Joy and Fun for Future Scientists, Though Micro Plastic Detection Examination

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Plastic is used in vast quantities around the world as an inexpensive and convenient material that is indispensable to our daily lives. However, in recent years, large amounts of discarded used plastics have been released into the ocean, causing social problems; it has been reported that the oceans in 2050 will contain more plastic waste than fish [1]. Among discarded plastics, microplastics (MPs), which are smaller than 5 mm in size, have the potential to affect the ecosystem. We have developed a simple observation kit to help children, who will be responsible for the future, learn about the plastic waste problem that is happening around them in an easy-to-understand manner. This paper briefly introduces the kit for simple observation of microplastics and hands-on learning activities using the kit.

Figure 1 A simple observation kit “PLAWATCH”

Introduction

HORIBA Techno Service, Co., Ltd. has developed “PLAWATCH” that is a simple observation kit to detect MPs, allowing ordinary citizens and children to detect the presence of MPs in their everyday environment using a smartphone (Figure 1).

For observation, samples such as sand collected on the seashores and in rivers are washed, and then stained using a mixture of the fluorescent dye “Nile Red” and an organic solvent (referred to as fluorescent staining solution in the rest of this document)[2]. The MPs mixed in the sand is stained through the pretreatment.

The stained sample is irradiated with green light from an LED using the fluorescent properties that Nile Red, contained in the staining solution, emits red fluorescence when excited by green light.
This causes only the MPs contained in the sand to emit red fluorescence (Figure 2). “PLAWATCH” is designed to capture only red fluorescence efficiently by blocking the green light with a red filter (made with cellophane or other material) (Figure 3) since green light as excitation light is not required.

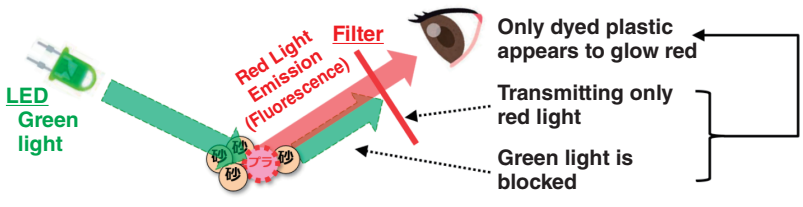


Figure 2 How MPs Emit Red light

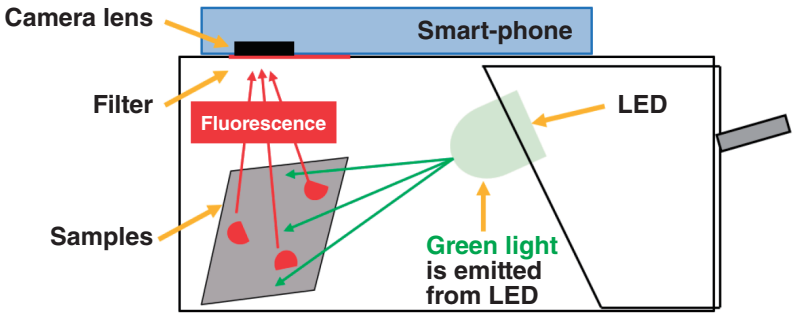


Figure 3 Schemic Diagram of Microplastic Simplified Observation kit (Cross-section)

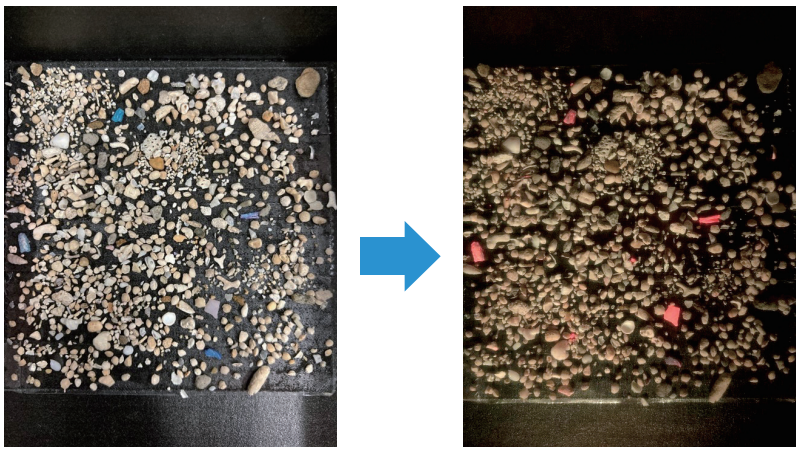
A smartphone or a camera on tablet devices is placed on the top of the enclosure of "PLAWATCH" to be use as a detector for the observation. Using a camera of smartphone or tablet device allows anyone to observe and record images easily (Figure 4).

Based on the concept of minimizing the use of plastic, the "PLAWATCH" enclosure is made of paper (cardboard) to be environmentally friendly. In addition, the kit is designed for users to assemble by themselves, allowing them to experience the joy of manufacturing.

The sand was collected on the rivers and the seashores in Kyoto Prefecture (Kameoka City), Hyogo Prefecture (Nishinomiya City), Kanagawa Prefecture (Kamakura City), and Okinawa (Iriomote Island), and was investigated using the prototypes of "PLAWATCH".

We found that the plastic waste was accumulated and washed ashore on the rivers and the seashores in the many places where we visited (Figure 5), and then we confirmed that the MPs were mixed with the sand particles using the kit after the surface sand from the surrounding areas were collected, washed, and stained.

