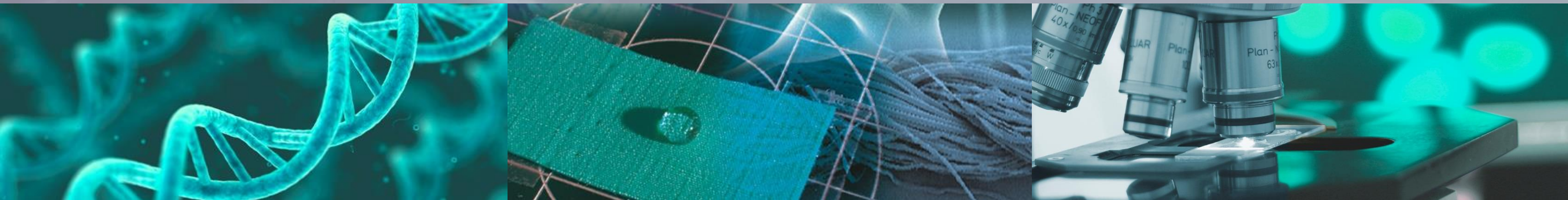


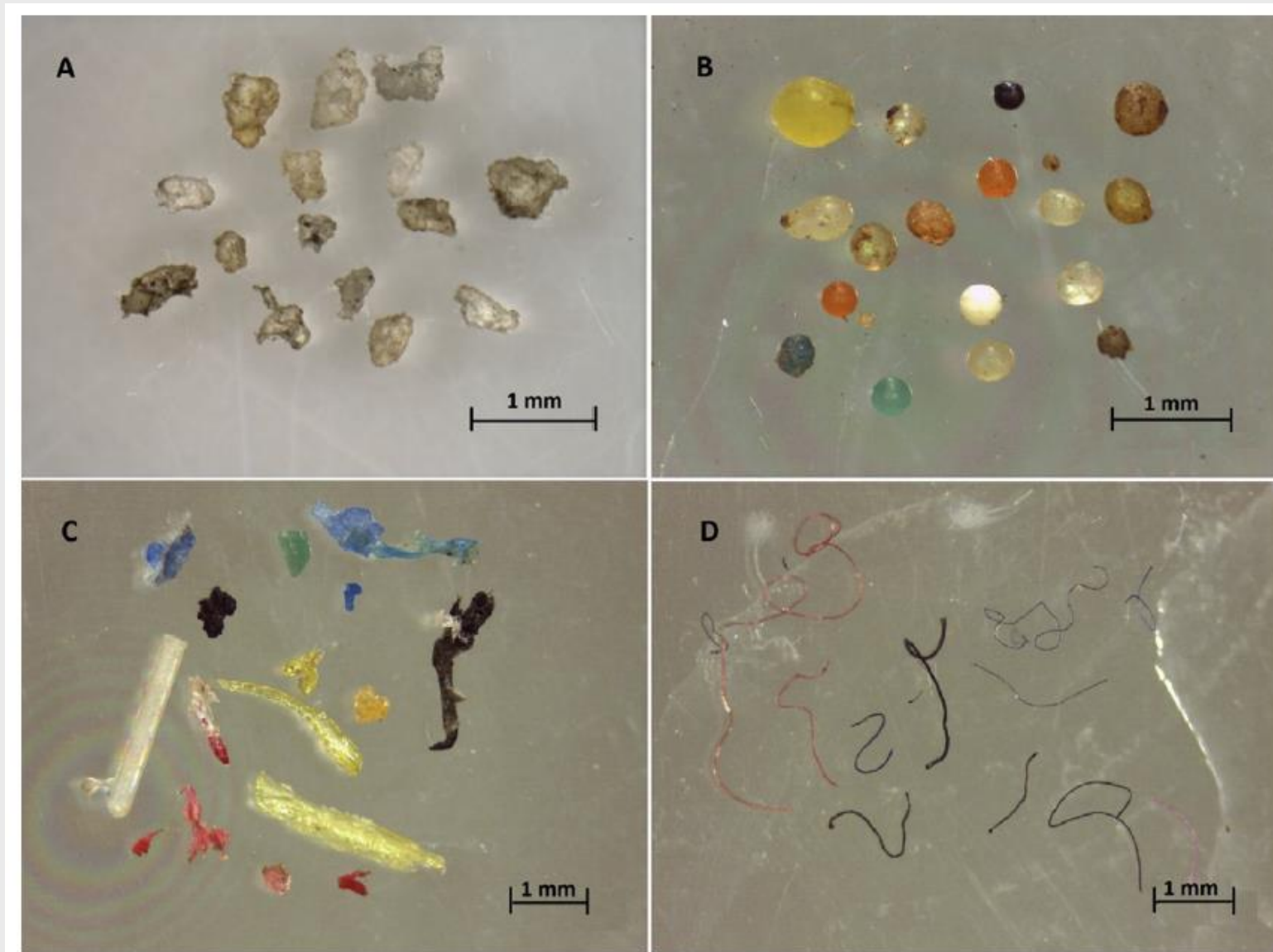
A new analytical approach for the detection of micro-sized fibers from textile laundry

Jasmin Haap | Hohenstein Institute | Germany

6IMDC, San Diego | March 13th, 2018



Introduction



Microplastics from WWTPs

- Particles are heterogenous in size, shape and chemical composition
- **Fibers** are a dominating shape of microplastic particles

Introduction

Sources of microplastic: Wastewater from laundry?

Microplastics from washing machine wastewater are polluting beaches

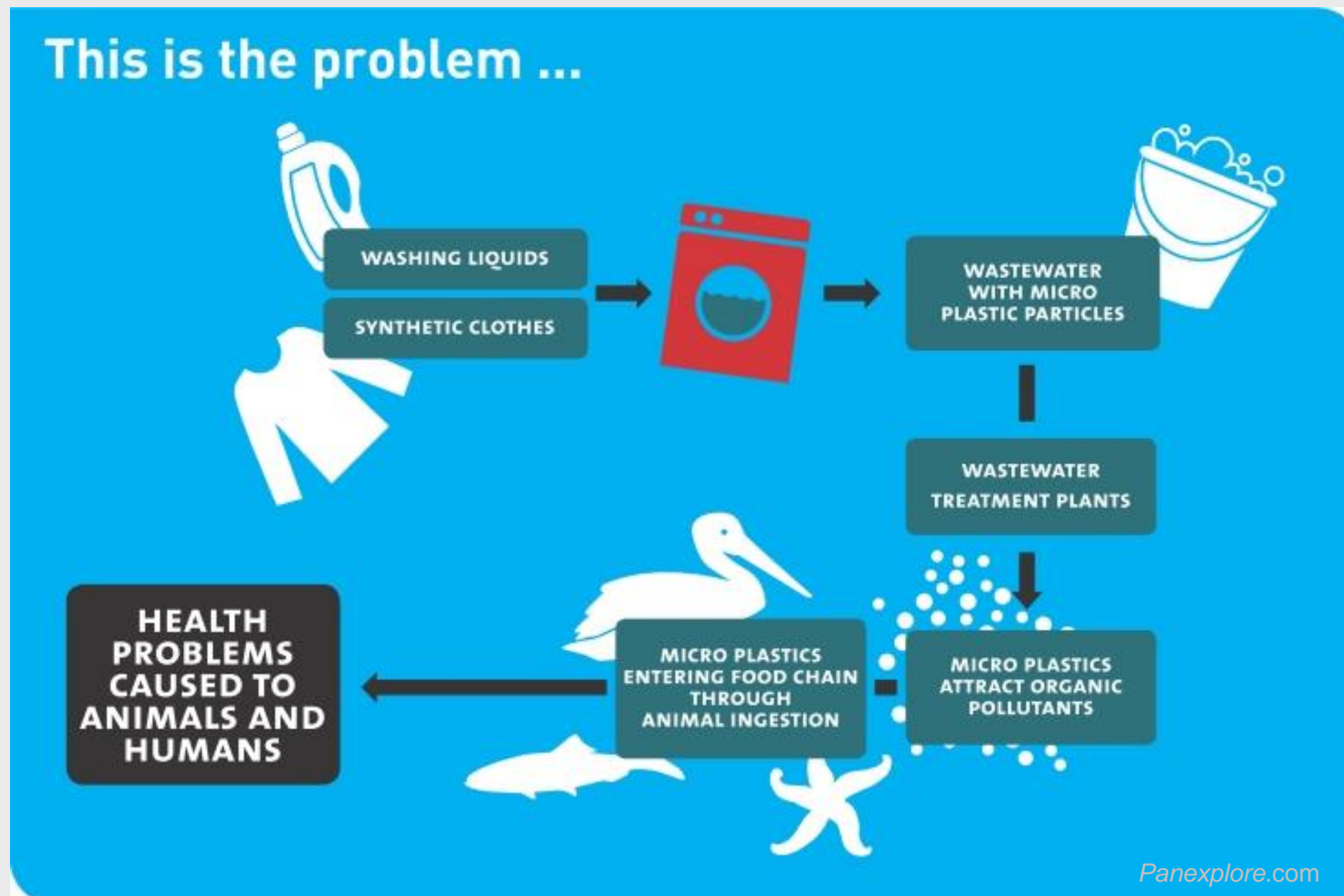
Tiny plastic particles from laundry wastewater are being washed into the marine environment, according to recent research. The plastic, from synthetic clothes cleaned in domestic washing machines, is a significant source of contamination and, unless measures are taken to address the problem, growing coastal populations will only exacerbate the situation.

