Microplastics from the North Saskatchewan River in the Edmonton Region

Jeremiah Bryksa, NAIT

Remtech 2021

Microplastics

You eat thousands of bits of plastic every year

NATIONAL GEOGRAPHIC

Microplastics Detected in 100 Percent of Human Organs Sampled

BY **SOPHIE HIRSH**

AUG. 17 2020, UPDATED 12:21 P.M. ET

GREENMATTERS

From Fish to Humans, A Microplastic Invasion May Be Taking a Toll

SCIENTIFIC AMERICAN

Bottle-fed babies swallow millions of microplastics a day, study finds

The Guardian

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Source: Google news: Microplastics.

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Microplastic Quick Facts

- Microscopic plastic polymer material that has entered the environment
- Size range 5 mm – 100 nm
- Fibers, fragments, spheres, etc.
- Polypropylene (PP), polyethylene (PE), polystyrene (PS), polyvinylchloride (PVC), polyethylene terephalate (PET), ect.

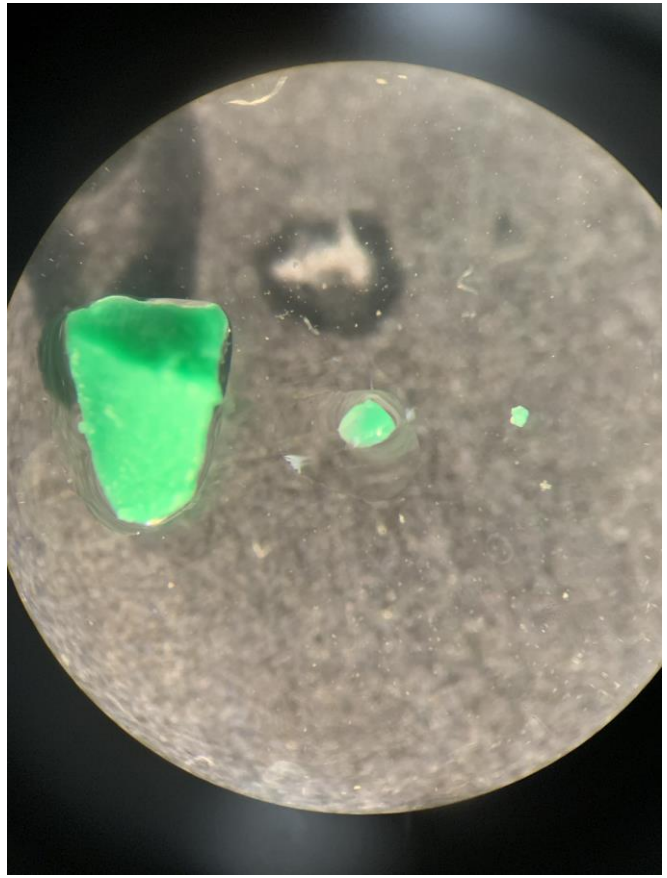

Image: Lab Created Polypropylene microplastics 1mm-100µm

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Microplastic Sources

Primary Microplastic 1º

Consumer products, wastewater treatment plants, accidental industrial discharge or spillage

Secondary Microplastic 2º

Breakdown of larger plastic, usually from landfills and littering of non-recycled plastics

Image: Getty Images

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Microplastics in Canada

- Prior research focused on marine environments
- Many major bodies of fresh water have limited data, especially western Canada
- Emerging science with minimal data sets to draw conclusions from
- Lack of standardized methods

