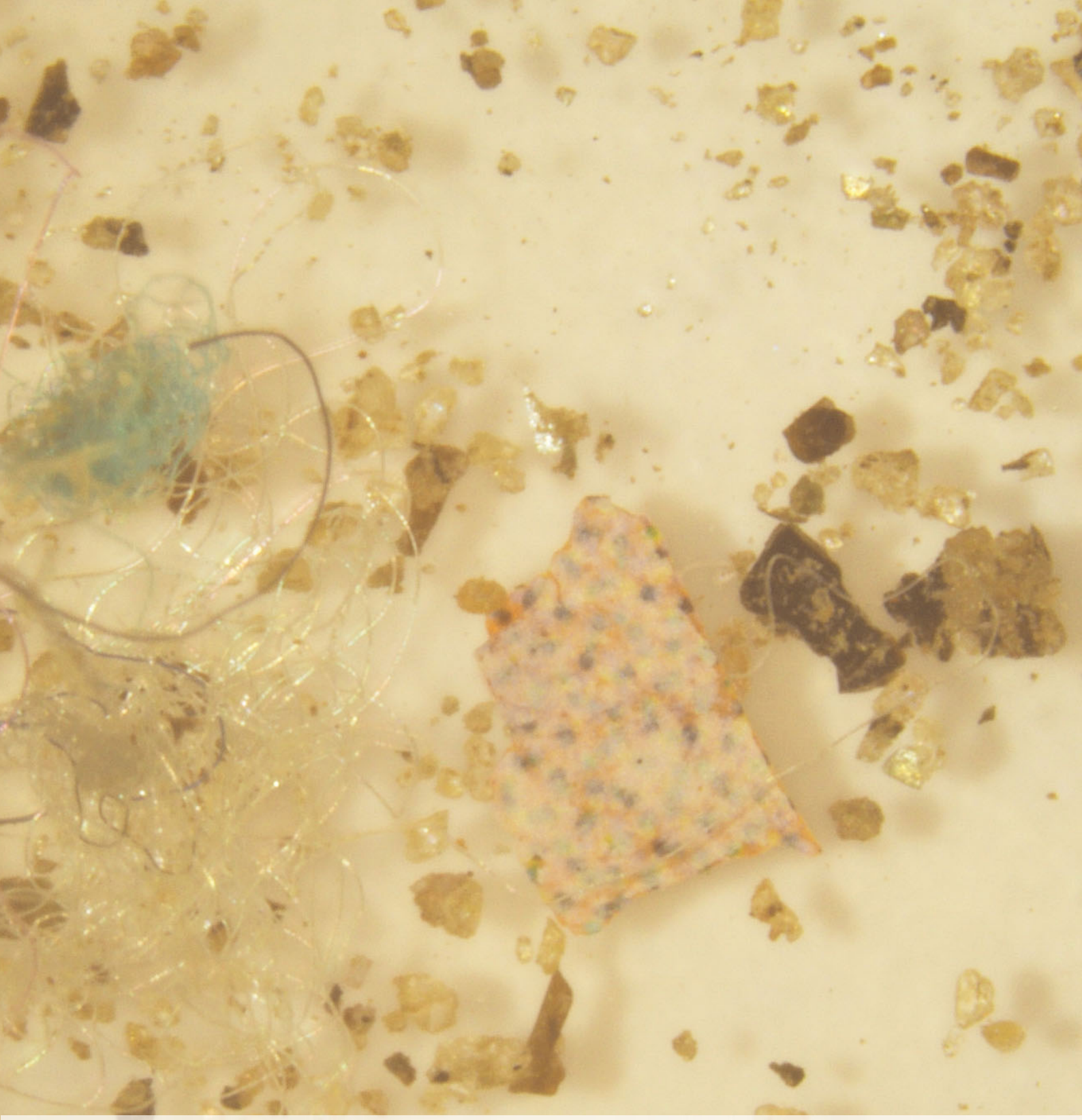

MICROPLASTIC-LIKE PARTICLES IN SEABED SEDIMENTS FROM INNER DANISH WATERS 2015

Scientific Report from DCE – Danish Centre for Environment and Energy No. 320 2019

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Data sheet

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Abstract: Contents and composition of microplastic-like particles have been analysed in twelve sediment samples from the inner Danish waters covering both the Kattegat, Belt Sea, Sound and western Baltic Sea that were collected in 2015. The number of microplastic-like particles in the size range 20-5,000 µm was determined to be in the range of 202-3511 particles per kg dry weight sediment, dominated by blue, transparent and black coloured particles, mainly as fibres, and particle sizes < 300 µm were dominating.

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Preface

This assessment report describes results of the national monitoring programme on microplastic-like particles contents and composition in sediments collected in the inner Danish waters in 2015. The national monitoring programme using the environmental indicator “microplastic” has been initiated by the Danish Environmental Protection Agency at the Ministry of Environment and Food, as part of the national implementation of EU’s Marine Strategy Framework Directive (MSFD) in relation to Descriptor 10 for assessments of characteristics, state, impact and trends of litter in the marine environment.

Summary

The presence of microplastic-like particles in the size range of 20-5000 µm have been studied in sediment collected at twelve stations in the period October - December 2015 in the inner Danish waters covering areas in the Kattegat, Belt Sea, Sound and western Baltic Sea. The content and composition of microplastic-like particles in all samples with volume of 50 ml were determined only by visual identification using microscopy after the samples had been chemically digested to remove natural organic matter, density fractionated with saturated saline solution and size fractionated in six size classes using metal test sieves. Visually identified particles were stored for later chemical analysis by µFT-IR spectroscopy.

The study showed that particles identified as microplastic-like occurred in all twelve sediment samples. Out of all the identified microplastic-like particles 71–100 % were fibres, i.e. elongated filaments. Fibres were the dominant type of microplastic-like particles followed by films / fragments which contributed up to 29 % of the microplastic–like particles found. The contents of microplastic-like particles were in the range 202-3511 particles per kg dry weight and 300-1340 particles per litre wet sediment. In addition, another group of the particles was characterised as of "uncertain" origin, because they most likely consisted of remains from natural organic matter, but it could not be fully excluded that they consisted of synthetic polymers. The levels of microplastic-like particles in this study were within the range of microplastics in sediment found in two previous danish studies.

