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Application News

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Spectrophotometric Analysis

Analysis of Plastic Pellets (Carriers for Water Treatment) Using FTIR and EDX

People use large quantities of water for both domestic and industrial use during the course of daily life. Even though the Earth has abundant water resources, the amount of safe, drinkable water within these resources is extremely limited. This means that securing drinking water through the process of recycling wastewater is a crucial issue.

The water treatment processes employed at wastewater treatment plants are primary treatment for physically separating and removing solid material (physical treatment) and secondary treatment for removing organic matter using microorganisms (biological treatment). In biological treatment, cultivated microorganisms feed on the organic matter dissolved and suspended in wastewater which results in the oxidative decomposition of the organic matter. Plastic pellets (carriers for water treatment) support the microorganisms on the surface of the wastewater and function to improve purification.

Plastic pellets are approximately 5 mm in diameter, as shown in Fig. 1 (left). A large number of pores are visible upon inspection of the cross section in Fig. 1 (right).

Fig. 1 (Left) Approx. 5-mm Diameter Plastic Pellet (Right) Cross Section

Plastic pellets serve a role in purifying water used in a wide range of applications. However, there is concern that these pellets may turn into marine pollution (microplastics etc.) by flowing into the sea and river systems when heavy rain or other circumstances cause wastewater to overflow.

This article introduces an example of using FTIR and EDX to analyze plastic pellets before and after use in water treatment.

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Measurement Samples

Fig. 2 shows the measurement samples of unused and used plastic pellets. The used pellets have lost their original shape and exhibit significant unevenness on their surface.

Fig. 2 (Left) Unused (Right) Used

Instruments Used and Measurement Conditions

Analysis was performed using a system comprised of an IRTracer™-100 Fourier transform infrared spectrophotometer connected to a Quest single-reflection ATR accessory, and an EDX-8000 energy dispersive X-ray fluorescence spectrometer. Figs. 3 and 4 show the appearance of each instrument and Tables 1 and 2 list the measurement conditions. The measurement samples shown in Fig. 2 were analyzed without undergoing any processing or special pretreatment.

Fig. 3 IRTracer™-100 (Left), Quest (Right)

Fig. 4 EDX-8000

Table 1 FTIR Measurement Conditions

Instrument	:	IRTracer-100 Quest (Diamond prism)
Resolution	:	4 cm^{-1}
Accumulation	:	100
Apodization function	:	Happ-Genzel
Detector	:	DLATGS

Table 2 EDX Measurement Conditions

Instrument	:	EDX-8000
X-Ray tube target	:	Rh
Voltage/current	:	50 kV (Al-U) / Auto 15 kV (C-Sc) / Auto
Atmosphere	:	Vacuum
Analysis diameter	:	10 mmφ
Filter	:	None
Integration time	:	100 s

Results of Measurement Using FTIR and EDX

Fig. 5 shows the results of measurement using FTIR and EDX. Measurement using FTIR was performed on both the sample surface and a cross section.

From the results of FTIR measurement, we found that the surface is a mixture of polyethylene and cellulose and the cross section is polyethylene for both the unused and used plastic pellets.

The results of qualitative and quantitative analysis using EDX show that $_{15}$P (red frame in Fig. 5) was detected in the unused plastic pellets but not in the used pellets. However, since there were no significant differences in composition between the two samples, we consider that contaminants that adhered to the surface or components that rubbed against the samples during use may be present in trace amounts.

Conclusion

In this article, we analyzed plastic pellets that are used as carriers for water treatment. The results of comparing unused and used pellets did not reveal any significant differences in composition between the two samples.

Since FTIR is capable of performing qualitative analysis of organic matter and some inorganic matter, this method was able to quickly identify the main components of plastic pellets. Moreover, the element information obtained using EDX was able to reveal the existence of contaminants and wear due to additives as well as minute material differences.

FTIR and EDX that are capable of performing rapid measurements are effective for analysis of plastic pellets (carriers for water treatment).