European Commission DG ENV, News Alert Issue 272, 2012



Browne et al., Environm. Sci.&Technol., 2011

Introduction

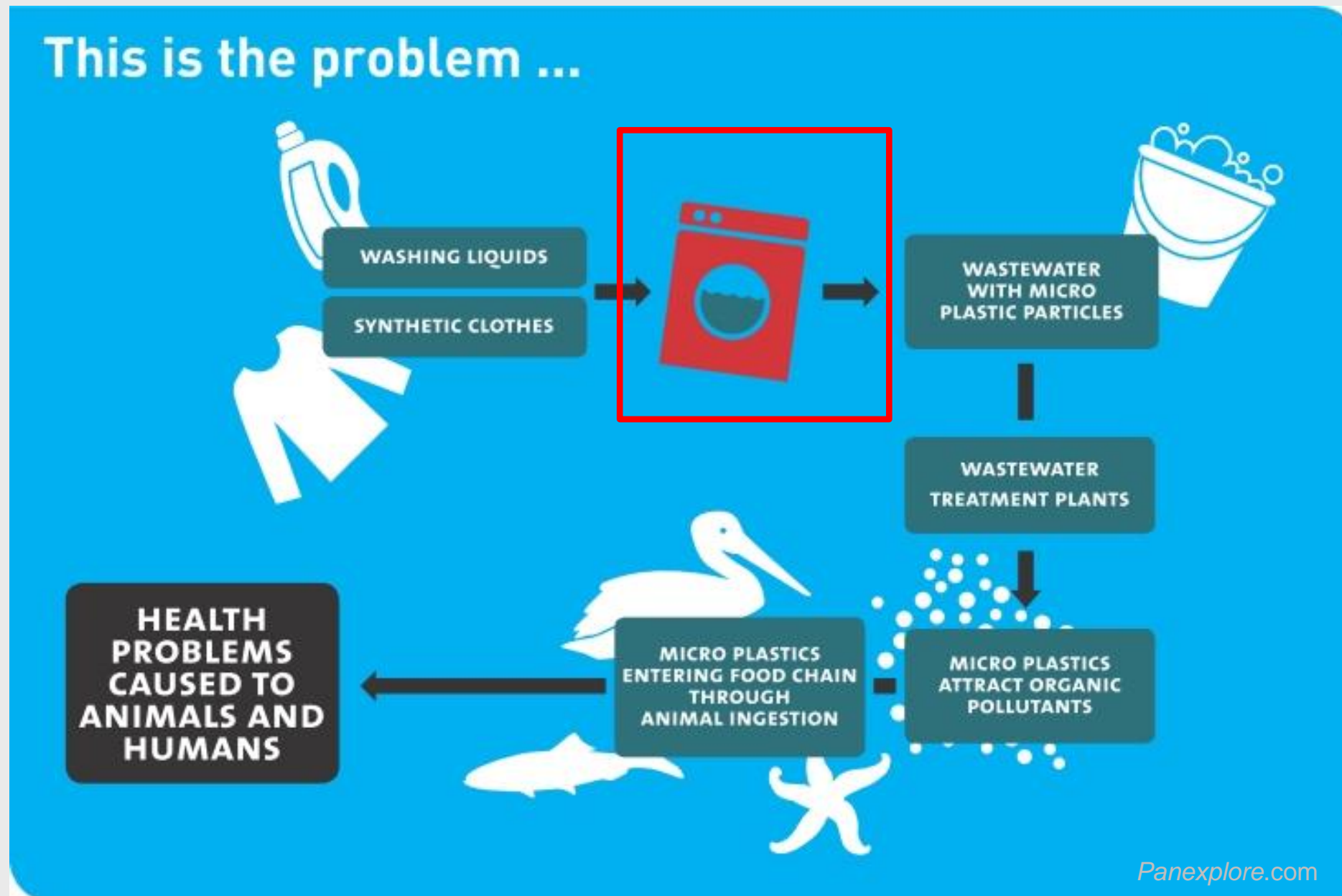


Average American family:
8-10 loads each week

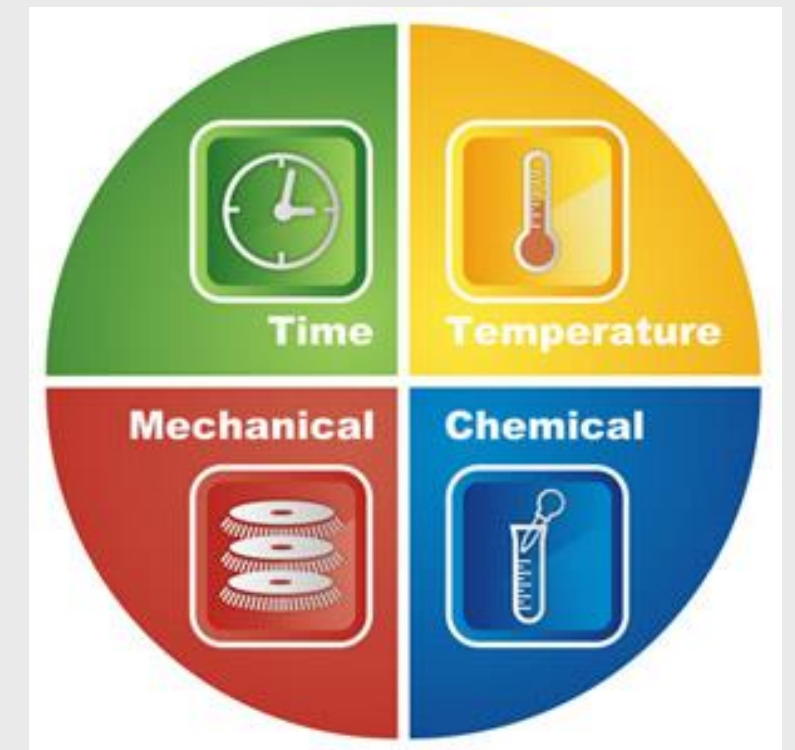
Domestic laundry (USA):
35 billion wash loads a year

thelaundryproject.net

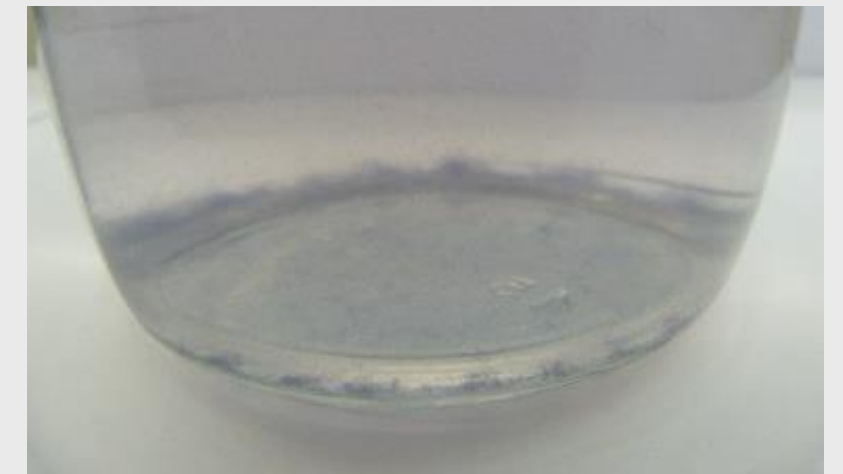
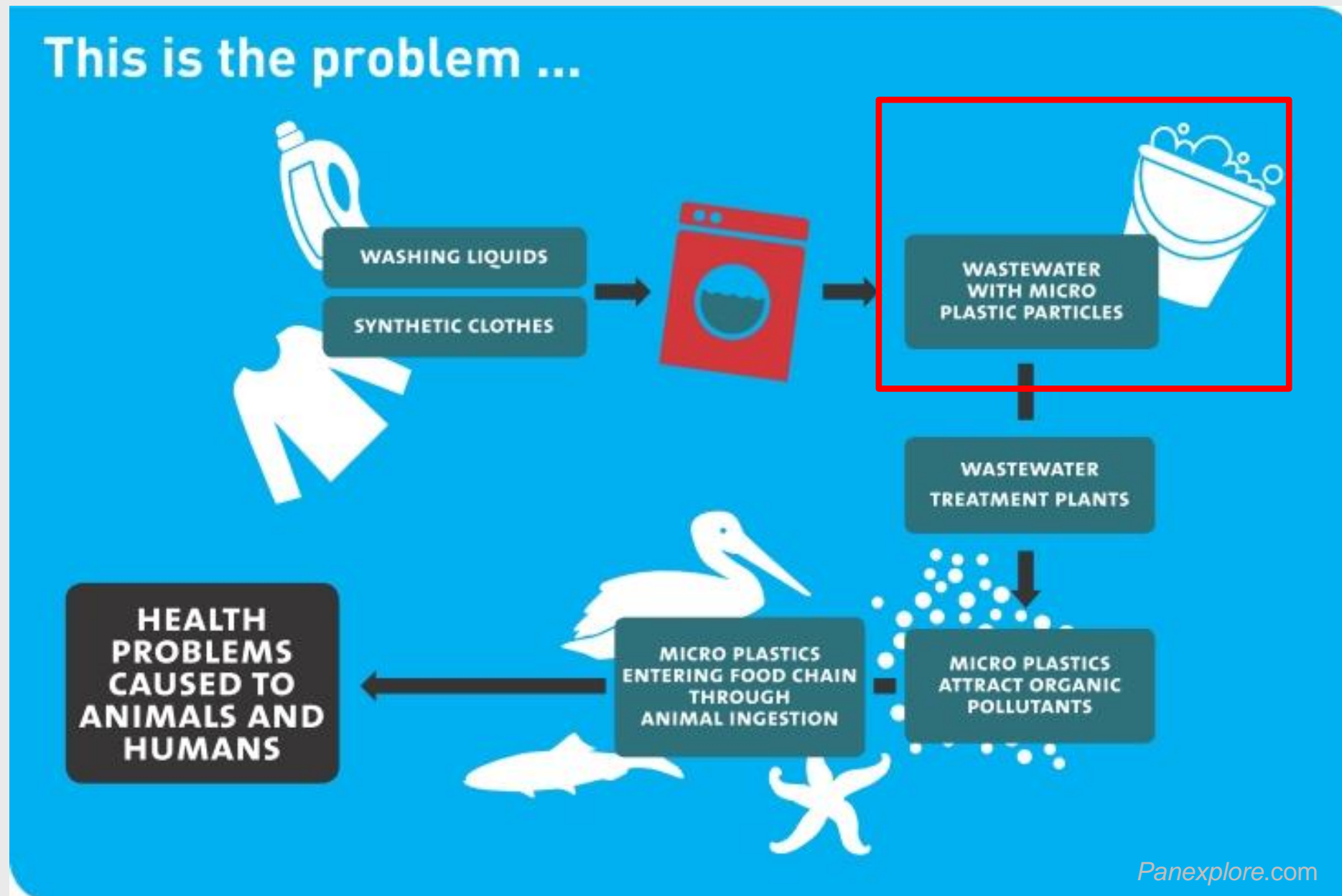
Introduction