Microplastic-like particles in the size range of 20-300 µm dominated contributing 62-100 % of all plastic-like particles in the sediment samples. The smallest particles in the size fraction 20-38 µm contributed with 8-42 % of the particles identified as microplastic-like in the different samples. No particles with sizes > 1000 µm were found in the samples.

Regarding colour composition, blue microplastic-like particles were with 53 % on average the most frequent group, followed by transparent and black particles with 22 % and 18 % on average. Some particles with other colours e.g. white, red, grey, brown, green and violet were also identified as microplastic-like.

A relationship was found between microplastic-like particles and sediment contents of total organic carbon (TOC), supporting the findings of Strand et al. (2013), that microplastic-like particles in the inner Danish waters mainly are deposited in sedimentary areas together with natural organic matter and not so much in erosion zones, where sediments mainly contain more dense sand and silt particles.

Sammenfatning

Forekomsten af mikroplastlignende partikler, i størrelsesintervallet 20-5000 µm, er blevet undersøgt i sedimentprøver indsamlet på tolv stationer fra de indre danske farvande i perioden oktober til december 2015. For hver prøve blev indholdet og sammensætningen af mikroplastlignende partikler identificeret visuelt ved mikroskopi i en prøve bestående af 50 ml sediment. Inden identificering af mikroplastligende partikler er prøven blevet behandlet kemisk for at fjerne naturligt organisk materiale, udrystet med mættet saltvand og til sidste størrelsesfraktioneret med Retsch testsigter i seks størrelsesintervaller. De visuelt identificerede partikler er opbevaret så senere kemisk analyse vha. advanceret µFT-IR spectroskopi er mulig.

Undersøgelserne viste, at mikroplastligende partikler, forekom i alle prøverne. Fibre var med 71-100 % af mikroplastlignende partiklerne den dominerende type, efterfulgt af 0-29 % plastfragmenter og flager. Koncentrationerne af mikroplast i prøverne lå på 202-3511 partikler per kg tørvægt og 300-1340 partikler per liter våd sediment. Derudover blev der også fundet en gruppe af partikler, som blev vurdereret til at være af ukendt oprindelse, idet det blev vurderet, at partiklerne sandsynligvis bestod af naturligt partikulært materiale, uden at det kunne udelukkes, om de egentlig bestod af syntetiske polymermaterialer som i mikroplast. Niveauet af mikroplastik lignende partikler i disse prøver var inden for niveauet at partikler fundet i to andre studier udført på sedimenter fra danske farvande

The levels of microplastic-like particles in the these sediments samples were within the range of microplastics in sediment found in both of the previous studies

En opdeling af mikroplast på de seks størrelsesfraktioner viste, at partikelstørrelser på 20-300 µm dominerede med en andel på 62-100 %. De mindste partikler med størrelser på 20-38 µm og 38-100 µm bidrog med henholdsvis 8-42 % og 19-59 %. Der blev ikke fundet partikler i sigter med maskestørrelser > 1000 µm.

Med hensyn til farvesammensætning af mikroplast, så udgjorde blå partikler med en andel på 53 % i gennemsnit den største gruppe, efterfulgt af transparente og sorte partikler med en andel på henholdsvist 22 % og 18 % i gennemsnit. Kun enkelte partikler med andre farver som hvid, rød, grå, brun, grøn og violet blev identificeret som mikroplast.

Der blev fundet en stærk sammenhæng mellem indholdet af mikroplast og total organic carbon (TOC) i sedimentprøverne, hvilket indikerer, at mikroplastpartikler fortrinsvis deponeres i sedimentationsområder i de indre danske farvande, og i mindre grad i erosionsområder, hvor sedimentet i højere grad består af uorganiske sand- og lerpartikler.

1 Introduction

Most plastics are materials that are persistent for many years when released to the marine environment. Plastics can fragment into smaller pieces of microscopic plastic particles in the environment with time, which, when smaller than 5 mm in size, are categorised microplastics. Microplastics can then be divided into two separate groups, primary and secondary microplastics. Primary microplastics are microplastics that have been designed to be of a microscopic size such as those found in some personal care products or as virgin plastic pellets used in plastic production. While secondary microplastics are formed from the degradation of larger plastic material due to weathering (SAPEA, 2019).

Microplastics in seabed sediments, i.e. amounts, distribution, trends and if possible, composition in marine environments, have as a new and emergent environmental issue been included as part of the national monitoring and management plans in Denmark. A first monitoring report on microplastic particles in North Sea sediments, also collected in 2015, has previously been published (Strand & Tairova 2016). The studies on microplastics in marine sediments will together with other marine litter indicators be used as national data input for assessments in relation to the Marine Strategy Framework Directive (MSFD) Descriptor 10 (D10) on marine litter (NST 2012a).

Marine litter has with descriptor 10 in the MSFD (EU 2008) been recognized as an important environmental pressure factor and identified as one of the eleven qualitative descriptors which is needed to describe what the environment should look like to achieve or maintain good environmental status (GES) in the marine environment by 2020 (EU 2017). In descriptor 10, one of the elements in Criteria D10C2 ”The composition, amount and spatial distribution of micro-litter on the coastline, in the surface layer of the water column, and in the seabed sediment, are at levels that do not cause harm to the coastal and marine environment”. Subsequently, the MSFD requires the establishment of monitoring programmes for assessing the current state of marine waters to be evaluated on a regular basis.

In line with this, the Regional Seas Conventions for protecting the marine environments in the northeast Atlantic (OSPAR) and the Baltic Sea (HELCOM) have as part of their Regional Action Plans (RAPs) also recommended the microplastic indicator as a relevant indicator for assessing state, impact and trends of marine litter in their sea regions (OSPAR 2014). It is recognized that there is a need for further experience on how assessments using the microplastic indicator including defining adequate monitoring strategies best can be performed, e.g. in relation to national monitoring programmes and project surveys.