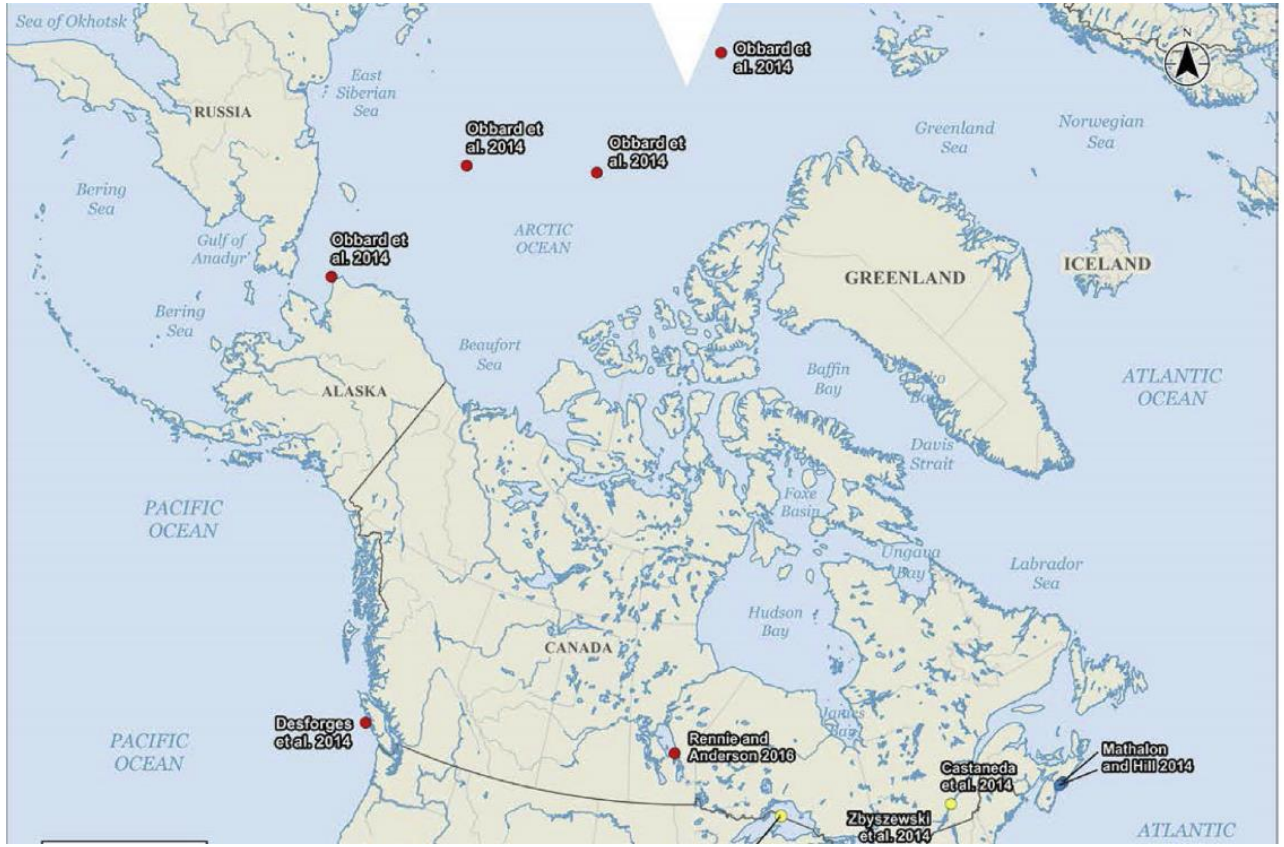

Image: Microplastics in aquatic environments: Implications for Canadian Ecosystems, Julie C. Anderson et al., 2016

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PRIA – Plastics Research in Action

In 2019 Inter Pipeline and NAIT founded PRIA, a 10 - year collaborative initiative focusing on plastic waste, environmental monitoring, recyclability and reusability of plastics.

The Microplastic project is the first PRIA applied research project under this initiative and aims to identify, quantify, and monitor microplastics in the North Saskatchewan River (NSR) in the Edmonton Metropolitan Region.

https://www.nait.ca/pria

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Microplastics from the North Saskatchewan River

Four -year study providing a baseline quantitative assessment of microplastic occurrence in North Saskatchewan River surface water and shore sediment

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Project Goals

Advance microplastic science by developing, improving, and validating analytical methods for collection, preparation, and analysis of microplastics.

Generate one of the largest microplastic Canadian freshwater data sets to date using robust, reliable, and repeatable methodology.