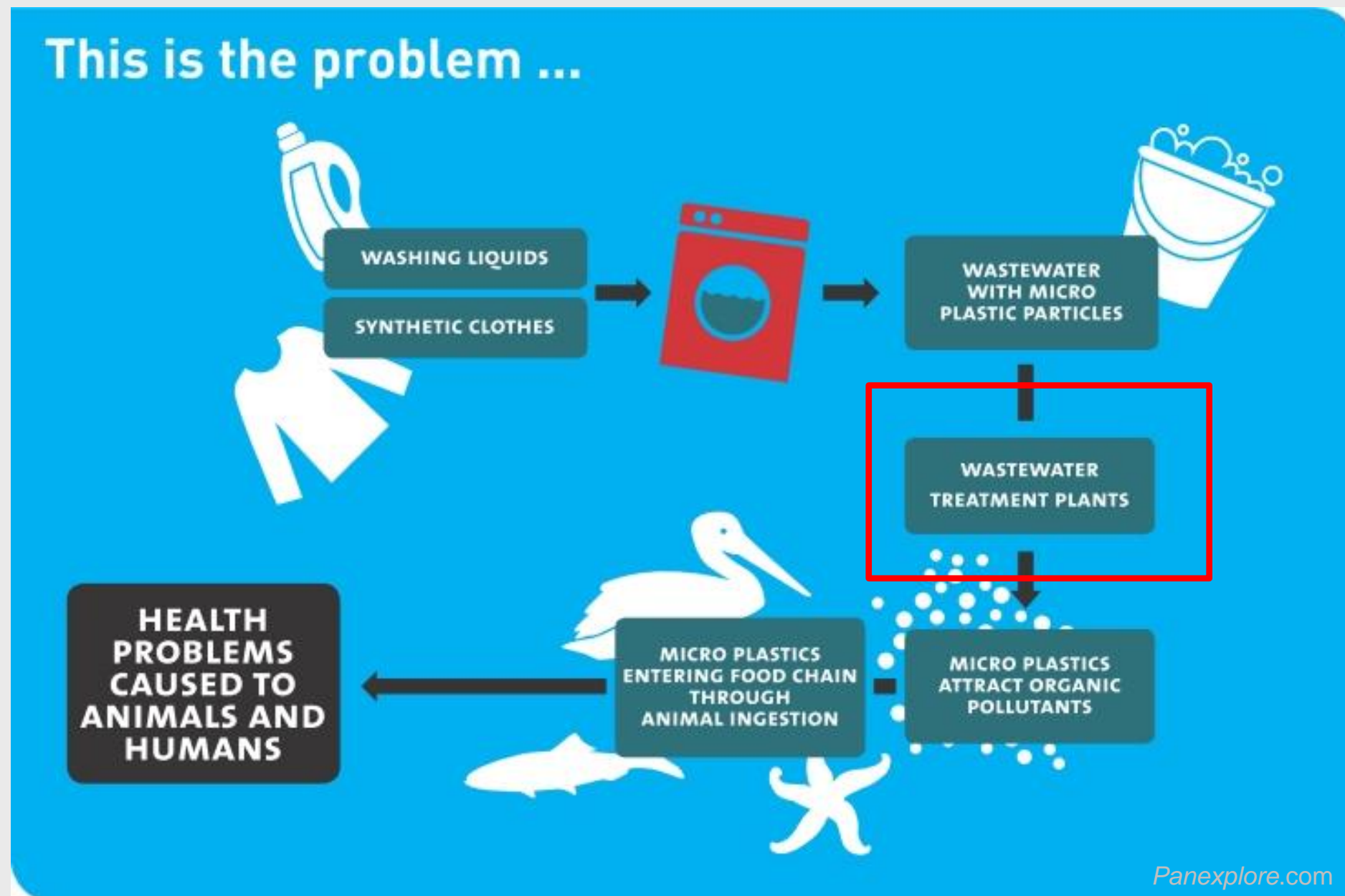
Sinner's Circle



Introduction



Introduction



ABWASSER

Microplastics impacting wastewater treatment processes

Posted 1 December 2016

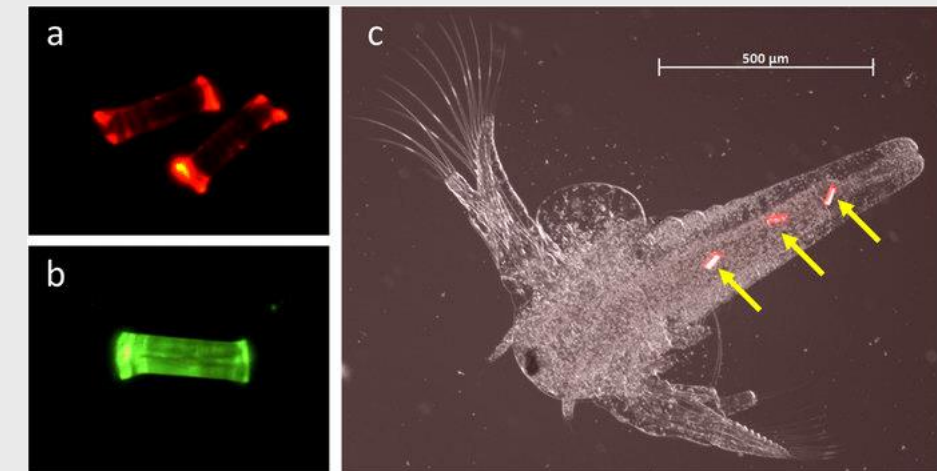
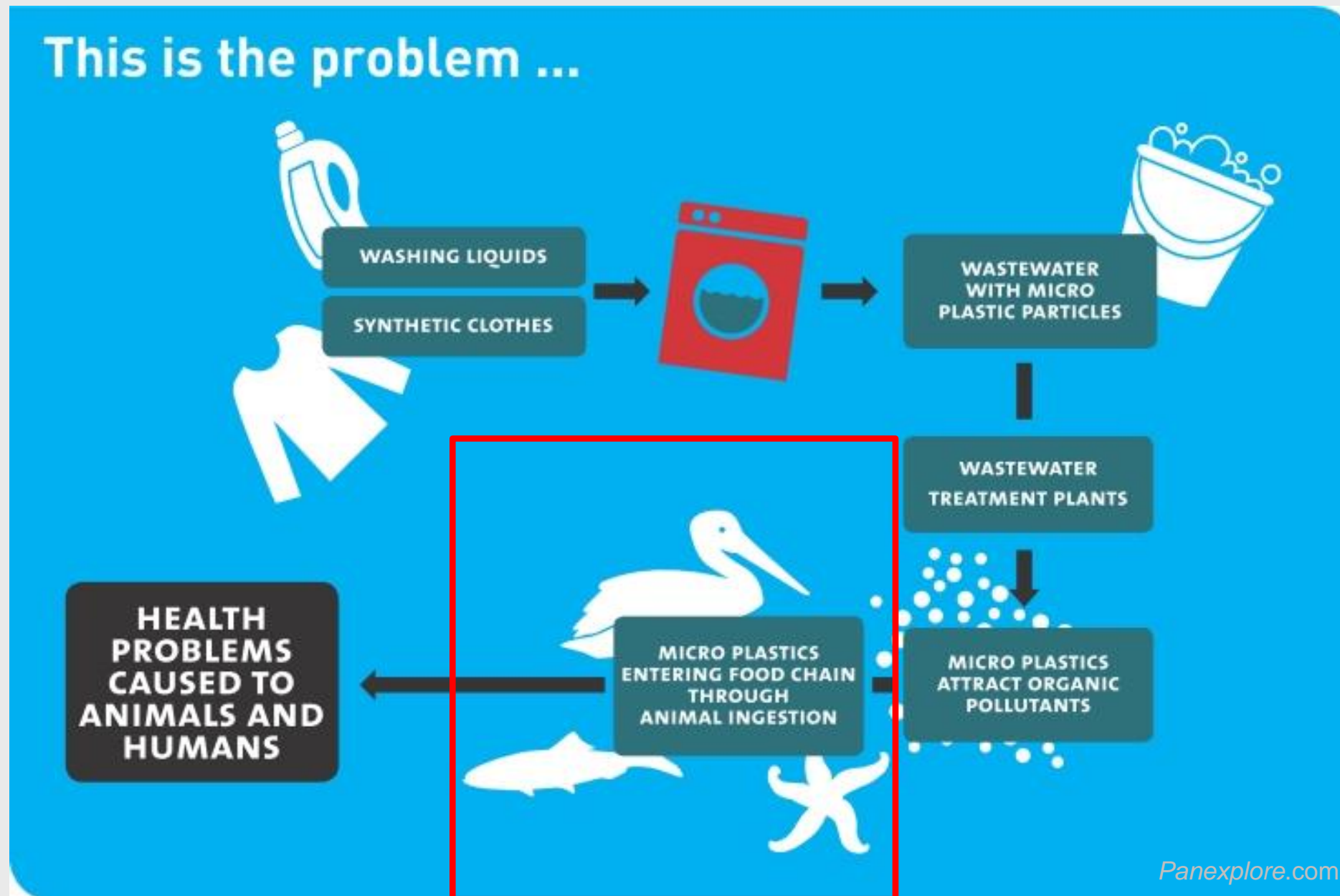
Experts have said wastewater treatment plants (WWTP) must ramp up their monitoring of microplastics, warning the issue is much broader than microbeads from personal care products ending up in treated effluent.

Although concerns about the [impact of microplastics on marine species](#) have been highly publicised, a recent International Water Association journal [report](#) explores the implications of microplastics for water utilities and their wastewater treatment processes.

Augsburger Allgemeine, 30.10.2014

96 % retention of fibers
Mintenig et. al (2014)