It has been recognized that today there is only a limited amount of data and other information available about the regional differences in amounts, composition, impact and sources of marine litter in the Danish parts of the Baltic Sea and the North Sea (NST 2012b). In addition to the previous data on microplastic particles in North Sea sediments (Strand & Tairova 2016), there exist also some project data from a survey in 2012-2013 in the Danish waters covering sediment samples from both the Baltic Sea, inner Danish waters and the North Sea. This study found levels of microplastic-like particles (sizes 38-1000 µm) in sediments in the range of 58-3622 particles per kg dry weight (Strand et al. 2013). Other

Nordic studies have also shown that microplastic particles are widely found in Skagerrak, Kattegat and the Baltic Sea, although most studies have focused on occurrence of microplastic in the water column and to a lesser extent in sediments and biota (Strand et al. 2015). However, microplastic studies are still difficult to compare between countries due to variations in sampling and analytical methodologies applied. Development of common international guidelines for microplastic particles are still in progress.

This report describes the results of the national monitoring on microplastic-like particles in sediments from the inner Danish waters collected in 2015. The results can be used as initial baseline levels for content and composition of microplastic-like particles in Denmark.

2 Stations and methodology

Sediment samples from twelve stations in the inner Danish waters (figure 2.1) were collected in 2015 as subsamples of sediment used for analyses of hazardous substances within the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environment (NOVANA). The sampling stations cover areas in the Kattegat, Belt Sea, Sound and western Baltic Sea. All sampling stations are situated at some distance from known local point sources to pollution like harbours and effluents from waste water treatment plants (WWTPs). For more detailed station information, see *Appendix 1*. From each station, 4-5 subsamples of sediment consisting of the top 2 cm layer were pooled into one representative sample. The subsamples were collected using either a HAPS bottom corer with a diameter of 13.5 cm or a Van Veen grab sampler (Larsen, 2013). The sediment samples were then frozen in Rilsan© plastic bags and transported to the laboratory, where the samples were taken for microplastic analyses as well as analyses for supporting parameters describing sediment characteristics. The analysed sediment samples represented both sandy and more muddy and silty samples with contents of total organic carbon (TOC) in the range of 0.3-11 % and fine silt particles (< 63 µm fraction) in the range of 5–91 %; see also *Appendix 1*.

Figure 2.1. Sediment sampling stations in 2015 located in inner Danish waters analysed for microplastic-like particles.

2.1 Methodology for microplastic analyses

Sediment samples consisting of ~50 ml (~100 g wet weight (ww)) were first "digested" by two hours of thoroughly shaking with the addition of 100 ml filtered solution consisting of ~3 % potassium hydroxide, ~1 % sodium tripolyphosphate and ~5 % sodium hypochlorite (made of pure chemicals bought from MERCK). This procedure decomposed dominant fractions of natural organic matter. This digestion agent corresponds to the 30% VIP1 solution (solution consisting of ~3 % potassium hydroxide, ~1 % potassium tripolyphosphate, ~1 % potassium silicate and ~7 % sodium hypochlorite) used in previous sediment study by Strand & Tairova (2016). Such treatment of different types of common plastic materials have only limited effects on particle structure and colour (Strand et al. 2013). Spectroscopic FT-IR and Raman studies found also only minor changes in spectre used for polymer identification using similar digestion technique using hypochlorite as oxidation agent under alkaline conditions (Strand, unpubl., Enders et al. 2017, Hasselöv, pers. corr.)

The chemical digestion step was followed by five minutes of ultrasonic treatment. The remaining particles were then allowed to settle for five minutes. Subsequently, the overlying water fraction was transferred into a new glass. The remaining sediment sample was then treated two times with saturated saline solution, to separate particles according to density, by adding 100 ml of saline solution, followed by ten minutes of shaking and consequently five minutes of ultrasonic treatment. The saline water samples were both times allowed to settle for five minutes after each of the two steps. The pool of the three water fractions was wet-sieved into six particle fractions according to the mesh sizes; 20-38, 38-100, 100-300, 300-1000 and 1000-5000 µm. The sieving the performed by flushing the sample with filtered freshwater through the sediment test sieves (Retsch) made of metal placed on top of each according to decreasing mesh size. The remaining sediment sample was also flushed through the test sieves of sizes 300-1000 and 1000-5000 µm using filtered freshwater.

For each size fraction, particles retained on the test sieves and regarded as synthetic were visually identified based on their relatively homogenous texture and structure using a stereo microscope (20-50x magnification). The identified microplastic-like particles were isolated, counted and characterised with respect to their colour and type / shape, i.e. as elongated filaments (i.e. "fibres"), plastic film and plastic fragments, granules or round spherules according to the descriptions adopted from European guidance on monitoring of marine litter (JRC 2013) (*figure 2.2*). Plastic film and plastic fragments were counted as one category, as they were relatively difficult to distinguish from each other, especially at sizes less than 300 µm. This group also only represented a minor group compared to other identified types of microparticles. An additional group of particles was characterised as particles of uncertain origin, as during the visual microscope analyses it was not possible to properly assess whether they consisted of remaining natural matter or were made of synthetic polymer materials. This "uncertain" group consisted mainly of transparent particles.

The fractions of 20-38 and 38-100 µm included fibers larger than 38 and 100 µm respectively as they were able to pass through on the "slim side". , Only fibres longer than 100 µm from those two fractions were isolated and counted. For some samples, only weight determined subsamples on 20 – 75 % of the entire 20-38 µm and 38-100 µm size fractions were analysed, because the amount of material were too huge for microscope analyses in the respective samples. Microplastic data for these reduced sample sizes was afterwards corrected to total sample based on weights of analysed subsample and the total size fraction.

