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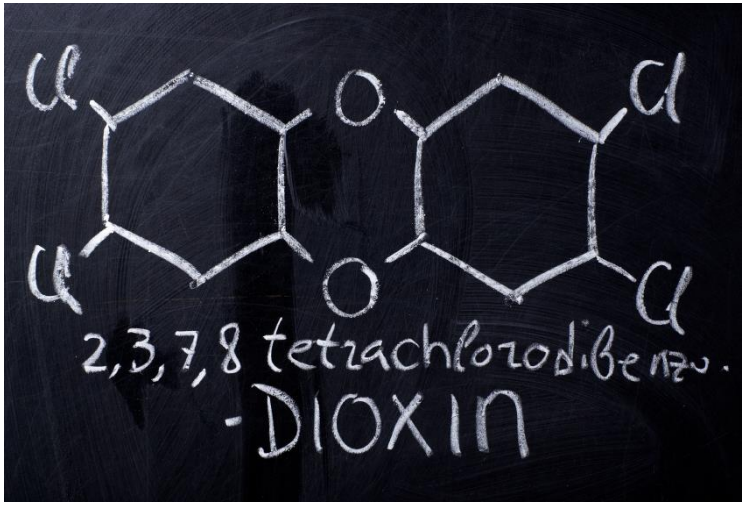
EnviroTalks Webinar

# Persistent Organic Pollutants: Dioxins in the Environment




**Dr. Bob Symons**
**Regional Technical Manager**
**Eurofins Environment Testing ANZ**

**Jonathon Angell**
**Business Unit Manager – QLD**
**Eurofins Environment Testing Australia**

# Acknowledgement of Country

We acknowledge the Traditional Owners of the country on which we meet today, and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past, present and emerging.

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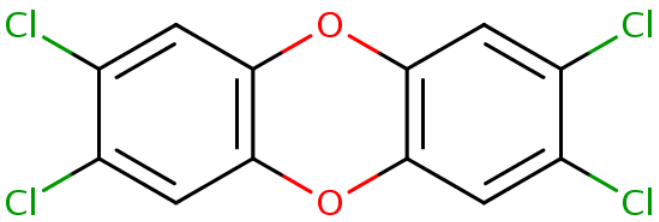
## AUDIENCE PARTICIPATION ENCOURAGED

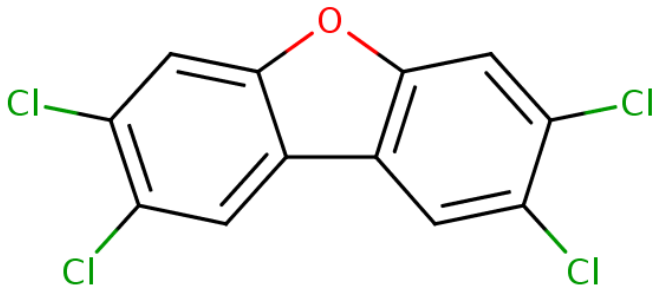
- Ask Questions using the ? at the RHS pane
- Q&A will be at the end of the presentation
- Recording link and slides will be shared

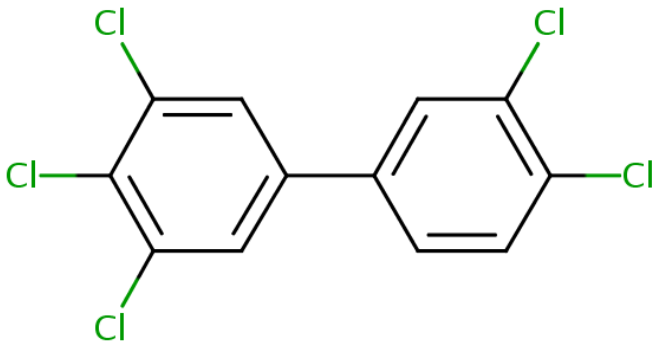
- NOTE: All participants will be muted from the beginning of the webinar

# What is Dioxin?

- Dioxin is a general name for a class of chlorinated chemical compounds with similar chemical structure
- It includes PCDDs, PCDFs and DL-PCBs
  - Polychlorinated dibenzo-*p*-dioxin (PCDDs)
  - Polychlorinated dibenzofurans (PCDFs)
  - Dioxin-like PCBs (DL-PCBs)
- Model is 2,3,7,8-TCDD (most toxic)
- Exist as mixtures (TEQ)

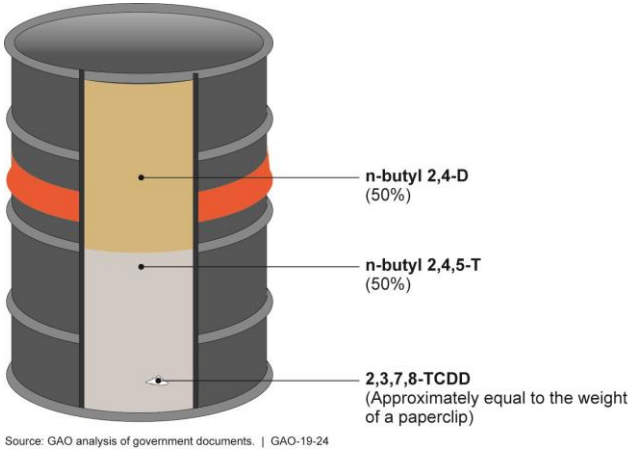


# Sources

- Chlorine bleaching processes at pulp and paper mills
- Chemical manufacturing contaminants
  - Agent Orange
  - Seveso
  - Wood preservatives (PCP)
  - Homebush Bay (Union Carbide)
- Released into air in emissions
  - Solid waste incinerators
  - Medical waste incinerators
  - Volcanoes
  - Bushfires



Source: GAO analysis of government documents. | GAO-19-24

# Use in Vietnam

**Table 1.1** Estimated quantities of tactical herbicides used in Vietnam, 1961–1972

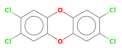
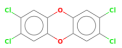
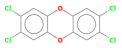
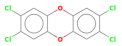
| Tactical herbicide | Commercial components | Number of drums[1] | Number of liters | Years of use |
|---|---|---|---|---|
| Green[2] | 2,4,5-T | 365[3] | 75,920 | 1962 |
| Pink[2] | 2,4,5-T | 1,315 | 273,520 | 1961–1963 |
| Purple[2] | 2,4-D; 2,4,5-T | 12,475 | 2,594,800 | 1962–1965 |
| Blue | Cacodylic Acid | 29,330 | 6,100,640 | 1966–1972 |
| White | 2,4-D; Picloram | 104,800 | 21,798,400 | 1966–1972 |
| Orange[2] | 2,4-D; 2,4,5-T | 208,330 | 43,332,640 | 1965–1970 |
| Total | | 356,615 | 74,175,920 | |

[1] Data based on US Defense Supply Agency and Air Force Logistics Command records (Craig 1975; Young 2006); Data as of March 2008.

[2] These tactical herbicides contained 2,4,5-T herbicide and its associated contaminant, 2,3,7,8-TCDD. Pink was used in the 1964 Thailand tests, but available data indicted last Pink Mission in South Vietnam was in 1963; the Daily Air Activity Reports often confused Purple and Pink.

[3] All herbicide drums sent to Vietnam were of 18-guage steel and held 208 l or 55 gal of product that were applied in concentrated form and not diluted.

# Persistent Organic Pollutants (POPs)

-  **Persistence**
-  **Bio-accumulation**
-  **Potential for long-range environmental transport**
-  **Adverse effects**

STOCKHOLM CONVENTION

UN environment

# The initial 12 POPs (Dirty Dozen)

## Annex A (Elimination)

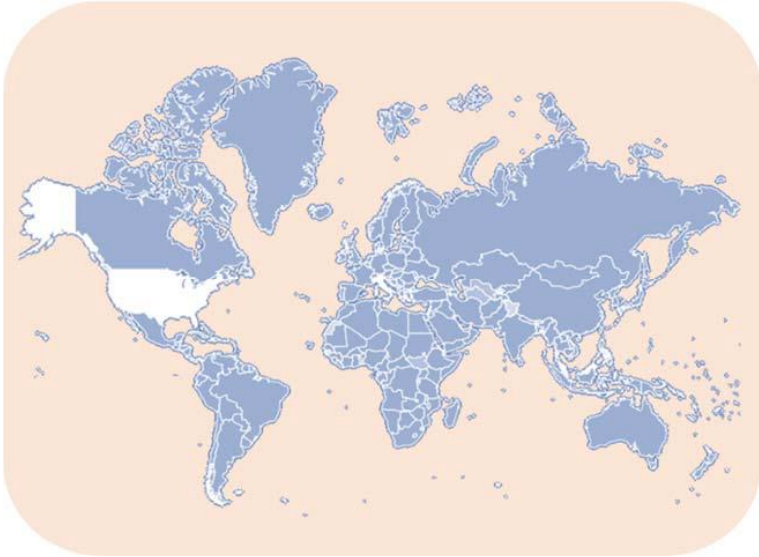
- Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, Hexachlorobenzene, Mirex, Toxaphene, PCB

## Annex B (Restriction)

- DDT

## Annex C (Unintentional production)

- Polychlorinated dibenzo-p-dioxins and dibenzofurans
- Hexachlorobenzene
- PCB



The Stockholm Convention is an international treaty to protect human health and the environment from POPs. It was adopted in 2001 and entered into force in 2004 initially covering 12 chemicals. Currently, 16 additional POPs have been added by 181 Parties as of 2017 to the Stockholm Convention

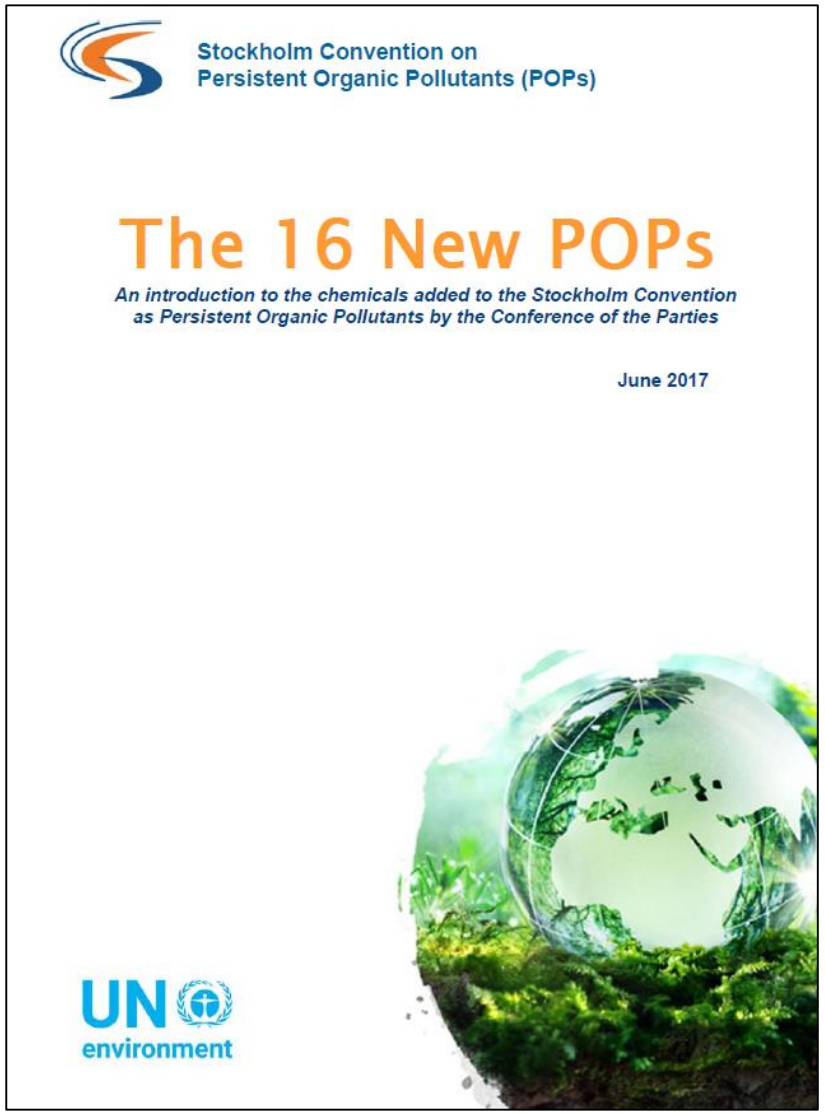
# New POPs

**Annex A (Elimination)**

- Alpha-hexachlorocyclohexane
- Beta-hexachlorocyclohexane
- Chlordecone
- Hexabromobiphenyl
- Hexabromocyclododecane (HBCDD)
- Tetrabromodiphenyl ether and Pentabromodiphenyl ether (commercial pentabromodiphenyl ether)
- Hexabromodiphenyl ether and heptabromodiphenyl ether (commercial octabromodiphenyl ether)
- Decabromodiphenyl ether (Commercial mixture, c-DecaBDE)
- Hexachlorobutadiene
- Lindane
- Pentachlorobenzene
- Pentachlorophenol and its salts and esters
- Polychlorinated naphthalenes
- Technical endosulfan and its related isomers
- Short-chain chlorinated paraffins (SCCPs)