Introduction



Cole, Sci. Rep., 2016



geog3443001.wordpress.com, 2017

Current state



home.bt.com



Hohenstein

Browne et al. (2011): > 1900 fleece fibers from a fleece sweater

Napper et al. (2016): ~ 700 000 acrylic fibers per 6 kg laundry

Pirc et al. (2016): 0.01 wt% microfibers from a fleece-textile

No investigations

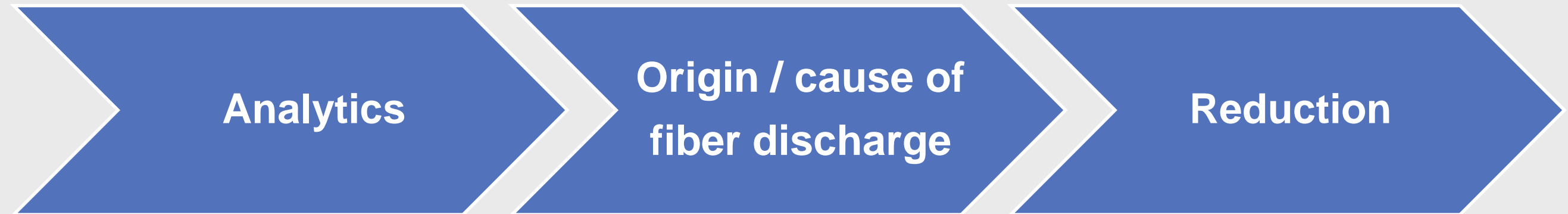
No data - so far

Aim of the Hohenstein research project

**Characterization and quantification
of textile fibers discharged in
industrial laundry processes**



Workflow of the project



Methods and Materials

Lab-scale washing



+



Based on ISO 105-C12, ISO 15797

Workwear fabrics



100% PES

50/50% PES/CO

100% CO

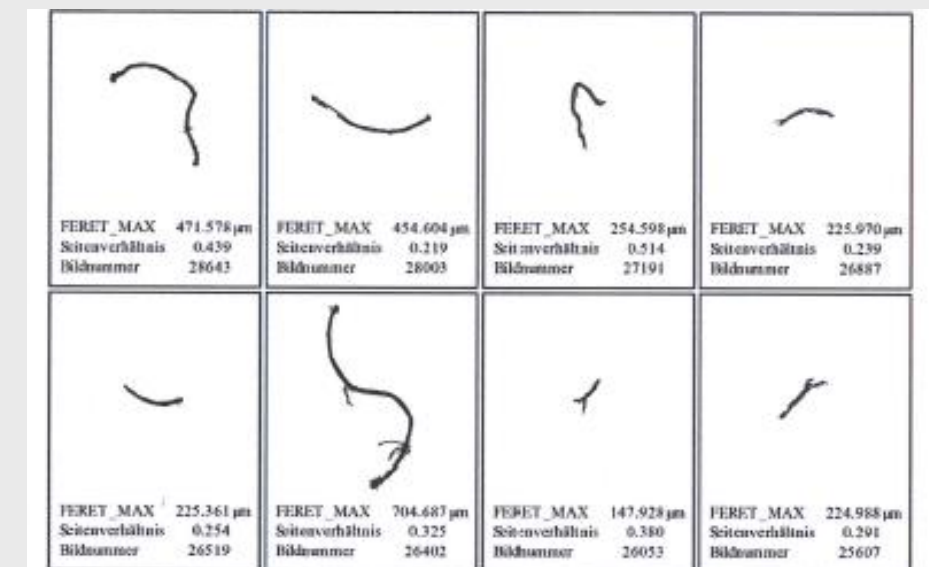
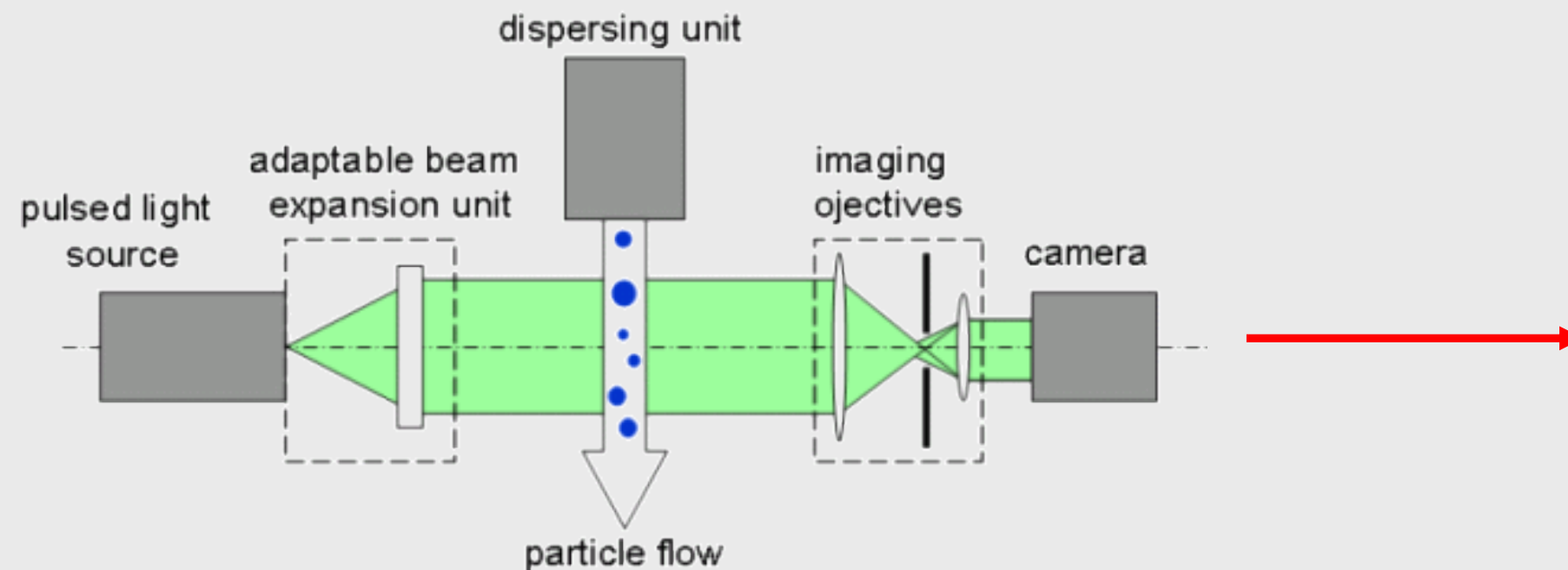
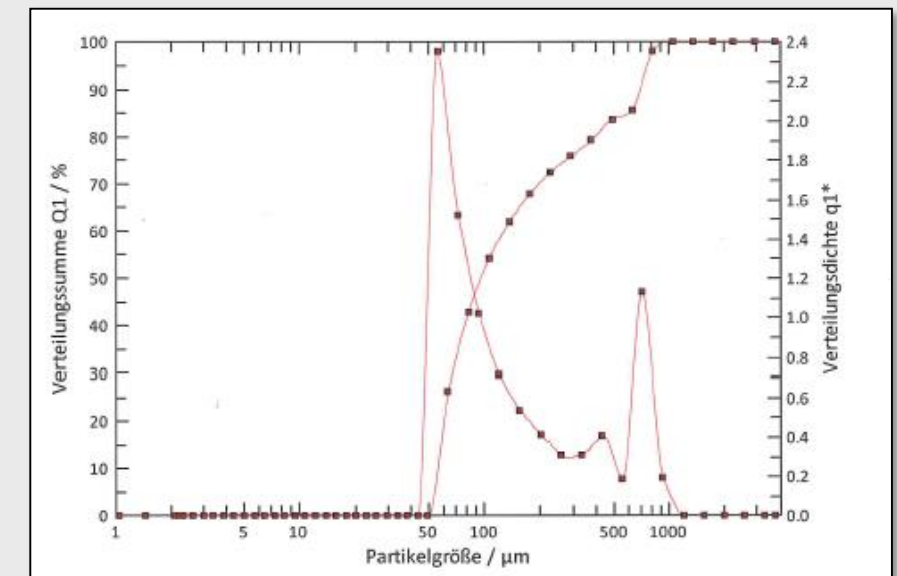
65/35% PES /CO

