Lesson learned from «TrackPlast» project
Tracking of plastic emissions from aquaculture industry

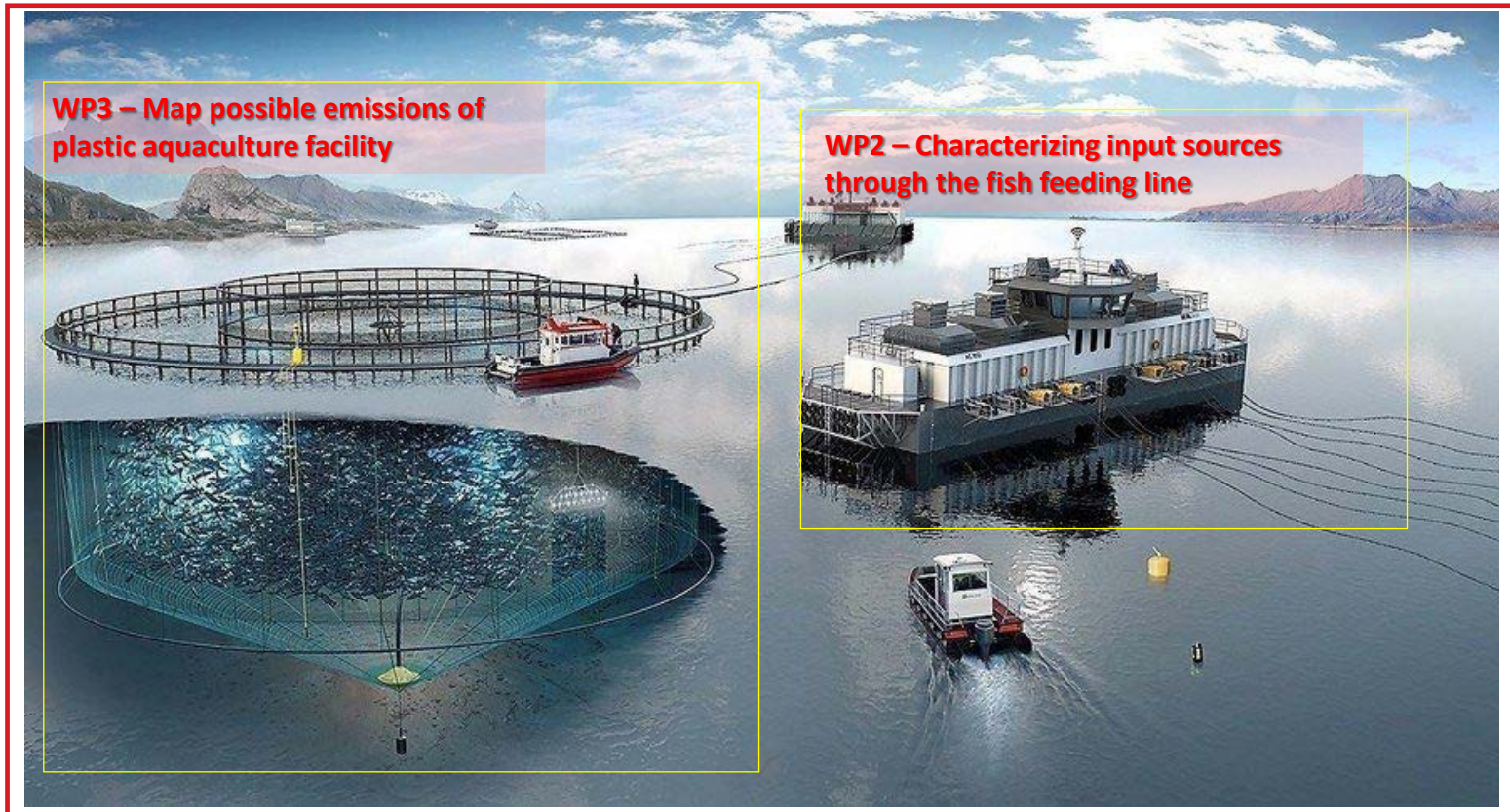
Alessio Gomiero, Norwegian Research Centre

FHF Webinar «Microplastics occurrence in fisheries and aquacolture », 21st April, 2021

The aim of TrackPlast project

- ✓ Identify the sources of emissions of plastic and micro-plastic in the sea from aquaculture facilities;
- ✓ To determine and quantify the contributions from aquaculture operations in the immediate vicinity of sea farms;
- ✓ Identify which processes within the seafood production is largely responsible for plastic discharge and suggest measures to reduce eventual emissions;
- ✓ Encourage an active exchange of information and discussion between academia, industry and stakeholders for a common solution towards marine plastic pollution.