Furthermore, building on previous activities, we conducted an MPs observation session using "PLAWATCH" at a workplace tour for children (elementary school students) of HORIBA group employees in August 2024. We collected



Natural light image Fluorescent Image

Figure 4 Comparison of Observation Fluorescence Imaging using PLAWATCH

Figure 5 Large amount of plastic waste washed ashore (on a remote island coast in Okinawa)

HTS engineers collecting sand for use at an event (at coast in Osaka)

Sand collected from various overseas locations (11 prefecutres,12 type)

Figure 6 Preparations for the event

sand from seashores across the country (Figure 6) with the cooperation of the service engineers in the offices of HORIBA Techno Service, Co., Ltd.

After giving an easy-to-understand explanation of the environmental impact of the MPs to the participated elementary school students, we conducted an experiment to observe how much the MPs were mixed in the sand from the seashores.

Each of the participated children selected the sand in which they were interested and observed the sand with “PLAWATCH” and their smartphone after the staining treatment with the fluorescent staining solution by themselves under the guidance of the staff. When they found MPs glowing red in the sand, they were surprised and reported to their parents, “I’ve found it!” (Figure 7).

Sand images taken by the children were overlaid on a map of Japan to create “MPs Map - What’s hidden in the sea sand?” (Figure 8). The observation results showed that MPs were observed in all of the sand collected. This result indicates that MPs are spreading in sand of seashores and rivers throughout the country. We hope that this kind of experiential learning will spark children’s interest in science experiments and environmental issues in the future.

Figure 7 Event highlights A child who participated in the event

Conclusion

Since the press release in October 2024 was very well received regarding the sale of this simple observation kit, we are now promoting further initiatives so that the kit can be used in the environmental education and the extracurricular activities for students.

The environmental education using “PLAWATCH” is also being conducted by educational personnel and research organizations. For example, we are conducting a survey of the MPs on rivers in Kameoka City in collaboration with TAKASAWA Nobue Laboratory at Kyoto University of Advanced Science (Kameoka City, Kyoto Prefecture). In addition, Prof. Makiko Okamoto, the University of the Ryukyus, conducted “Environmental Education through Fluorescent Visualization of Microplastics” using “PLAWATCH” for elementary school students on Iriomote Island in Okinawa in 2024, and we also participated in the local classes.

Additionally, teachers including Mr. Suzuki, Tokyo Metropolitan High School of Science and Technology, are conducting observations using “ PLAWATCH” as one of the ways to confirm that the MPs are contained in bird droppings[3]. In this way, we expect that the product application will expand further in the future.

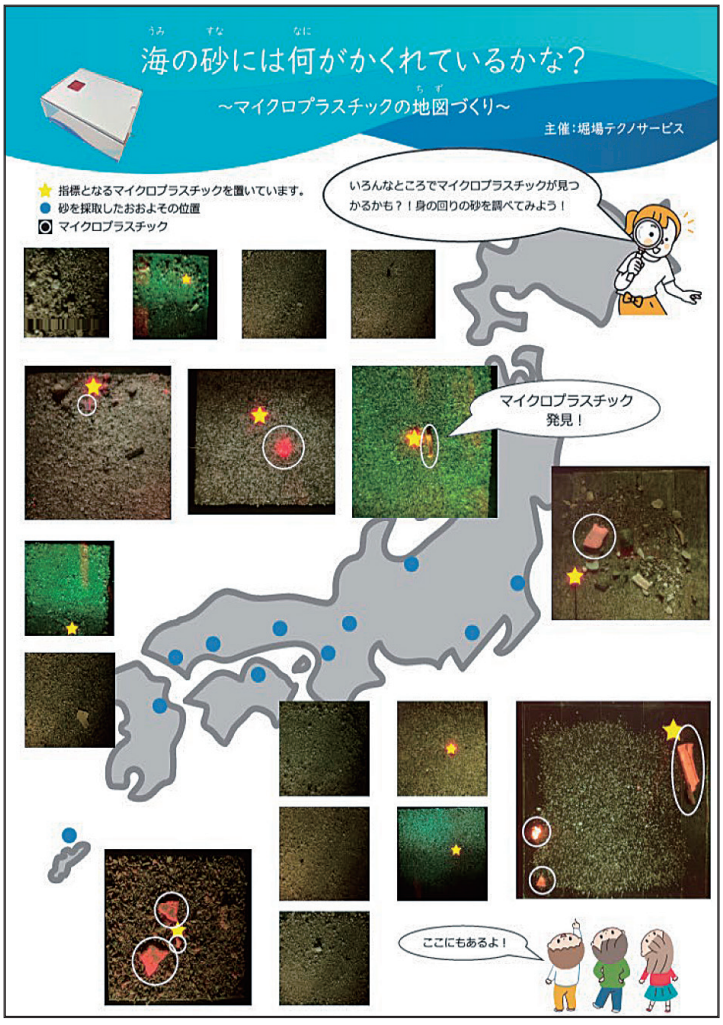


Figure 8 Japanese Map of MPs Observation Images Using the PLAWATCH

We are also working on developing an application that will enable the creation of a global distribution map of microplastics using images captured by "PLAWATCH".

* Editorial note: This content is based on HORIBA's investigation at the year of issue unless otherwise stated.

References

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[2] Maes Thomas et.al., "A rapid-screening approach to detect and quantify microplastics based on fluorescent tagging with Nile Red", *SCIENTIFIC REPORTS*, 7(1), 1-10 (2017).

[3] 東京都立科学技術高等学校 科学研究部生活科学班. "鳥フンの調査結果から見えるもの". 日本動物学会 第94回大会, 2023.09.09. (In Japanese)

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