The following fractions were stored for potential, later analysis of polymer composition by Fourier transform infrared (FT-IR) spectroscopy:

1) all isolated particles of plastic origin including particles categorised as "uncertain origin"

2) all remains of samples from size fractions 20-38 and 38-100 µm.

Size	Record size of each item. Minimum resolution is to allocate in to bin sizes of 100 µm
Type	Plastic fragments, pellets, filaments, plastic films, foamed plastic, granules, and styrofoam
Shape	For pellets: cylindrical, disks, flat, ovoid, spheruloids; For fragments: rounded, subrounded, subangular, angular; For general- irregular, elongated, degraded, rough, and broken edges
Colour	Transparent, crystalline, white, clear-white-cream, red, orange, blue, opaque, black, grey, brown, green, pink, tan, yellow

CATEGORIES FOR MICROPARTICLES	
Material	**Description**
Plastic	Plastic fragments rounded
	Plastic fragments subrounded
	Plastic fragments subangular
	Plastic fragments angular
	cylindrical pellets
	disks pellets
	flat pellets
	ovoid pellets
	spheruloids pellets
	filaments
	plastic films
	foamed plastic
	granules
	styrofoam
Other	Other (glass, metal, tar)

Figure 2.2. Table 9 from "Guidance on Monitoring of Marine Litter in European Seas" (EU 2013).

2.1.1 Quality assurance

For quality assurance of the analyses, all glassware was cleaned and baked in the oven at 450 °C prior to the start of the microplastic analysis, and all the reagents were filtered using 20 µm mesh sizes. Additionally, the risk for airborne particulate contamination was controlled every day of sample analysis, by leaving two-three open Petri dishes with filtered water. On a daily basis, 0-2.7 particles on average (range: 0-5 particles) were recorded in the water from Petri dishes. Most of the days the particles were dominated by single transparent, blue, black and / or metallic fibre particles. Data for all analysed samples were therefore assessed to have adequate quality, because the potential, airborne contamination did not seem to have significant impact on the total amount of the collected microparticles.

Two replicates were analysed for sample NSJ230015 (2015-14738), and average data is reported in Chap. 3 whereas data for both replicates are shown in Appendix 2.

The characterisation of colours of microplastic-like particles was performed according to the colour codes listed in the EU guidance document (see table in *figure 2.2*), and were as following: transparent, crystalline, white, red, orange, blue, black, grey, brown, green, pink, violet and yellow.

3 Results

3.1 Contents of microplastic-like particles in sediments

Microplastic-like particles were found in all analysed sediment samples from the inner Danish waters with a total sum of 416 particles visually identified as microplastic-like plus 31 particles characterised as of more "uncertain" origin.

The predominant type was fibres (i.e. elongated filaments), accounting for 71-100 % of particles identified as microplastic-like in the sediment samples. The shape category of "plastic film / fragments" was also present in five of the samples, accounting for up to ~ 29%. Only one particle categorised as "granules" was registered and none as "spherules". The particles categorised as "uncertain origin" were in the range of 0-17 % of the total number of particles characterised in the samples (*table 3.1*). The group of particles characterised as of "uncertain origin" was excluded from the further analyses of contents and composition of microplastic-like particles in the sediments.

Table 3.1. Distribution of microplastic-like particles in analysed sediments characterised according to their type. The group of particles characterised as of "uncertain origin" is not included in further data analyses, although it was assessed that it could not be fully excluded that they consisted of plastic materials.

Station ID	Fibres/ filaments	Plastic films/ fragments	Granules	Uncertain origin
2015-14624	88%	0%	0%	12%
2015-14669	79%	14%	0%	7%
2015-14670	71%	29%	0%	0%
2015-14677	83%	0%	0%	17%
2015-14678	100%	0%	0%	0%
2015-14722	100%	0%	0%	0%
2015-14726	90%	5%	0%	5%
2015-14728	90%	0%	0%	10%
2015-14738a,b	93%	0%	0%	7%
2015-14739	92%	1%	1%	6%
2015-14757	83%	9%	0%	9%
2015-14759	94%	0%	0%	6%
Average	89%	5%	0%	6%

The results of contents and composition of microplastic-like particles are presented following the directions from western to eastern stations, and from northern to southern stations (see *figure 2.1*).

The contents of microplastic-like particles in the sediment samples were determined as numbers of particles per dry weight and per volume of wet sediment and grouped into each size interval and colour fractions, see also *Appendix 2*.

Microplastic-like particles with sizes of 20-5000 µm were present in the range of 202-3511 particles per kg dry weight (*figure 3.1)* and 300-1340 particles per litre wet sediment representing particles from all size fractions ((*Figure 3.2*). No plastic particles above 1000 µm were found in the sediment samples. The lowest density of particles was found at the stations ARH148001, STO0104016 and NSJ230015 and the higest levels at STOVSJ51013, VEJ0004669 and NSJ230016. Normalisation of microplastic-like particle densitities to either volume (per litre) or masss units (per kg dry weight) did have some influence

when ranking the microplastic-like levels between the stations, solely depending on the variations in dry weight content of the samples. No clear spatial pattern for microplastic-like particles were observed.

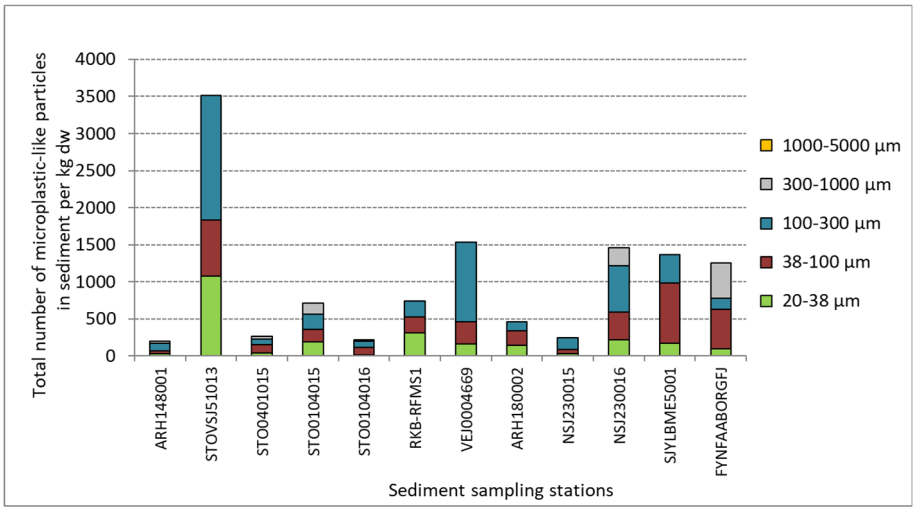

Figure 3.1. Total number of microplastic-like particles per size fraction in each sediment sampling, determined per kilogram sediment, dry weight (dw).