**Annex B (Restriction)**

- Perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF)

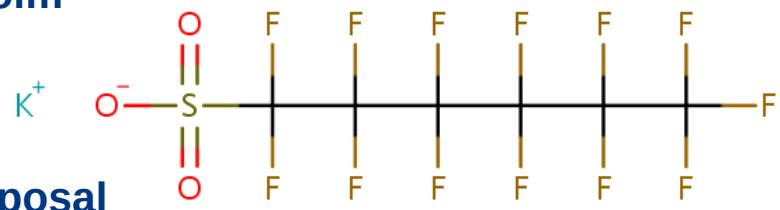


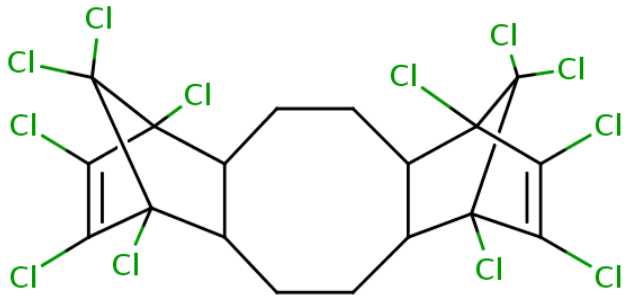
# Candidate POPs

**Process for listing a new chemical under the Stockholm Convention**

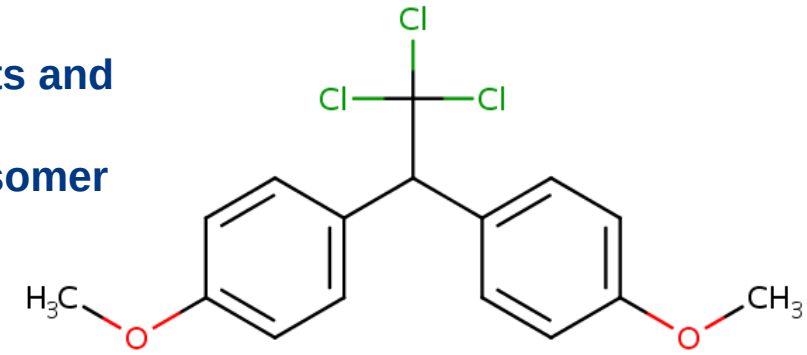
**Article 8;**

1) A Party submits a proposal
2) The POPs Review Committee examines the proposal against Annex D screening criteria
3) If fulfilled, the POPs Review Committee prepares a risk profile based on Annex E information from Parties and observers
4) If adopted, the POPs Review Committee prepares a risk management evaluation based on Annex F information from Parties and observers
5) If adopted, the POPs Review Committee makes a recommendation on listing

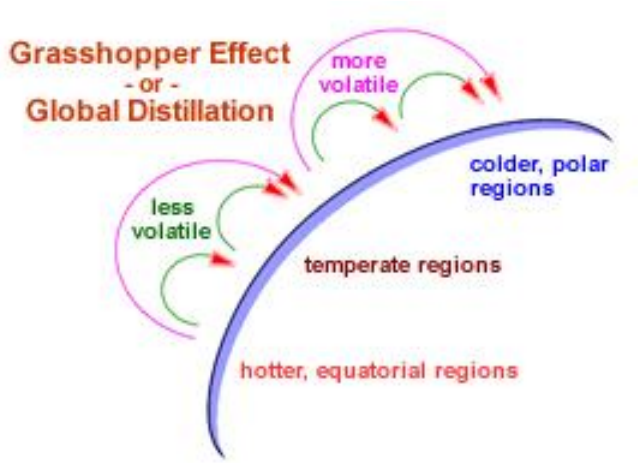


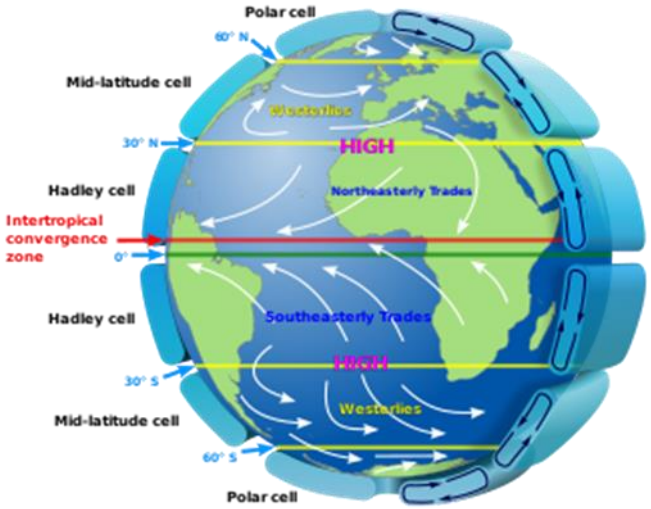



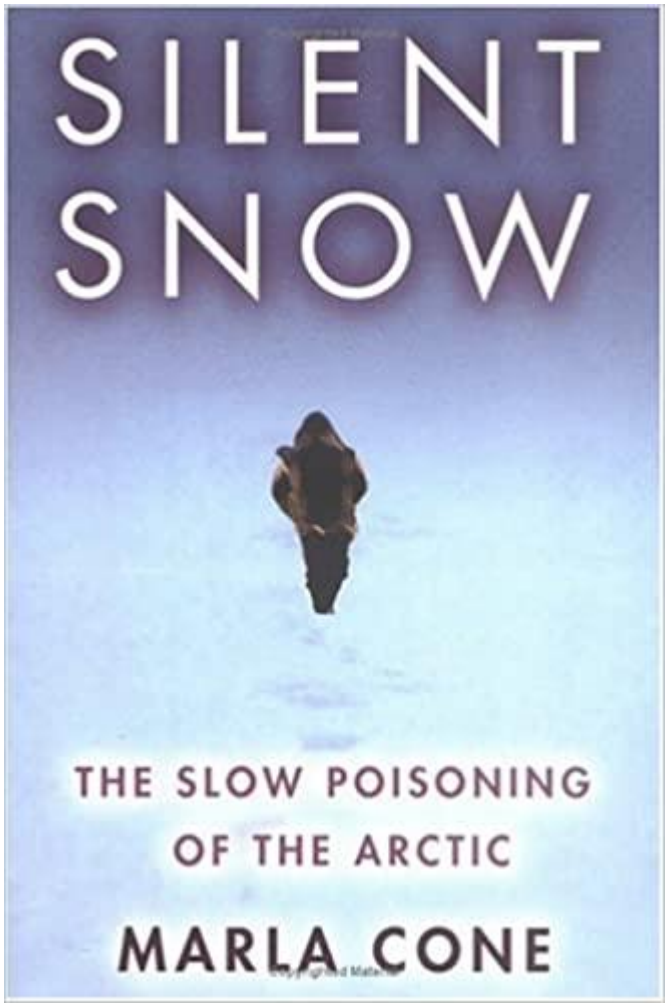

- Perfluorohexane sulfonic acid (PFHxS), its salts and PFHxS-related compounds
- Dechlorane Plus and its syn-isomer and anti-isomer
- Methoxychlor



# Persistent Organic Pollutants



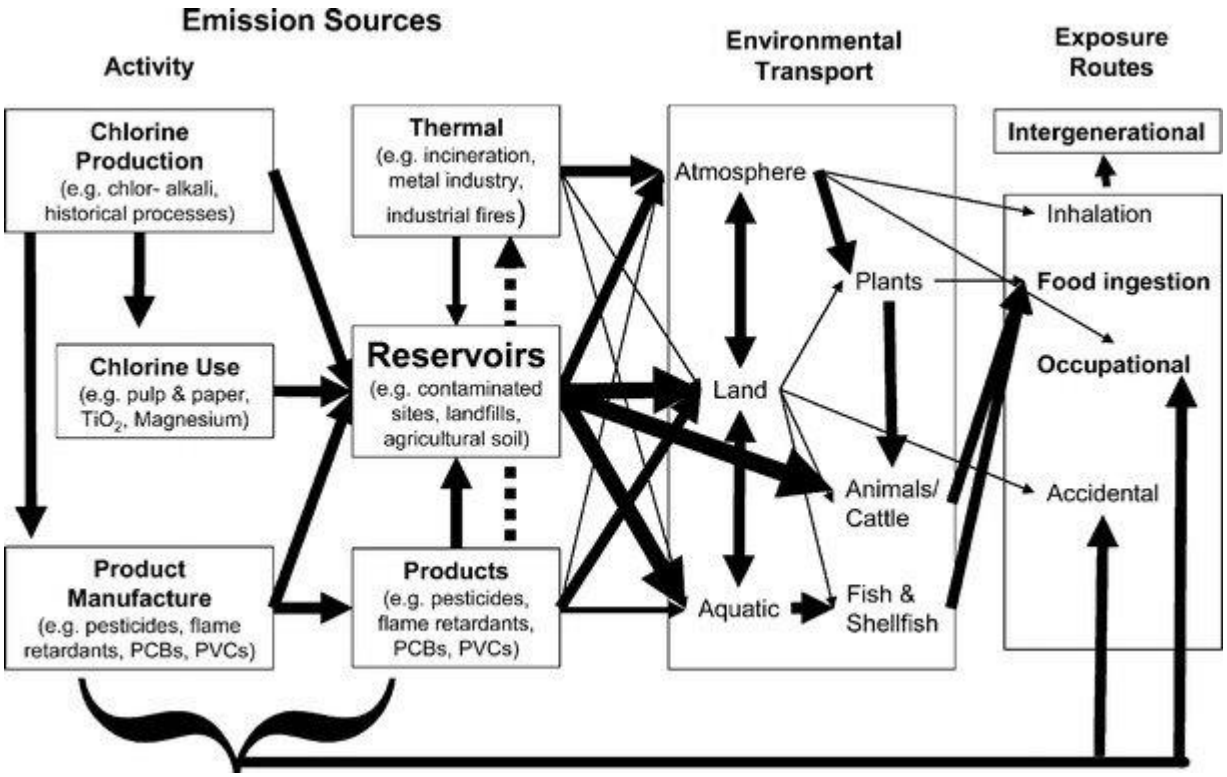



# Dioxins Inventory

- Polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) and other persistent organic pollutants (POPs) can persist in soils and sediments and in waste repositories for periods extending from decades to centuries

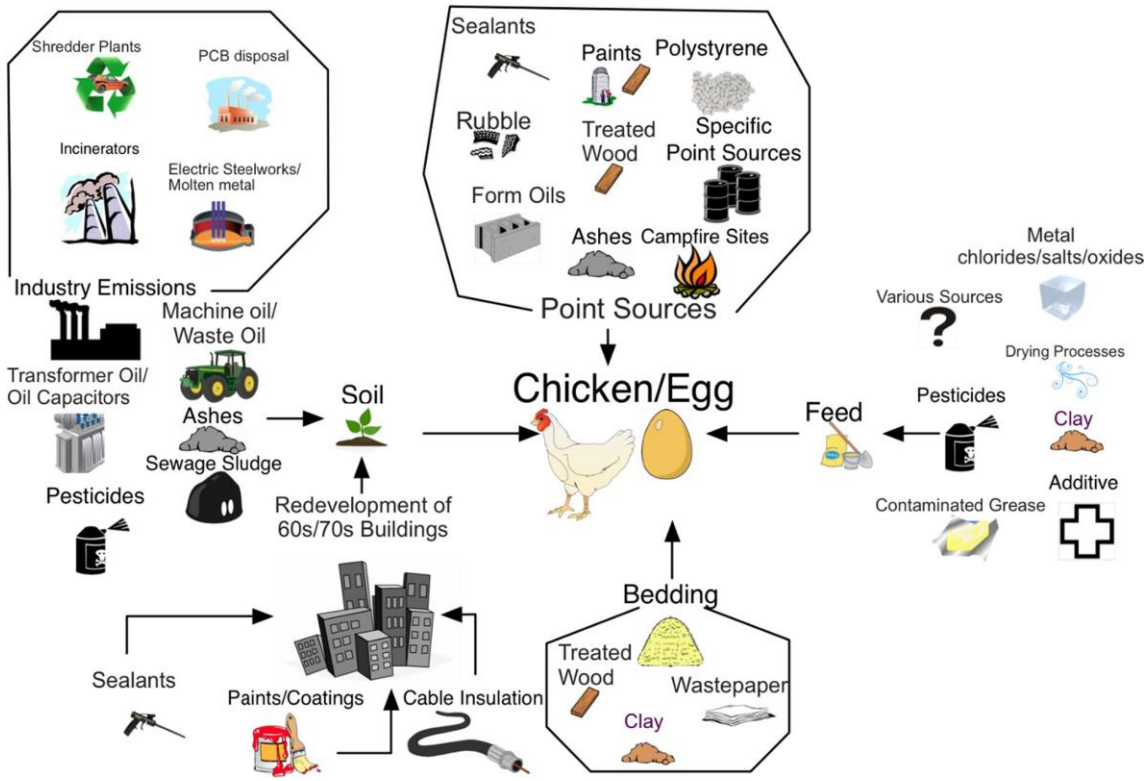
- A conceptual model for the sources, environmental transport pathways and human exposure routes for dioxins and dioxin-like compounds is shown in Figure 1 (adapted from Weber et al., 2008).