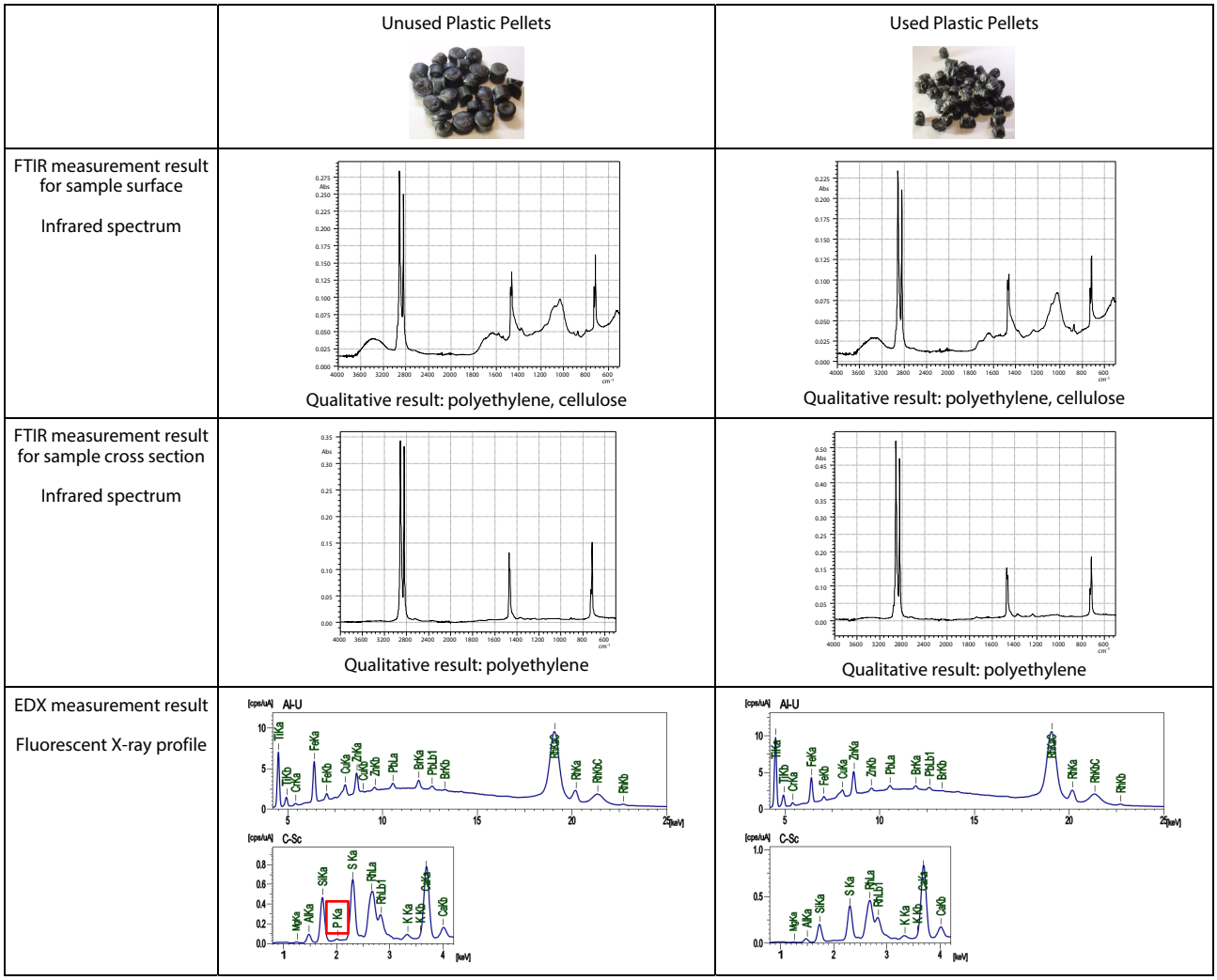

Fig. 5 Measurement Results

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