5th PEROSH Research Conference
Stockholm 6-8 September 2023

Occupational exposure to airborne micro- and nanoplastics

Øyvind P. Haugen

Postdoc
Research group for Occupational Toxicology
The National Institute of Occupational Health in Norway (STAMI)

PlasticsFatE

What are the fate and effects of micro and nanoplastics on human health?

The Challenge

Plastics particles are found in food, water, air and soils. Our current knowledge of human risks associated with these is insufficient because we lack the reliable, validated methods that can produce the scientific data that we need

The Goal

PlasticsFatE aims to improve our current understanding of the impact of micro- and nano-plastics (MNPs) and associated additives or adsorbed contaminants in the human body

The Proposal

PlasticsFatE will implement a measurement and testing programme to identify MNPs in food, human tissue, consumer products, and different media, examine the fate and toxicity of MNPs and develop a Risk Assessment strategy

The Timescale

PlasticsFatE is a 48-month EU-funded Horizon 2020 project that runs from the 1st April 2021 to 31st March 2025

The Partners

28 Partners from 11 European Countries

7 Private-public research organizations
ISTEC-CEN, CSIC, ITENE, UFZ, FHG, IGB, GAIKER

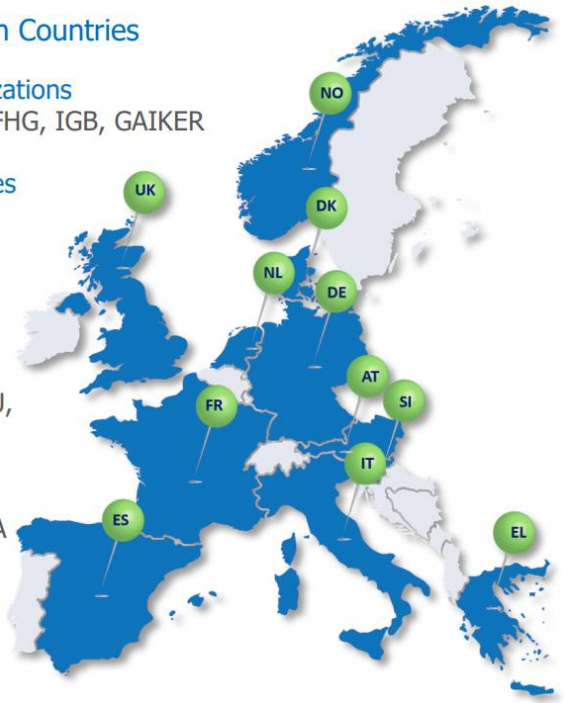
4 National governmental agencies
STAMI, BAM, NRCWE, UBA

1 Medical research centre
UMCU

10 Universities
WFSR, ULEIDEN, FAU, UL, BOKU, UBT, UNITO, URTV, UP, NTUA

5 SMEs
ENAS, ERS, OPTIMAT, DECHEMA INNOSIEVE DIAGNOSTICS

1 Large company
ECAMRICERT

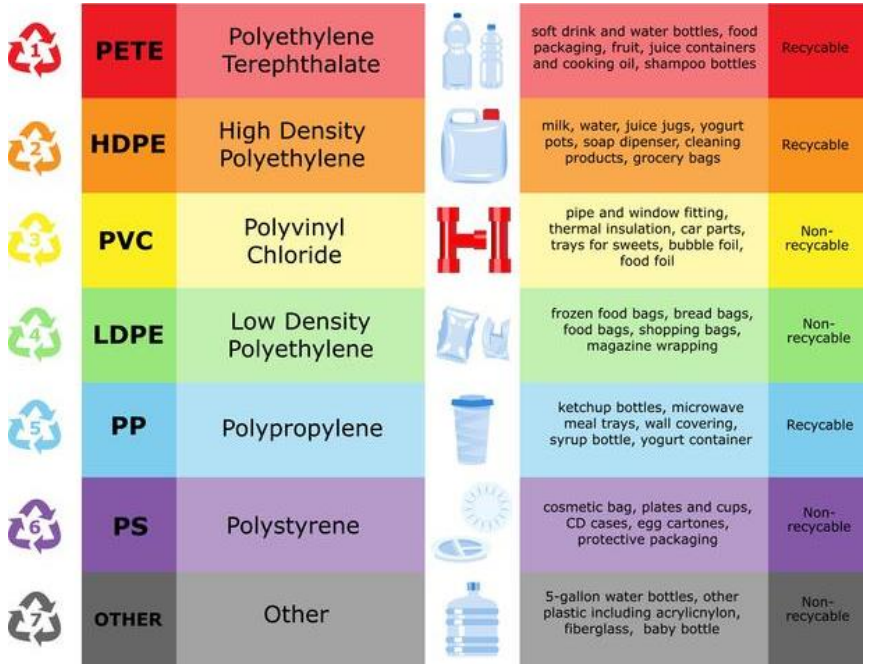


https://www.plasticsfate.eu/

STAMI
STATENS ARBEIDSMILJØINSTITUTT

What is micro- and nanoplastics (MNPs)?

