NORWEGIAN INSTITUTE FOR WATER RESEARCH (NIVA) Q&A CUSTOMER STORY

INTRODUCTION:

The challenges of microplastics pollution in the environment continues to generate global interest. Many studies are underway to better understand the impact that plastics can have on human and environmental health as well as the scope of the problem. Micro- and nanoplastics have been found across the globe from deep under the seas to the tops of mountains to the most remote areas of Antarctica.

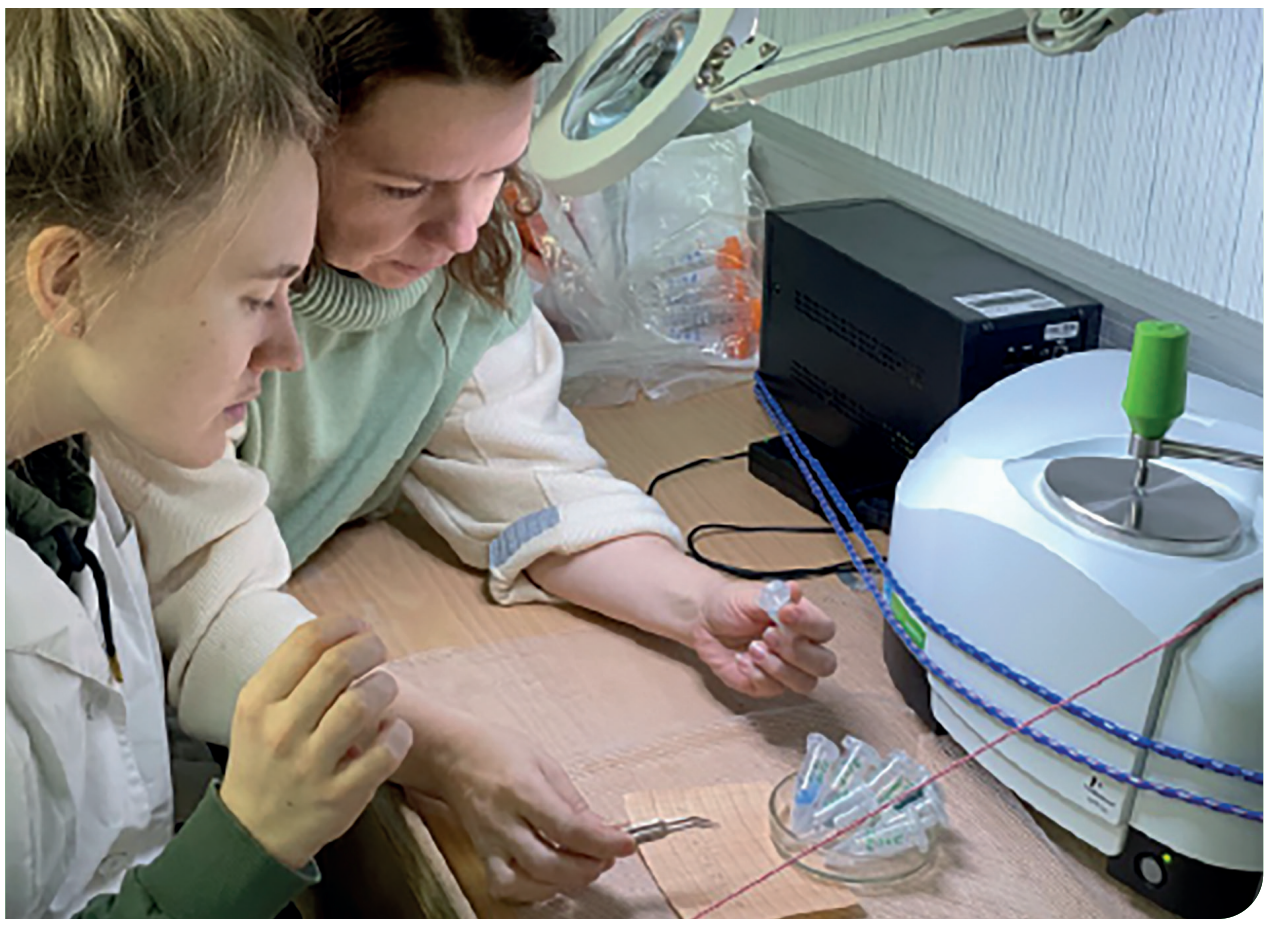
PerkinElmer is supporting these efforts with our microplastics analysis solutions including the Spectrum Two™ and Spotlight™ 400 FT-IR. We recently sat down with representatives from the Norwegian Institute for Water Research (NIVA) to discuss their work in this area. The team is collaborating with colleagues from Russia to investigate the presence of microplastics in the Arctic Ocean. This pristine environment is particularly sensitive to environmental pollution and pressures because it has very short food chains where impacts to any one species will quickly spread. In a region highly reliant on the health of its fisheries, the is significant concern on maintaining a healthy environment. The investigations underway are focused on understanding the amount of microplastics which might be present and the sources of the pollution. This information can be used in the future to make informed decisions for regulating and monitoring microplastics.