WP1 – Project management & Dissemination

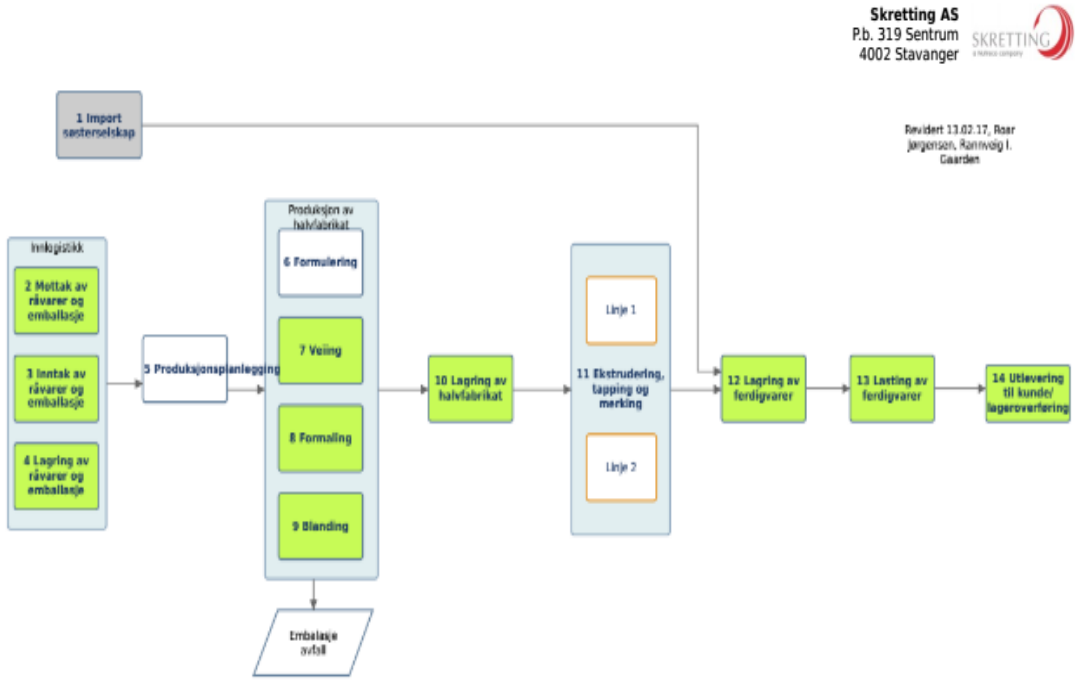


WP4 – Evaluation of collected data and identification of possible measures targeting emissions reduction

Characterizing input sources through the fish feeding line

Objectives:

- Characterize and quantify plastic fragment sources from fish feed production
- Characterize and quantify environmental inputs of plastic fragments from fish feeding systems



Identify key processes in the production potentially responsible of plastic fragments enrichment in the final product

Analyzed raw material

Feed ingredient	Meal or oil	Ingredient group	% in the final product
Soy protein concentrate	Meal	Vegetable protein	26,8
Wheat gluten	Meal	Vegetable protein	11,9
Fishmeal	Meal	Marine protein	12,9
Wheat	Meal	Carbohydrates	9,1
Faba beans	Meal	Vegetable protein	4,4
Sunflower meal	Meal	Vegetable protein	0,6
Rapeseed	Oil	Vegetable oils	19,6
Fish oil	Oil	Marine oils	11,6
Fish oil from farmed fish	Oil	Marine oils	NA

Product	Type	Finished feed fat coated
Feed	Finished feed before fat coating	Grower type
Feed	Finished feed fat coated	Grower type

KÖSTER MARINE PROTEINS GMBH
TRACEABILITY CERTIFICATE
for: Skretting AS date: 26.09.2018

Contractual Data:

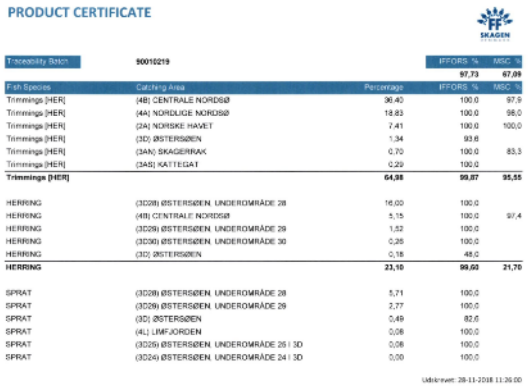
Fishmeal contract No. 18.V.0268 of 27.06.2018
Consignment-No.: 18.V.0268-1
Skretting order no.: 1525575

