53	pg / gram fat	U+/-	39%
3,4,4',5-Tetrachlorobiphenyl (#81)	LOQ (<2)	pg / gram fat	U+/-	32%
3,3',4,4',5-Pentachlorobiphenyl (#126)	56	pg / gram fat	U+/-	26%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	5.4	pg / gram fat	U+/-	53%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	1800	pg / gram fat	U+/-	51%
2,3,4,4',5-Pentachlorobiphenyl (#114)	54	pg / gram fat	U+/-	32%
2,3',4,4',5-Pentachlorobiphenyl (#118)	4000	pg / gram fat	U+/-	44%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	84	pg / gram fat	U+/-	36%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	1000	pg / gram fat	U+/-	36%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	130	pg / gram fat	U+/-	37%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	520	pg / gram fat	U+/-	35%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	190	pg / gram fat	U+/-	37%

Recovery Dioxins/furans

2,3,7,8-Tetrachlorodibenzo-p-dioxin	9.9%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	16.7%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	25.7%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	32.6%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	41.7%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	29.1%
Octachlorodibenzo-p-dioxin	31.3%
2,3,7,8-Tetrachlorodibenzofuran	13.6%
1,2,3,7,8-Pentachlorodibenzofuran	20.5%
2,3,4,7,8-Pentachlorodibenzofuran	20.7%
1,2,3,4,7,8-Hexachlorodibenzofuran	31.2%
1,2,3,6,7,8-Hexachlorodibenzofuran	32.8%
1,2,3,7,8,9-Hexachlorodibenzofuran	22.9%
2,3,4,6,7,8-Hexachlorodibenzofuran	28.6%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	22.6%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	24.9%
Octachlorodibenzofuran	32.3%

Recovery dl-PCBs

3,3',4,4'-Tetrachlorobiphenyl (#77)	28.5%
3,4,4',5-Tetrachlorobiphenyl (#81)	40%
3,3',4,4',5-Pentachlorobiphenyl (#126)	15.6%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	32.4%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	21.6%
2,3,4,4',5-Pentachlorobiphenyl (#114)	24.1%
2,3',4,4',5-Pentachlorobiphenyl (#118)	18.2%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	17.6%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	33.4%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	31.7%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	19.5%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	25.3%

compound out of recovery range

1,2,3,7,8-Pentachlorodibenzo-p-dioxin	16.7%
3,3',4,4',5-Pentachlorobiphenyl (#126)	15.6%

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Analysis report

Client:
Toxicowatch
Abel Arkenbout
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8861 CP
Harlingen
Nederland

Authorized by:
Emiel Felzel

Date report (dd-mm-yyyy):
14-12-2022

Responsible person BDS:
Emiel Felzel
Head of Testing Laboratory

Information about report
The results of examination refer exclusively to the checked samples.
All analysis results comply with EU requirements as indicated in Commission Regulation (EU) 2017/644 of 5 April 2017 laying down methods of sampling and analysis for the control of levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in certain foodstuffs. Maximal levels according to COMMISSION REGULATION (EU) 2015/704 of 30 April 2015.
For the analyses on dioxins/furans/dl-PCBs/ndl-PCB the sample is extracted with organic solvents (hexane); the extracts are cleaned on an acid silica column/alumina/florisil/carbon. For recovery calculation all 13C labeled congeners are added. The concentrations are determined by GC-MS/MS.

Information about sample

BDS sample number	44341
Client identification	TW22-BE-02-BP-eggs
Sample recieved on	18-11-2022
Start of test	21-11-2022
End of test	29-11-2022
Matrix	Food, egg(product)

Judgement

Non-compliant for maximal level limit (expressed as WHO PCDD/F TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-02-BP-eggs is above the maximal level of 2.5 pg TEQ / gram fat.

Non-compliant for maximal level limit (expressed as WHO PCDD/F + dl-PCBs TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-02-BP-eggs is above the maximal level of 5 pg TEQ / gram fat.