PES: Polyester, CO: Cotton

Development of a detection system

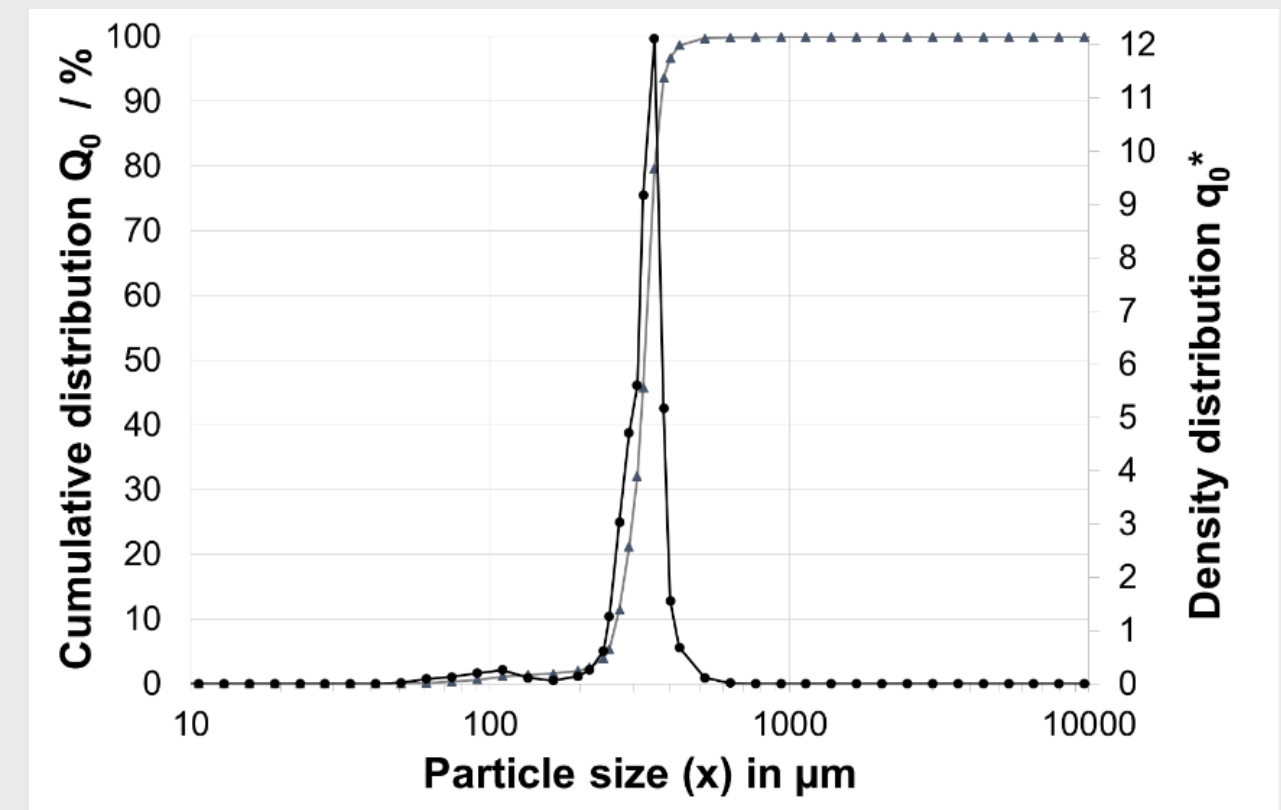
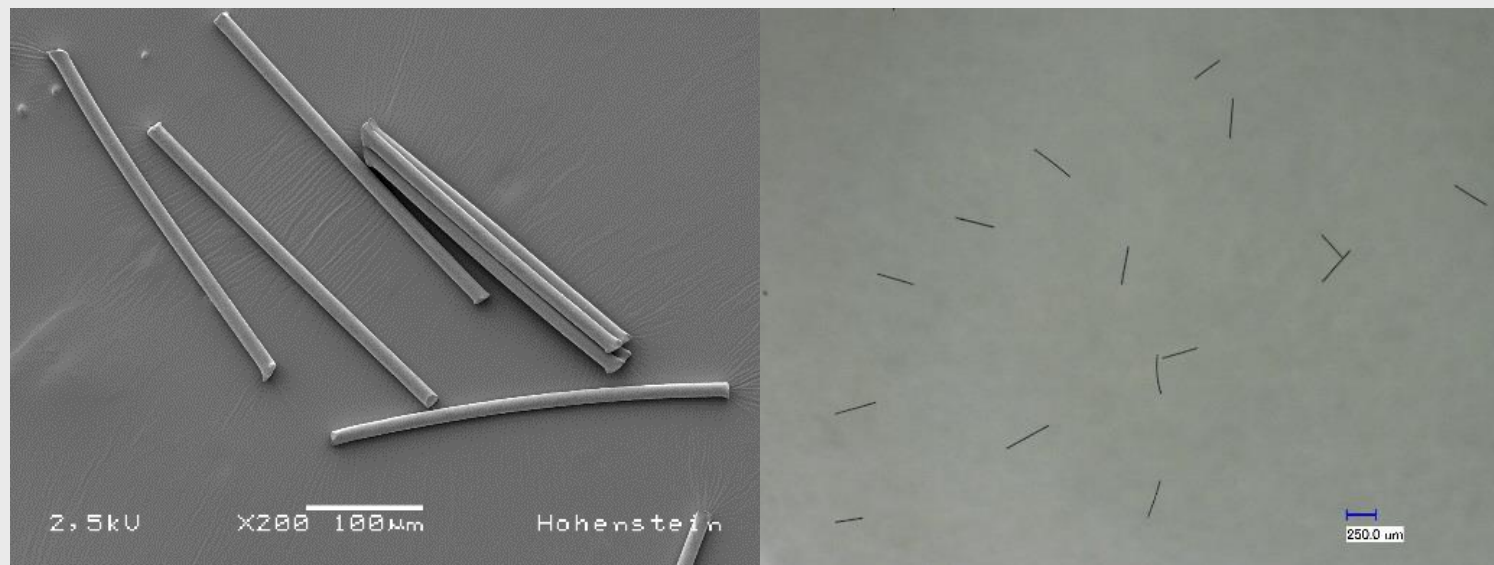
Dynamic Image Analysis (DIA)