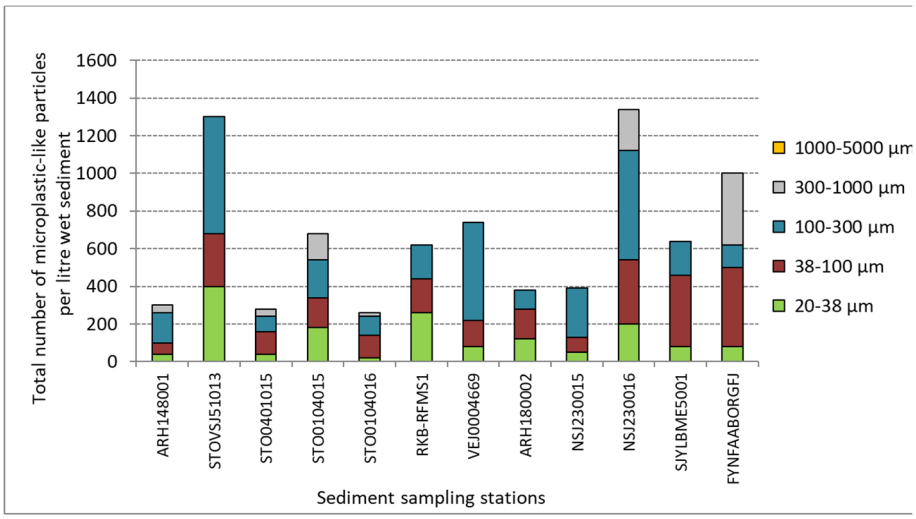

Figure 3.2. Total number of microplastic-like particles per size fraction in each sediment sampling, determined per litre wet sediment.

The levels of microplastic-like particles in the these sediments samples were within the range of microplastics in sediment found in both of the previous studies, Strand et al 2013 covering Danish waters in 2012-2013 and Strand & Tairova 2016 covering the North Sea where 58-3622 and 192-675 particles per kg dry weight were found, respectively.

However, the microplastic-like particle levels occurring in the sediment samples from the inner Danish waters in 2015 were also found to be closely and significantly related to the biogeochemical sediment characters, i.e. especially the content of natural organic matter. This is as also in accordance with the previous study by Strand et al. (2013). A strong relationship was found between microplastic-like particles and Total Organic Carbon (TOC) in the sediment ($p < 0.0001$), but not to total particle size fraction < 63 µm ($p > 0.65$) (*figure 3.3*). This supports that microplastic-like particles in the inner Danish waters mainly are deposited in sedimentary areas together with natural organic matter and not so much in erosion zones, where sediment mainly contain more dense sand and silt particles. Taken this into account, it

also indicates a generally diffuse distribution of sedimentary microplastic-like particles in the inner Danish waters compared to areas not affected directly by local point sources of microplastic such as harbours and wastewater treatment plant (WWTP) effluents.