Test results:

WHO sum parameters (accredited under RvA L401)

WHO PCDD/F TEQ lowerbound 2005	7.7	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ mediumbound 2005	7.7	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ upperbound 2005	7.7	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ lowerbound 2005	5.1	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ mediumbound 2005	5.1	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ upperbound 2005	5.1	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F/dl-PCBs TEQ lowerbound 2005	13	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ mediumbound 2005	13	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ upperbound 2005	13	pg TEQ / gram fat	U+/-	23%

Dioxins/furans (accredited under RvA L401)

2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.51	pg / gram fat	U+/-	44%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.1	pg / gram fat	U+/-	31%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.83	pg / gram fat	U+/-	44%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	5.2	pg / gram fat	U+/-	46%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.7	pg / gram fat	U+/-	41%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	25	pg / gram fat	U+/-	34%
Octachlorodibenzo-p-dioxin	43	pg / gram fat	U+/-	49%
2,3,7,8-Tetrachlorodibenzofuran	6.9	pg / gram fat	U+/-	27%
1,2,3,7,8-Pentachlorodibenzofuran	5.2	pg / gram fat	U+/-	31%

2,3,4,7,8-Pentachlorodibenzofuran	7.9	pg / gram fat	U+/-	29%
1,2,3,4,7,8-Hexachlorodibenzofuran	2.3	pg / gram fat	U+/-	37%
1,2,3,6,7,8-Hexachlorodibenzofuran	2.3	pg / gram fat	U+/-	25%
1,2,3,7,8,9-Hexachlorodibenzofuran	LOQ (<0.3)	pg / gram fat	U+/-	41%
2,3,4,6,7,8-Hexachlorodibenzofuran	1.7	pg / gram fat	U+/-	32%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	12	pg / gram fat	U+/-	25%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.91	pg / gram fat	U+/-	28%
Octachlorodibenzofuran	2.2	pg / gram fat	U+/-	37%

dl-PCBs (accredited under RvA L401)

3,3',4,4'-Tetrachlorobiphenyl (#77)	56	pg / gram fat	U+/-	39%
3,4,4',5-Tetrachlorobiphenyl (#81)	5.4	pg / gram fat	U+/-	32%
3,3',4,4',5-Pentachlorobiphenyl (#126)	47	pg / gram fat	U+/-	26%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	9.5	pg / gram fat	U+/-	53%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	1300	pg / gram fat	U+/-	51%
2,3,4,4',5-Pentachlorobiphenyl (#114)	59	pg / gram fat	U+/-	32%
2,3',4,4',5-Pentachlorobiphenyl (#118)	3200	pg / gram fat	U+/-	44%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	63	pg / gram fat	U+/-	36%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	790	pg / gram fat	U+/-	36%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	180	pg / gram fat	U+/-	37%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	480	pg / gram fat	U+/-	35%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	120	pg / gram fat	U+/-	37%

Recovery Dioxins/furans

2,3,7,8-Tetrachlorodibenzo-p-dioxin	72.6%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	75.5%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	55.4%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	74.6%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	55.3%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	58.5%
Octachlorodibenzo-p-dioxin	83.4%
2,3,7,8-Tetrachlorodibenzofuran	52.4%
1,2,3,7,8-Pentachlorodibenzofuran	62%
2,3,4,7,8-Pentachlorodibenzofuran	49.9%
1,2,3,4,7,8-Hexachlorodibenzofuran	74.6%
1,2,3,6,7,8-Hexachlorodibenzofuran	59.4%
1,2,3,7,8,9-Hexachlorodibenzofuran	57.3%
2,3,4,6,7,8-Hexachlorodibenzofuran	66.9%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	51.7%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	63.3%
Octachlorodibenzofuran	93.1%