Sampling Campaign

- Biweekly sampling from the shore during spring, summer, and fall months (May-October)
- 12 sites ranging from Devon to Vinca Bridge (near Bruderheim)
- Use of boats provided by Inter Pipeline to sample mid- river and sites not accessible from shore

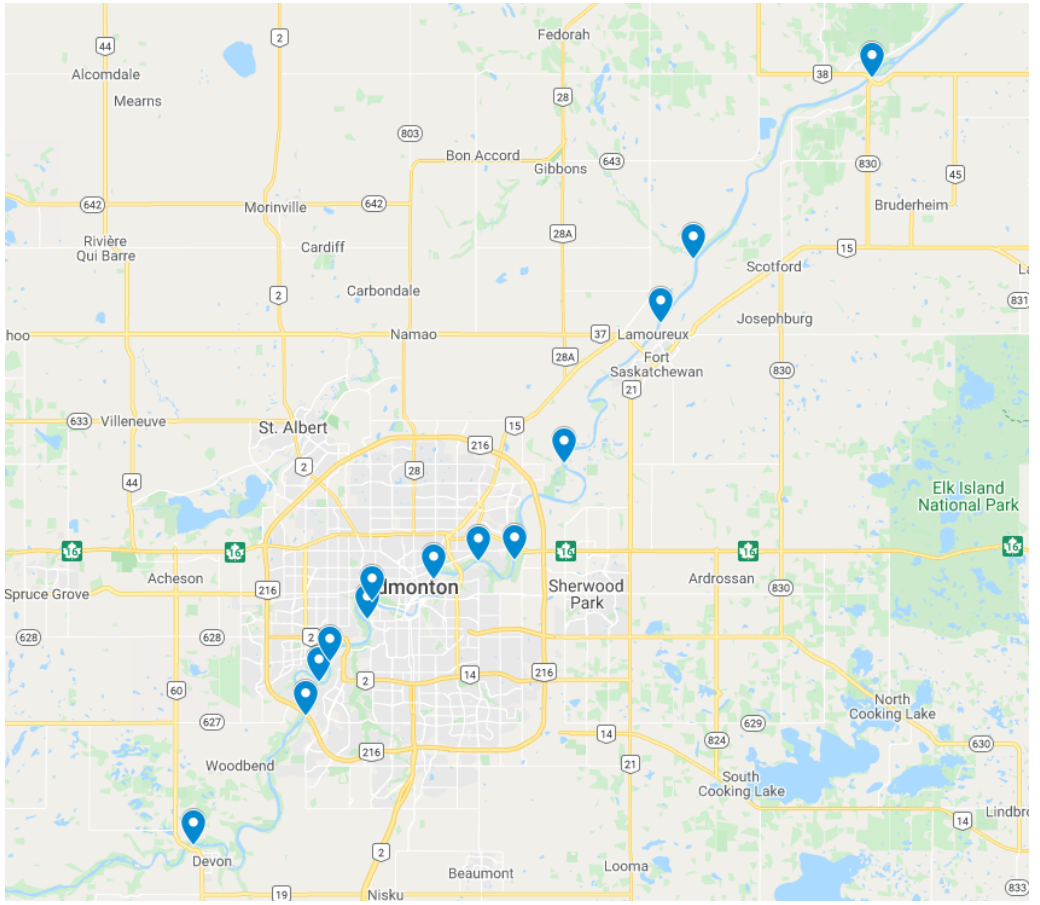

Image: Route for Microplastics Sampling of NSR created by google maps

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ASTM D8332

- Many previous literature sampling techniques developed for marine environments, not easily applied to river systems such as NSR
- ASTM D8332 for surface water, no method for sediment
- Filter 1500 L through cascading sieve stack to collect suspended solids