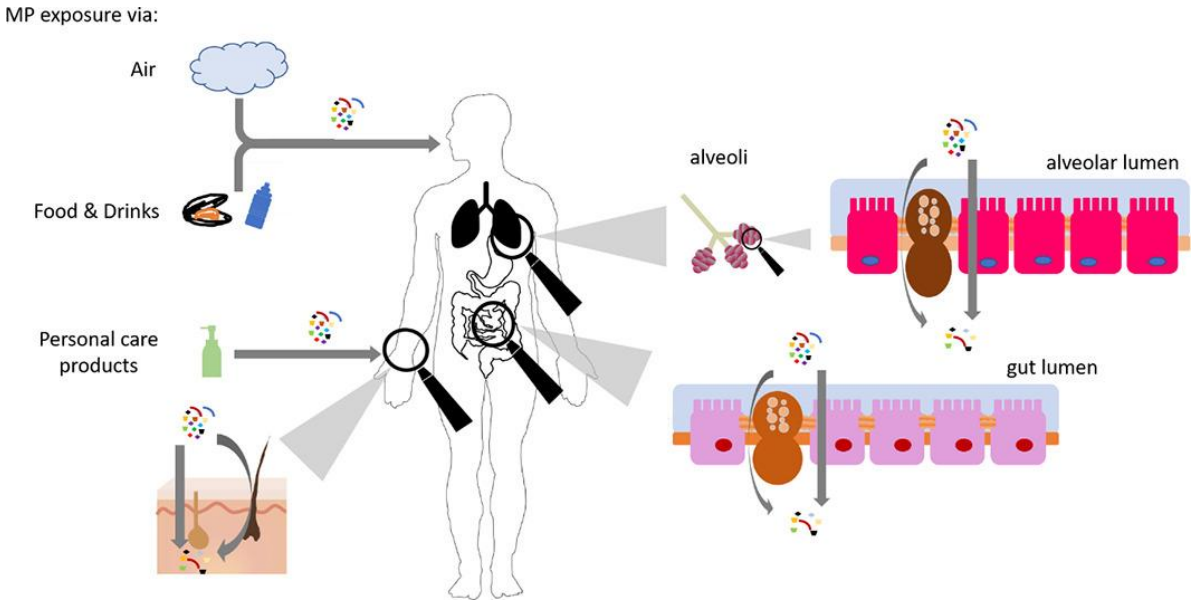
- Plastics: synthetic or natural materials (bio-plastics) that use polymers as the main ingredient. Can be moulded, extruded or pressed into solid objects of various shapes.
- **Microplastics** >1000 nm
  Nanoplastics <100 nm
- Formed by degradation of larger plastic objects or intentially manufactured
- We find them everywhere!



1	PETE	Polyethylene Terephthalate	soft drink and water bottles, food packaging, fruit, juice containers and cooking oil, shampoo bottles	Recycable
2	HDPE	High Density Polyethylene	milk, water, juice jugs, yogurt pots, soap dipenser, cleaning products, grocery bags	Recycable
3	PVC	Polyvinyl Chloride	pipe and window fitting, thermal insulation, car parts, trays for sweets, bubble foil, food foil	Non-recycable
4	LDPE	Low Density Polyethylene	frozen food bags, bread bags, food bags, shopping bags, magazine wrapping	Non-recycable
5	PP	Polypropylene	ketchup bottles, microwave meal trays, wall covering, syrup bottle, yogurt container	Recycable
6	PS	Polystyrene	cosmetic bag, plates and cups, CD cases, egg cartones, protective packaging	Non-recycable
7	OTHER	Other	5-gallon water bottles, other plastic including acrylicnylon, fiberglass, baby bottle	Non-recycable

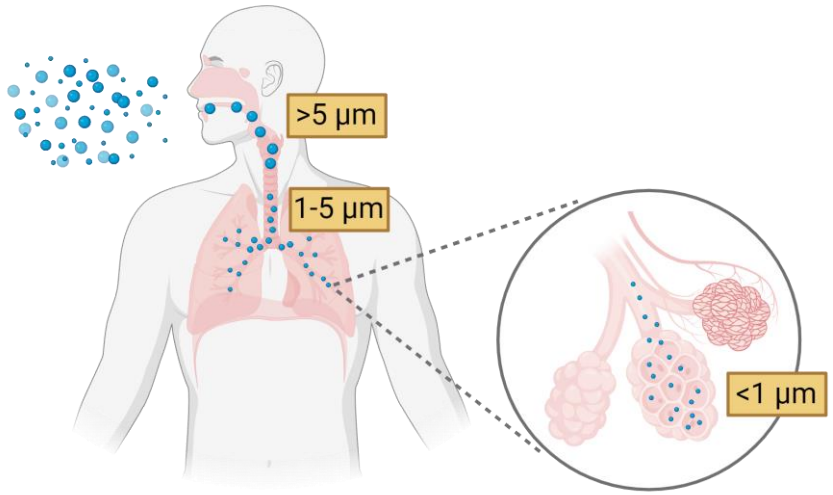
STAMI
STATENS ARBEIDSMILJØINSTITUTT

How are we exposed to MNPs?