Traceability data:

1.194.056 kgs Peruvian Fishmeal 67% steamdried in bulk
Shipped by MV "PRIDE" – B/L dated 26.09.2018
from Bremen to Stavanger + Averoy

Origin/catch area: Peru / FAO 87 (Pacific, Southeast)
Species: 100% Peruvian anchoveta (engraulis ringens) (whole fish)

Producer(s):	Registration no. of produciton unit(s):	IFFO-RS no. of production unit(s):	Salmonella negative result of the Bremen Veterinary Authorities:
Pesquera Diamante S.A.	H305-RAZ-PSDA H116-CAL-PSDA H010-SUP-PSDA	IFFO 108J IFFO 108A IFFO 108C	GVDE 128-2-933-18



PRODUCT CERTIFICATE

SKAGEN

Traceability Batch	90010219		IFFORS %	MSC %
			97,73	67,09
Fish Species	Catching Area	Percentage	IFFORS %	MSC %
Trimmings [HER]	(4B) CENTRALE NORDSØ	96,40	100,0	97,9
Trimmings [HER]	(4A) NORDLIGE NORDSØ	18,83	100,0	98,0
Trimmings [HER]	(2A) NORSKE HAVET	7,41	100,0	100,0
Trimmings [HER]	(3D) ØSTERSØEN	1,34	93,6	
Trimmings [HER]	(3AN) SKAGERRAK	0,70	100,0	83,3
Trimmings [HER]	(3AS) KATTEGAT	0,29	100,0	
Trimmings [HER]		**64,98**	**99,87**	**95,55**
HERRING	(3D28) ØSTERSØEN, UNDEROMRÅDE 28	16,00	100,0	
HERRING	(4B) CENTRALE NORDSØ	5,15	100,0	97,4
HERRING	(3D29) ØSTERSØEN, UNDEROMRÅDE 29	1,52	100,0	
HERRING	(3D30) ØSTERSØEN, UNDEROMRÅDE 30	0,26	100,0	
HERRING	(3D) ØSTERSØEN	0,16	48,0	
HERRING		**23,10**	**99,60**	**21,70**
SPRAT	(3D28) ØSTERSØEN, UNDEROMRÅDE 28	5,71	100,0	
SPRAT	(3D29) ØSTERSØEN, UNDEROMRÅDE 29	2,77	100,0	
SPRAT	(3D) ØSTERSØEN	0,49	82,6	
SPRAT	(4L) LIMFJORDEN	0,08	100,0	
SPRAT	(3D26) ØSTERSØEN, UNDEROMRÅDE 26 I 3D	0,08	100,0	
SPRAT	(3D24) ØSTERSØEN, UNDEROMRÅDE 24 I 3D	0,00	100,0	

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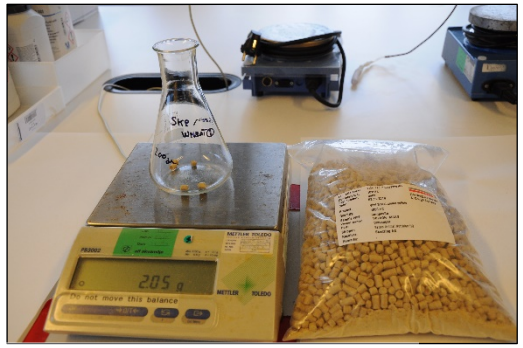
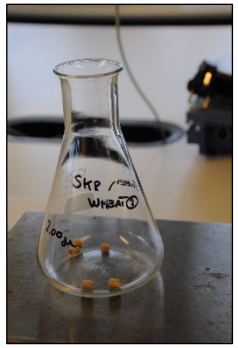
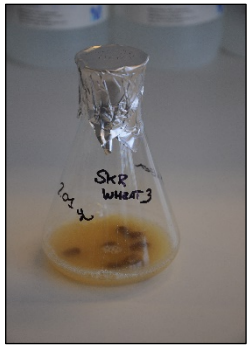
Sample preparation in brief