shape, number and size distribution in **turbid and colored** liquid, 85 fps



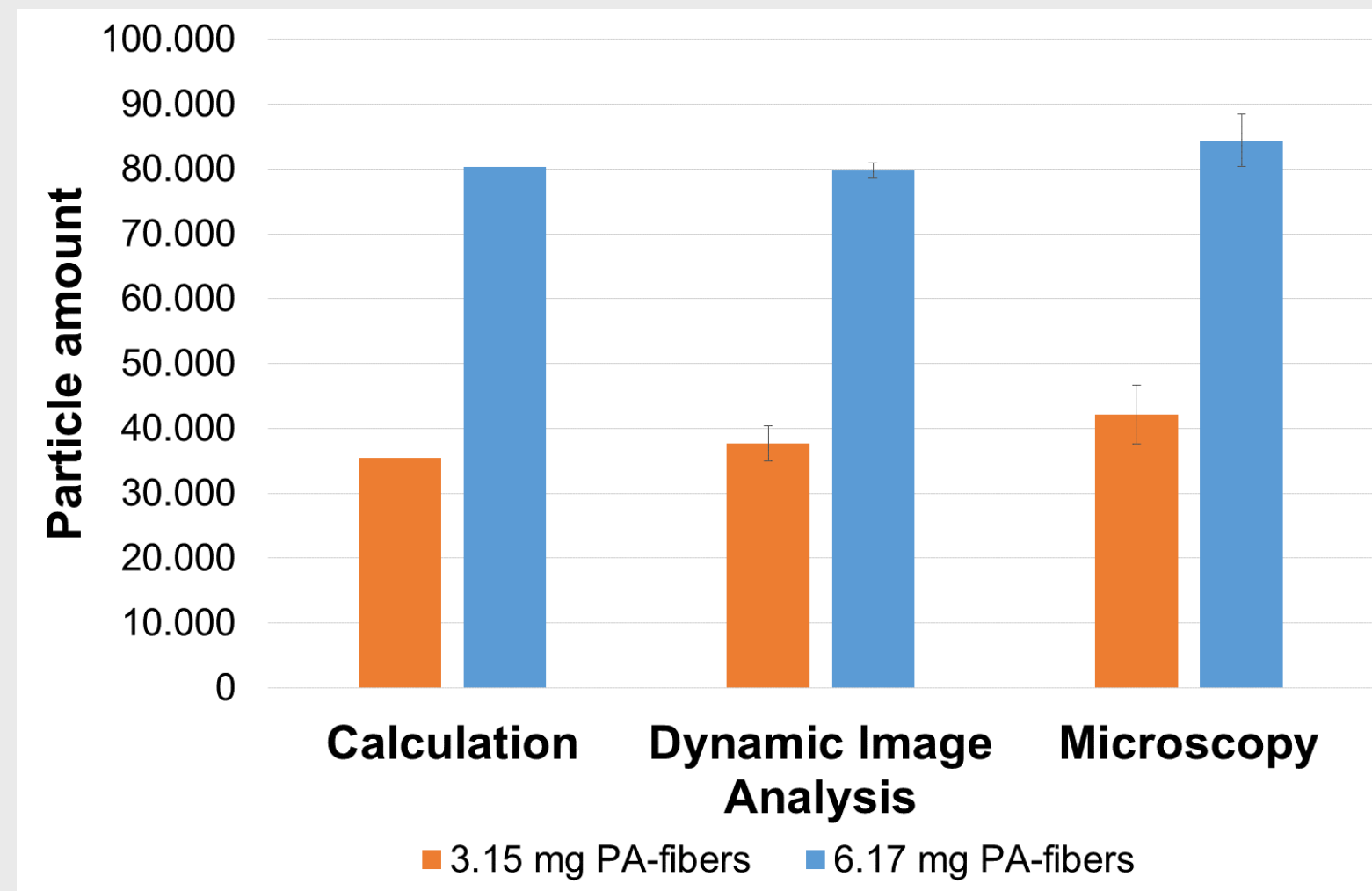
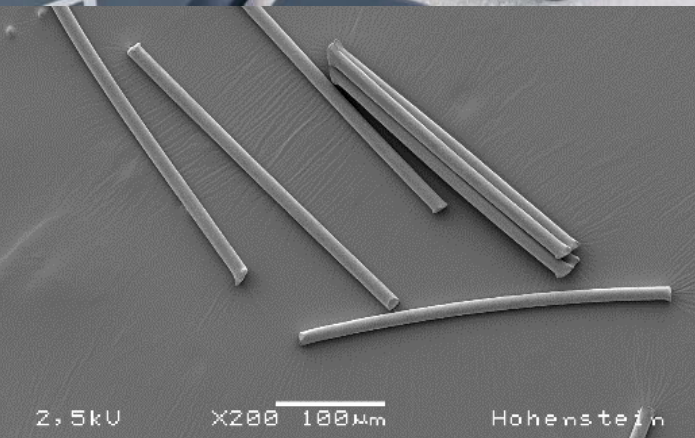
Validation of the detection system

Reference fibers: PA6.6, 0.3 mm, 1.7 dtex, flock fibers



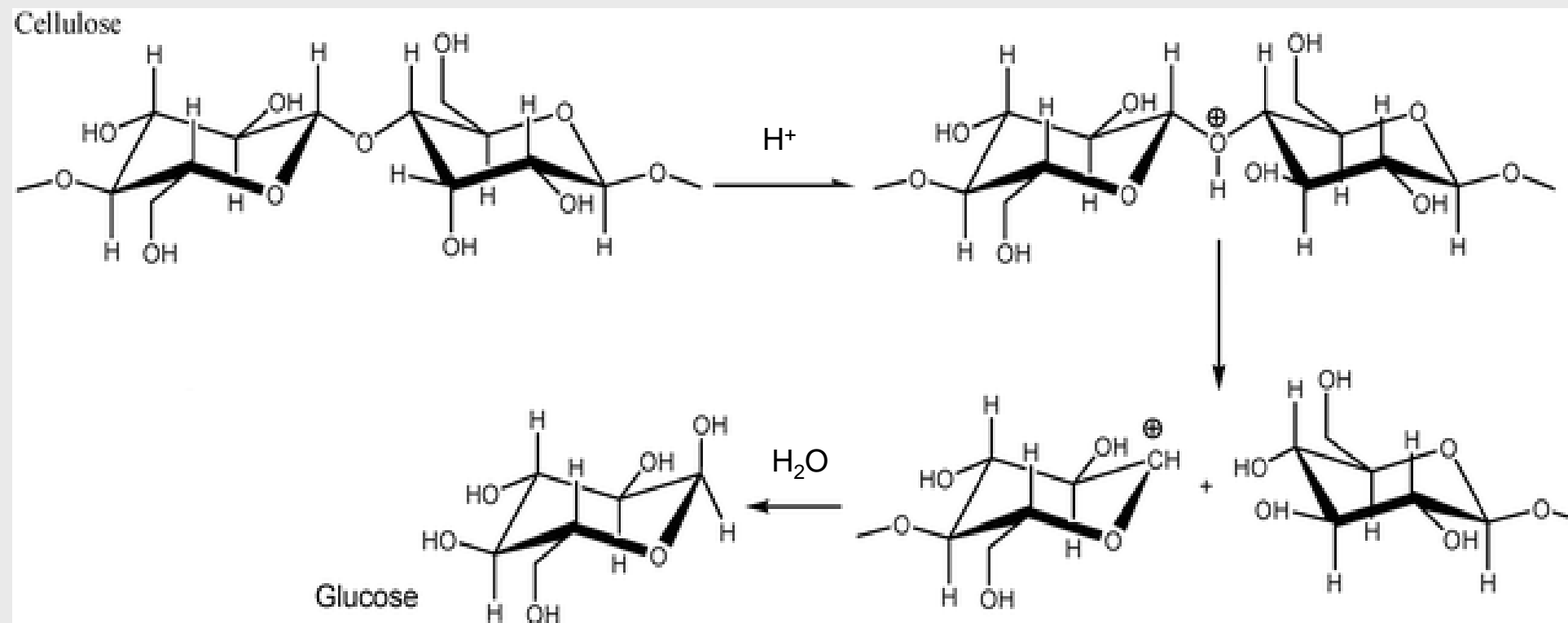
			—		/		\		/
LEFI	342.462 μm	LEFI	327.414 μm	LEFI	380.458 μm	LEFI	333.436 μm	LEFI	320.740 μm
DIFI	16.678 μm	DIFI	18.052 μm	DIFI	17.886 μm	DIFI	16.729 μm	DIFI	16.714 μm
Sphärizität	0.373	Sphärizität	0.392	Sphärizität	0.345	Sphärizität	0.354	Sphärizität	0.369
Geradheit	0.990	Geradheit	0.997	Geradheit	0.999	Geradheit	1.000	Geradheit	1.000
Elongation	0.049	Elongation	0.055	Elongation	0.047	Elongation	0.050	Elongation	0.052

Quantitative Method Comparison



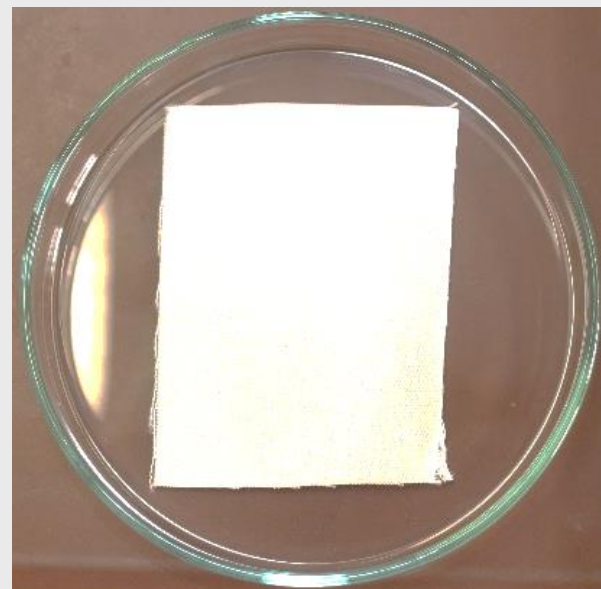
Chemical fiber identification from blended fabrics