NIVA Representatives:

Professor Bert van Bavel, Chief Scientist – an analytical chemist and expert on QA/QC with over 30 years of experience in the analyses of priority and emerging pollutants, Dr. van Bavel has been leading United Nations Environment Program's capacity building program for the Stockholm Convention. He is part of the EU project Clean Sea, which is focused on developing technology to measure microplastics in the aquatic environment and harmonizing microplastics measurement methods.

Dr. Evgeny Yakushev, Senior Research Scientist – a chemical oceanographer, Dr. Yakushev has extensively studied nutrient cycling in seawater and is involved with mathematical modeling of ecological systems. He is focused regionally on the Artic and scientific collaborations with Russia including several projects between the Norwegian Ministry of Environment and the Russian Ministry of Environment focused on studying environmental pollution, including microplastics.

Dr. Svetlana Pakhomova, Engineer – Dr. Pakhomova has been with NIVA for the last 5 years and her work includes a focused on the evaluation of technologies for the measurement and identification of microplastics.



Science on a ship: samples are numbered, measured and photographed.

Q: Please tell us about your work studying microplastics in the Barents and Arctic Seas and why it was conducted?

A:

van Bavel: If you look at the area of microplastics research, there is very little information about this particular region. These joint expeditions between NIVA and our Russian counterparts provided us with a good opportunity to obtain more knowledge. There is a lot of discussion about microplastics possibly entering this pristine area, so we wanted to obtain more information.

Yakushev: There were several research questions which we wanted to answer. Before we conducted our studies, it wasn't clear whether this area was polluted with microplastics or not, so we wanted to confirm the presents of microplastics. And once we found microplastics, we wanted to understand how microplastics came to be found in this region – is it currents from the Atlantic which brings polluted water or is it rivers in the region which flow into the Barents Sea? Around the world rivers are a main source of microplastic introduction into ocean so we wanted to examine that dynamic in this region as well.

We found that the concentration of microplastics in river waters was less than that at sea because these rivers flow through unpopulated areas. So, we really wanted to find the sources of microplastics so that we could have data that we can then examine and extrapolate with mathematical models. If we can identify sources of microplastics, we can inform decision makers who can then take action to prevent this pollution.

Russia conducts several scientific expeditions to the Arctic every year and NIVA's participation allowed for the application of more modern methods and technologies for the detection of microplastics that are not available in Russia. The data that we were able to generate can be used to help both Russia and Western nations in combating plastics pollution.

van Bavel: With our expertise in the instrumentation including the PerkinElmer Spectrum Two which was on board, we have the technology to measure the pollution. Our Russian colleagues have the access to areas of interest with their expeditions. Coming together we can lend our expertise and help harmonize methods for measuring microplastics.

There are also some big questions related to microplastics. Is there an accumulation zone in the Barents Sea? If so, where do these plastics come from? Those were the main questions we tried to focus on for this project.

Q: Could you explain what the environment is like in this region and what impact pollution could have on the ecosystems there?

A:

Van Bavel: While the area is very pristine it is also very biologically active. The food webs are very abundant from plankton to whales. If you disturb this area which is already under pressure from climate change, what will be the impact – that is what we are trying to investigate and understand.

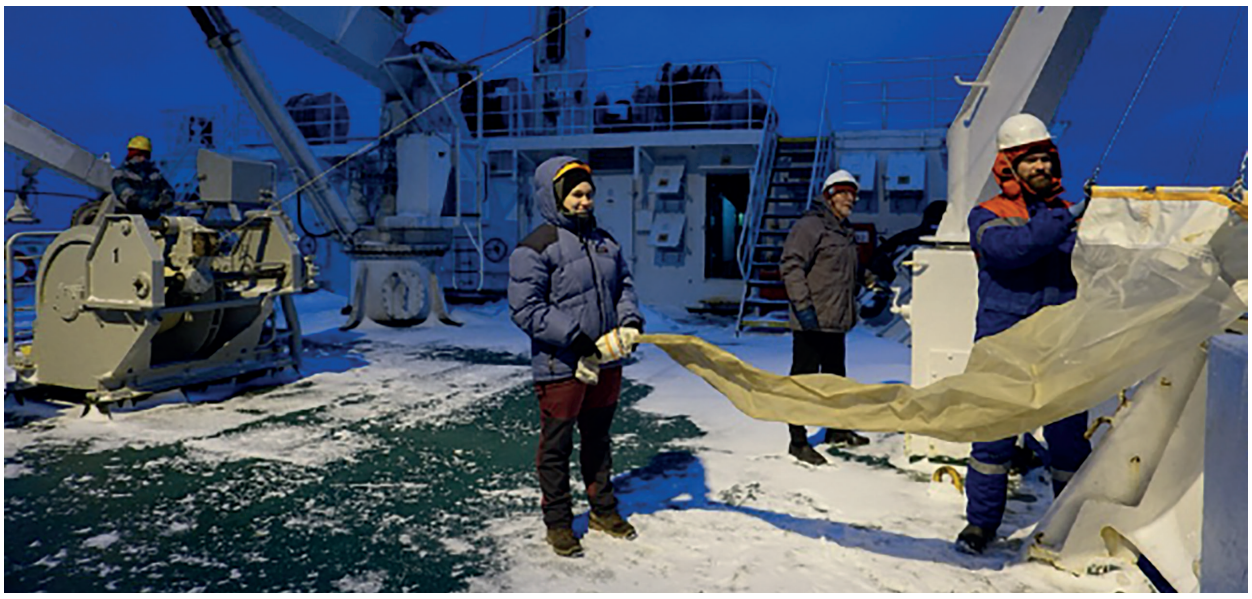
Yakushev: Its ecosystem isn't as diverse as some other areas, but it is being impacted by pollution. The Arctic is an important are for fisheries. We found microplastic fibers inside fish, so it is there an effect on organisms. How dangerous is it? We still don't know; we need to study more.