Sun Flower Meal

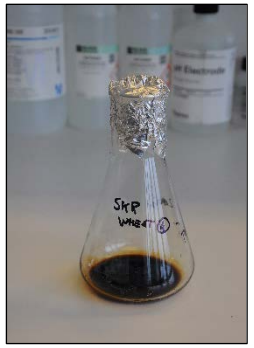


Wheat gluten

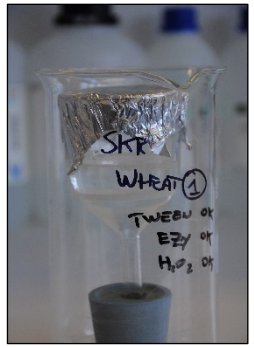




Permeation



Enzyme driven selective degradation



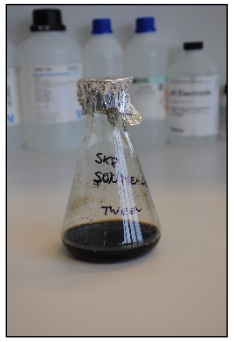
Oxidation

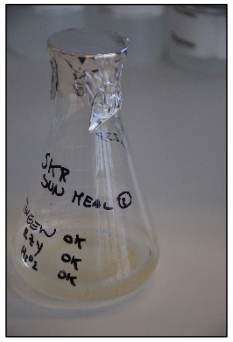
or

strong alkali

+

selective solubilization

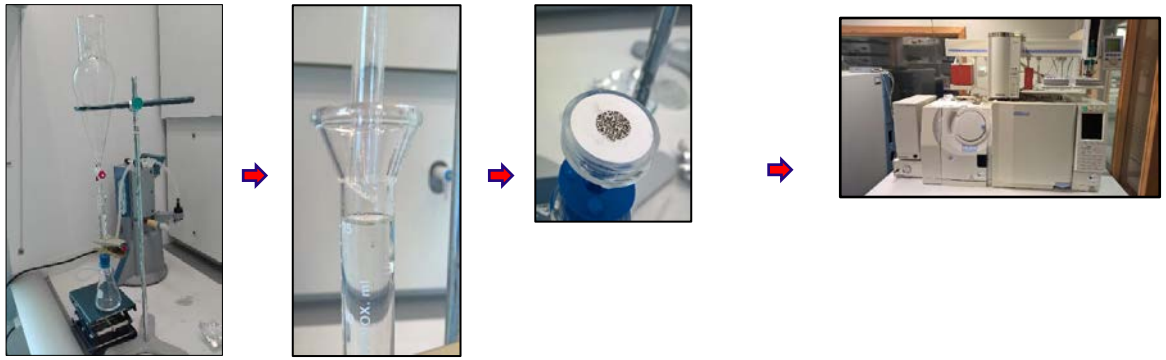


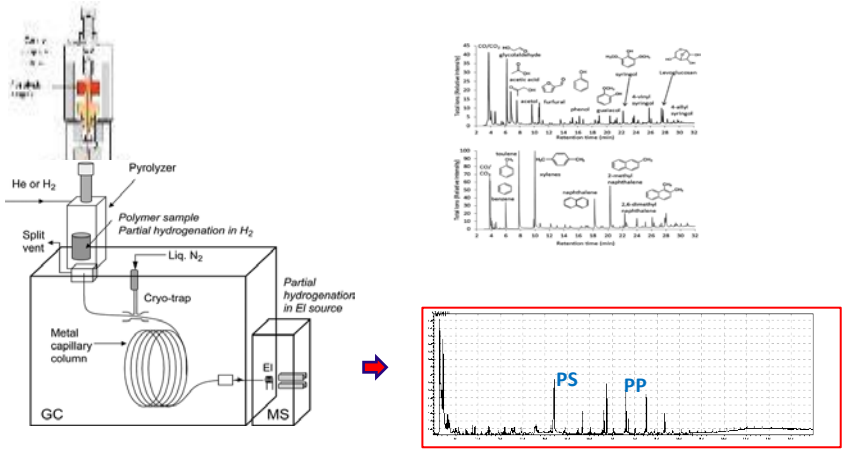


Flotation

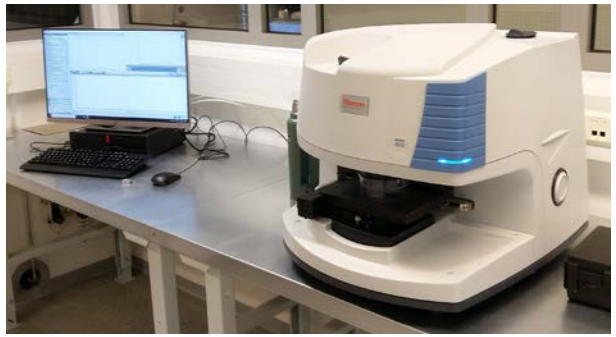
Polymers characterization and quantification analysis