Recovery dl-PCBs

3,3',4,4'-Tetrachlorobiphenyl (#77)	64.6%
3,4,4',5-Tetrachlorobiphenyl (#81)	69.4%
3,3',4,4',5-Pentachlorobiphenyl (#126)	63.2%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	113.3%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	80.4%
2,3,4,4',5-Pentachlorobiphenyl (#114)	84.2%
2,3',4,4',5-Pentachlorobiphenyl (#118)	70%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	74.1%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	76.4%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	68.6%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	62.7%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	74.6%

compound out of recovery range

2,3,4,7,8-Pentachlorodibenzofuran	49.9%

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Analysis report

Client:
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Abel Arkenbout
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8861 CP
Harlingen
Nederland

Authorized by:
Emiel Felzel

Date report (dd-mm-yyyy):
14-12-2022

Responsible person BDS:
Emiel Felzel
Head of Testing Laboratory

Information about report
The results of examination refer exclusively to the checked samples.
All analysis results comply with EU requirements as indicated in Commission Regulation (EU) 2017/644 of 5 April 2017 laying down methods of sampling and analysis for the control of levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in certain foodstuffs. Maximal levels according to COMMISSION REGULATION (EU) 2015/704 of 30 April 2015.
For the analyses on dioxins/furans/dl-PCBs/ndl-PCB the sample is extracted with organic solvents (hexane); the extracts are cleaned on an acid silica column/alumina/florisil/carbon. For recovery calculation all 13C labeled congeners are added. The concentrations are determined by GC-MS/MS.

Information about sample

BDS sample number	44342
Client identification	TW22-BE-04-LJ-eggs
Sample recieved on	18-11-2022
Start of test	21-11-2022
End of test	29-11-2022
Matrix	Food, egg(product)

Judgement

Non-compliant for maximal level limit (expressed as WHO PCDD/F TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-04-LJ-eggs is above the maximal level of 2.5 pg TEQ / gram fat.

Non-compliant for maximal level limit (expressed as WHO PCDD/F + dl-PCBs TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-04-LJ-eggs is above the maximal level of 5 pg TEQ / gram fat.

Test results:

WHO sum parameters (accredited under RvA L401)

WHO PCDD/F TEQ lowerbound 2005	4.5	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ mediumbound 2005	4.5	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ upperbound 2005	4.6	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ lowerbound 2005	2.1	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ mediumbound 2005	2.1	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ upperbound 2005	2.1	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F/dl-PCBs TEQ lowerbound 2005	6.7	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ mediumbound 2005	6.7	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ upperbound 2005	6.7	pg TEQ / gram fat	U+/-	23%

Dioxins/furans (accredited under RvA L401)

2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.63	pg / gram fat	U+/-	44%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.91	pg / gram fat	U+/-	31%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.56	pg / gram fat	U+/-	44%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	6.9	pg / gram fat	U+/-	46%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	1.9	pg / gram fat	U+/-	41%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	11	pg / gram fat	U+/-	34%
Octachlorodibenzo-p-dioxin	47	pg / gram fat	U+/-	49%
2,3,7,8-Tetrachlorodibenzofuran	3.0	pg / gram fat	U+/-	27%
1,2,3,7,8-Pentachlorodibenzofuran	2.9	pg / gram fat	U+/-	31%

2,3,4,7,8-Pentachlorodibenzofuran	2.8	pg / gram fat	U+/-	29%
1,2,3,4,7,8-Hexachlorodibenzofuran	1.8	pg / gram fat	U+/-	37%
1,2,3,6,7,8-Hexachlorodibenzofuran	2.2	pg / gram fat	U+/-	25%
1,2,3,7,8,9-Hexachlorodibenzofuran	LOQ (<0.4)	pg / gram fat	U+/-	41%
2,3,4,6,7,8-Hexachlorodibenzofuran	2.4	pg / gram fat	U+/-	32%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	5.3	pg / gram fat	U+/-	25%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	LOQ (<0.4)	pg / gram fat	U+/-	28%
Octachlorodibenzofuran	1.7	pg / gram fat	U+/-	37%

dl-PCBs (accredited under RvA L401)