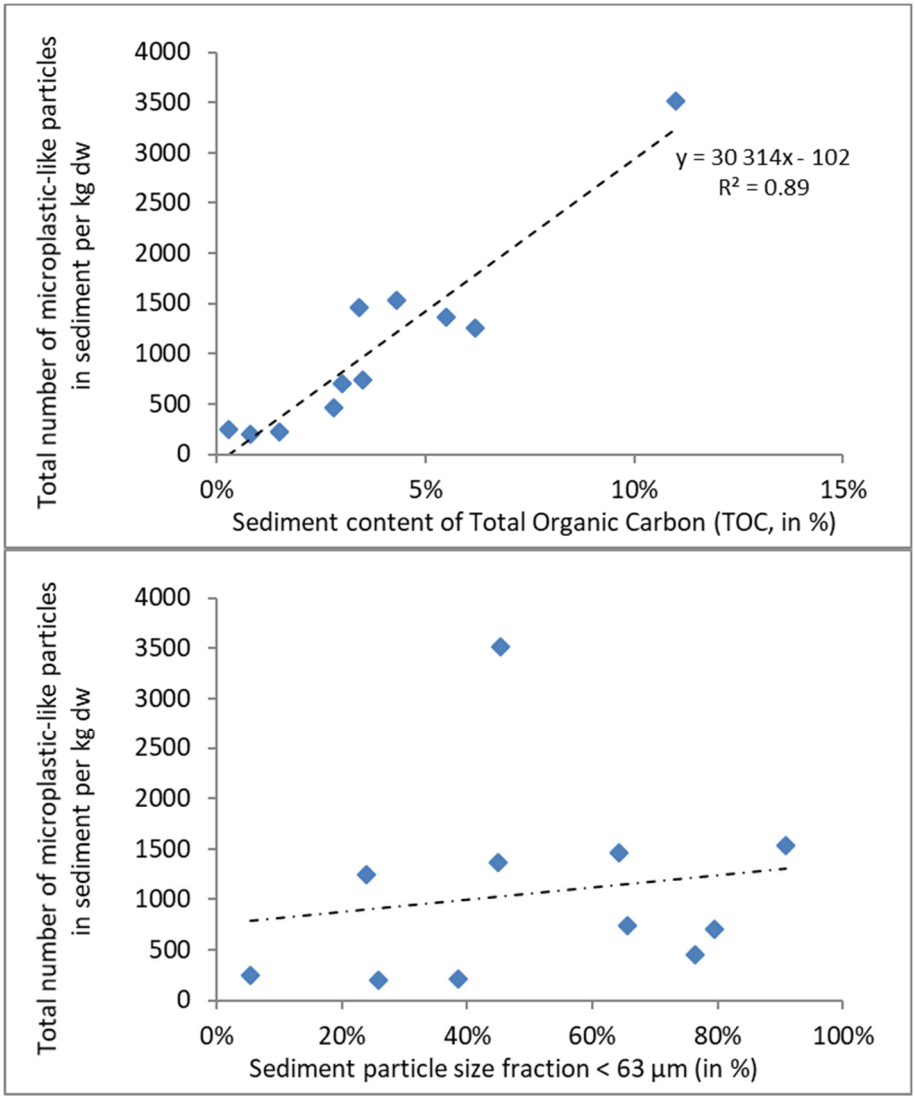

Figure 3.3. Significant relationships between the sediment character TOC and the content of microplastic-like particles in sediment samples from inner Danish waters 2015 (top). Similar clear relationship was not found for the < 63 µm fraction (bottom).

3.2 Composition of microplastic-like particles in sediments

The composition of microplastic-like particles in sediments can be assessed according to distribution between the different categories of type, size and colour. The distribution between different types of microplastic-like particles has already been described in *table 3.1*, which showed that fibres were the dominant type, followed by particles characterized as plastic films/fragments, and only one granule and no spherules were found.

3.2.1 Composition according to size fractions

Microplastic-like particles in the size range of 20-300 µm contributed with 62-100 % of particles in the sediment samples. The smallest particles being the size fraction 20-38 µm and 38-100 µm, where only fibres >100 µm were registered in this study, contributed with 8-42 % and 19-59 %, respectively, of all identified as microplastic-like particles. No particles with sizes > 1000 µm were identified microplastic-like particles (*figure 3.4*). No clear trends in the

dataset for composition of size fractions were observed in relation to the stations, regional differences or sediment characteristics when comparing the data between stations. Composition of size fractions was comparable with results found in previous studies (Strand et al. 2013; Strand & Tairova 2016). The two replicates sampled at NSJ230015 (2015-14738 a and b) differed in size composition, but the overall identified number was almost the same (appendix 2 table A2.1). However most of the variation was between two neighbouring size classes.

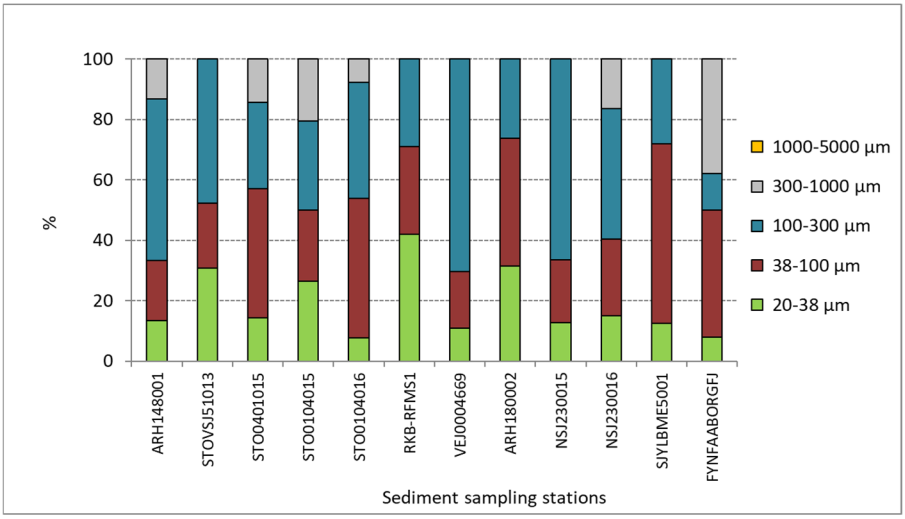

Figure 3.4. Composition of the total number of microplastic-like particles per size fraction in each sediment sample.

3.2.2 Composition according to colour fraction

Blue microplastic-like particles made up 53 % on average (range 41-68 %) the most frequent group of particles identified as microplastic-like followed by transparant with 22 % (range 0-46 %) and black with 18 % (range 2-57 %). Some particles with colours of e.g. white, red, grey, brown, green and violet were also registered as microplastic-like particles (*figure 3.5*). No clear trends in the dataset for composition of colour fractions were observed in relation to type of stations, regional differences or sediment characters when comparing the data between stations. Composition of colour fractions was comparable with results found in previous studies (Strand et al. 2013; Strand & Tairova 2016).

The colour composition of the two replicates sampled at NSJ230015 (2015-14738 a and b) differ substantially with a high number of transparent particles in one sample and none in the other. Also the number identified as black particles varied between the samples (Appendix 2 table A2.2)

