Tekniske muligheter for fjerning av persistente organiske miljøgifter i fôr

FHF-dialogmøte «Fôrets påvirkning på miljø», Gardermoen 30/1-25.

Åge Oterhals

Seniorforsker, PhD

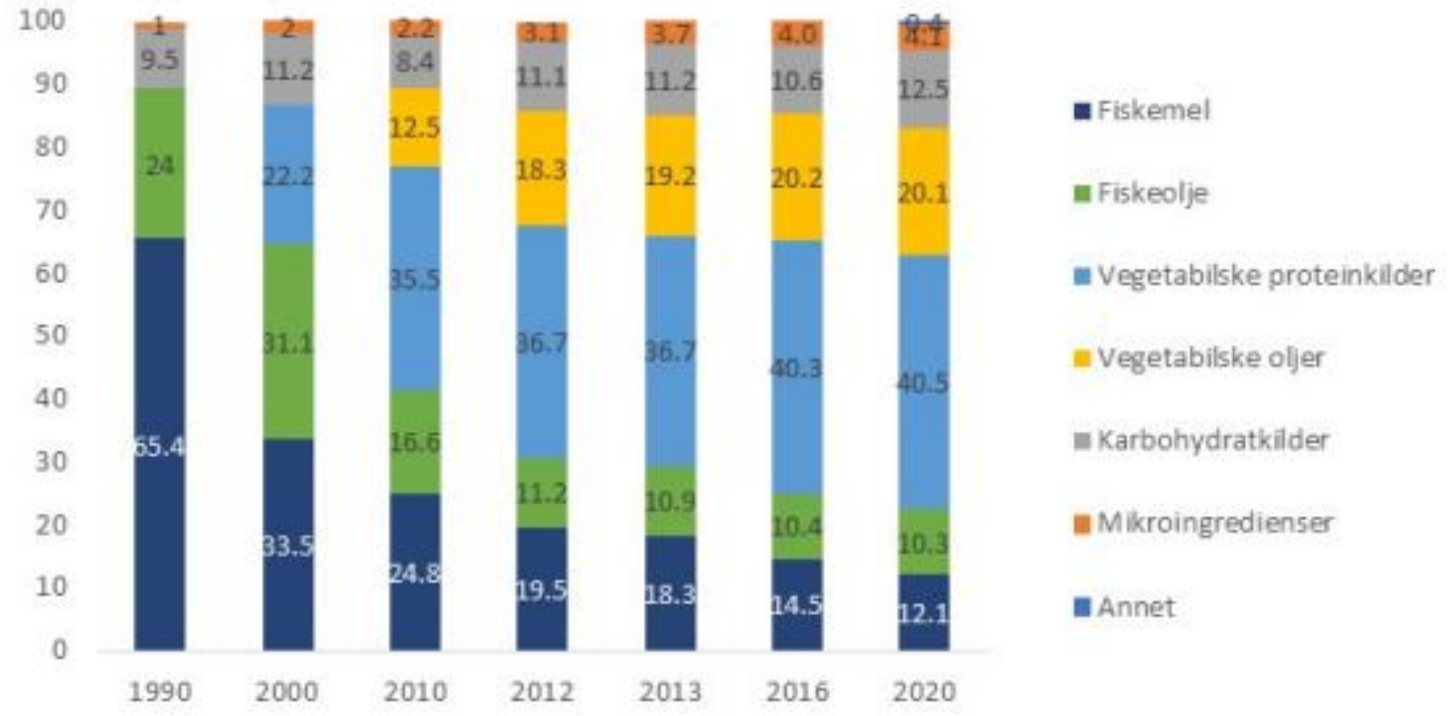
Viktige hendelser

1999, January, Ghent, Belgium: Dioxin contamination of an animal-fat storage tank at fat-rendering plant. Fat used in poultry and pig feed with resulting contaminated food products on the market.

- The crisis began on May 27 when the Belgian Ministry of Agriculture informed the European Commission of the situation.
- The European Commission asked the Scientific Committee on Animal Nutrition (SCAN) and the Scientific Committee on Food (SCF) to evaluate the situation.

2000, November: SCAN report conclude that:
«Fishmeal and fish oil are the most contaminated feed materials with products of European fish stocks more heavily contaminated than those from South Pacific stocks»
«Greatest concerns arise from the use of fishmeal and fish oil of European origin in diets for farmed fish and where fishmeal is incorporated in diets of other food producing animals»

Andel fiskemel/olje i fôr til laks – historisk utvikling



Figur 3 Ingredienser brukt i norsk lakseför fra 1990 til 2020, gitt som % av fôr (Ytrestøyl et al., 2015, Aas et al., 2019). 'Annet' inkluderer Insektmel, encelleprotein, fermenterte produkt og mikroalger.