3,3',4,4'-Tetrachlorobiphenyl (#77)	20	pg / gram fat	U+/-	39%
3,4,4',5-Tetrachlorobiphenyl (#81)	LOQ (<4)	pg / gram fat	U+/-	32%
3,3',4,4',5-Pentachlorobiphenyl (#126)	20	pg / gram fat	U+/-	26%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	4.0	pg / gram fat	U+/-	53%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	410	pg / gram fat	U+/-	51%
2,3,4,4',5-Pentachlorobiphenyl (#114)	18	pg / gram fat	U+/-	32%
2,3',4,4',5-Pentachlorobiphenyl (#118)	910	pg / gram fat	U+/-	44%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	21	pg / gram fat	U+/-	36%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	260	pg / gram fat	U+/-	36%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	59	pg / gram fat	U+/-	37%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	180	pg / gram fat	U+/-	35%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	46	pg / gram fat	U+/-	37%

Recovery Dioxins/furans

2,3,7,8-Tetrachlorodibenzo-p-dioxin	27.4%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	33%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	28%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	23.1%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	21.2%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	29.5%
Octachlorodibenzo-p-dioxin	39.8%
2,3,7,8-Tetrachlorodibenzofuran	30%
1,2,3,7,8-Pentachlorodibenzofuran	31.8%
2,3,4,7,8-Pentachlorodibenzofuran	33.4%
1,2,3,4,7,8-Hexachlorodibenzofuran	40.8%
1,2,3,6,7,8-Hexachlorodibenzofuran	38.9%
1,2,3,7,8,9-Hexachlorodibenzofuran	49.1%
2,3,4,6,7,8-Hexachlorodibenzofuran	34.9%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	34.3%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	33.4%
Octachlorodibenzofuran	46.7%

Recovery dl-PCBs

3,3',4,4'-Tetrachlorobiphenyl (#77)	35.5%
3,4,4',5-Tetrachlorobiphenyl (#81)	33.3%
3,3',4,4',5-Pentachlorobiphenyl (#126)	29.2%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	47.3%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	63.8%
2,3,4,4',5-Pentachlorobiphenyl (#114)	73.4%
2,3',4,4',5-Pentachlorobiphenyl (#118)	57.7%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	61.7%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	60.5%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	56%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	48.7%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	60.2%

compound out of recovery range

1,2,3,7,8-Pentachlorodibenzo-p-dioxin	33%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	23.1%
2,3,4,7,8-Pentachlorodibenzofuran	33.4%
3,3',4,4',5-Pentachlorobiphenyl (#126)	29.2%

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Analysis report

Client:
Toxicowatch
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8861 CP
Harlingen
Nederland

Authorized by:
Emiel Felzel

Date report (dd-mm-yyyy):
14-12-2022

Responsible person BDS:
Emiel Felzel
Head of Testing Laboratory

Information about report

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For the analyses on dioxins/furans/dl-PCBs/ndl-PCB the sample is extracted with organic solvents (hexane); the extracts are cleaned on an acid silica column/alumina/florisil/carbon. For recovery calculation all 13C labeled congeners are added. The concentrations are determined by GC-MS/MS.

Information about sample

BDS sample number	44343
Client identification	TW22-BE-05-FH-eggs
Sample recieved on	18-11-2022
Start of test	21-11-2022
End of test	29-11-2022
Matrix	Food, egg(product)

Judgement

Non-compliant for maximal level limit (expressed as WHO PCDD/F TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-05-FH-eggs is above the maximal level of 2.5 pg TEQ / gram fat.

Non-compliant for maximal level limit (expressed as WHO PCDD/F + dl-PCBs TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-05-FH-eggs is above the maximal level of 5 pg TEQ / gram fat.