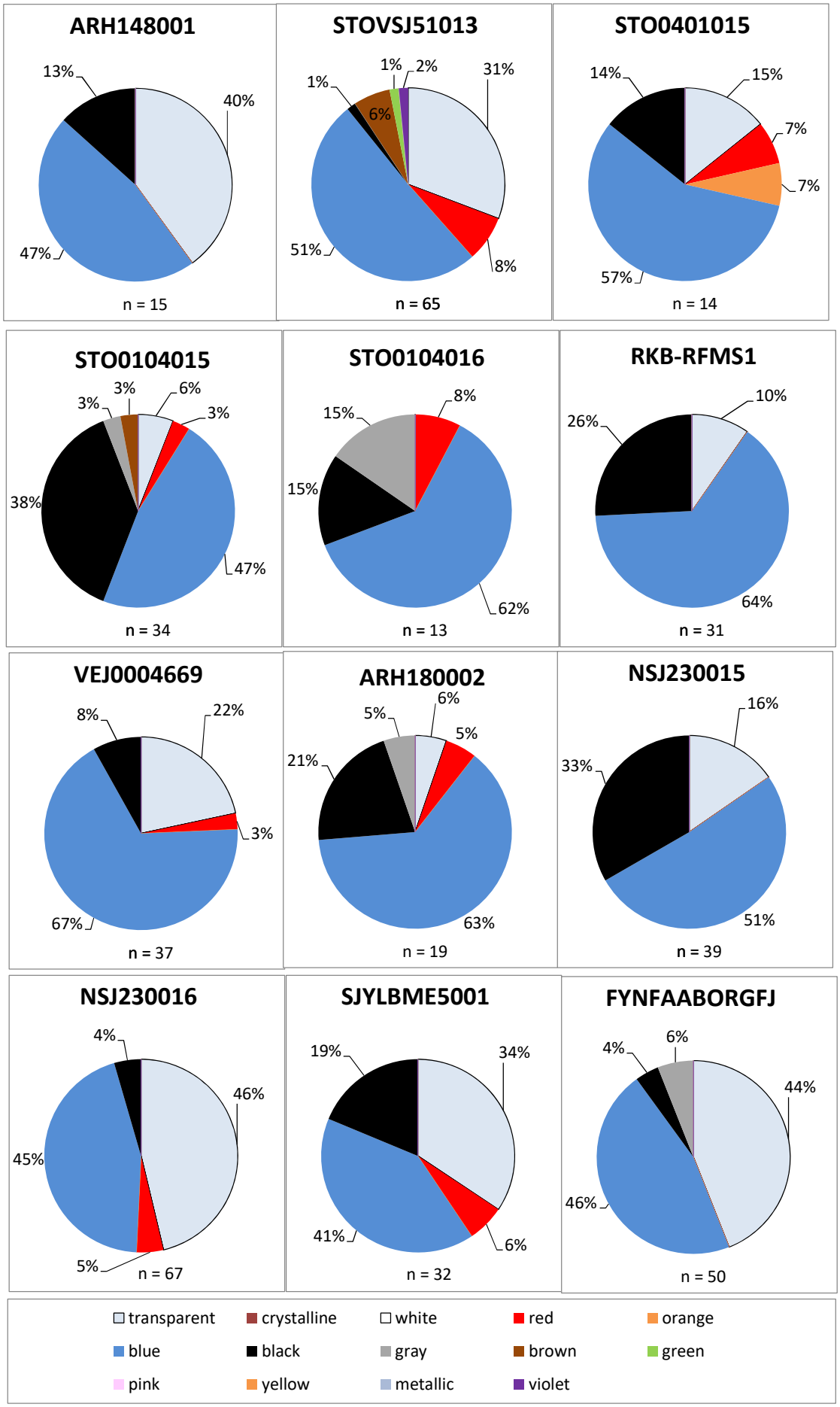

Figure 3.5. Fraction of microplastic-like particles per colour in each sediment sample.

4 Conclusions

The analyses performed of microplastic-like particles in sediments showed that:

- Microplastic-like particles were found in all twelve analysed sediment samples from the inner Danish waters. The number of microplastic-like particles with sizes of 20-5000 µm was in the range 202-3511 particles per kg dry weight and 300-1340 particles per litre wet sediment. Note that only fibres >100 µm were isolated and saved from the mesh size 20-38 µm and 38-100 µm.
- Fibres, i.e. elongated filaments, were the dominant type of identified microplastic-like particles contributing with 71-100% followed by plastic films / fragments (0-29 %). Only a single granule and no spherules were found. In addition, another group of particles, mainly transparent fibres, was characterised as of "uncertain" origin and not as microplastic-like, because they likely consisted of natural matter. However, it could not be fully excluded that they consisted of synthetic polymer materials.
- Microplastic-like particles in the range of 20-300 µm contributed with 62-100 % of the particles. The smallest particles the size fraction 20-38 µm contributed with 8-42 % of all the particles. No particles with sizes > 1000 µm were identified as microplastic-like.
- Blue microplastic-like particles were with 53 % on average the most frequent colour fraction followed by transparent and black particles contributing with 22 % and 18 % on average. Some particles with other colours, e.g. white, red, grey, brown, green and violet, were also identified as microplastic-like in the samples.
- Relationship was found between total contents of microplastic-like particles to contents of total organic carbon (TOC) in the sediment supporting that microplastic particles in the inner Danish waters are mainly deposited in sedimentary areas together with natural organic matter. This is in keeping with a previous study investigating the relationship between microplastic-like and TOC in sediment from Danish waters (Strand et al. 2013).
- The results of this report should be interpreted with some caution. Differences between the microplastic-like content in the the two studied replicate samples indicate that a greater sampling effort might be needed or more stringent quality assurence and quality control during sampling in the field and sample treatment in the lab to reduce potentiel risk for contamination. In addition, visual identication has the potential to missidentify or overrepresent the amount of microplastic present. For this reason, the microplastic-like particles were stored allowing for future chemical identification using for instance FT-IR spectroscopy. This equipment is present now but was not availible for use in time for this report.

5 References

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Appendix 1 - Sampling stations and sediment characteristics

Table A1.1. Sampling stations for the sediments from inner Danish waters analysed for microplastic contents in 2015.

Station ID	Station name	Date	Position N	Position E	Depth (m)
ARH148001	Anholt 12sm 1	26-10-2015	5628.812	1131.168	27
STOVSJ51013	Skælskør nor	04-11-2015	5515.60	1117.78	-
STO0401015	Femernbælt Vest	03-11-2015	5441.977	1111.163	11
STO0104015	Avnø Fjord	24-11-2015	5504.119	1146.000	5
STO0104016	Avnø Fjord	24-11-2015	5504.825	1142.679	6
RKB-RFMS1	Nr. Lyngvig	03-11-2015	5602.97	810.39	2
VEJ0004669	Vejle Fjord	03-12-2015	5540.168	944.135	11
ARH180002	Århus Bugt	25-11-2015	5602.98	1023.92	16
NSJ230015	Nord for Gilleleje	14-12-2015	5609.371	1218.621	12.7
NSJ230016	ØST for Skodsborg	14-12-2015	5549.608	1242.009	23.5
SJYLBME5001	Lillebælt, Nord for Als	08-12-2015	5508.40	946.225	24
FYNFAABORGFJ	Fåborg Fjord	08-12-2015	5505.322	1014.29	6

Table A1.2. Sediment characteristics of analysed samples from the inner Danish waters. TOC: Content of Total Organic Carbon.