Aas et al., 2022. Utilization of feed resources in the production of Atlantic salmon (Salmo salar) in Norway: An update for 2020. Aquaculture Reports 26: 101316

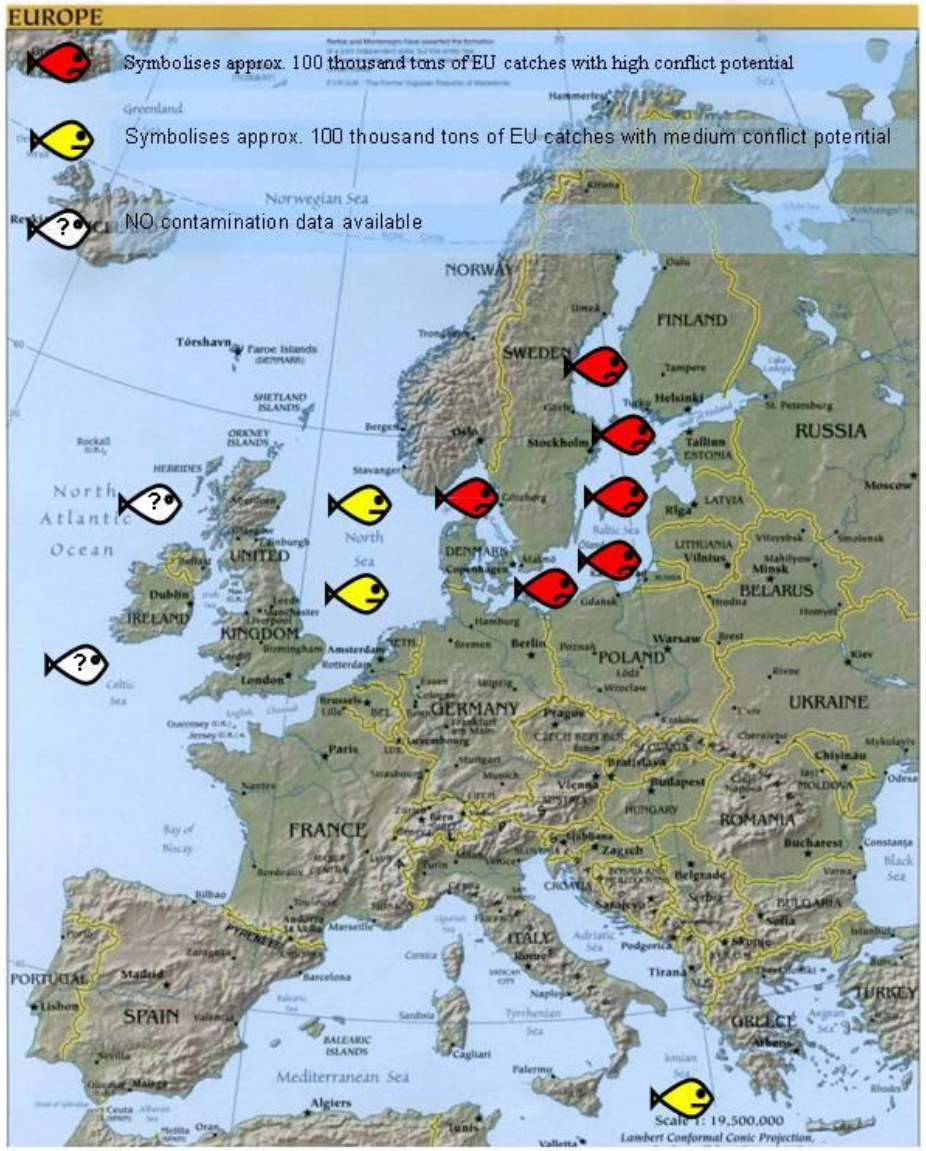


Figure 1: Areas and amounts concerned

Fishes and fishing areas of concern for fish meal/oil production

Baltic Sea

- Herring
- Sprat

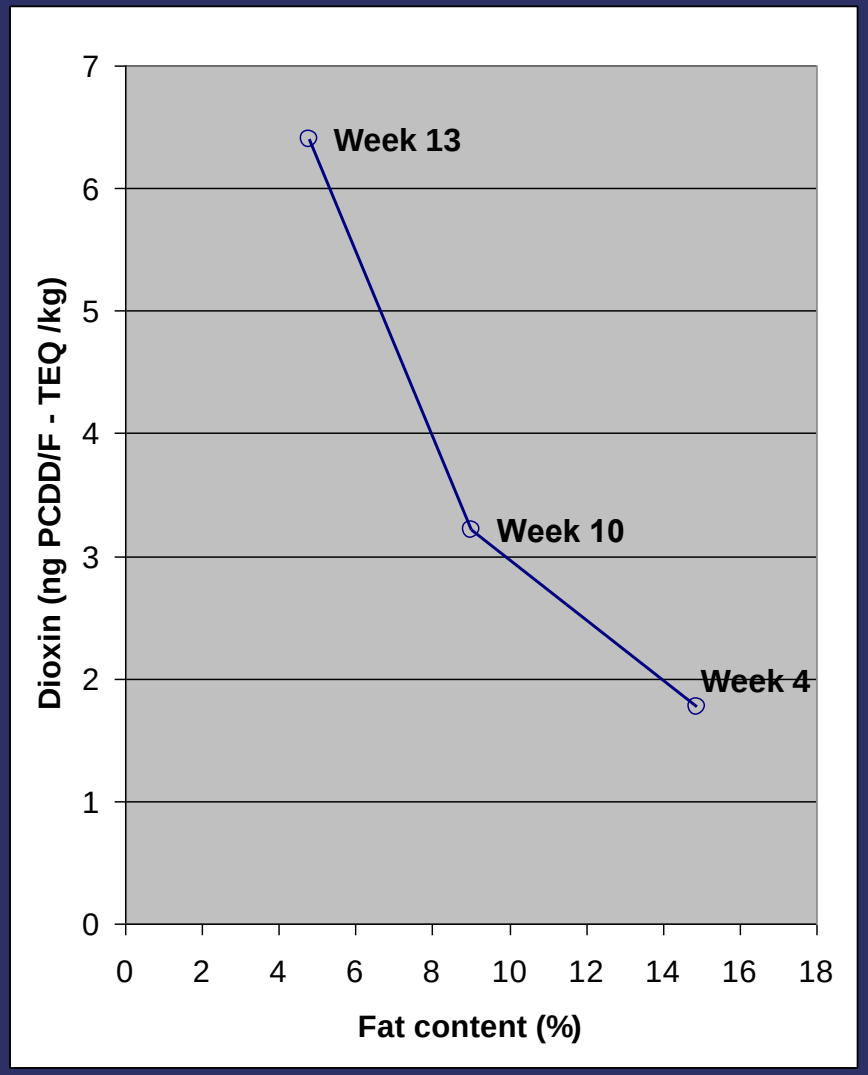
North Sea

- Herring
- Sprat
- Sand eel
- Blue whiting

Mediterranean Sea

- no data

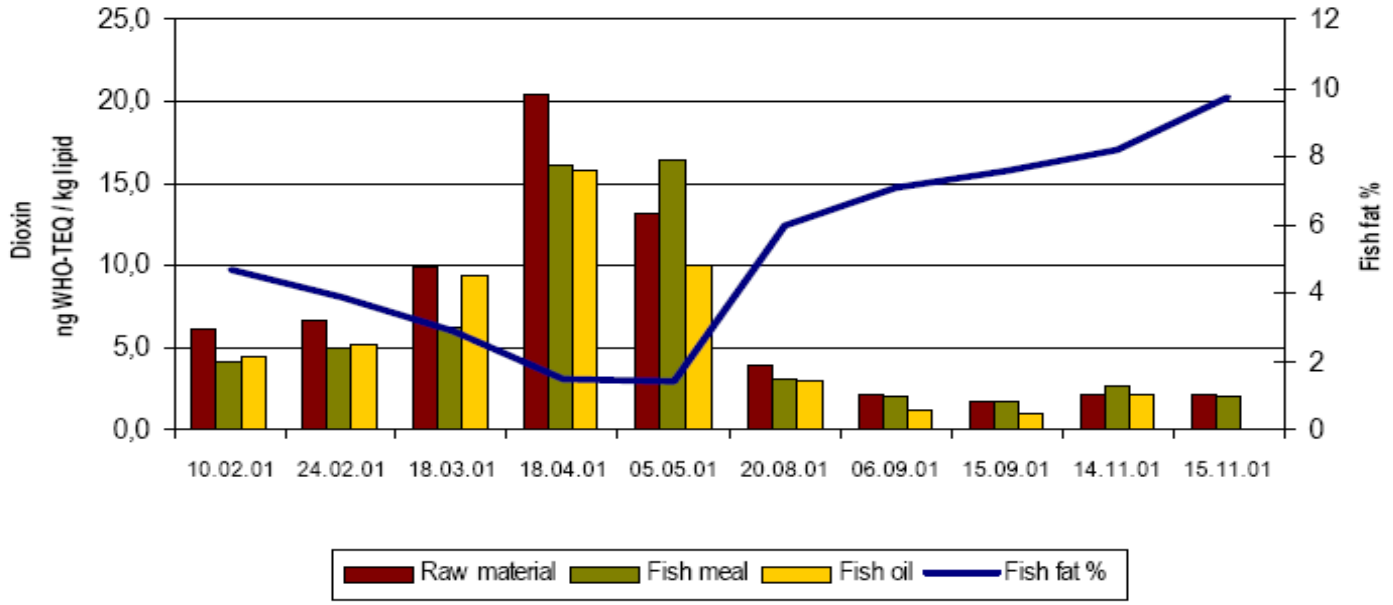
Lodde i Barentshavet 2000



Oterhals, Å. 2011. Decontamination of persistent organic pollutants in fishmeal and fish oil. Process optimization and modelling. PhD-thesis.

Kolmule mel og olje 2002

Figure 7: Concentration of dioxin in all blue whiting samples, expressed on a lipid basis, together with the variation in fat level in the raw fish samples.



Mundell et al., 2003. Dioxin and PCB in four commercial important pelagic fish stocks in the North-East Atlantic. Http://www.nora.fo

EU-strategi for redusert eksponering

- EU strategy (SCF, 2001) to reduce the average population intake to below 2 pg WHO-TEQ/kg bw and day.
- Integrated approach to reduce the level throughout the food chain from:

→ Feed ingredients

→ Formulated feed

→ Food products

Fiskaren 1/10-2004

TripleNine investerer 130 millioner DKr i renseanlegg for fiskeolje (aktivt kull) og fiskemel (heksanekstraksjon) ved fiskemelfabrikken i Esbjerg.