Dioxin- and POP-contaminated sites—contemporary and future relevance and challenges
July 2008 Environmental Science and Pollution Research 15(5):363-393
DOI: 10.1007/s11356-008-0024-1
Weber R, Gaus C, Tysklind M, Johnston P, Forter M, Hollert H, Heinisch H, Holoubek I, Lloyd-Smith M, Masunaga S, Moccarelli P, Santillo D, Seike N, Symons R, Torres JPM, Verta M, Varbelow G, Vijgen J, Watson A, Costner P, Wölz J, Wycisk P, Zennegg M

# Dioxins Inventory

- In the earlier part of this century and late last century, cases of PCDD/F and PCB contamination exceeding limits in food from animal origin (eggs, meat or milk) were mainly caused by industrially produced feed.
- Exceedances of EU limit values in the last 10 years were discovered more frequently for PCDD/Fs or dioxin-like(dl)-PCBs from free-range chicken, sheep, and beef, often in the absence of any known contamination source
- The major sources of PCDD/F and dl-PCB contamination of food of animal origin in Germany are soils contaminated from past PCB and PCDD/F releases; PCBs emitted from buildings and constructions; PCBs present at farms




Reviewing the relevance of dioxin and PCB sources for food from animal origin and the need for their inventory, control and management
Roland Weber* , Christine Herold, Henner Hollert, Josef Kamphues, Markus Blepp and Karlheinz Ballschmiter
Weber et al. Environ Sci Eur (2018) 30:42
https://doi.org/10.1186/s12302-018-0166-9

# Measurement of Dioxins

- Until recently, the analysis of dioxins in foods and feeds was performed using magnetic sector GC-MS (GC-HRMS), which provided highly accurate quantitation.
- In recent years, the quantitative accuracy of GC-MS/MS has improved significantly.
- Accordingly, this method has become officially recognised in the EU as able to be used for analysing dioxins
- 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 and repealing Regulation (EU) No 589/2014

# Measurement of Dioxins

- Monitoring of at least two specific precursor ions, each with one specific corresponding transition product ion for all labelled and unlabelled analytes in the scope of analysis
- Maximum permitted tolerance of relative ion intensities of ± 15% for selected transition product ions in comparison to calculated or measured values (average from calibration standards), applying identical MS/MS conditions, in particular collision energy and collision gas pressure, for each transition of an analyte
- Resolution for each quadrupole to be set equal to or better than unit mass resolution (unit mass resolution: sufficient resolution to separate two peaks one mass unit apart) in order to minimise possible interferences on the analytes of interest.
- Fulfilment of the further criteria as described in internationally recognised standards, for example, in standard EN 16215:2012 (Animal feed - Determination of dioxins and dioxin-like PCBs by GC/HRMS and of indicator PCBs by GC/HRMS) and/or in EPA methods 1613 and 1668 as revised, except the obligation to use GC-HRMS

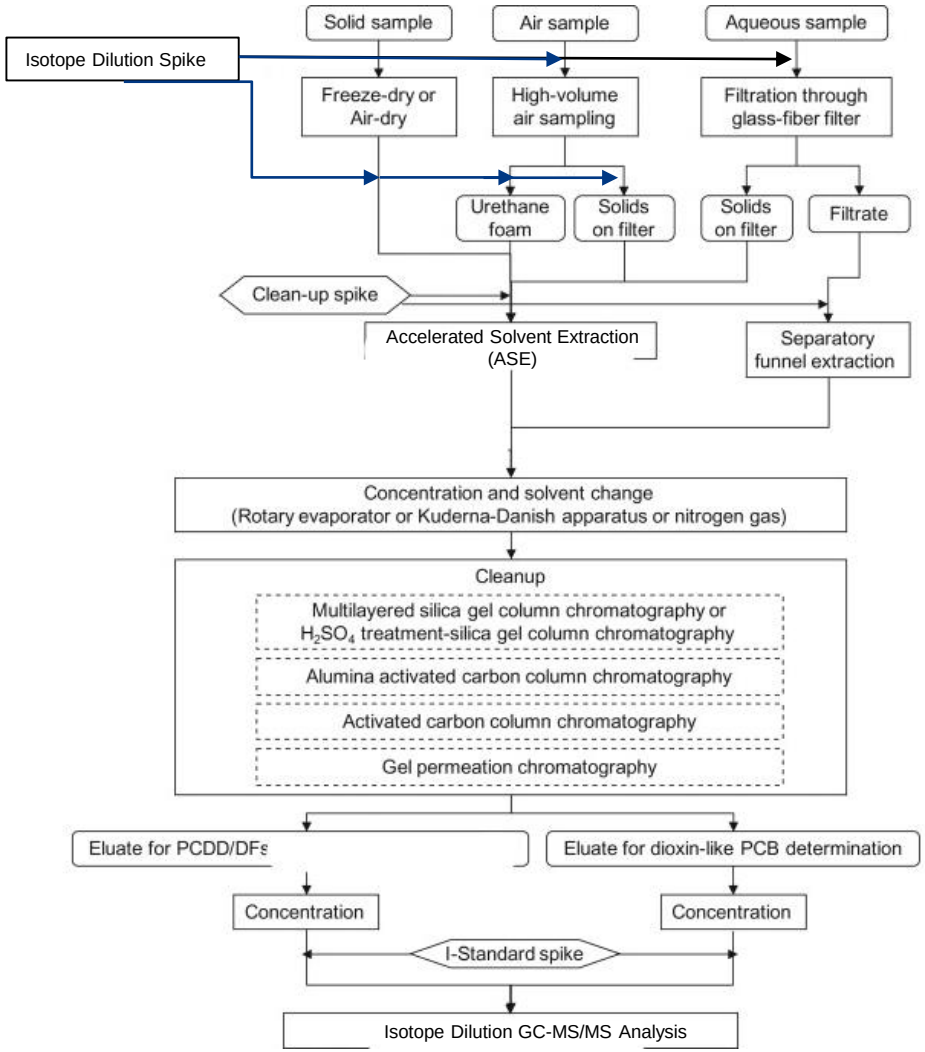
# Measurement of Dioxins – QSM 5.3

DoD/DOE QSM 5.3
Appendix B
2019

**Table B-5. Dioxin/Furan Analysis by High-Resolution Gas Chromatography/Low-Resolution Mass Spectrometry (Method 8280)**

| QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action | Flagging Criteria | Comments |
|---|---|---|---|---|---|
| **GC Column performance check (for DB-5 column or equivalent)** | At the beginning and end of each 12-hr period during which samples or calibration solutions are analyzed.<br><br>Included with the ICAL standard (CC3) and the calibration verification standard. | Peak separation of standard CC3: Peak between the $^{13}$C-2,3,7,8-TCDD and $^{13}$C-1,2,3,4-TCDD must be resolved with a valley of ≤ 25%;<br><br>For calibration verification standard only: Peak separation between 1,2,3,4,7,8-HxCDD and 1,2,3,6,7,8-HxCDD must be resolved with a valley of ≤ 50%. | Correct problem, then repeat column performance checks. | Flagging is not appropriate. | No samples shall be analyzed until GC column performance check is within criteria. |
| **Initial calibration (ICAL) for all analytes identified in method** | At instrument set-up and after ICV or CCV failure, prior to sample analysis. | Ion abundance ratios must be in accordance with the method.<br><br>RSD of the RFs ≤ 15% for labeled IS and unlabeled PCDD/PCDF. | Correct problem then repeat ICAL. | Flagging is not appropriate. | No samples shall be analyzed until ICAL has passed. |

# Measurement of Dioxins




# Toxic Equivalents Scheme (TEFs & TEQs)

| *Compound* | *NATO (I-TEF)* | *WHO 1998 TEF* | *WHO 2005 TEF* |
|---|---|---|---|
| chlorinated dibenzo-p-dioxins | | | |
| 2,3,7,8-TCDD | 1 | 1 | 1 |
| 1,2,3,7,8-PeCDD | 0.5 | 1 | 1 |
| 1,2,3,4,7,8-HxCDD | 0.1 | 0.1 | 0.1 |
| 1,2,3,6,7,8-HxCDD | 0.1 | 0.1 | 0.1 |
| 1,2,3,7,8,9-HxCDD | 0.1 | 0.1 | 0.1 |
| 1,2,3,4,6,7,8-HpCDD | 0.01 | 0.01 | 0.01 |
| OCDD | 0.001 | 0.0001 | 0.0003 |
| chlorinated dibenzofurans | | | |
| 2,3,7,8-TCDF | 0.1 | 0.1 | 0.1 |
| 1,2,3,7,8-PeCDF | 0.05 | 0.05 | 0.03 |
| 2,3,4,7,8-PeCDF | 0.5 | 0.5 | 0.3 |
| 1,2,3,4,7,8-HxCDF | 0.1 | 0.1 | 0.1 |
| 1,2,3,6,7,8-HxCDF | 0.1 | 0.1 | 0.1 |
| 1,2,3,7,8,9-HxCDF | 0.1 | 0.1 | 0.1 |
| 2,3,4,6,7,8-HxCDF | 0.1 | 0.1 | 0.1 |
| 1,2,3,4,6,7,8-HpCDF | 0.01 | 0.01 | 0.01 |
| 1,2,3,6,7,8,9-HpCDF | 0.01 | 0.01 | 0.01 |
| OCDF | 0.001 | 0.0001 | 0.0003 |
| non-ortho substituted PCBs | | | |
| 3,3',4,4'-tetraCB (PCB 77) | | 0.0001 | 0.0001 |
| 3,4,4',5-tetraCB (PCB 81) | | 0.0001 | 0.0003 |
| 3,3',4,4',5-pentaCB (PCB 126) | | 0.1 | 0.1 |
| 3,3',4,4',5,5'-hexaCB (PCB 169) | | 0.01 | 0.03 |
| mono-ortho substituted PCBs | | | |
| 2,3,3',4,4'-pentaCB (PCB 105) | | 0.0001 | 0.00003 |
| 2,3,4,4',5-pentaCB (PCB 114) | | 0.0005 | 0.00003 |
| 2,3',4,4',5-pentaCB (PCB 118) | | 0.,0001 | 0.00003 |
| 2',3,4,4',5-pentaCB (PCB 123) | | 0.0001 | 0.00003 |
| 2,3,3',4,4',5-hexaCB (PCB 156) | | 0.,0005 | 0.00003 |
| 2,3,3',4,4',5'-hexaCB (PCB 157) | | 0.0005 | 0.00003 |
| 2,3',4,4',5,5'-hexaCB (PCB 167) | | 0.00001 | 0.00003 |
| 2,3,3',4,4',5,5'-heptaCB (PCB 189) | | 0.0001 | 0.00003 |

$$TEQ = \sum PCDD_i \, x \, TEF_i + \sum PCDF_i \, x \, TEF_i + \sum PCB_i \, x \, TEF_i$$

*TEQ* — *total toxicity equivalent concentration*

*$TEF_i$* — *toxicity equivalent factor of compound i*

F. W. Kutz et al.: The international toxicity equivalency factor (I-TEF) method of risk assessment for complex mixtures of dioxins and related compounds. Chemosphere 20:751–757, 1990, cited after Ballschmiter und Bacher (1996); this system has first been suggested by the NATO-Committee on the challenges of the Modern Society (NATO-CCMS) in 1988

Van den Berg M, Birnbaum L, Bosveld ATC, Brunstrom B, Cook P, Feeley M, Giesy JP, Hanberg A, Hasegawa R, Kennedy SW, Kubiak T, Larsen JC, van Leeuwen FXR, Djien Liem AK, Nolt C, Peterson RE, Poellinger L, Safe S, Schrenk D, Tillitt D, Tysklind M, Younes M, Waern F, Zacharewski T. 1998. Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife. Environ. Health Perspect. 106:775-792

Van den Berg M, Birnbaum LS, Denison M, De Vito M, Farland W, Feeley F, Fiedler H, Hakansson H, Hanberg A, Haws L, Rose M, Safe S, Schrenk D, Tohyama C, Tritscher A, Tuomisto J, Tysklind M, Walker N, Peterson RE. 2006. The 2005 World Health Organization reevaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds, Toxicol. Sci. 93:223–241.