Van Bavel: From the NIVA perspective, we do a lot of work in the Arctic area, and this is another pressure on a pristine area and its short food chains. These food chains are important for a lot of species which are unique to the arctic area. We see that there are a lot of plastics accumulating in ice and if the ice melts, that would be another source for the release of microplastics into this environment. So, we are looking at this multi-pressure environment to try and protect the Arctic as much as possible.

Q: When you speak about the collaboration between NIVA and Russia, can you tell us what institutes were involved?

A:

Yakushev: There were several institutes that were involved in the expeditions that we have referenced. These include Institute of Oceanography which is situated in Moscow and the Pacific Oceanographic Institute from Vladivostok. They were studying the methane cycle, CO2 levels and climate related phenomena but were kind enough to give us ship time and invite us on the expedition to study plastics.



Floating particles are collected with a Neuston net.

In addition, there are expeditions organized which are "floating universities" where students from several universities go on a cruise to conduct scientific experiments. We were happy to show them how to collect samples for microplastics analysis which were then analyzed with the Spectrum Two. These universities included Moscow State University, St. Petersburg State University, St. Petersburg Hydrometeorological University and Northeaster University.

Q: What type of work were the students involved with?

A:

Pakhomova: The students and young scientists on-board were very interested in microplastics studies and asked how to do the sampling and analysis. The Spectrum Two is a very good device and easy to use. It works very well for microplastics. I taught several students how to use it and they helped us process our large number of samples – almost 130 samples with each sample having from 5 to 1000 microplastic particles.

The PerkinElmer solution is the gold standard at NIVA. We tested other devices and always compare them to the Spectrum Two.

Van Bavel: We can analyze the microplastics down to 500 microns, or half a millimeter, with the Spectrum Two. The other samples go to the lab, and we analyze them with the Spotlight 400, micro FT-IR.

If you take the strict definition from 2 millimeters to 0.5, larger microplastics can be analyze on-board the ship which is a big achievement because that is a large portion of the microplastics. The real small particles we need to do in the lab because we need liquid nitrogen to cool down the Spotlight and that's not available on research ships.

Q: What has been the results of your research thus far?

Yakushev: We have been able to determine that there are indeed microplastics present in the Arctic Ocean. The most polluted location that we have samples thus far is the Barents Sea, especially the Kara Gate area. The plastic concentration generally decreases from West to East and from the Central Arctic to the unpopulated Siberian coast.

Van Bavel: One of the big learnings is that we need more information. This is one of the first analyses of this area. Weather conditions, season, and currents can all influence the data so we would like to have more information.

We have purchased two Spectrum Two instruments to be placed on cruise ships which will be visiting these areas. Our objective would be to use these cruise ships as a platform to expand our sampling. I'll be installing one of the instruments on a cruise ship next week.

This additional information will be fed into the models that we are developing to provide us with a better view of the microplastic distribution and influxes in the region.

Q: What will be your next steps in this work?

Van Bavel: We must figure out what the biggest sources of microplastics are and if our data is reliable in terms of season, place, time, and weather conditions. We will continue working on site with the students to test a large number of samples and we will make a Spectrum Two available for the student from Russia to work with.

Pakhomova: Another existing problem in microplastics research is that different research groups utilize different methods which makes it difficult to compare results. We have been trying to harmonize methods and analysis techniques to allow for a comparison of results from different regions, seasons and weather conditions.

Van Bavel: We are leading a harmonization effort for which we have 15 or 18 European partners. Our collaboration with our Russian partners gives us the opportunity to introduce the same methods to them so that we will be able to reliably compare results and feed the data that they generate into the same models.

Author Contact Details

John Martin, Segment Marketing Manager - Environmental • PerkinElmer

• Address: 68 Elm St., Hopkinton, MA, USA, 01748 • Tel: +1 617.416.2034

• Email: john.martin@perkinelmer.com • **Web: www.perkinelmer.com**