1/10

kystens næringsavis

Fiskaren

Årgang 81 • Nr 116 • Uke 40 — Fredag 1. oktober 2004 • Løssalg kr 15,- • Norden DKK 20,- — www.intrafish.no

SILDOLJE OG SILDMELSIND
KJÆRREIDVINKEN 14
5143 FYLLINGSDALEN

fredag

Klart for hummer-fiske i dag
Side 12

– Selg sunnhet og øk salget av fisk
Side 15

FERSK LAKS

Berget seg fra dramatisk brann
Terje Mathisen fra Sandefjord berget livet da reketråleren hans brant.
Side 9

Havforsker-tvil om laksefjorder
Havforskerne er skeptisk til nasjonale laksefjorder.
Side 8

164 sjarker er blitt borte
164 har så langt takket ja til å kondemnere båten sin.
Side 11

FHL måtte krabbe tilbake
Det kjøpes atter krabber.
Side 12

Dansk dioksin-kupp!

FOTO: THOR NIELSEN

Den største danske mel- og oljefabrikken, tripleNein, investerer 130 millioner danske kroner for å rense fiskemel og fiskeolje for dioksiner. Dermed kan oppdrettsbransjen få et fiskefôr nesten helt uten miljøgifter.
Side 4 og 5

Maksimum tillatte nivå av PCDD/F- and PCDD/F-PCB-TEQ Commission Directive 2006/13/EC

	PCDD/F (ng WHO-TEQ kg^{-1})	PCDD/F-PCB (ng WHO-TEQ kg^{-1})
Fiskeolje		
- Fôr (12% vann)	6	24
- Mat	2	10
Fiskemel (12% vann)	1.25	4.5
Fiskefôr (12% vann)	2.25	7.0

1) Commission Directive 2006/13/EC

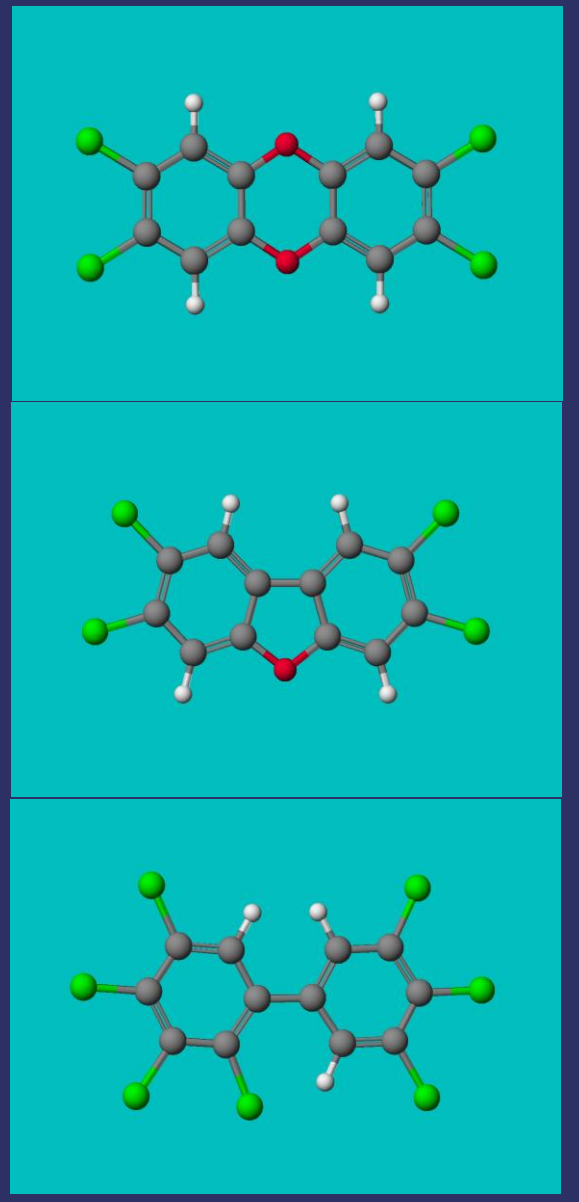
2) Commission Regulation (EC) No 199/2006

Maksimum tillatt nivå og TEF-verdier revidert etter dette.

Nye TEF-verdier publisert i 2024. Reviderte MPL-nivå forventes publisert i 2025.

Rensing av fiskeolje

- ❑ Aktivt kull adsopsjon
- ❑ Vakuum damp-stipping (deodorisering)
- ❑ Molekylærdestillasjon



DESOTEC activated carbon filter tank (MOBICON® 2000)

SCIENTIFIC OPINION

EFSA Journal

ADOPTED: 4 July 2017

doi: 10.2903/j.efsa.2017.4961

Assessment of a decontamination process for dioxins and dioxin-like PCBs in fish oil by physical filtration with activated carbon