Test results:

WHO sum parameters (accredited under RvA L401)

WHO PCDD/F TEQ lowerbound 2005	6.7	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ mediumbound 2005	6.9	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ upperbound 2005	7.1	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ lowerbound 2005	2.6	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ mediumbound 2005	2.6	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ upperbound 2005	2.6	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F/dl-PCBs TEQ lowerbound 2005	9.2	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ mediumbound 2005	9.5	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ upperbound 2005	9.7	pg TEQ / gram fat	U+/-	23%

Dioxins/furans (accredited under RvA L401)

2,3,7,8-Tetrachlorodibenzo-p-dioxin	LOQ (<0.4)	pg / gram fat	U+/-	44%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	2.0	pg / gram fat	U+/-	31%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	1.3	pg / gram fat	U+/-	44%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3.5	pg / gram fat	U+/-	46%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	2.0	pg / gram fat	U+/-	41%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	20	pg / gram fat	U+/-	34%
Octachlorodibenzo-p-dioxin	37	pg / gram fat	U+/-	49%
2,3,7,8-Tetrachlorodibenzofuran	3.3	pg / gram fat	U+/-	27%
1,2,3,7,8-Pentachlorodibenzofuran	5.5	pg / gram fat	U+/-	31%

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2,3,4,7,8-Pentachlorodibenzofuran	4.9	pg / gram fat	U+/-	29%
1,2,3,4,7,8-Hexachlorodibenzofuran	8.2	pg / gram fat	U+/-	37%
1,2,3,6,7,8-Hexachlorodibenzofuran	5.1	pg / gram fat	U+/-	25%
1,2,3,7,8,9-Hexachlorodibenzofuran	LOQ (<0.4)	pg / gram fat	U+/-	41%
2,3,4,6,7,8-Hexachlorodibenzofuran	4.1	pg / gram fat	U+/-	32%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	9.8	pg / gram fat	U+/-	25%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	1.2	pg / gram fat	U+/-	28%
Octachlorodibenzofuran	4.6	pg / gram fat	U+/-	37%

dl-PCBs (accredited under RvA L401)

3,3',4,4'-Tetrachlorobiphenyl (#77)	25	pg / gram fat	U+/-	39%
3,4,4',5-Tetrachlorobiphenyl (#81)	LOQ (<4)	pg / gram fat	U+/-	32%
3,3',4,4',5-Pentachlorobiphenyl (#126)	23	pg / gram fat	U+/-	26%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	5.3	pg / gram fat	U+/-	53%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	470	pg / gram fat	U+/-	51%
2,3,4,4',5-Pentachlorobiphenyl (#114)	LOQ (<20)	pg / gram fat	U+/-	32%
2,3',4,4',5-Pentachlorobiphenyl (#118)	800	pg / gram fat	U+/-	44%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	28	pg / gram fat	U+/-	36%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	300	pg / gram fat	U+/-	36%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	69	pg / gram fat	U+/-	37%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	180	pg / gram fat	U+/-	35%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	56	pg / gram fat	U+/-	37%

Recovery Dioxins/furans

2,3,7,8-Tetrachlorodibenzo-p-dioxin	50.6%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	37.3%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	48.6%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	59.6%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	64.7%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	40.7%
Octachlorodibenzo-p-dioxin	56.7%
2,3,7,8-Tetrachlorodibenzofuran	44.9%
1,2,3,7,8-Pentachlorodibenzofuran	42.1%
2,3,4,7,8-Pentachlorodibenzofuran	46.2%
1,2,3,4,7,8-Hexachlorodibenzofuran	35.8%
1,2,3,6,7,8-Hexachlorodibenzofuran	47.2%
1,2,3,7,8,9-Hexachlorodibenzofuran	43.8%
2,3,4,6,7,8-Hexachlorodibenzofuran	40.8%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	47.5%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55.7%
Octachlorodibenzofuran	90.2%