# The day GREENPEACE hit NUFARM

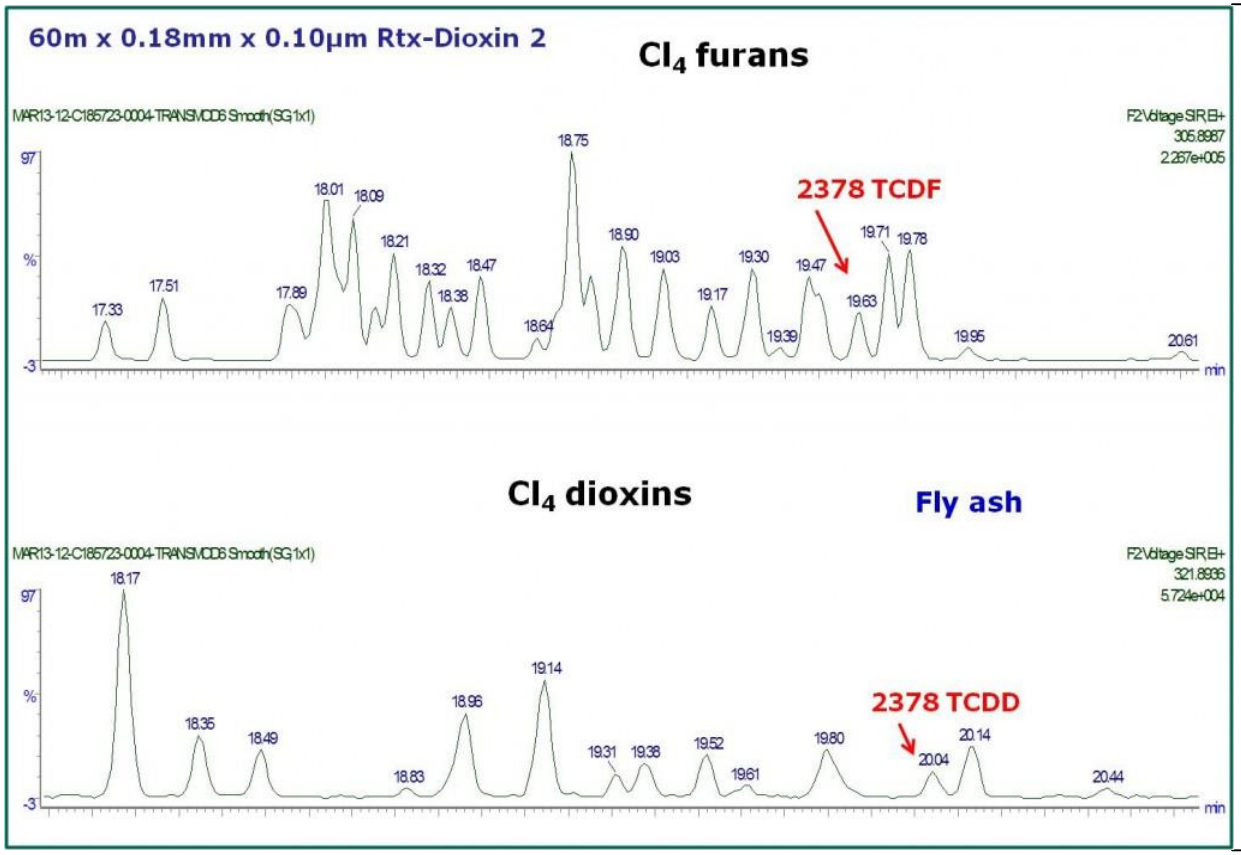
- Nufarm is a pesticide company in North Laverton, Melbourne
- On 7 May 1990 - Greenpeace arrived at the Nufarm chemical company in North Laverton
- Greenpeace conducted a direct action at the Nufarm pesticide factory, taking control of the plant's effluent discharge into the sewer.
- The Greenpeace action was taken following testing of samples of Nufarm's effluent.
- The discharge sample was tested by National Analytical Laboratories and found to contain 1.4 parts per billion of the furan 2,3,7,8-TCDF
- This level of 2,3,7,8-TCDF is equivalent to 143 parts per trillion of the dioxin, 2,3,7,8-TCDD, the substance used as the world standard for comparisons of dioxin/furan toxicity.

# The day GREENPEACE hit NUFARM

- Doug Rathbone, managing director of the Australian chemical manufacturer Nufarm Ltd, describes May 7, 1990, as a date indelibly burnt in his memory
- Mr Rathbone estimated the total cost of the exercise to Nufarm at $5-6 million - $1 million in studies, including $200,000 for the environmental audit, and $4-5 million because of lost production.

FINANCIAL REVIEW

# Did they get it right?



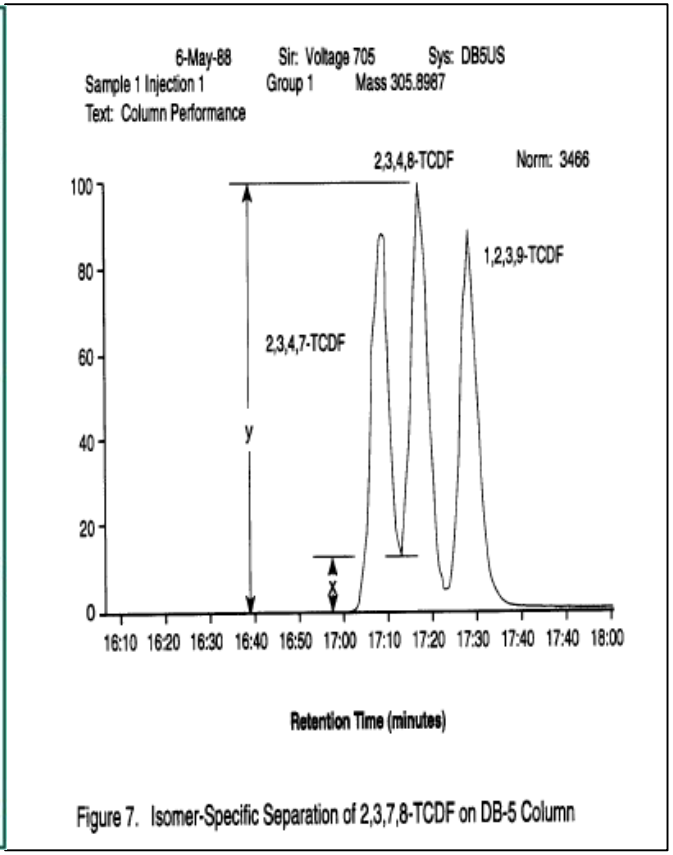




Figure 7. Isomer-Specific Separation of 2,3,7,8-TCDF on DB-5 Column

# Dioxins in New Zealand

- Polychlorinated biphenyls (PCBs), which are used in transformers and capacitors in the electrical industry
- 2,4,5-T, a herbicide used to control gorse and other woody weeds
- Pentachlorophenol (PCP), a fungicide used to treat timber
- PCBs, 2,4,5-T and PCPs are no longer used in New Zealand
- A total of 51 composite soil samples were collected from reference sites, and agricultural and urban areas
- Urban soils were collected from parks and reserves in the provincial centres of Whangarei, Hamilton, Napier, New Plymouth, Masterton, Timaru, Greymouth and Invercargill
- Two samples had elevated concentrations of 2,3,7,8-TCDD, which could be associated with the manufacture and use of the herbicide 2,4,5-T

# Dioxins in Australia

Technical Reports (12)

- Dioxins emissions from Bushfires in Australia
- Dioxins emissions from Motor Vehicles in Australia
- Inventory of Dioxin emissions in Australia, 2004
- Dioxins in Ambient Air in Australia
- Dioxins in Soils in Australia
- Dioxins in Aquatic Environments in Australia
- Dioxins in Fauna in Australia
- Dioxins in Agricultural Commodities in Australia
- Addendum to Technical Report No. 8 - Dioxins in Agricultural Commodities in Australia - Summary of tuna dioxin and dioxin-like PCB testing.
- Dioxins in the Australian Population: Levels in Blood
- Dioxins in the Australian Population: Levels in Human Milk
- Ecological Risk Assessment of Dioxins in Australia
- Human Health Risk Assessment of Dioxins in Australia

**National Dioxins Program**

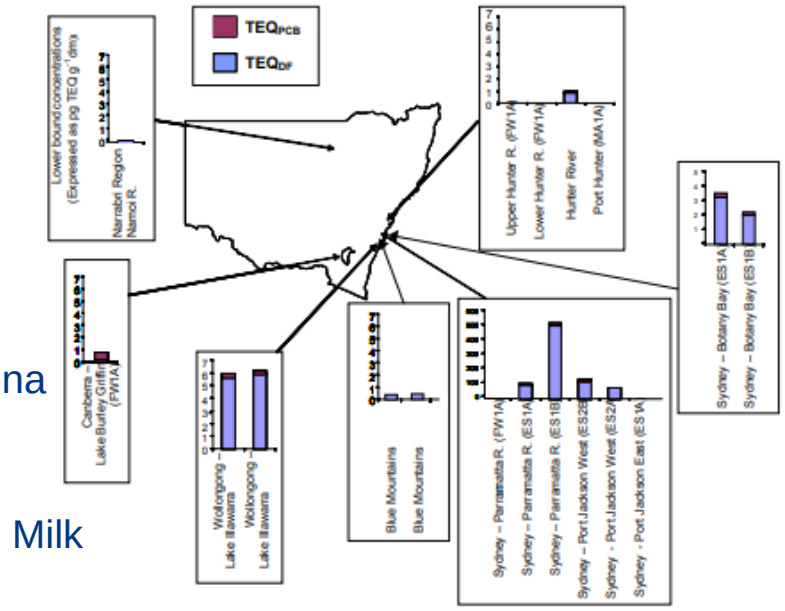



Figure 3.10 NSW and ACT sediment sampling locations and the corresponding TEQ.

Australian Government
Department of the Environment and Heritage



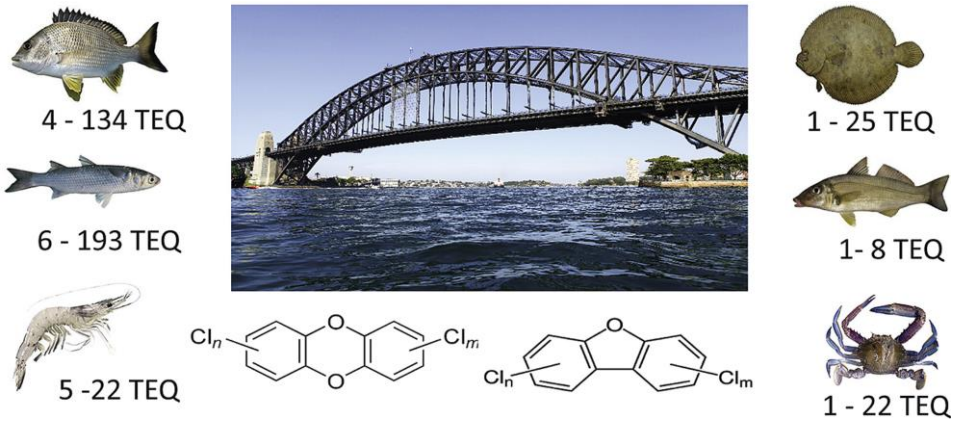
Source presentation EDR:
Source modification date: 7/19/2016

# Fishing in Sydney Harbour

Recreational fishing in the Harbour has not been banned, but fishers are urged to follow dietary advice on the consumption of seafood from the Sydney Harbour, Parramatta River and other connected tidal waterways. Fishers can also continue to practise catch and release. Based on advice from an expert panel, the Government is recommending that:

- No fish or crustaceans caught west of the Sydney Harbour Bridge should be eaten. You should release your catch.
- For fish caught east of the Sydney Harbour Bridge generally no more than 150 grams per month should be consumed.
- Testing of popular species has allowed for more accurate dietary advice.