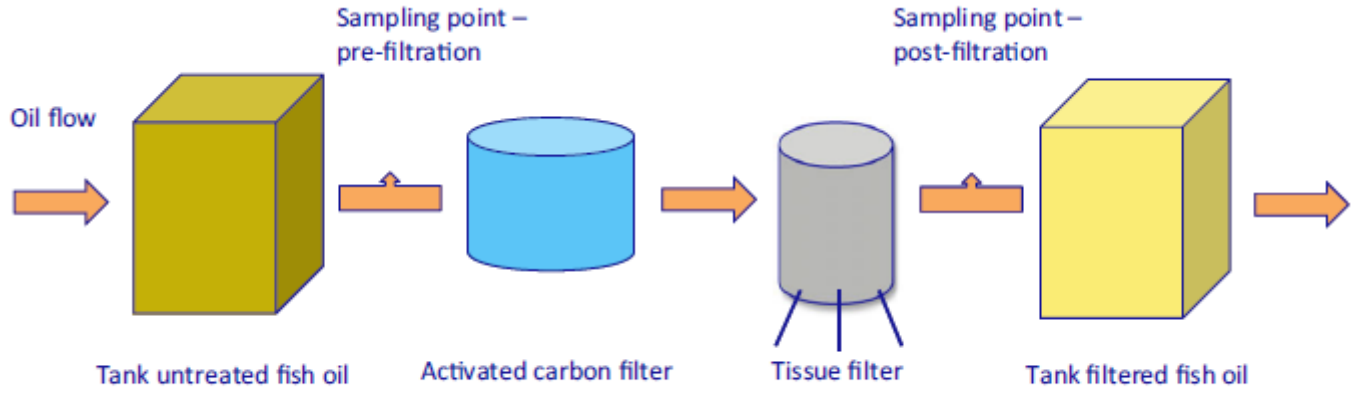


Figure 1: Schematic diagram of the process used by the feed business operator

Batch-prosess

SCIENTIFIC OPINION

EFSA Journal

ADOPTED: 12 July 2022

doi: 10.2903/j.efsa.2022.7524

Decontamination process for dioxins and dioxin-like PCBs from fish oil and vegetable oils and fats by a physical process with activated carbon

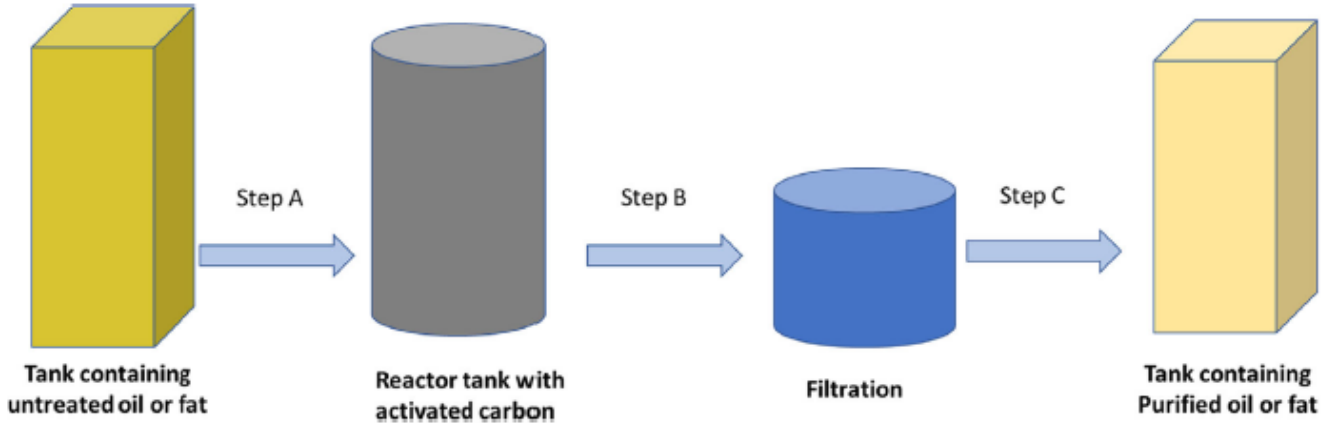
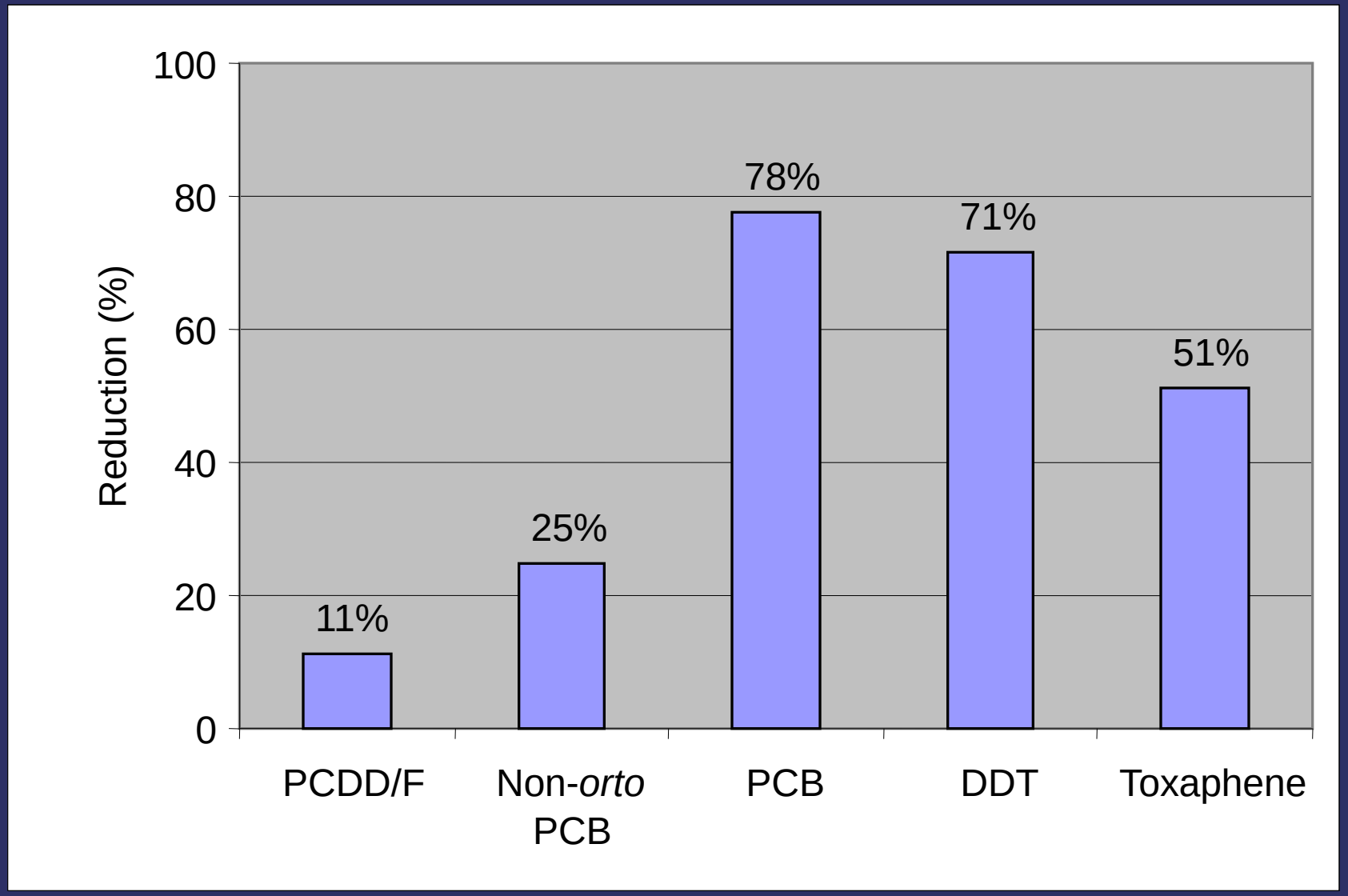