Station ID	DCE sample ID	Dry weight content (% of wet weight)	Ignition loss (% of dry weight)	TOC (% of dry weight)	< 63 µm fraction (% of dry weight)
ARH148001	2015-14624	73.9%	2.1%	0.8%	25.8%
STOVSJ51013	2015-14669	20.1%	25.1%	11.0%	45.3%
STO0401015	2015-14670	50.3%	5.7%	*n.a.*	*n.a.*
STO0104015	2015-14677	46.9%	4.1%	3.0%	79.5%
STO0104016	2015-14678	58.0%	2.9%	1.5%	38.5%
RKB-RFMS1	2015-14722	40.0%	9.5%	3.5%	65.5%
VEJ0004669	2015-14726	25.1%	16.6%	4.3%	90.9%
ARH180002	2015-14728	40.0%	10.3%	2.8%	76.4%
NSJ230015	2015-14738	76.2 ± 0.5% *	1.4 ± 0.1% *	0.3%	5.4%
NSJ230016	2015-14739	46.1%	8.6%	3.4%	64.2%
SJYLBME5001	2015-14757	25.7%	16.8%	5.5%	44.9%
FYNFAABORGFJ	2015-14759	39.9%	19.8%	6.2%	23.9%

** Replicate data for sediment dry weight content and ignition loss on samples analysed for microplastic, but not for TOC and < 63 µm fraction of samples, which were analysed as part of the NOVANA contaminant monitoring programme.*

n.a.: not analysed.

Appendix 2 - Data tables for microplastics in sediment samples

Table A2.1. Sediment contents of microplastic particles (number of particles per kg dry weight (DW)) per size fraction in analysed samples from inner Danish waters. "Uncertain" particles are not included. Replicate data for sample 2015-14738a and b. Se appendix 1 for conversion between location, ID names and numbers.

Size fractions	**2015-14624**	**2015-14669**	**2015-14670**	**2015-14677**	**2015-14678**	**2015-14722**	**2015-14726**	**2015-14728**	**2015-14738a**	**2015-14738b**	**2015-14739**	**2015-14757**	**2015-14759**
20-38 µm	27	1080	38	188	17	309	166	145	38	26	218	171	100
38-100 µm	41	756	113	167	100	214	291	193	13	92	371	814	525
100-300 µm	108	1674	75	208	83	214	1080	121	216	118	632	385	150
300-1000 µm	27	0	38	146	17	0	0	0	0	0	240	0	475
1000-5000 µm	0	0	0	0	0	0	0	0	0	0	0	0	0
> 5000 µm	0	0	0	0	0	0	0	0	0	0	0	0	0
Total sum	203	3511	263	709	217	737	1536	459	267	236	1461	1370	1250

Table A2.2. Contents of microplastic particles (particles per kg dry weight (DW)) grouped per colour in analysed sediment samples from inner Danish waters 2015. "Uncertain" particles are not included. Replicate data for sample 2015-14738a and b. Se appendix 1 for conversion between location, ID names and numbers.

Colour fractions	**2015-14624**	**2015-14669**	**2015-14670**	**2015-14677**	**2015-14678**	**2015-14722**	**2015-14726**	**2015-14728**	**2015-14738a**	**2015-14738b**	**2015-14739**	**2015-14757**	**2015-14759**
Transparent	81	1080	38	42	0	71	332	24	0	79	676	471	550
White	0	0	0	0	0	0	0	0	0	0	0	0	0
Red	0	270	19	21	17	0	42	24	0	0	65	86	0
Orange	0	0	19	0	0	0	0	0	0	0	0	0	0
Blue	95	1782	150	333	133	476	1038	290	114	144	654	557	575
Black	27	54	38	271	33	190	125	97	152	13	65	257	50
Grey	0	0	0	21	33	0	0	24	0	0	0	0	75
Brown	0	216	0	21	0	0	0	0	0	0	0	0	0
Green	0	54	0	0	0	0	0	0	0	0	0	0	0
Pink	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow	0	0	0	0	0	0	0	0	0	0	0	0	0
Metallic	0	0	0	0	0	0	0	0	0	0	0	0	0
Violet	0	54	0	0	0	0	0	0	0	0	0	0	0
Total sum	203	3511	263	709	217	737	1536	459	267	236	1461	1370	1250

Table A2.3. Contents of microliter particles characterised as of “uncertain” origin (particles per kg dry weight (DW)). Replicate data for sample 2015-14738a and b. Se appendix 1 for conversion between location, ID names and numbers.

	2015-14624	**2015-14669**	**2015-14670**	**2015-14677**	**2015-14678**	**2015-14722**	**2015-14726**	**2015-14728**	**2015-14738a**	**2015-14738b**	**2015-14739**	**2015-14757**	**2015-14759**
Other particles of uncertain origin	27	270	0	146	0	0	83	48	13	26	87	128	75

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MICROPLASTIC-LIKE PARTICLES IN SEABED SEDIMENTS FROM INNER DANISH WATERS 2015

Contents and composition of microplastic-like particles have been analysed in twelve sediment samples from the inner Danish waters covering both the Kattegat, Belt Sea, Sound and western Baltic Sea that were collected in 2015. The number of microplastic-like particles in the size range 20-5,000 µm was determined to be in the range of 202-3511 particles per kg dry weight sediment, dominated by blue, transparent and black coloured particles, mainly as fibres, and particle sizes < 300 µm were dominating.

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