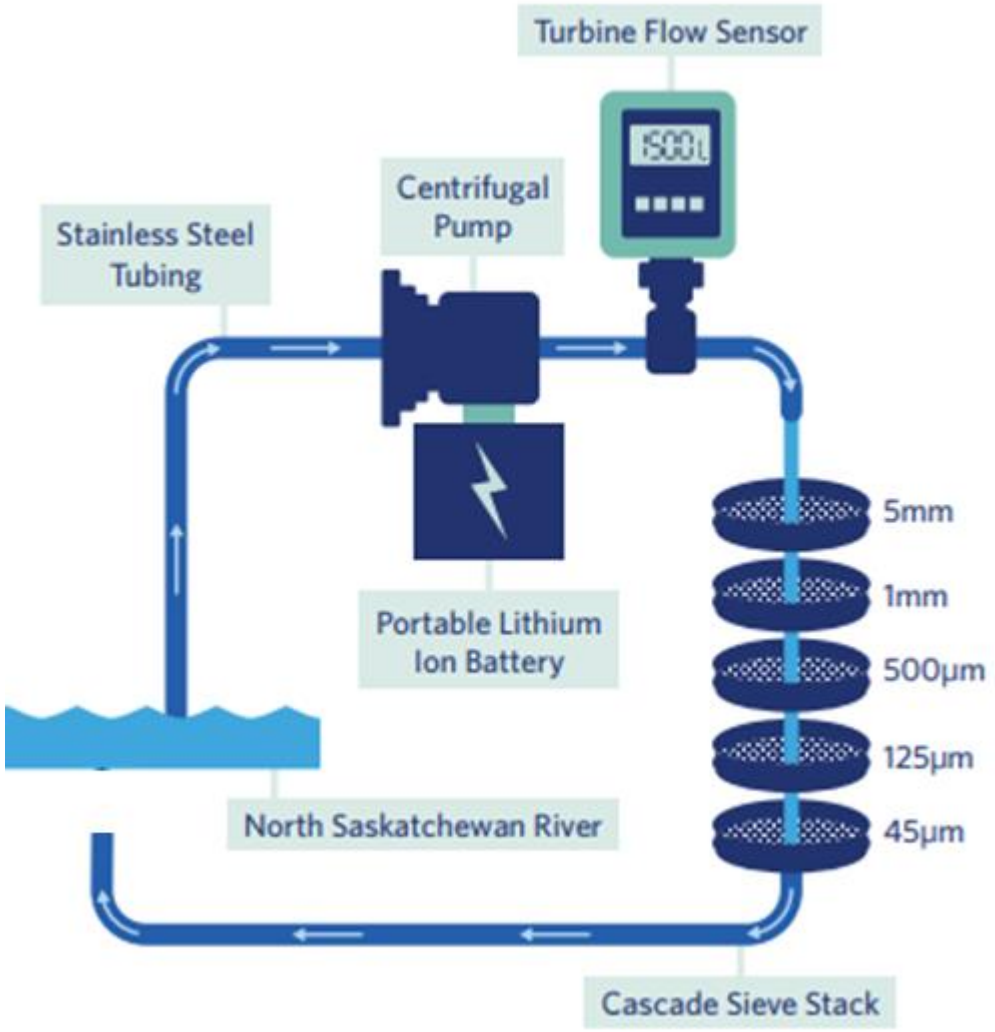

Image: Graphical illustration of NAIT sampling technique
Artist: Amelie Dufresne

ASTM Prototype Sampling System

- Designed and fabricated at NAIT by *Centre for Sensors and System Integration* (CSSI)
- Plastic free system, battery powered, small enough to fit into backpack

Images: ASTM pumping system with cascade sieves for microplastic sampling

Image (*Left*): Version 1 ASTM microplastic sampling system – flexible stainless-steel whips

Image (*Below*): Version 2 ASTM microplastic sampling system – Completely rigid

Laboratory Preparation

- Varying laboratory methods exist for preparation and analysis – current issue in microplastic science
- ASTM D8333 published in 2020
- “gentle” approach to minimize damage to microplastics that have been in the environment for an indeterminant time