Figure 1: Schematic diagram of the process used by the feed food business operator

Konklusjon:
The procedure has the potential to reduce the concentrations of PCDD/Fs and DL-PCBs but not those of the NDL-PCBs.

Batch-deodorisering av fiskeolje (180 °C, 1 mbar)



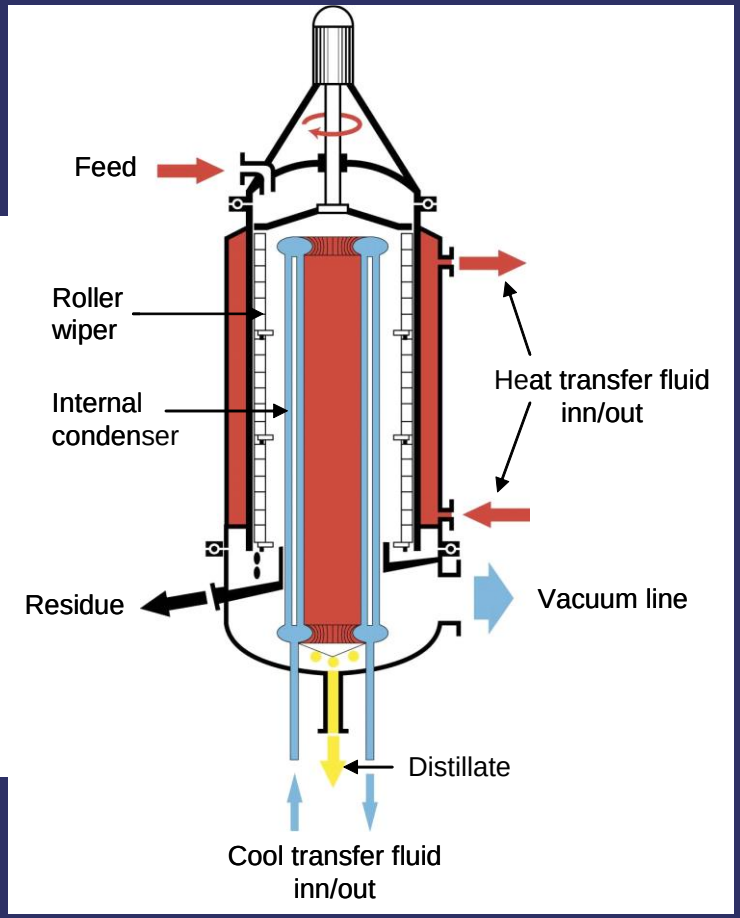
Oterhals, unpublished results

Molekylærdestillasjon

UIC KD6 pilotanlegg
3 kg/h, 220 °C, 0,005 mbar

pg TEQ/g	Dioxin		Dioxin-lignende PCB		
	PCDD	PCDF	N-ortho PCB	M-ortho PCB	Sum
Ubehandlet	2.6	6.1	9.2	2.6	20.5
SPD-behandlet	0.3	0.6	0.7	0.2	1.9
Reduksjon	89 %	90 %	92 %	91 %	91 %