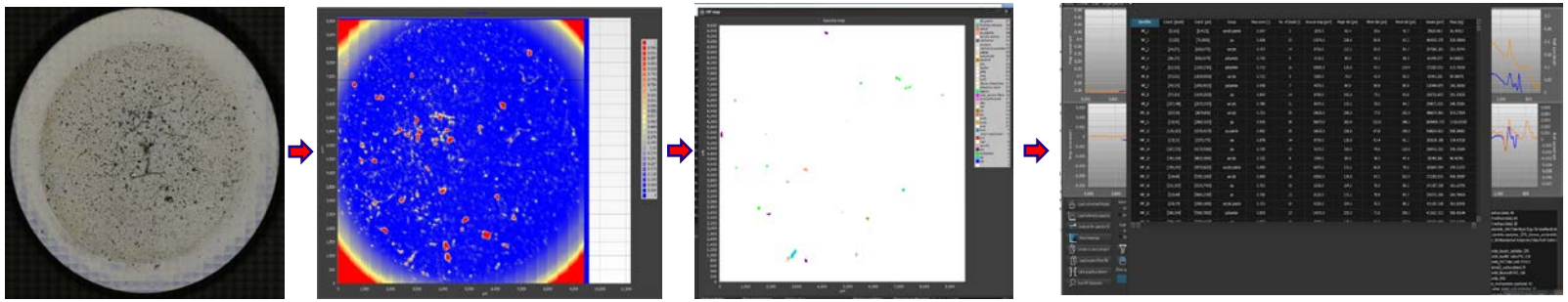
Thermal degradation analysis (GCMS-Pyr)





µ-Fourier Transformed Infra Red analysis (µ-FTIR)





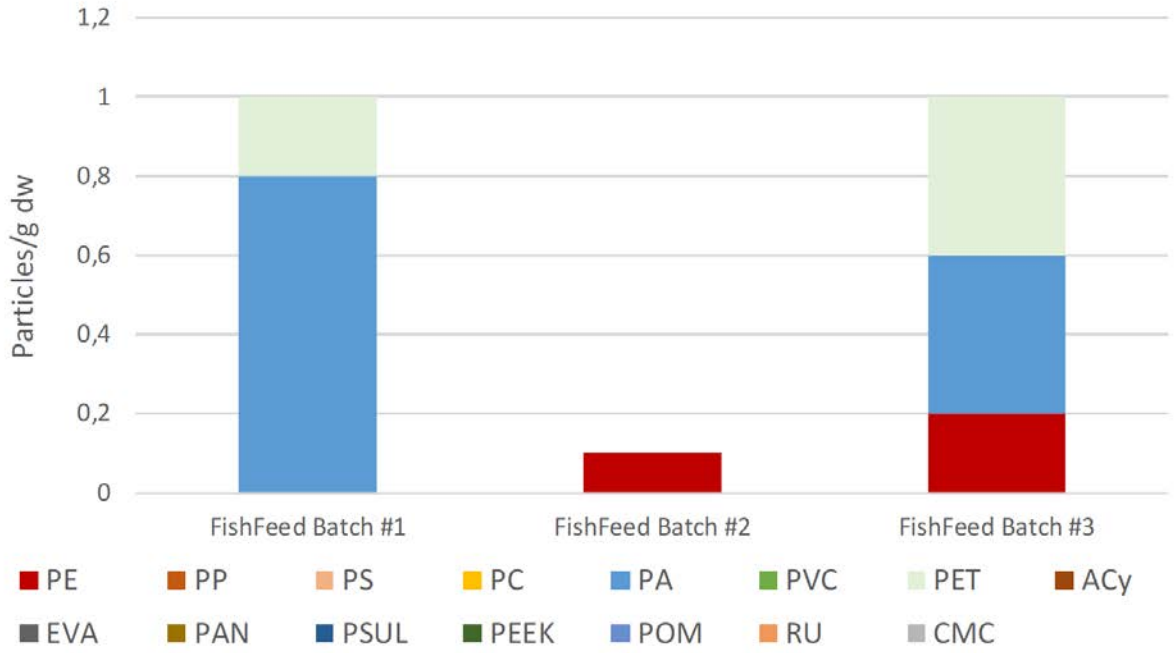
Characterization and quantification of plastic fragments sources from fish feed production by thermal degradation analyses (GCMS-pyr)