Ramsperger et al., 2023

Airway exposure is particularly relevant in an occupational setting



Created with BioRender.com

Occupational exposure to MNPs

- Aim:
  - Assess exposure levels of airborne MNPs in working environments

- Waste management and recycling facilities
- Wastewater treatment plants
- Plastic packaging manufacturers

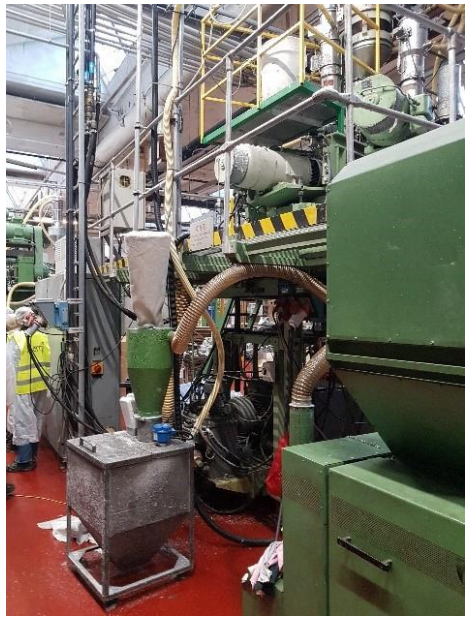
STAMI
STATENS ARBEIDSMILJØINSTITUTT

Plastic packaging facility in Norway

- uses plastic granules as raw material for the production of plastic packaging and plastic film.

Plastic granules

Overview of the facility



Grinding of plastic waste

Heat-Extrusion-Moulding machine for white bottles

STAMI
STATENS ARBEIDSMILJØINSTITUTT

Sampling equipment

Personal air sampler (PAS)

Scanning mobility particle sizer (SMPS)

Personal air sampling

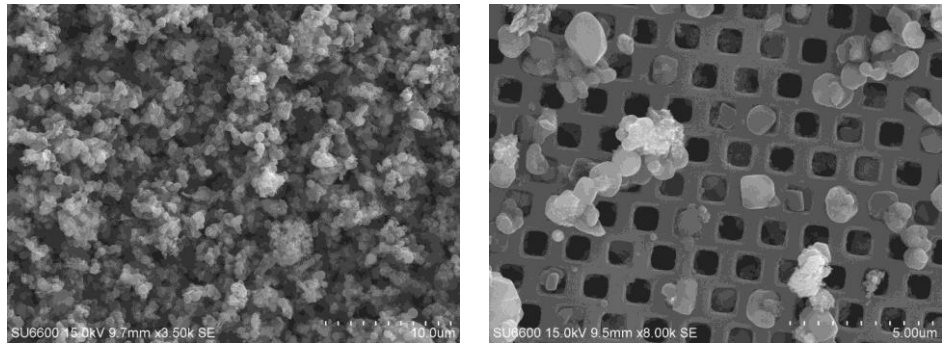
Sample ID	Sampling time (min)	Air volume (m^3)	Mass (mg/m^3)	Work task
PAS6-1	444	0,89	0,2	Package operator
PAS6-2	450	0,86	0,4	Package operator
PAS6-3	447	0,89	0,1	Package operator
PAS6-4	448	0,85	0,2	Machinist
PAS6-6	440	0,88	0,2	Package operator
PAS6-B8	424	0,85	0,1	Machinist