+ 4% WF					
SPD-behandlet	0.09	0.12	0.12	0.03	0.4
Reduksjon	97 %	98 %	99 %	99 %	98 %



Oterhals et al., 2010. Modeling of a short-path distillation process to remove persistent organic pollutants in fish oil based on process parameters and quantitative structure properties relationships. Chemosphere 80:83–92.

Endring i kjemisk sammensetning og stabilitet etter rensing

	Aktivt kull behandling [a]	Molekylærdestillasjon
Fettsyre sammensetning	–	–
Frie fettsyrer	–	÷
Uforsåpbare forbindelser	NA[b]	÷
Vitaminer	÷	÷
Totox verdi (2xPV + AV)	–	(÷)
Oksidasjonsstabilitet	÷	÷

a) Maes et al., 2005. JAOCS 82(8):593-597.
b) NA = ikke analysert

Maes et al., 2005. Removal of Dioxins and PCB from Fish Oil by Activated Carbon and Its Influence on the Nutritional Quality of the Oil. JAOCS 82: 593-597.
Oterhals et al., 2007. Optimization of activated-carbon based decontamination of fish oil by response surface methodology. Eur. J. Lipid Sci. Technol. 109:691-705.
Oterhals og Berntssen, 2010. Effects of Refining and Removal of Persistent Organic Pollutants by Short-Path Distillation on Nutritional Quality and Oxidative Stability of Fish Oil. J. Agric. Food Chem. 58:12250–12259 .

Rensing av fiskemel

- ❑ Ekstraksjon med organisk løsemiddel
- ❑ Økt fettseparasjon i fiskemelprosessen
- ❑ Ekstraksjon med triglyserid-olje (plante eller fiskeolje)

TripleNine Esbjerg is located right out to the North Sea at the Danish west coast.

TripleNine Esbjerg holds various facilities

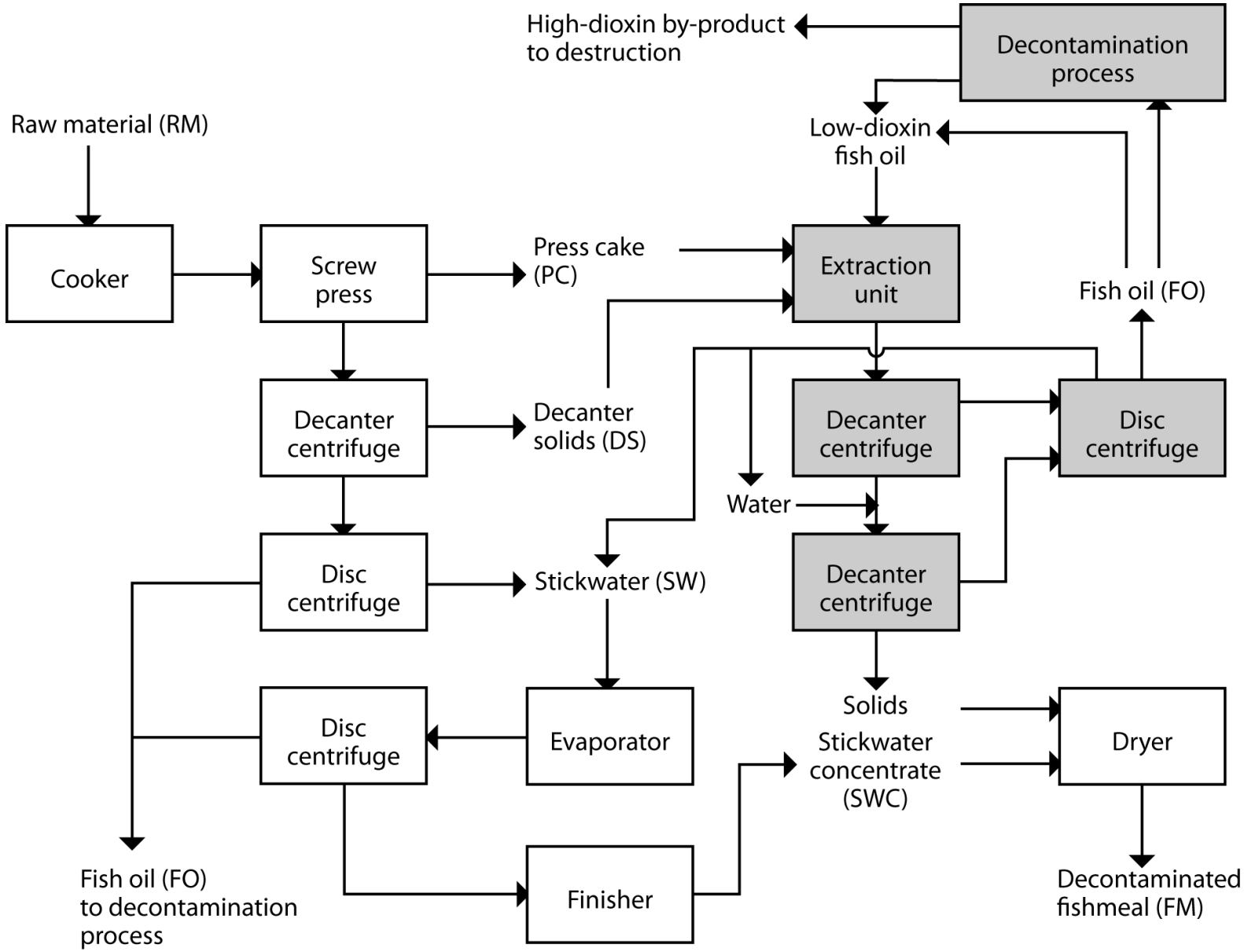
- Storage and mixing facilities
- Meal and oil cleaning facilities
- Processing of phospholipids and value added special products