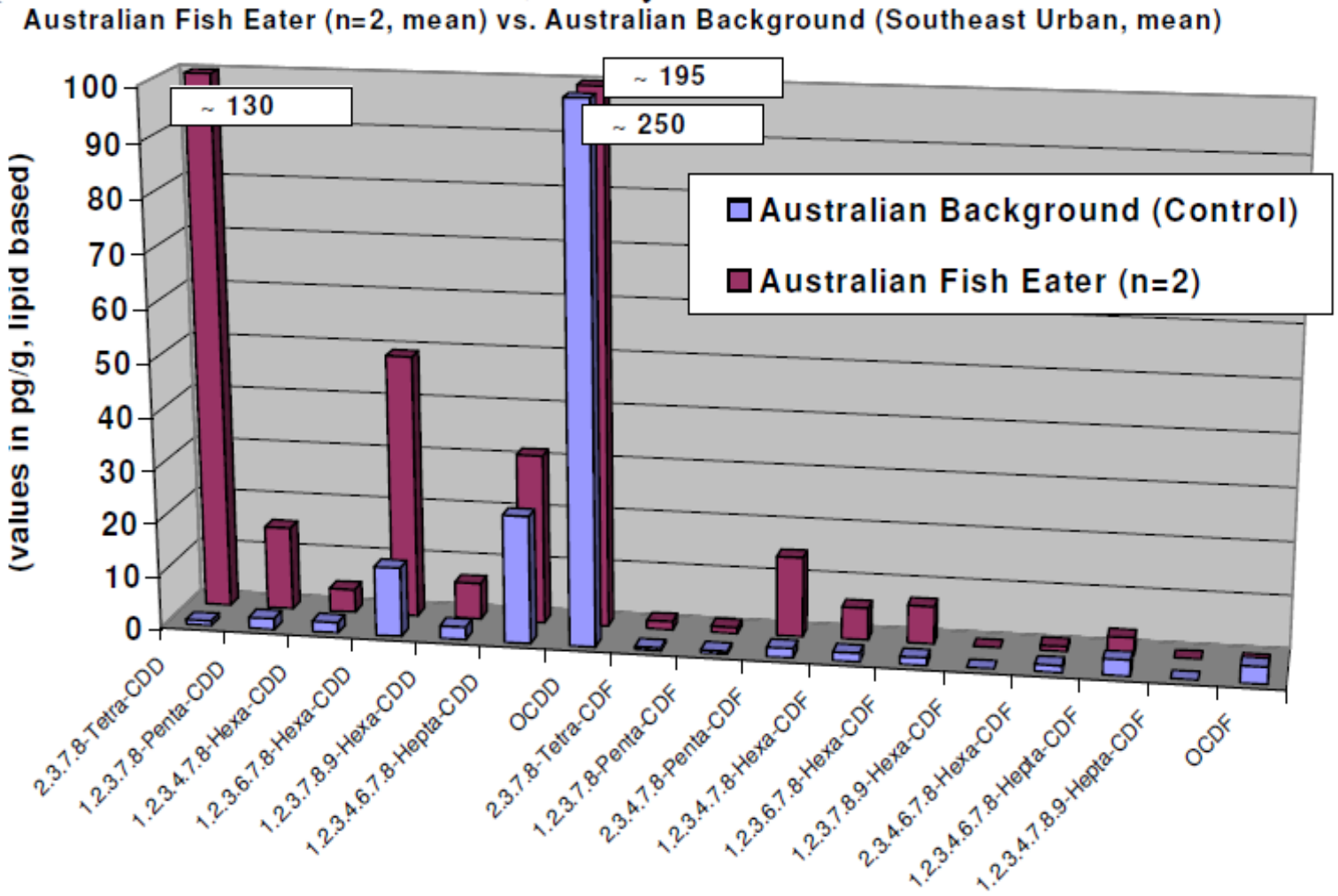
Photo credit: DALLAS KILPONEN




Levels of PCDD/Fs and dioxin-like PCBs in seafood from Sydney Harbour, Australia
Therese M.Manning, Anthony C.Roach, Katelyn J.Edge, Doug J.Ferrell

# SYDNEY HARBOUR FISHERMEN

**Figure 2:** Comparison of PCDD/PCDF Pattern, Family B



# Hexabromobiphenyl

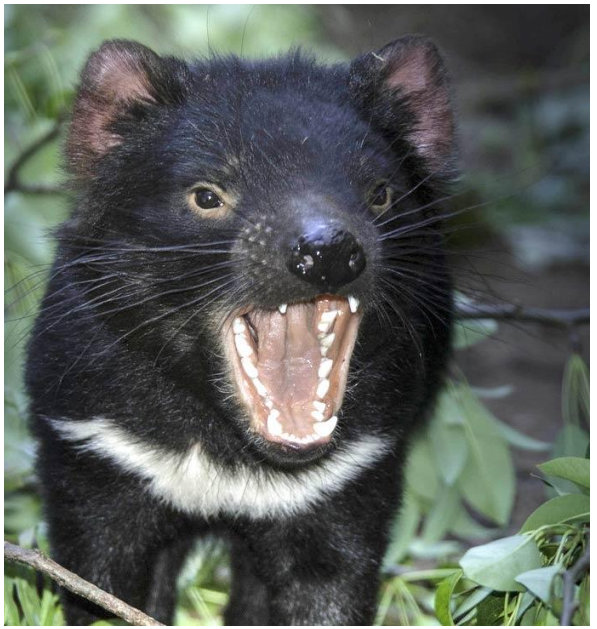
RAPID COMMUNICATIONS IN MASS SPECTROMETRY
*Rapid Commun. Mass Spectrom.* 2008; **22**: 4165–4170
Published online in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/rcm.3845

RCM

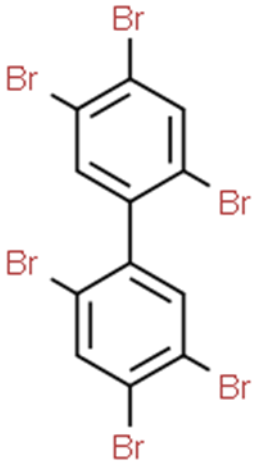
## Determination of polybrominated biphenyls in Tasmanian devils (*Sarcophilus harrisii*) by gas chromatography coupled to electron capture negative ion tandem mass spectrometry or electron ionization high-resolution mass spectrometry

**Walter Vetter[1]*, Roland von der Recke[1], Robert Symons[2] and Stephen Pyecroft[3]**
[1]University of Hohenheim, Institute of Food Chemistry (170b), Garbenstr. 28, D-70599 Stuttgart, Germany
[2]National Measurement Institute, PO Box 385, Pymble NSW 2073, Australia
[3]Department of Primary Industries and Water, PO Box 46, Kingsmeadow, Tasmania, Australia

Received 12 August 2008; Revised 21 October 2008; Accepted 24 October 2008



Firemaster FF-1, technical grade
[Polybrominated biphenyls]
CAS RN 67774-32-7
2,2',4,4',5,5'-Hexabromobiphenyl




# White-Bellied Sea-Eagles (*Haliaeetus Leucogaster*) from Sydney, Australia

- In the Spring of 2004, a breeding pair of White-bellied Sea-eagles (Haliaeetus leucogaster) were discovered deceased within days of each other in the area of Homebush Bay with no apparent infectious/parasitic diseases or trauma that appeared to be responsible.
- White-bellied Sea-Eagles are a common sight in coastal and near coastal areas of Australia.
- Birds form permanent pairs that inhabit territories throughout the year.
- They feed mainly off aquatic animals, such as fish, but they take other birds and mammals as well.

| Tissue | PCDDs pg TEQ/g lw | PCDFs pg TEQ/g lw | Non-ortho PCBs pg TEQ/g lw | Mono-ortho PCBs pg TEQ/g lw | ΣPBDEs ng/g lw | % Lipid Content |
|---|---|---|---|---|---|---|
| **Male** | | | | | | |
| **Brain** | 13,310 | 180 | 2,790 | 360 | 2,030 | 7.6 |
| **Breast muscle** | 76,930 | 5,890 | 40,310 | 3,460 | 45,900 | 62.5 |
| **Liver** | 46,040 | 4,620 | 12,860 | 1,210 | 8,610 | 4.5 |
| **Female** | | | | | | |
| **Brain** | 7,450 | 85 | 1500 | 175 | 890 | 6.6 |
| **Breast muscle** | 55,670 | 2,690 | 27,100 | 1,960 | 7,500 | 58.4 |
| **Liver** | 21,460 | 1,625 | 6,450 | 585 | 2,390 | 4.7 |

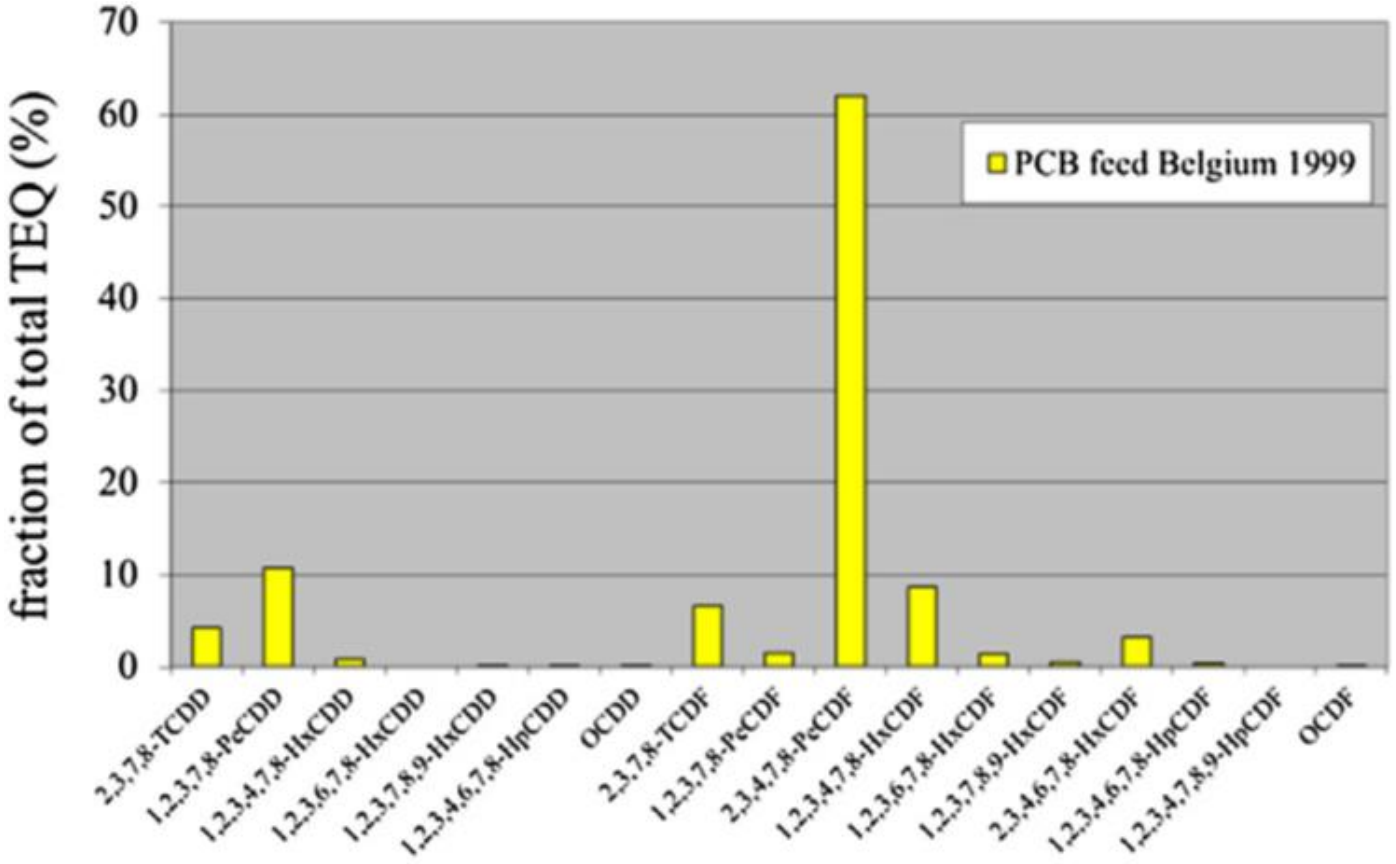
Thanks the staff at Taronga Zoo's Veterinary and Quarantine Centre for the preparation of these samples and to Dr. Dick Montali for insightful discussions. Also to Mr Geoff Ross from the National Parks & Wildlife Service Department of Environment & Conservation, New South Wales for access to these tissue samples.