Recovery dl-PCBs

3,3',4,4'-Tetrachlorobiphenyl (#77)	56.6%
3,4,4',5-Tetrachlorobiphenyl (#81)	57.5%
3,3',4,4',5-Pentachlorobiphenyl (#126)	47.9%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	67.7%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	50.2%
2,3,4,4',5-Pentachlorobiphenyl (#114)	57.9%
2,3',4,4',5-Pentachlorobiphenyl (#118)	45.3%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	49.8%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	47.9%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	45.4%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	38%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	45.8%

compound out of recovery range

1,2,3,7,8-Pentachlorodibenzo-p-dioxin	37.3%
2,3,4,7,8-Pentachlorodibenzofuran	46.2%
3,3',4,4',5-Pentachlorobiphenyl (#126)	47.9%

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Analysis report

Client:
Toxicowatch
Abel Arkenbout
info@toxicowatch.org

8861 CP
Harlingen
Nederland

Authorized by:
Emiel Felzel

Date report (dd-mm-yyyy):
14-12-2022

Responsible person BDS:
Emiel Felzel
Head of Testing Laboratory

Information about report
The results of examination refer exclusively to the checked samples.
All analysis results comply with EU requirements as indicated in Commission Regulation (EU) 2017/644 of 5 April 2017 laying down methods of sampling and analysis for the control of levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in certain foodstuffs. Maximal levels according to COMMISSION REGULATION (EU) 2015/704 of 30 April 2015.
For the analyses on dioxins/furans/dl-PCBs/ndl-PCB the sample is extracted with organic solvents (hexane); the extracts are cleaned on an acid silica column/alumina/florisil/carbon. For recovery calculation all 13C labeled congeners are added. The concentrations are determined by GC-MS/MS.

Information about sample

BDS sample number	44344
Client identification	TW22-BE-10-SB-eggs
Sample recieved on	18-11-2022
Start of test	21-11-2022
End of test	29-11-2022
Matrix	Food, egg(product)

Judgement

Non-compliant for maximal level limit (expressed as WHO PCDD/F TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-10-SB-eggs is above the maximal level of 2.5 pg TEQ / gram fat.

Non-compliant for maximal level limit (expressed as WHO PCDD/F + dl-PCBs TEQ) taking into account expanded measurement uncertainity.
Sample TW22-BE-10-SB-eggs is above the maximal level of 5 pg TEQ / gram fat.

Test results:

WHO sum parameters (accredited under RvA L401)

WHO PCDD/F TEQ lowerbound 2005	10	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ mediumbound 2005	10	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ upperbound 2005	10	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ lowerbound 2005	4.5	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ mediumbound 2005	4.5	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ upperbound 2005	4.5	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F/dl-PCBs TEQ lowerbound 2005	15	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ mediumbound 2005	15	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ upperbound 2005	15	pg TEQ / gram fat	U+/-	23%

Dioxins/furans (accredited under RvA L401)

2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.81	pg / gram fat	U+/-	44%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	3.2	pg / gram fat	U+/-	31%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	2.6	pg / gram fat	U+/-	44%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	11	pg / gram fat	U+/-	46%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	4.6	pg / gram fat	U+/-	41%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	60	pg / gram fat	U+/-	34%
Octachlorodibenzo-p-dioxin	130	pg / gram fat	U+/-	49%
2,3,7,8-Tetrachlorodibenzofuran	5.8	pg / gram fat	U+/-	27%
1,2,3,7,8-Pentachlorodibenzofuran	5.0	pg / gram fat	U+/-	31%

2,3,4,7,8-Pentachlorodibenzofuran	5.2	pg / gram fat	U+/-	29%
1,2,3,4,7,8-Hexachlorodibenzofuran	4.6	pg / gram fat	U+/-	37%
1,2,3,6,7,8-Hexachlorodibenzofuran	3.6	pg / gram fat	U+/-	25%
1,2,3,7,8,9-Hexachlorodibenzofuran	LOQ (<0.4)	pg / gram fat	U+/-	41%
2,3,4,6,7,8-Hexachlorodibenzofuran	5.8	pg / gram fat	U+/-	32%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	10	pg / gram fat	U+/-	25%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	1.5	pg / gram fat	U+/-	28%
Octachlorodibenzofuran	7.5	pg / gram fat	U+/-	37%

dl-PCBs (accredited under RvA L401)