Our sales, logistics and administration are also placed in Esbjerg.

Capacity

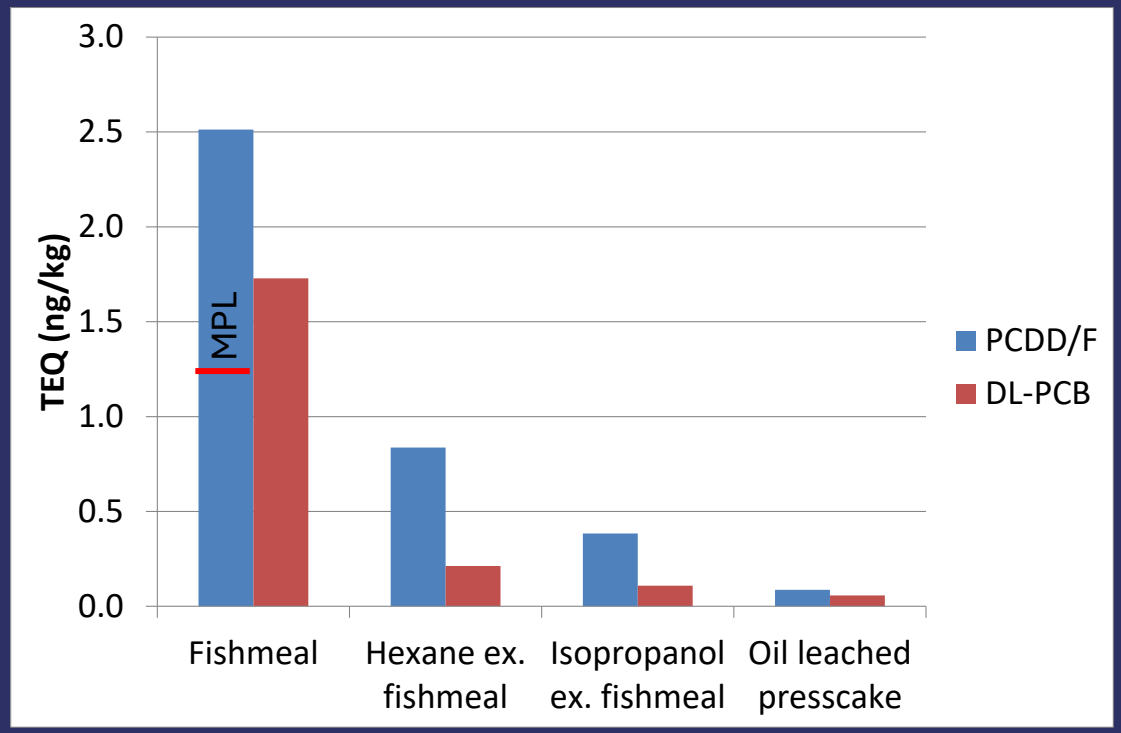
- Annual handling: 30,000 tonnes of fish meal and 25,000 tonnes of fish oil.

Prosess-flytskjema



Oterhals, Å., Nygård, E.,2008. Reduction of Persistent Organic Pollutants in Fishmeal: A Feasibility Study. J. Agric. Food Chem. 56, 2012–2020.

Sammenligning ekstraksjon av fiskemel med organisk løsemiddel og soyaolje



	Bl&D-fat/DM (%)	PCDD/F-PCB-TEQ reduction (%)
Fiskemel	14.5	---
Heksan-ekstrahert fiskemel	3.1	75
Isopropanol-ekstrahert fiskemel	1.7	88
Olje-ekstrahert presskake	14.4	97

Oterhals, Å., Nygård, E.,2008. Reduction of Persistent Organic Pollutants in Fishmeal: A Feasibility Study. J. Agric. Food Chem. 56, 2012–2020.

Oppsummering

- Finnes alternativ og meget effektiv teknologi for rensing av PCDD/F og DL-PCB i fiskeolje og fiskemel.

- Dersom behov kan samme type teknologi anvendes på andre oljetyper og proteinråvarer.

Takk for oppmerksomheten!

Nofima - www.nofima.no
The Norwegian Institute of Food, Fisheries and Aquaculture Research

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