Robert Symons, Jesuina De Araujo, Rania Jaber, Nino Piro, Shana Rogic, Gavin Stevenson and Alan Yates Organohalogen Compounds - Volume 67 (2005)

# PCDD/PCDF Congener Profiles

## Belgium Crisis – Summer 1999

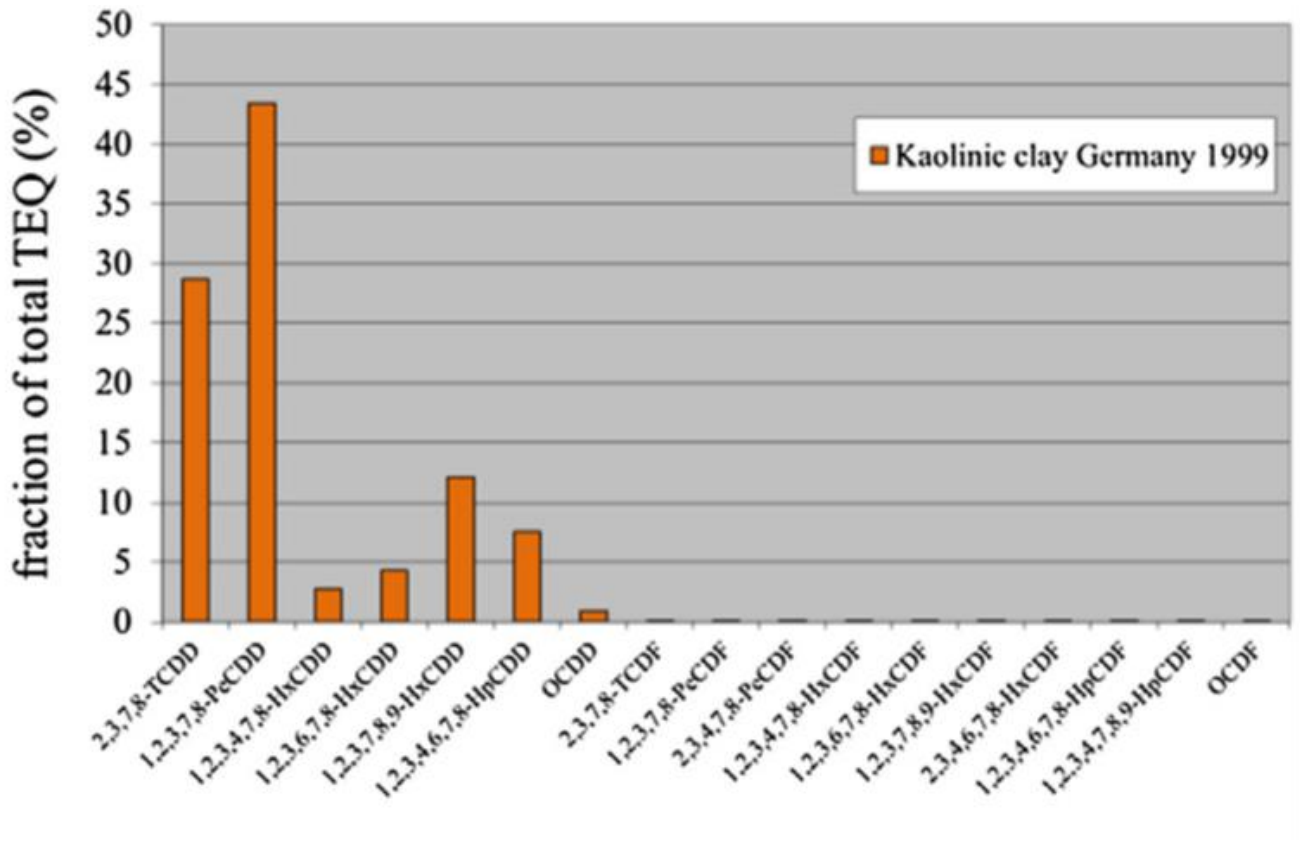
- Oil-and-fat-recycling company, Verkest, from Deinze. The fats were reprocessed into animal feed that also contained transformer oil (coolant fluid), a known source of PCBs



# PCDD/PCDF Congener Profiles

## Kaolinic clay – Germany 1999

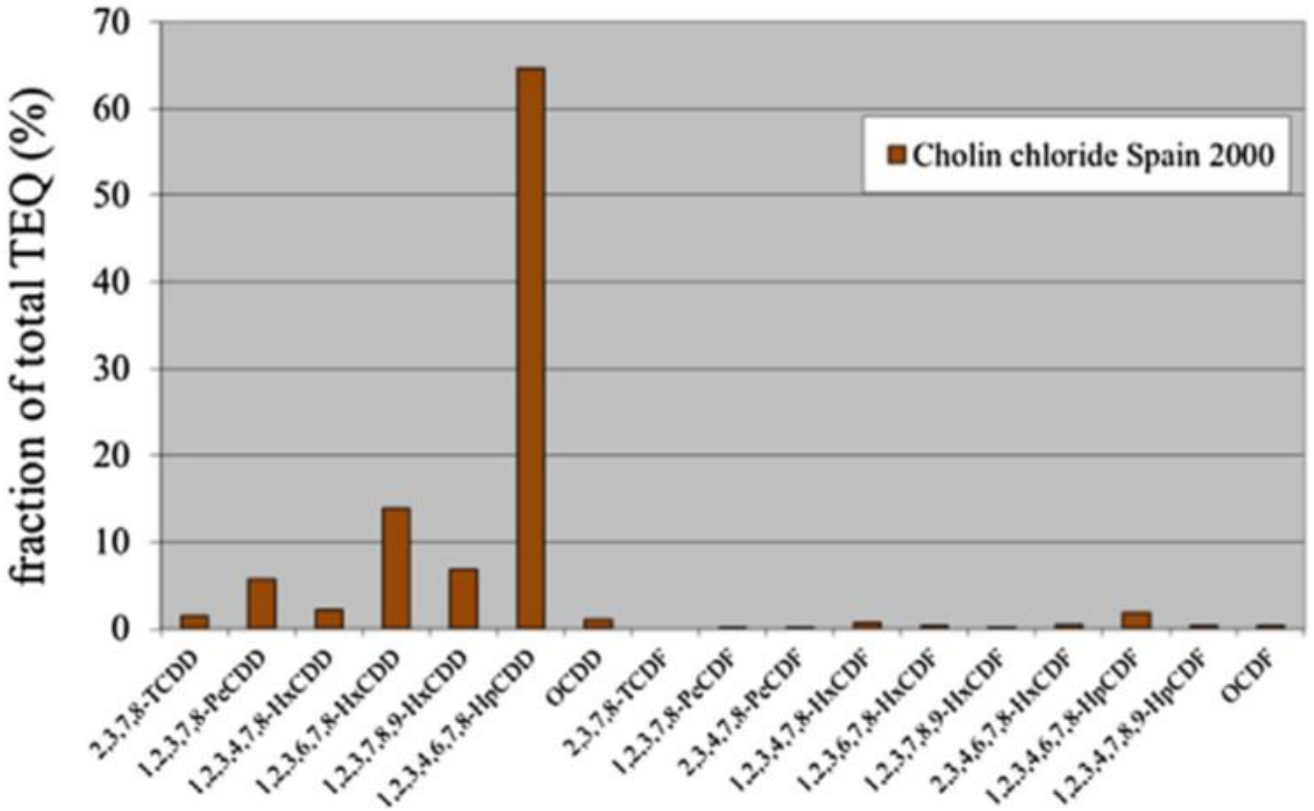
- Kaolin is widely used for mixing of vitamins and minerals



# PCDD/PCDF Congener Profiles

## Choline chloride, Spain, 2000

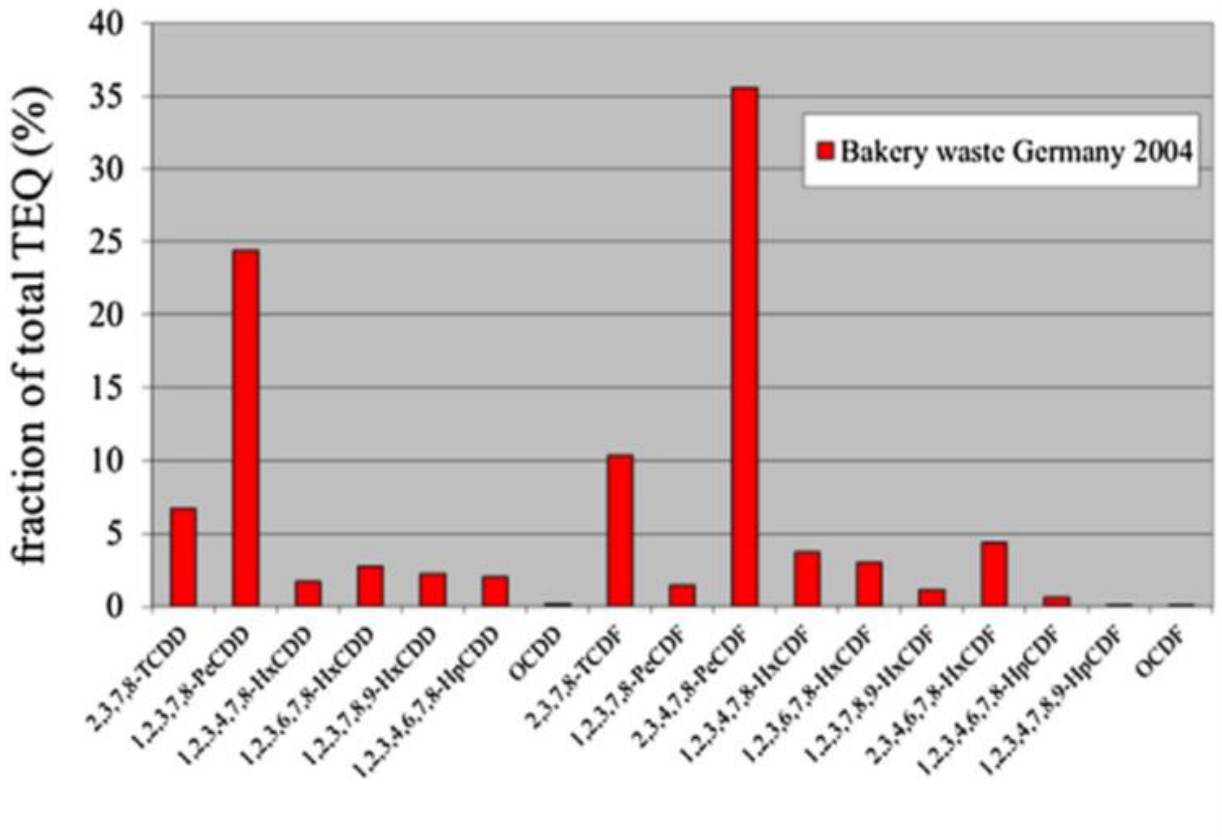
- This was the source of the dioxins in the feed additive choline chloride in 2000, which was mixed with sawdust contaminated with PCP



# PCDD/PCDF Congener Profiles

## Dried bakery waste, waste wood
## Germany 2003/4

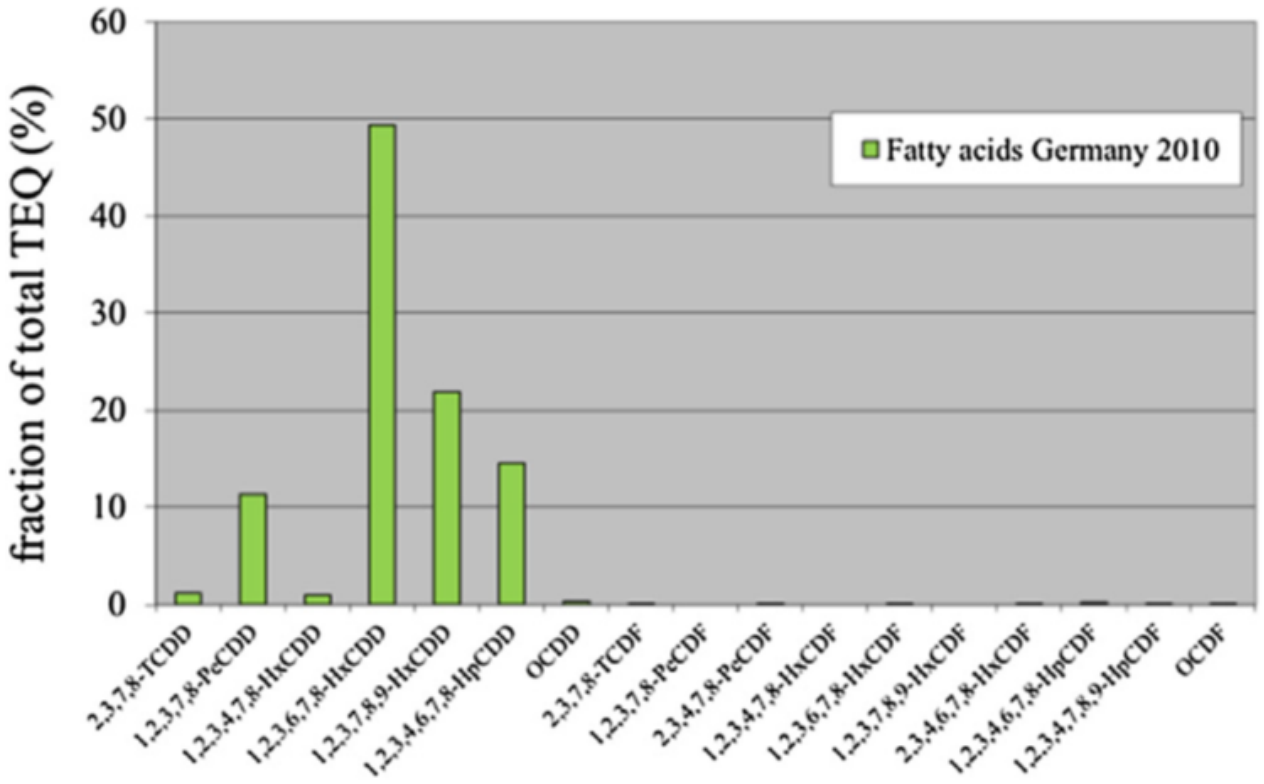
- the use of painted wood as fuel for drying bakery by-products in Germany caused a contamination of these materials and the temporary closure of many farms in the Netherlands