3,3',4,4'-Tetrachlorobiphenyl (#77)	38	pg / gram fat	U+/-	39%
3,4,4',5-Tetrachlorobiphenyl (#81)	LOQ (<4)	pg / gram fat	U+/-	32%
3,3',4,4',5-Pentachlorobiphenyl (#126)	42	pg / gram fat	U+/-	26%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	6.8	pg / gram fat	U+/-	53%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	1100	pg / gram fat	U+/-	51%
2,3,4,4',5-Pentachlorobiphenyl (#114)	38	pg / gram fat	U+/-	32%
2,3',4,4',5-Pentachlorobiphenyl (#118)	2300	pg / gram fat	U+/-	44%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	51	pg / gram fat	U+/-	36%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	650	pg / gram fat	U+/-	36%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	130	pg / gram fat	U+/-	37%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	340	pg / gram fat	U+/-	35%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	100	pg / gram fat	U+/-	37%

Recovery Dioxins/furans

2,3,7,8-Tetrachlorodibenzo-p-dioxin	40.8%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	41.4%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	43.7%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	49.7%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	49.1%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	41.3%
Octachlorodibenzo-p-dioxin	55.2%
2,3,7,8-Tetrachlorodibenzofuran	40.4%
1,2,3,7,8-Pentachlorodibenzofuran	44.2%
2,3,4,7,8-Pentachlorodibenzofuran	49%
1,2,3,4,7,8-Hexachlorodibenzofuran	70.4%
1,2,3,6,7,8-Hexachlorodibenzofuran	50.3%
1,2,3,7,8,9-Hexachlorodibenzofuran	59%
2,3,4,6,7,8-Hexachlorodibenzofuran	40.3%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	50.4%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	38.8%
Octachlorodibenzofuran	62.8%

Recovery dl-PCBs

3,3',4,4'-Tetrachlorobiphenyl (#77)	50%
3,4,4',5-Tetrachlorobiphenyl (#81)	50.5%
3,3',4,4',5-Pentachlorobiphenyl (#126)	40.6%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	81.4%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	48.4%
2,3,4,4',5-Pentachlorobiphenyl (#114)	58.4%
2,3',4,4',5-Pentachlorobiphenyl (#118)	43.9%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	47.6%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	46.8%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	43.3%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	35.3%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	44.3%

compound out of recovery range

1,2,3,7,8-Pentachlorodibenzo-p-dioxin	41.4%
2,3,4,7,8-Pentachlorodibenzofuran	49%
3,3',4,4',5-Pentachlorobiphenyl (#126)	40.6%

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Analysis report

Client:
Toxicowatch
Abel Arkenbout
info@toxicowatch.org

8861 CP
Harlingen
Nederland

Authorized by:
Emiel Felzel

Date report (dd-mm-yyyy):
14-12-2022

Responsible person BDS:
Emiel Felzel
Head of Testing Laboratory

Information about report
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For the analyses on dioxins/furans/dl-PCBs/ndl-PCB the sample is extracted with organic solvents (hexane); the extracts are cleaned on an acid silica column/alumina/florisil/carbon. For recovery calculation all 13C labeled congeners are added. The concentrations are determined by GC-MS/MS.