Feed ingredient	µg/Kg DW							
	PE	PP	PS	PVC	PA66	PMMA	PC	PET
Soy protein concentrate	< 1	< 5	< 1	< 5	< 5	< 5	< 10	< 5
Wheat gluten	< 1	< 5	< 1	< 5	< 5	< 5	< 10	< 5
Fishmeal batch #1	11 ± 1	< 5	< 1	< 5	8 ± 5	< 5	< 10	< 5
Fishmeal batch #2	6 ± 1	< 5	< 1	< 5	< 10	< 5	< 10	< 5
Fishmeal batch #3	< 1	< 5	< 1	< 5	6 ± 5	< 5	< 10	12 ± 5
Wheat	< 1	< 5	< 1	< 5	< 5	< 5	< 10	< 5
Faba beans	< 1	< 5	< 1	< 5	< 5	< 5	< 10	< 5
Sunflower meal	< 1	< 5	< 1	< 5	< 5	< 5	< 10	< 5
Rapeseed	< 1	< 5	< 1	< 5	< 5	< 5	< 10	< 5
Fish oil crude low	< 1	< 5	< 1	< 5	< 5	< 5	< 10	< 5
Fish oil from farmed fish	< 1	< 5	< 1	< 5	< 5	< 5	< 10	< 5
Cruched beans	< 1	< 5	< 1	< 5	< 5	< 5	< 10	< 5
Finished feed before fat coating	7 ± 6	23 ± 5	< 1	< 5	< 5	< 5	< 10	< 5
Finished feed fat coated	< 1	19 ± 10	< 1	< 5	< 5	< 5	< 10	< 5

Characterization and quantification of plastic fragments from fish feed production by vibrational spectroscopy analysis (µFTIR)

Among all raw materials the occurrence of MPs (in the 10-300 µm range), was primarily found in fish meal batches with an average of 1.3 particles/ gr (21- 38 µm size).

PA, PE and PET accounted for the most abundant polymer types

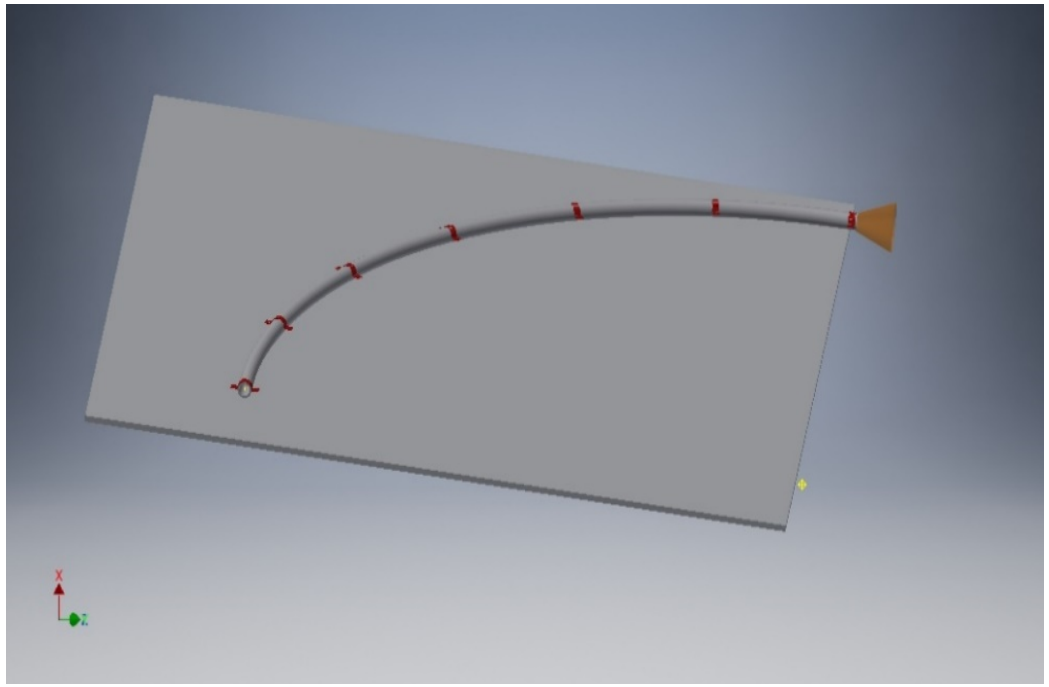


Characterizing input sources through the fish feeding line

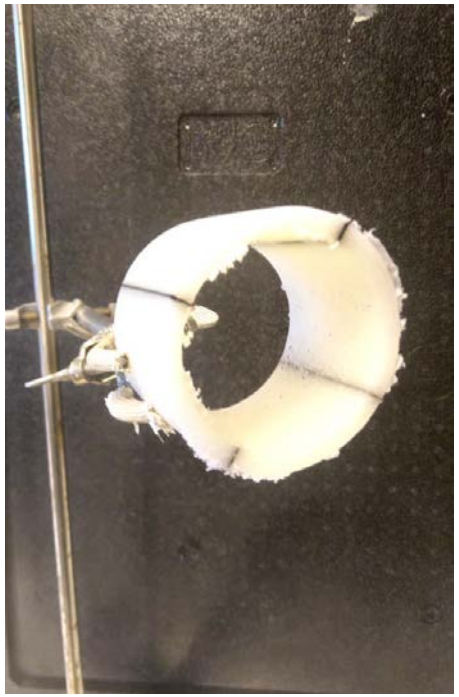
To simulate different naturally occurring shapes of the pipes in an aquaculture site:

- A new and an aged pipe were placed on a plane testing table and curved off by a horizontal plane to reach a 10° angle
- A new and an aged pipe were kept straight
- Pipes were weighed before and after the experiment. Pellets were pushed through the pipes twice a day (6h + 6h).

Generated debris was analyzed for particles size distribution ……

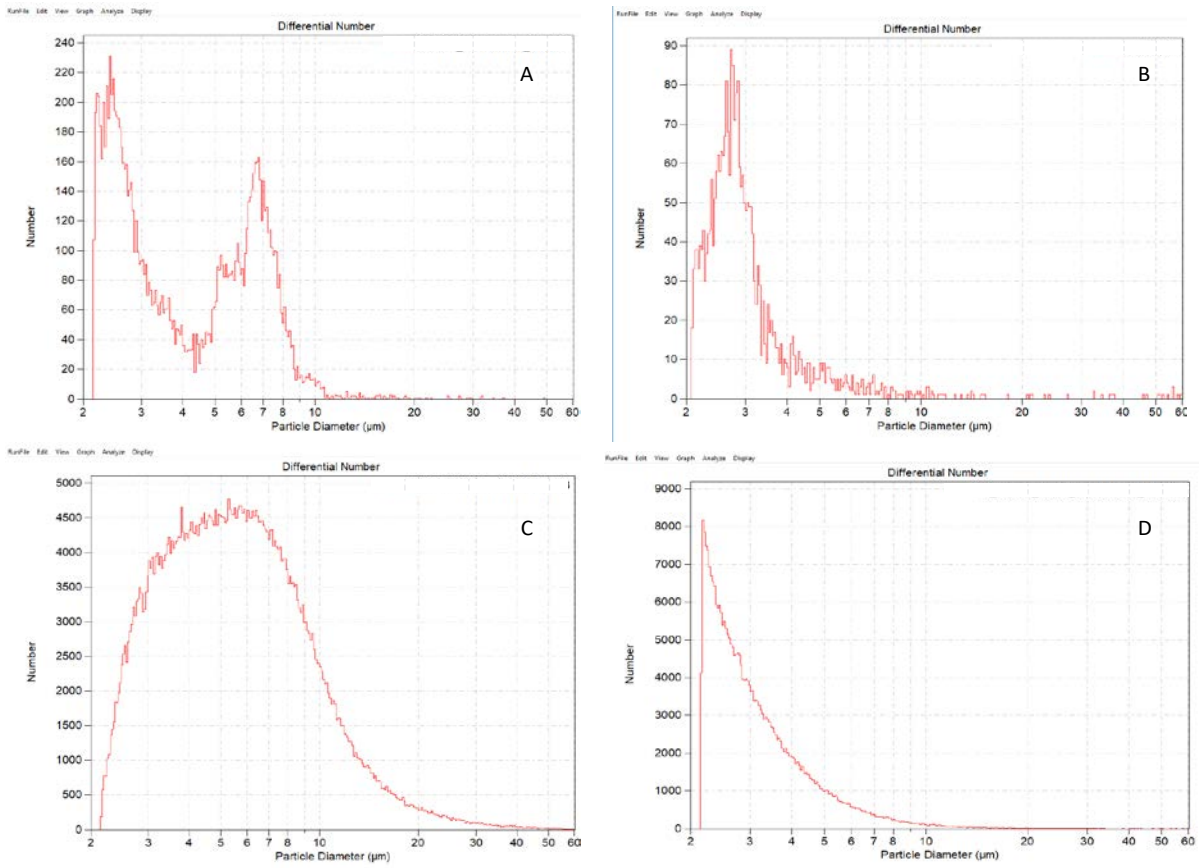


Parameter	Value
Air speed	20 m/s
Pellet speed	15 m/s
Pressure	0.5 bar
Temperature	70 ˚C
Blower system - Air volume	200 m^3/h
Blower system - pressure	1 bar



Results of abrasion test

An abrasion test was performed on new curved and new straight pipes (NCP-A and NSP-C, respectively) as well as aged curved (ACP-B) and aged straight (ASP-D) feed pipes.