# PCDD/PCDF Congener Profiles

## Fatty Acids - Germany 2010

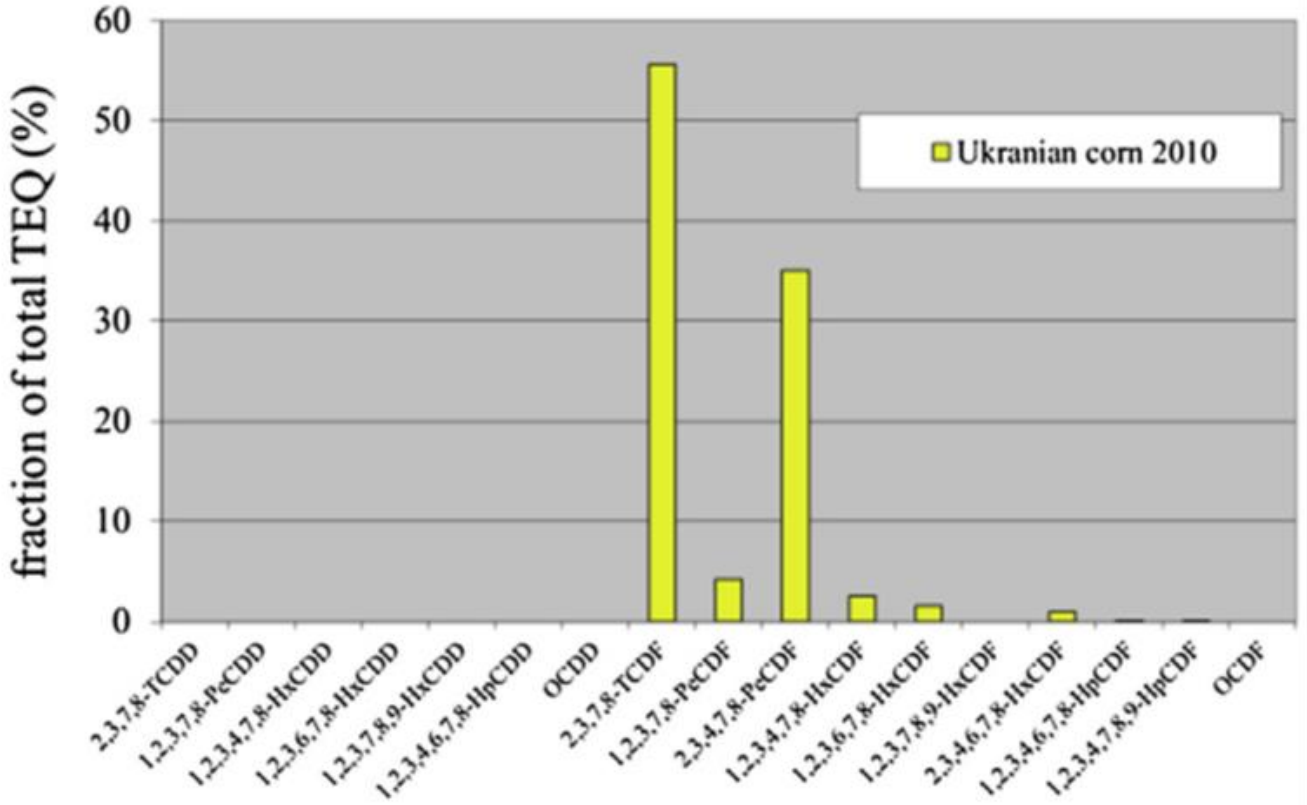
- the fatty acids from the biodiesel production in Germany contaminated with tetra chlorinated phenols



# PCDD/PCDF Congener Profiles

## Dried corn imported from Ukraine (2010)

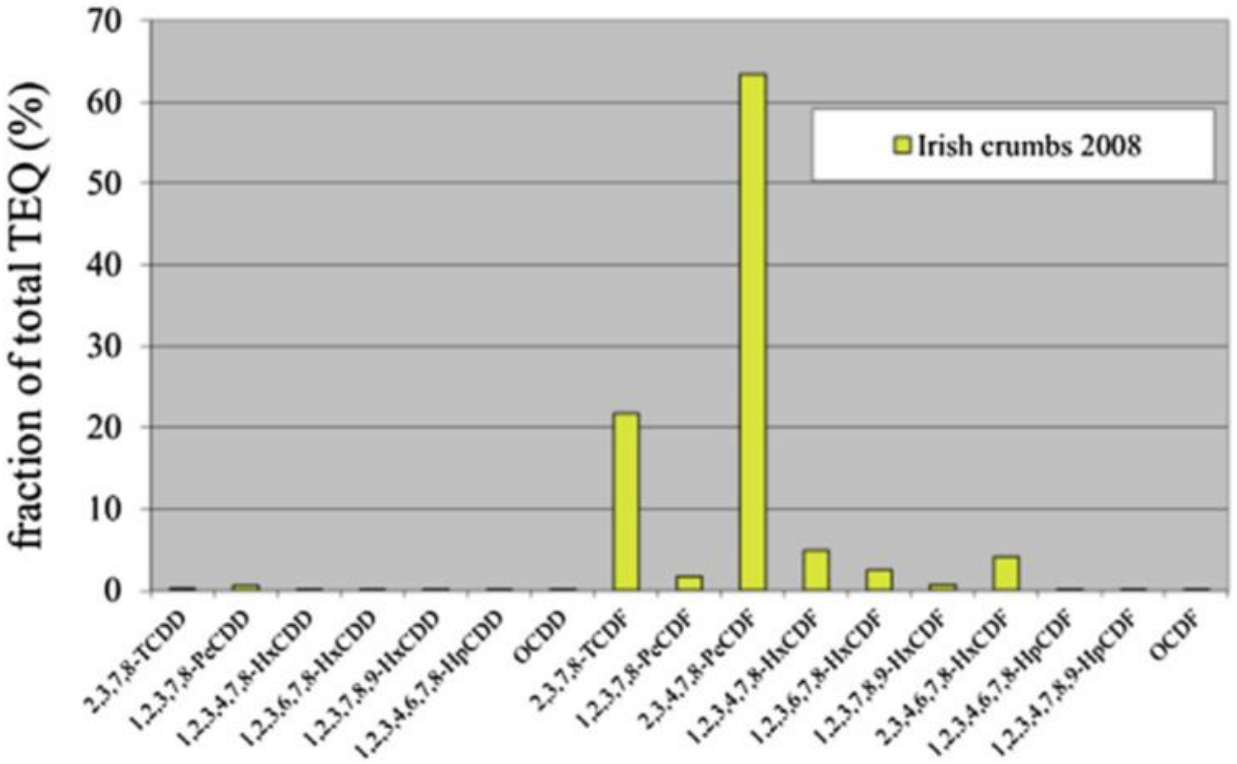
PCB-contaminated fuel also appeared to be the source of the contamination of 2500 tonnes of organic corn from the Ukraine, as discovered in the spring of 2010 in The Netherlands and Germany by Dutch authorities and self-control by the organic egg producers



# PCDD/PCDF Congener Profiles

## Bakery Products in Ireland (2008)

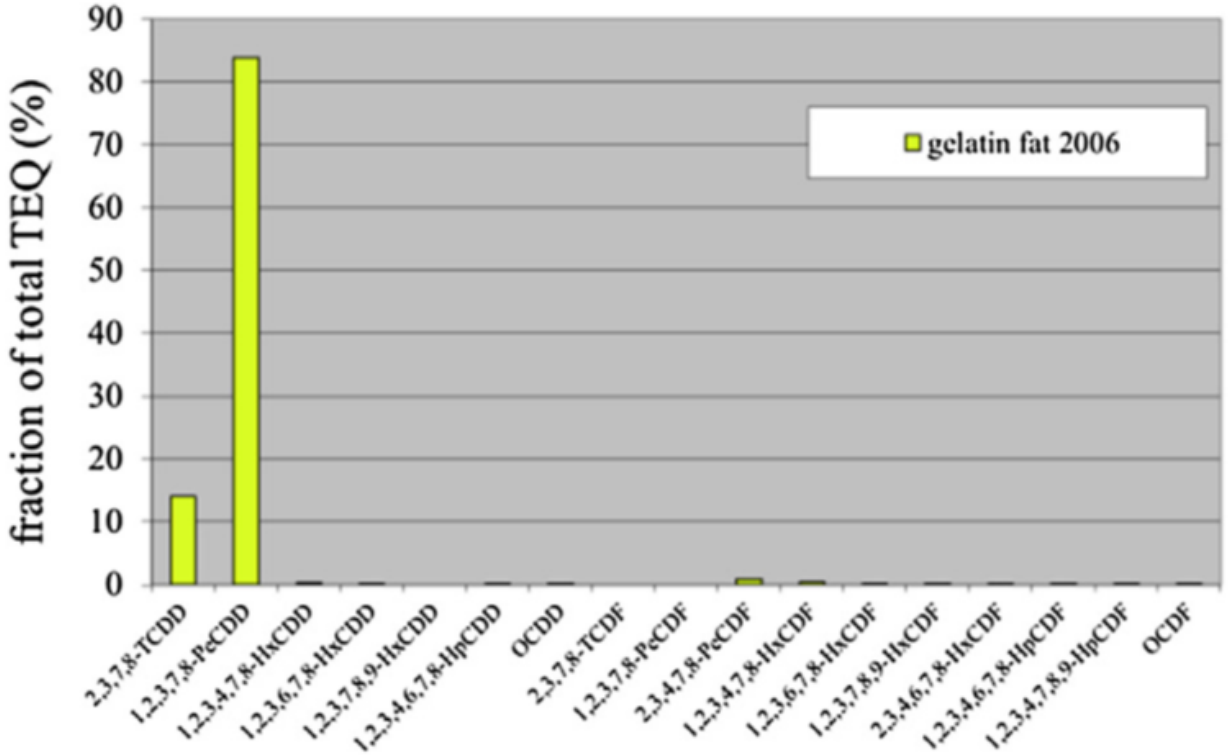
The bread crumbs had been dried with diesel contaminated with PCBs, the diesel being used as fuel to generate hot gases in a direct drying system used in the production of the feed. Improper combustion of the PCBs in the diesel oil led to the production of high levels of PCDFs in the exhaust gasses.