Information about sample

BDS sample number	44345
Client identification	TW22-BE-07-JF-eggs
Sample recieved on	18-11-2022
Start of test	21-11-2022
End of test	29-11-2022
Matrix	Food, egg(product)

Test results:

WHO sum parameters (accredited under RvA L401)

WHO PCDD/F TEQ lowerbound 2005	2.1	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ mediumbound 2005	2.3	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F TEQ upperbound 2005	2.5	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ lowerbound 2005	2.3	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ mediumbound 2005	2.3	pg TEQ / gram fat	U+/-	24%
WHO dl-PCBs TEQ upperbound 2005	2.3	pg TEQ / gram fat	U+/-	24%
WHO PCDD/F/dl-PCBs TEQ lowerbound 2005	4.4	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ mediumbound 2005	4.6	pg TEQ / gram fat	U+/-	23%
WHO PCDD/F/dl-PCBs TEQ upperbound 2005	4.7	pg TEQ / gram fat	U+/-	23%

Dioxins/furans (accredited under RvA L401)

2,3,7,8-Tetrachlorodibenzo-p-dioxin	LOQ (<0.3)	pg / gram fat	U+/-	44%
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.50	pg / gram fat	U+/-	31%
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.58	pg / gram fat	U+/-	44%
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	3.1	pg / gram fat	U+/-	46%
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.54	pg / gram fat	U+/-	41%
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	8.2	pg / gram fat	U+/-	34%
Octachlorodibenzo-p-dioxin	22	pg / gram fat	U+/-	49%
2,3,7,8-Tetrachlorodibenzofuran	2.8	pg / gram fat	U+/-	27%
1,2,3,7,8-Pentachlorodibenzofuran	2.0	pg / gram fat	U+/-	31%
2,3,4,7,8-Pentachlorodibenzofuran	1.3	pg / gram fat	U+/-	29%
1,2,3,4,7,8-Hexachlorodibenzofuran	1.6	pg / gram fat	U+/-	37%
1,2,3,6,7,8-Hexachlorodibenzofuran	1.0	pg / gram fat	U+/-	25%
1,2,3,7,8,9-Hexachlorodibenzofuran	LOQ (<0.3)	pg / gram fat	U+/-	41%
2,3,4,6,7,8-Hexachlorodibenzofuran	0.96	pg / gram fat	U+/-	32%
1,2,3,4,6,7,8-Heptachlorodibenzofuran	3.5	pg / gram fat	U+/-	25%
1,2,3,4,7,8,9-Heptachlorodibenzofuran	LOQ (<0.3)	pg / gram fat	U+/-	28%

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Octachlorodibenzofuran	1.1	pg / gram fat	U+/-	37%

dl-PCBs (accredited under RvA L401)

3,3',4,4'-Tetrachlorobiphenyl (#77)	47	pg / gram fat	U+/-	39%
3,4,4',5-Tetrachlorobiphenyl (#81)	4.3	pg / gram fat	U+/-	32%
3,3',4,4',5-Pentachlorobiphenyl (#126)	21	pg / gram fat	U+/-	26%
3,3',4,4',5,5'-Hexachlorobiphenyl (#169)	3.0	pg / gram fat	U+/-	53%
2,3,3',4,4'-Pentachlorobiphenyl (#105)	630	pg / gram fat	U+/-	51%
2,3,4,4',5-Pentachlorobiphenyl (#114)	35	pg / gram fat	U+/-	32%
2,3',4,4',5-Pentachlorobiphenyl (#118)	1300	pg / gram fat	U+/-	44%
2,3',4,4',5'-Pentachlorobiphenyl (#123)	31	pg / gram fat	U+/-	36%
2,3,3',4,4',5-Hexachlorobiphenyl (#156)	420	pg / gram fat	U+/-	36%
2,3,3',4,4',5'-Hexachlorobiphenyl (#157)	80	pg / gram fat	U+/-	37%
2,3',4,4',5,5'-Hexachlorobiphenyl (#167)	220	pg / gram fat	U+/-	35%
2,3,3',4,4',5,5'-Heptachlorobiphenyl (#189)	82	pg / gram fat	U+/-	37%

compound out of recovery range

3,3',4,4',5-Pentachlorobiphenyl (#126)	40.6%