Upper exposure limit for nuisance dust: 10 mg/m^3

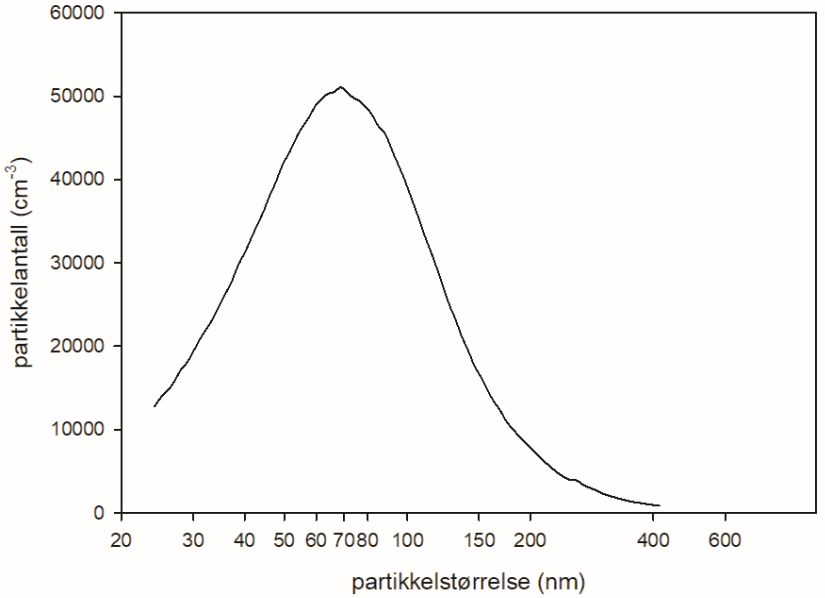
STAMI
STATENS ARBEIDSMILJØINSTITUTT

Stationary sampling

Sample ID	Sampling time (min)	Air volume (m^3)	Mass (mg/m^3)	
PAS6-PVC1	2429	4,9	0,03	Stationary
PAS6-PVC2	2625	5,3	0,03	Stationary
PAS6-PVC4	2648	5,3	0,03	Stationary
PAS6-PVC4	2678	5,4	0,03	Stationary



Scanning electron micrographs



STAMI
STATENS ARBEIDSMILJØINSTITUTT

Chemical analysis

	Conc. per m³ (ng/m³), blank corrected				
First sampling campaign	**PE**	**PU**	**PP**	**Work task**	**Location**
Personal sample	<LOQ	<LOQ	<LOQ	Package operator	Clean room
Personal sample	<LOQ	<LOQ	<LOQ	Package operator	PET
Personal sample	<LOQ	<LOQ	89,37	Package operator	Clean room
Personal sample	217,87	6,38	30,26	Machinist	PE
Personal sample	72,83	3,3	66,43	Package operator	PE
Personal sample	257,31	6,01	22,62	Machinist	PE
Second sampling campaign					**Location**
Stationary sample	12,42	2,4	<LOQ		PE station
Stationary sample	<LOQ	2,25	<LOQ		PE station
Stationary sample	<LOQ	1,1	<LOQ		PE station
Stationary sample	<LOQ	0,86	<LOQ		PE station

*LOQ = Limit of quantification

NILU Norsk institutt for luftforskning
Norwegian Institute for Air Research

Dorte Herzke
Senior scientist

Linda Hanssen
Senior scientist

Natascha Schmidt
Scientist

STAMI STATENS ARBEIDSMILJØINSTITUTT

Summary

- We detected micro- and nanosized particles in collected air samples
- Nanosized particles were detected in close proximity to where heating and moulding of plastic occurred
- Chemical analysis detected three different types of plastic polymers

- Remaining question:
  How much of the detected plastic exist in the nanosized range?

STAMI
STATENS ARBEIDSMILJØINSTITUTT

PlasticsFatE at STAMI

Research group for Occupational Toxicology

Shan Narui
Gruppeleder/ledende seniorforsker
+47 23 19 52 84
shan.narui@stami.no

Anani K. Johnny Afanou
Forsker
+47 23 19 52 47
anani.afanou@stami.no

Håkan Wallin
Ledende seniorforsker
+47 23 19 52 70
hakan.wallin@stami.no

Øyvind Pernell Haugen
Postdoktor
+47 23 19 53 06
oyvind.haugen@stami.no

Sarah Alsaedi, MSc

Andreas S. Sagen, MSc

Research group for Chemical Work Environment

Torunn Kringlen Ervik
Forsker
+47 23 19 53 37
torunn.ervik@stami.no

Pål Graff
Ledende seniorforsker
+47 23 19 51 67
pal.graff@stami.no

Stine Eriksen Hammer
Forsker
+47 23 19 53 39
Stine.Hammer@stami.no

Animal facility

Hanne Friis Berntsen
Seniorforsker/veterinær
+47 23 19 52 77
hanne.berntsen@stami.no

Fang-Chin Lin
Forskningstekniker
Tlf: +47 23 19 52 95
fang.chin.lin@stami.no

Research group for Occupational Medicine and Epidemiology

Karl-Christian Nordby
Avdelingsdirektør
+47 23 19 53 78
kcn@stami.no

Bendik Brinchmann
Lege i spesialisering
+47 23 19 53 74
Bendik.Brinchmann@stami.no

NILU
Norsk institutt for luftforskning
Norwegian Institute for Air Research

Dorte Herzke
Senior scientist

Linda Hanssen
Senior scientist

Natascha Schmidt
Scientist

STAMI
STATENS ARBEIDSMILJØINSTITUTT