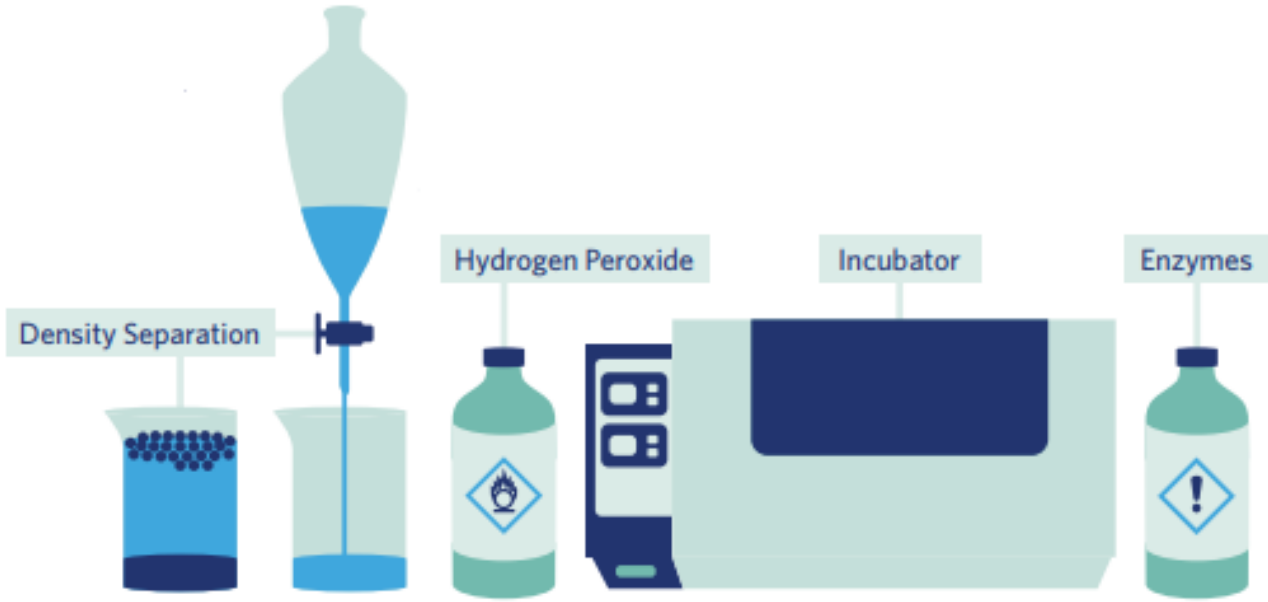

Image: Graphical illustration of NAIT laboratory preparation technique
Artist: Amelie Dufresne

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Laboratory Analysis

- Partnership with Dow Canada core R&D team

- Home of state-of-the-art microplastic analysis equipment: Quantum Cascade Laser Direct Infrared Chemical Imaging System (*LDIR*)