Size distribution of collected plastic fragments

Straight shape

New (NSP-C) = 5.9 µm (median average)

Aged (ASP-D) = < 2.1 (median average)

Curved shape

New (NCP-A) = 2.2 µm + 6.7 µm (median average)

Aged (ACP-B)= 2.8 µm (median average)

Abrasion test – Some final considerations

The abrasion experiments indicated that most MPS generated were smaller than < 10 µm

Despite the limits of the simulation and the applied experimental set up such as short length of pipes, static shape, flow set up parameter, the study documents the potential formation of plastic particles in the low µm size range**.**

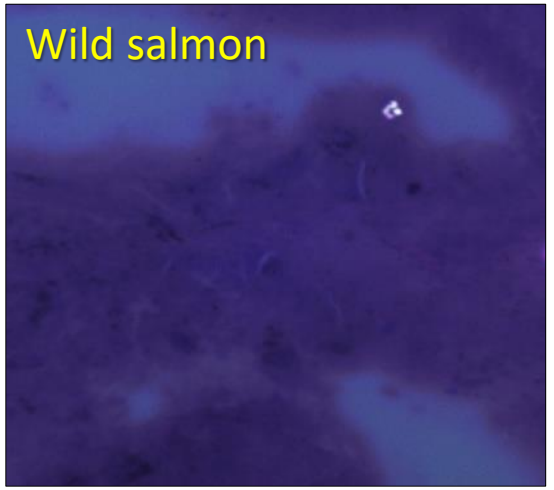
The current methods struggle to detect potential nanoscale plastic particles that are likely to form.

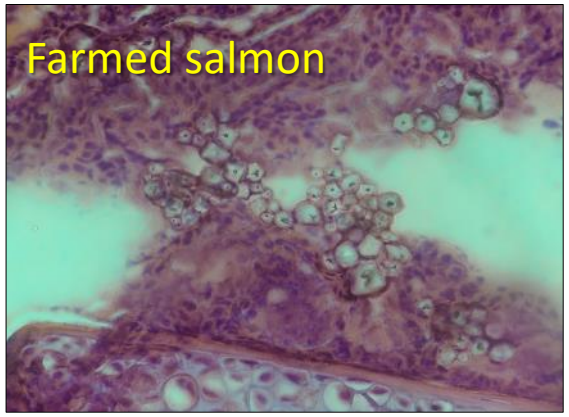
In a real life scenario there will be a large variability of key parameters, such as the length of the pipes, their age, the occurrence of wind and waves resulting in different shapes when applied, the feeding schedule and the feeding set up (pressure and flow, the amount of pellets per hour, dimension, shape and characteristics of the pellets). These all influence the final wearing processes.

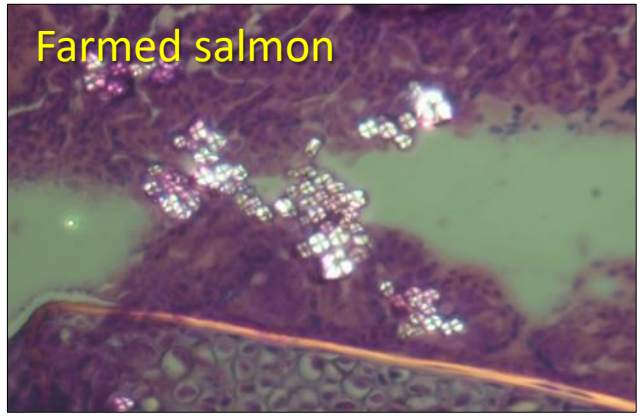
During the one week experiment a loss of 5-14 g of pipe material was recorded, meaning an average loss of **0.10-0.40 g/meter/day** at the given experimental conditions.

Occurrence of MPs in gills

	Gill	
µg/g	Wild	Farmed
PP	< 0,5	< 0,5
PS	< 0,5	< 0,5
PE	< 0,5	18
PVC	< 0,5	< 0,5
PET	< 0,5	< 0,5
PMMA	< 0,5	< 0,5
PA66	< 0,5	< 0,5







Acknowledgments

Participants:

SKRETTING

NORCE

AKVA GROUP

MOWI

HAVFORSKNINGS INSTITUTTET

Veterinærinstituttet
Norwegian Veterinary Institute

Project info and final report: https://www.fhf.no/prosjekter/prosjektbasen/901519/

Questions: algo@norceresearch.no