Sulphuric acid method (ISO 1833-11)



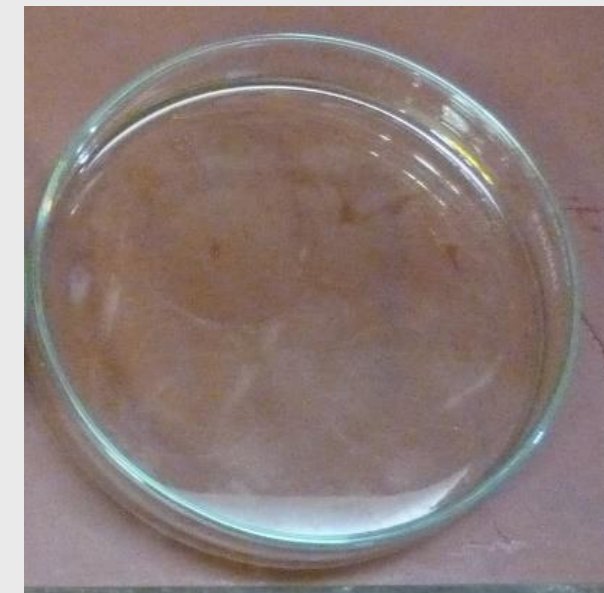
Chemical fiber identification from blended fabrics

Sulphuric acid method (ISO 1833-11)



100 % CO

75% H₂SO₄
50C/122F
1 hr



Removal of cotton by sulphuric acid

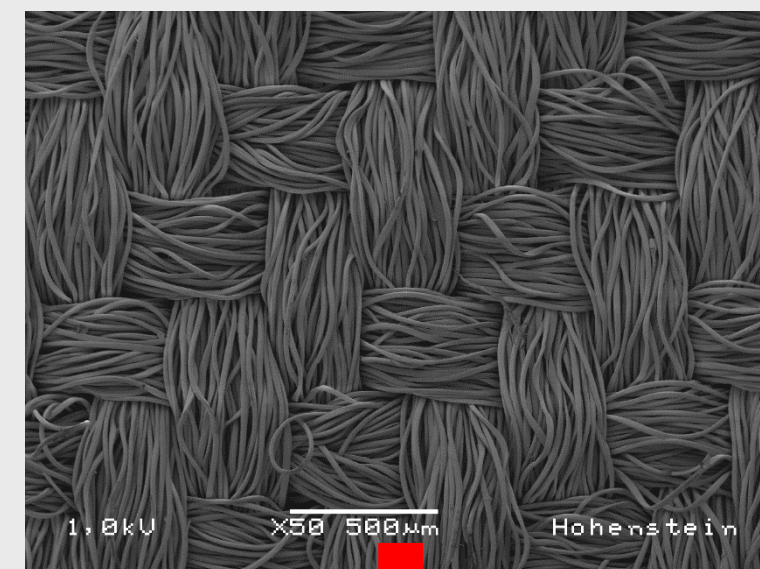
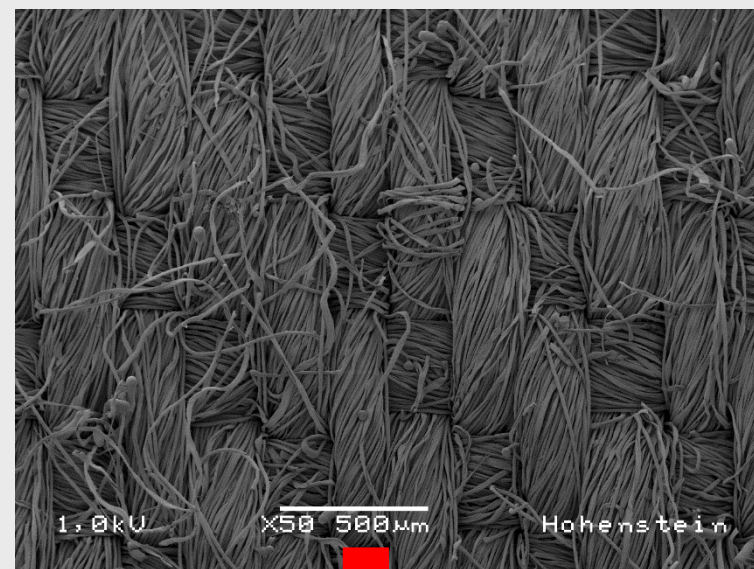
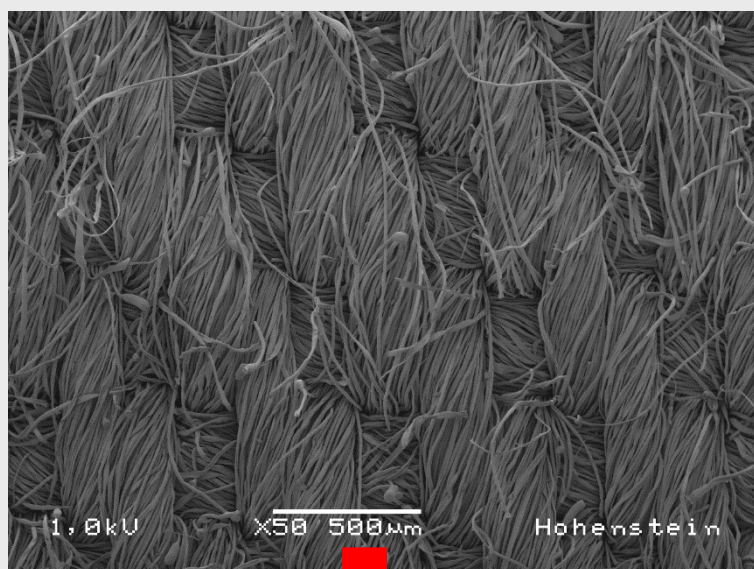
50/50% PES/CO

65/35% PES/CO

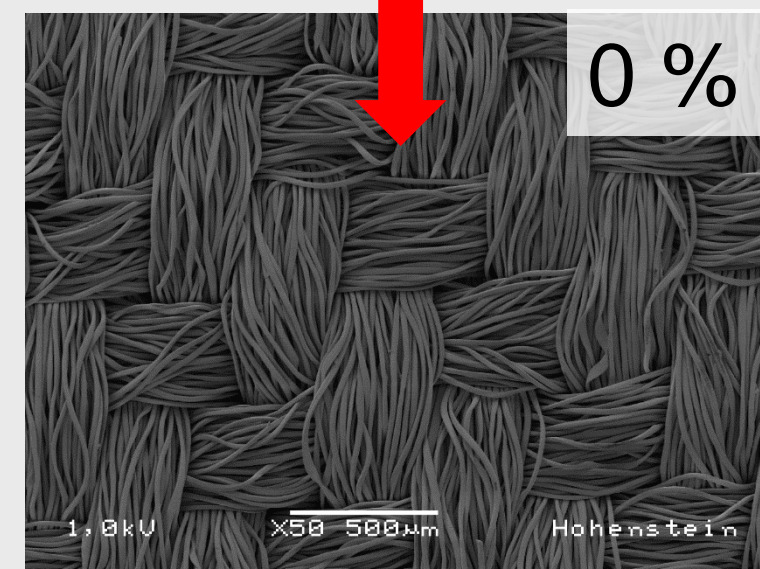
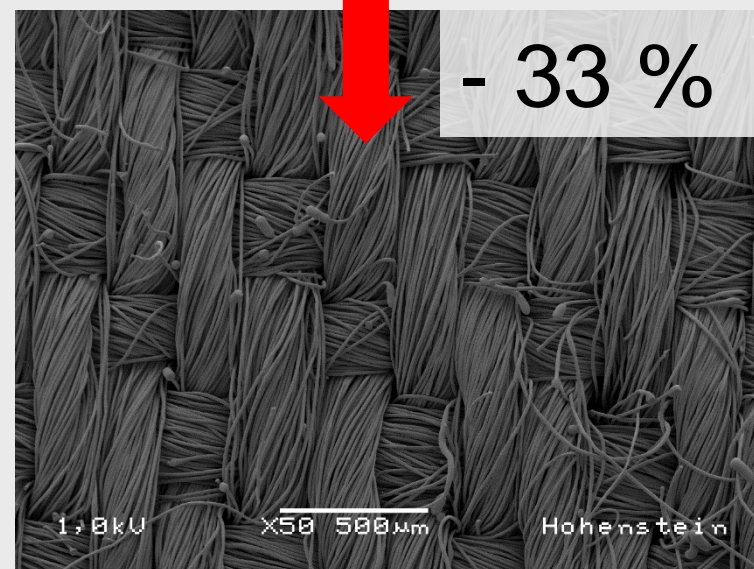
100% PES