# PCDD/PCDF Congener Profiles

## Gelatin – Netherlands (2006)

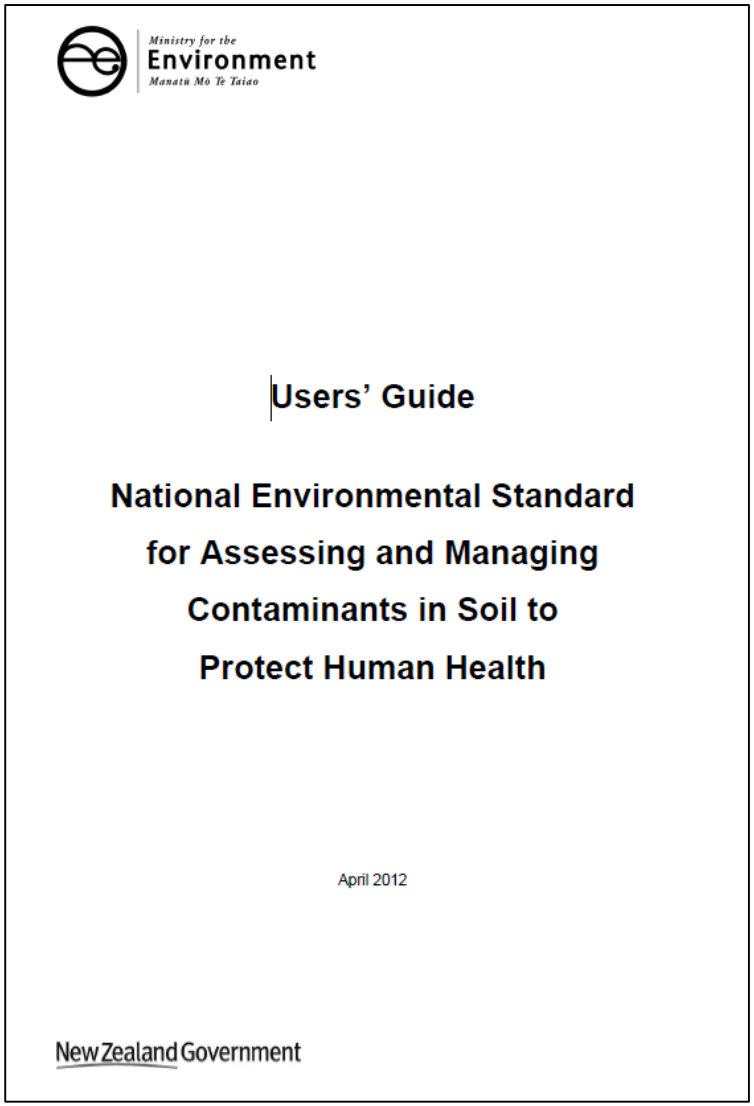
- gelatine fat from Belgium, due to contaminated HCl used for feed production
- The fat was imported from Belgium and was a by-product from the production of gelatine from pig bones. The incident was traced back to the use of contaminated hydrochloric acid, a by-product from a chemical company that filtered the acid before use. Due to malfunction of the filters, the PCDD/Fs were not removed and eventually ended up in the fat



# National Environmental Standard (NES)

## Priority Contaminant

- Defined in regulation 7 of the NES as:
  - a contaminant for which the Methodology derives a soil contaminant standard.
- There are 12 priority soil contaminants: arsenic, boron, cadmium, chromium, copper, lead, mercury, benzo(a)pyrene, DDT, dieldrin, PCP, and dioxin (including dioxin-like PCBs).


Ministry for the Environment
Manatū Mō Te Taiao

Users' Guide

National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health

April 2012

New Zealand Government

# Hazardous Activities and Industries List (HAIL) with hazardous substances

eurofins

**Table B3: Soil contaminant standards for health ($SCSs_{(health)}$) for organic compounds**

| Scenario | BaP[1] | DDT | Dieldrin[2] | PCP | Dioxin | |
|---|---|---|---|---|---|---|
| | | | | | TCDD | Dioxin-like PCBs |
| | mg/kg TEQ | mg/kg | mg/kg | mg/kg | µg/kg TEQ | µg/kg TEQ |
| Rural residential / lifestyle block 25% produce | 6 | 45 | 1.1 | 55 | 0.12 | 0.09 |
| Residential 10% produce | 10 | 70 | 2.6 | 55 | 0.15 | 0.12 |
| High-density residential | 24 | 240 | 45 | 110 | 0.35 | 0.33 |
| Recreation | 40 | 400 | 70 | 150 | 0.6 | 0.52 |
| Commercial / industrial outdoor worker (unpaved) | 35 | 1,000 | 160 | 360 | 1.4 | 1.2 |

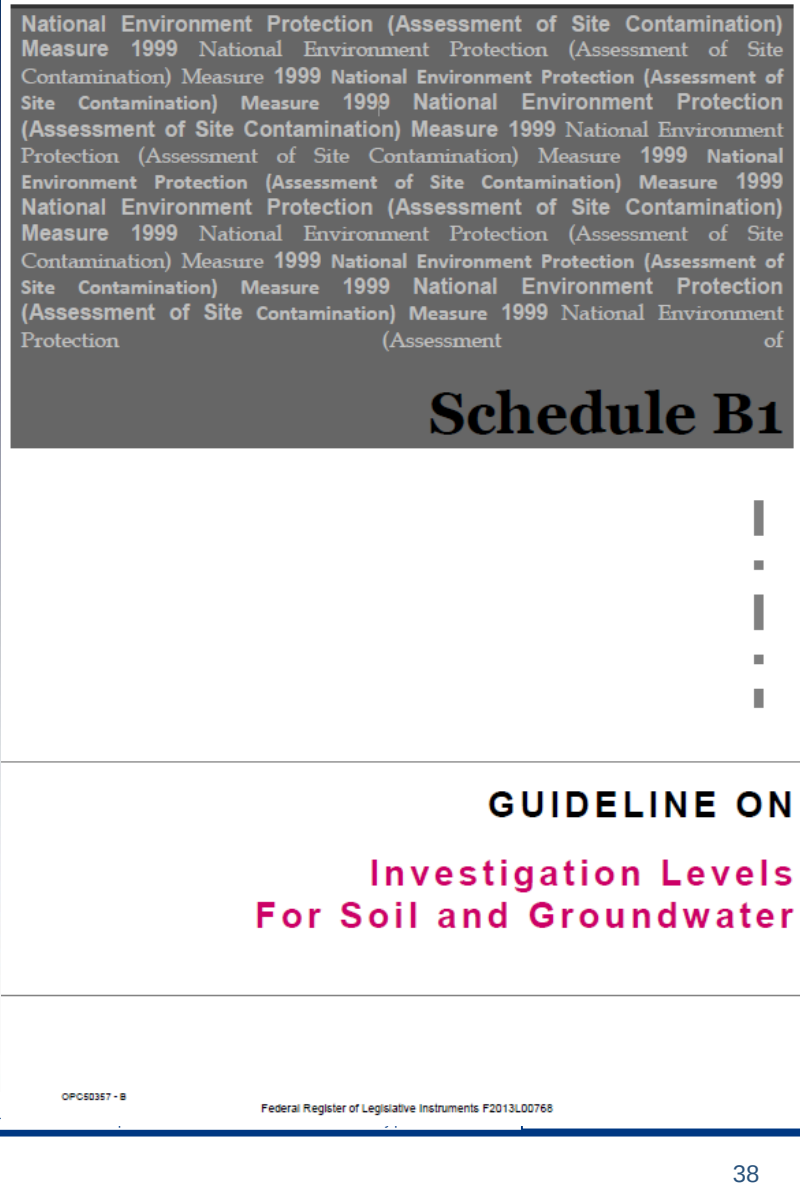
Notes: All concentrations refer to dry weight (ie, mg/kg dry weight or µg/kg dry weight).

# National Environment Protection Measure (NEPM)

## Table 1A(1) Health investigation levels for soil contaminants

| Chemical | Health-based investigation levels (mg/kg) | | | |
|---|---|---|---|---|
| | Residential[1] A | Residential[1] B | Recreational[1] C | Commercial/ industrial[1] D |
| MCPB | 600 | 900 | 800 | 5000 |
| Mecoprop | 600 | 900 | 800 | 5000 |
| Picloram | 4500 | 6600 | 5700 | 35000 |
| **Other Pesticides** | | | | |
| Atrazine | 320 | 470 | 400 | 2500 |
| Chlorpyrifos | 160 | 340 | 250 | 2000 |
| Bifenthrin | 600 | 840 | 730 | 4500 |
| **Other Organics** | | | | |
| PCBs[8] | 1 | 1 | 1 | 7 |
| PBDE Flame Retardants (Br1–Br9) | 1 | 2 | 2 | 10 |

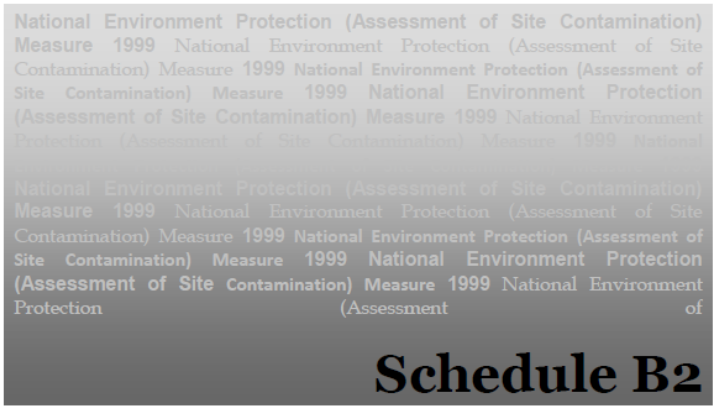
(8) PCBs: HIL relates to non-dioxin-like PCBs only. Where a PCB source is known, or suspected, to be present at a site, a site-specific assessment of exposure to all PCBs (including dioxin-like PCBs) should be undertaken



# National Environment Protection Measure (NEPM)

## 12 Assessment of dioxins and dioxin-like compounds

- Laboratory analysis for dioxins is only recommended when the site history clearly indicates that dioxins are likely to be present as a by-product resulting from specific manufacturing and industrial activities, or from waste disposal
- Dioxin contamination may be present following long-term and large-scale use of a site for the following activities:
  - manufacture and waste disposal associated with certain chlorinated compounds, for example, PCBs, phenoxy herbicides, organochlorine pesticides, chlorinated benzenes, chlorinated aliphatic compounds, chlorinated catalysts, and halogenated diphenyl ethers
  - bleach pulp and paper mill processes known to produce dioxin
  - incineration of substantial chlorinated compounds
  - former municipal solid waste incinerators
  - hospital waste incinerators
  - extensive use of pentachlorophenol (PCP) in timber treatment.
- Where dioxins are detected at levels significantly above background, a site-specific assessment will be required to determine the appropriate action (refer to Schedule B4 for further information).
- Further background information on dioxins is provided in Appendix E.





OPC50357 - B

Federal Register of Legislative Instruments F2013L00768

# Dioxin Testing - Eurofins

# Market Leading Technology

- GC-MS/MS Platform
  - High Efficiency source to provide sensitivity and selectivity comparable to High-Res platforms used historically
  - Robust and reliable
- Sample Extraction Automation
  - In-house developed world leading phase separation techniques
- Simultaneous analysis for PCDD/PCDF/DL-PCB and other POP's

# World Class Technical Specialists

Dr Laurence Hearn – Senior Chemist

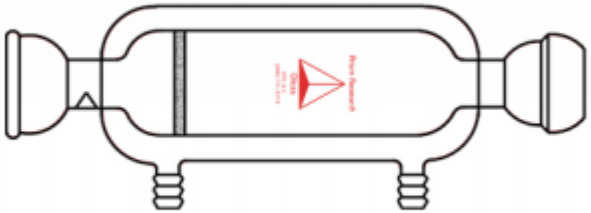
- PhD in Environmental Toxicology
- Brominated Flame Retardants
- PCDD/PCDF
- POP's
- GC-MS/MS and QToF methodology development

Dr Greta Dalle Luche – Chemist

- PhD in Environmental Science
- Analysis of POP's in Antarctic sediment, air and biota (hump back whales)

# Efficiency in Delivery

- NATA Accreditation
  - Dioxins/Furans/Dioxin-Like PCB
  - Local service
- ‘Whole of Project’ Support
  - Project scope and implementation
  - Equipment preparation
  - Ongoing technical support
- World Leading TAT
  - Efficiency through LEAN Principles
  - Robust and reliable



# What's next?

- PAH in air - GC-QQQ
- PPCP (Personal and Pharmaceutical Care Products) - LC-QQQ
- Brominated Flame Retardants (BFRs)
  - Polybrominated Diphenyl Ethers (PBDEs) – GC-QQQ
  - Hexabromocyclododecane (HBCDD) – LC-MS/MS
  - Tetrabromobisphenol A (TBBPA) – LC-MS/MS
- Polycyclic Musk Compounds – GC-QQQ
- QToF – "Unknown Unknowns"

# Contact Information:

If you have any questions please do not hesitate to contact us:

**Dr Bob Symons–** Regional Technical Manager
Eurofins Environment Testing Australia & New Zealand
BobSymons@eurofins.com

**Jonathon Angell** – Business Unit Manager - QLD
Eurofins Environment Testing Australia
JonathonAngell@eurofins.com

Sales inquiries to: EnviroSales@Eurofins.com

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**Questions?**

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# What's next?

SARS-CoV-2 in Wastewater

Unknown Unknowns (QToF)

Mobile Asbestos Testing

Microplastics

Air Toxics