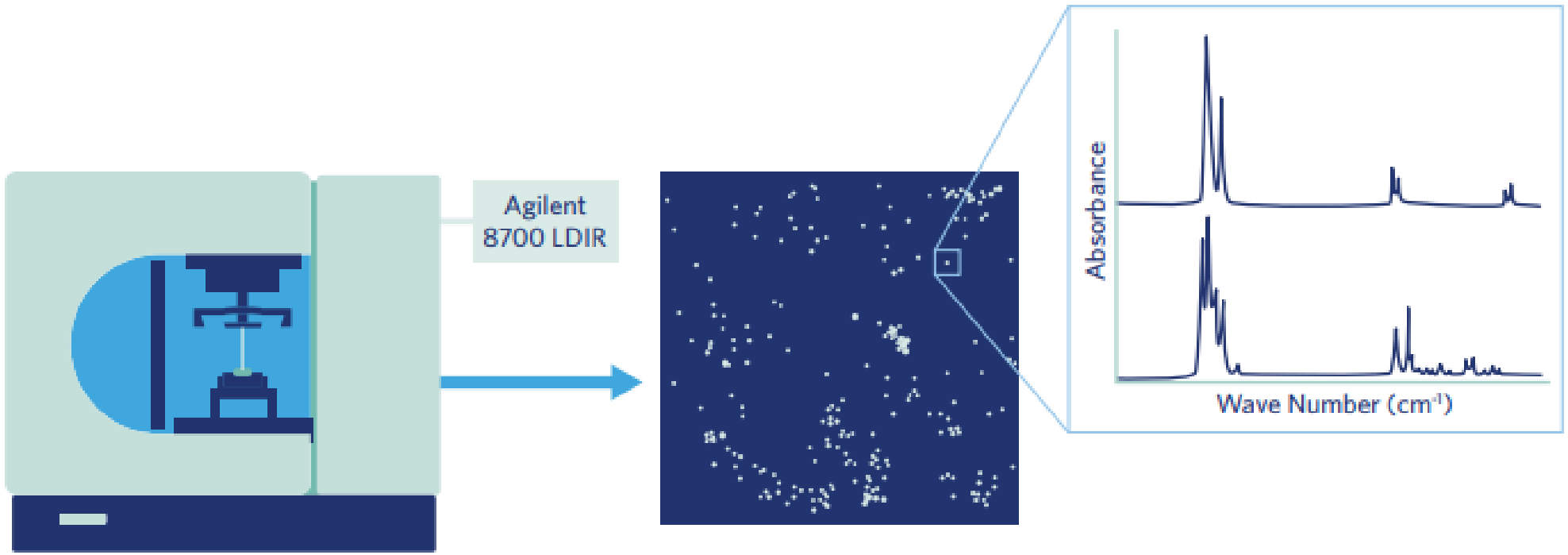

Image: Graphical illustration of LDIR Instrumentation
Artist: Amelie Dufresne

Challenges for Microplastic Science

1500 L to **droplet** volumes

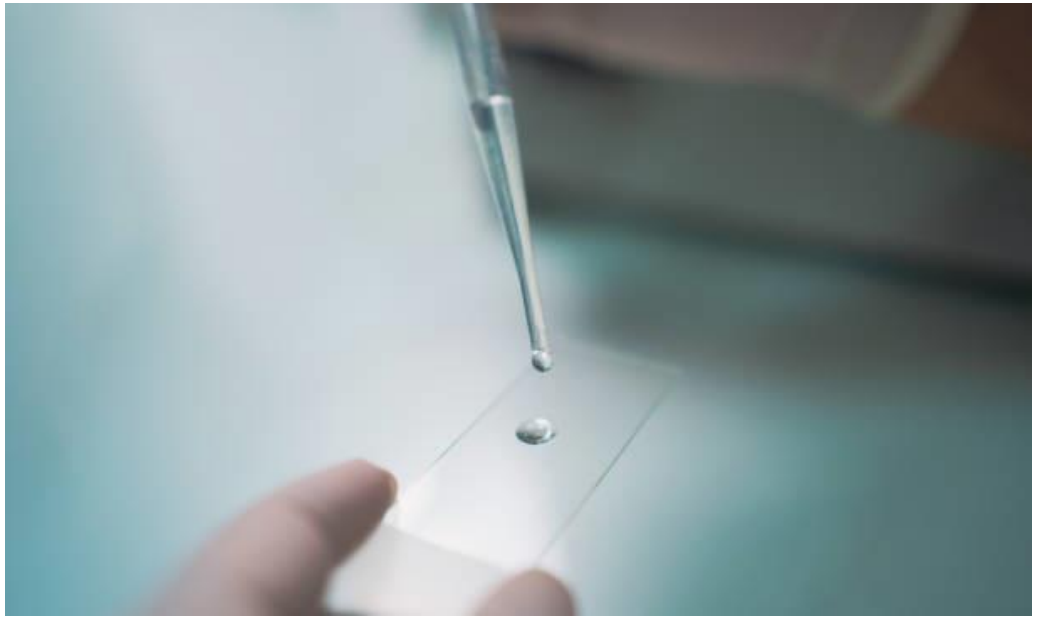

Image: Getty Images

- Multiple orders of magnitude change in volume from sampling to analysis
- Working with almost invisible particles; ensure we are not losing microplastics in our procedure
- Working with a contaminant that is literally everywhere from reagents, lab and field materials, clothes, and air

Quality Control Procedures

- Extensive effort to remove all possible sources of contamination in lab and field
- Rule of thumb: don’t use any plastics
- Cotton clothes for sampling
- Lab blanks and field blanks

Quality Control Procedures

Image: Heisenberg performing chemistry

Quality Control Procedures

- Creation of in-house microplastic standards using PP, PE, PET, PVC
- Multiple size classes, individually coloured
- Possible to count without LDIR for method optimization
- Perform spike recovery studies
- Determine %RSD