PES: Polyester
CO: Cotton

before

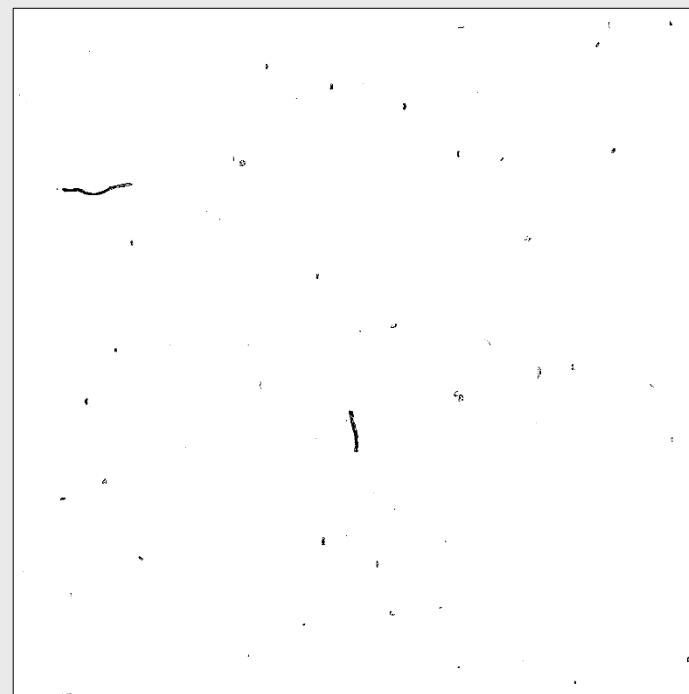


after

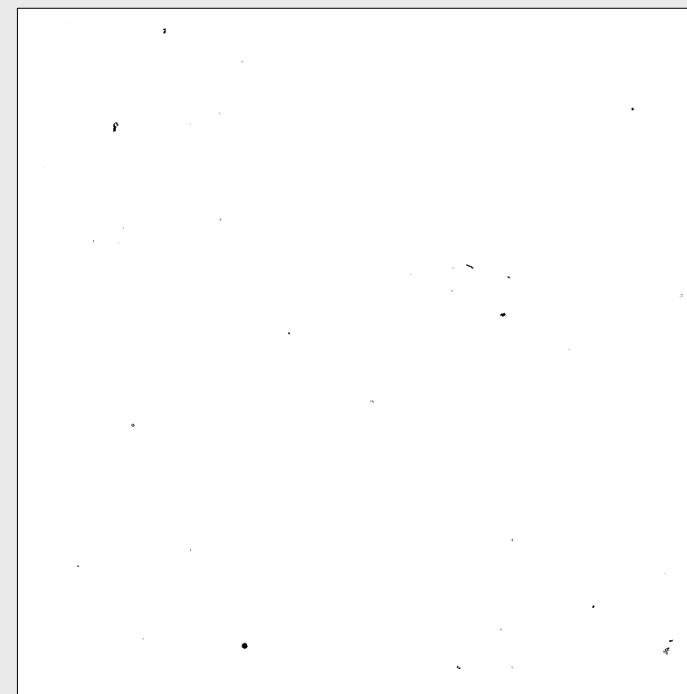


Sulphuric acid method in combination with dynamic image analysis

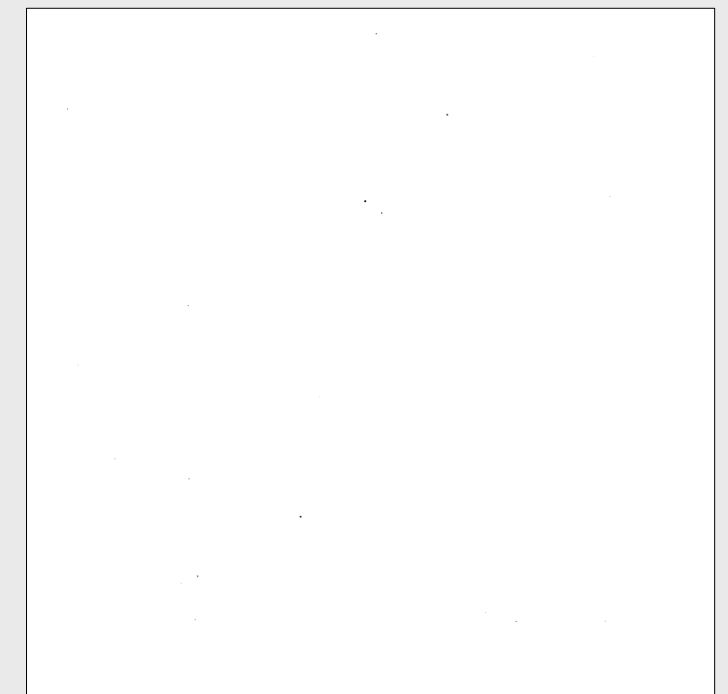
50/50% PES/CO



50/50% PES/CO + H₂SO₄



CO-Filter + H₂SO₄

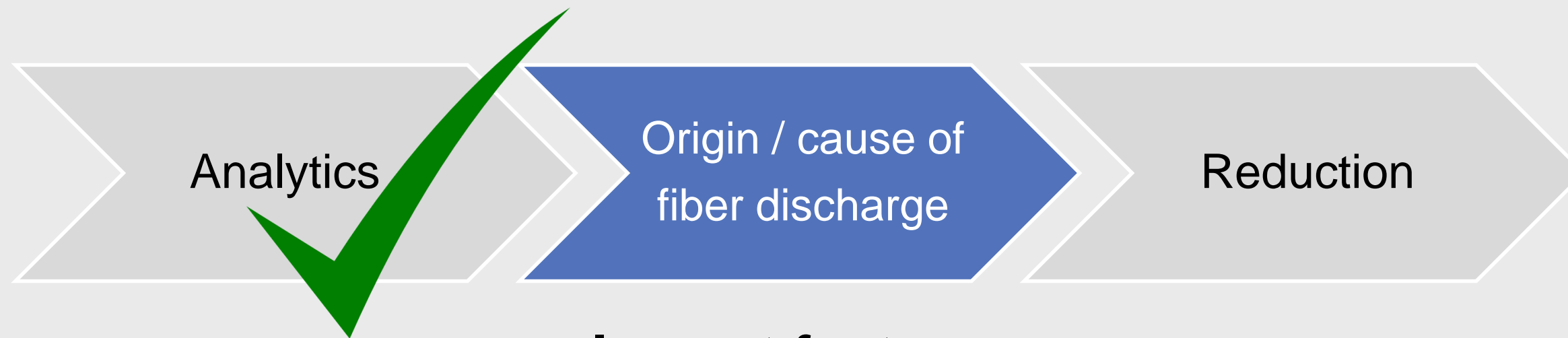


LEFI 636.806 μm	LEFI 454.880 μm	LEFI 395.652 μm
DIFI 10.507 μm	DIFI 11.188 μm	DIFI 12.092 μm
Sphärizität 0.244	Sphärizität 0.196	Sphärizität 0.266
Bildnummer 1707	Bildnummer 1707	Bildnummer 352

LEFI 424.567 μm	LEFI 1491.906 μm	LEFI 574.372 μm
DIFI 15.926 μm	DIFI 12.695 μm	DIFI 12.763 μm
Sphärizität 0.292	Sphärizität 0.142	Sphärizität 0.232
Bildnummer 2130	Bildnummer 4907	Bildnummer 8259

PES: Polyester
 CO: Cotton
 H₂SO₄: Sulphuric acid

Future steps

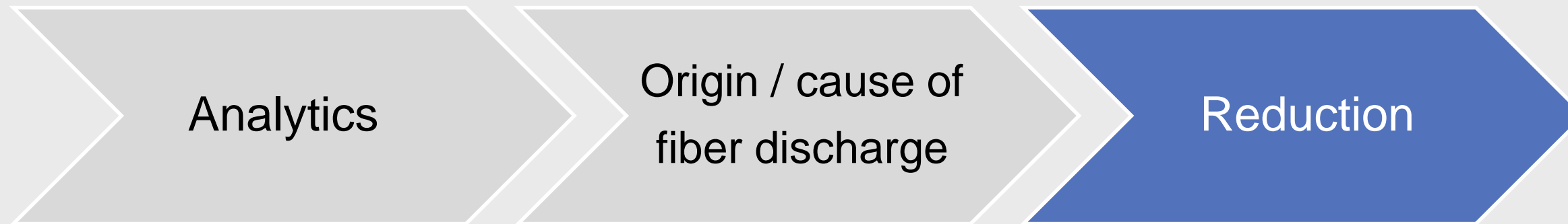


Impact factors

- Laundry (Sinner's circle)
- Material
(surface treatment, finish, polymer, quality...)
- Use/stress



Next steps



Preventive measures

- Washing process?
- Textile finishing chem.?
- Textile finishing mech.?
- Fabric?
- Yarn?
- Polymer?



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Gefördert durch:



aufgrund eines Beschlusses
des Deutschen Bundestages

Thank you for your
kind attention!

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