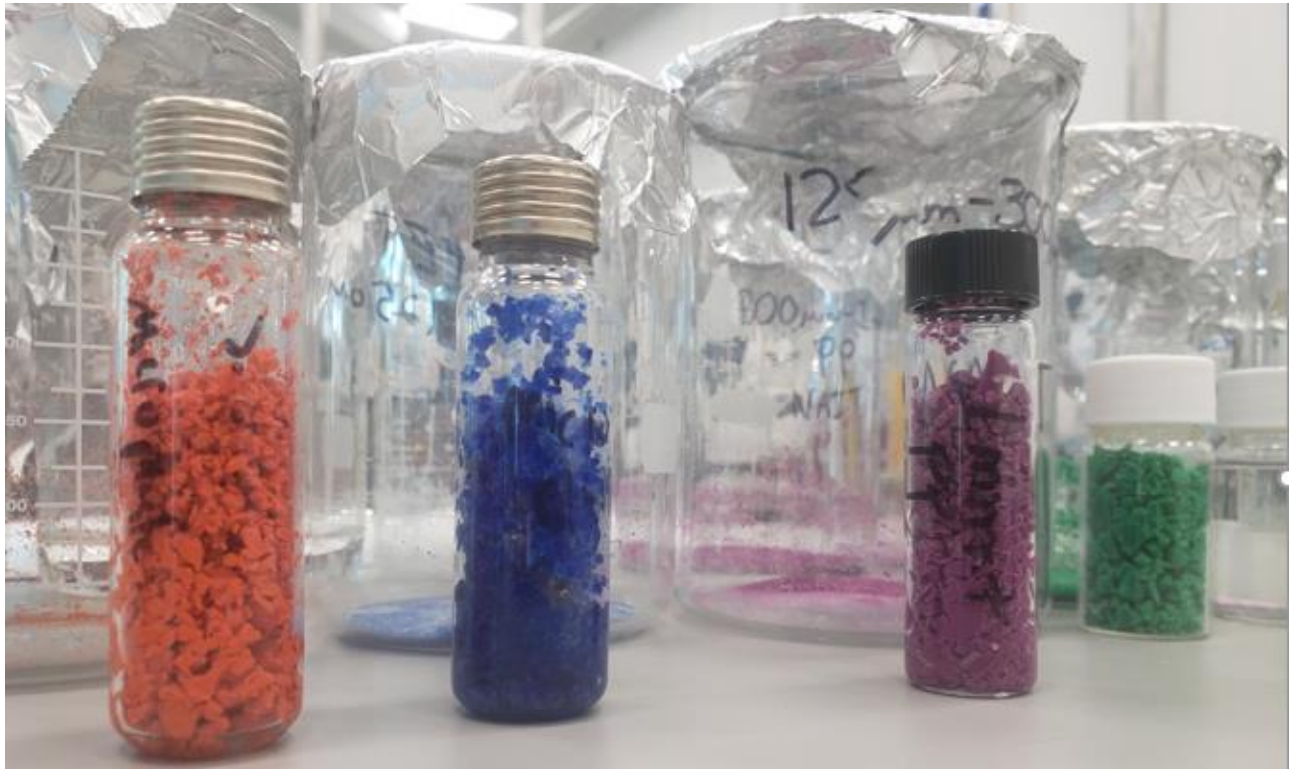

Image: Microplastic standards created from common plastics found in the lab (PVC, PET, PE, PP)

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Stay Tuned

- Field season wrapped up
- Method validation continues
- Sample processing
- Continue into 2022, 2023

Image: Patric McGlashan, Microplastic Technician

Acknowledgments

- Inter Pipeline Team – Dan Morrison, Jessica James, Mark Jones
- Dow Team – Dr. Jim Luong, Guangyu Liu, Ronda Gras, Yujuan Hau
- PRIA
- Paolo Mussone, NAIT Clean Technology group
- CSSI

Image: 2021 NAIT Microplastic Team (left to right) Nadia Leenders, Jeremiah Bryksa, Jon Wong, Patric McGlashan

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