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# Analytical Technology for Environmentally Hazardous Substances at JFE Techno-Research†

## 1. Introduction

Recycling is being promoted worldwide from the viewpoints of effective utilization of limited resources and preventing further damage to the environment. On the other hand, in some cases, the substances which are added to products in order to give those products special functions show strong toxicity and have an adverse effect on the natural environment and the human body. Such substances are called environmentally hazardous substances. As increasingly strict regulations are applied to the contents of those substances, analytical technologies for controlling these environmental hazardous substances is important.

JFE Techno-Research has been involved in environmental control at JFE Steel for many years and started analysis of dioxins 20 years ago. Subsequently, the company began practical application of analytical methods for a wide variety of environmentally hazardous substances which are regulated in Japan and other countries, and in recent years has also developed characterization technologies for evaluation of the safety of products, etc. This article introduces some of these technologies.

## 2. Analytical Technology for Environmentally Hazardous Substances Responding to Legal and Regulatory System

With the number of organizations handling dioxin analysis on a commissioned basis now decreasing, JFE Techno-Research performs analyses of several thousand specimens each year using of 4 high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) devices.

The RoHS 2.0 Directive (Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) in the EU restricts the use of 10 substances, including cadmium, mercury, hexavalent chromium, brominated flame retardants (BFRs), and others, and manufacturers are required to label products for conformity accordingly. These substances are collectively termed SOC10. Although analytical methods have been specified to a certain extent, various ingenuity is applied to specimen pretreatment processes in order to apply those methods to diverse products. In JFE Techno-Research, after the screening analysis of specimen, the quantitative analyses are carried out using plasma mass spectrometry, emission spectrometry, etc. for the determination of inorganic elements. Various types of chromatography are used for the determination of organic components. Particularly in the case of BFRs, analysis of multiple compounds is necessary; accurate analysis is possible by using the high resolution mass spectrometer employed in analyses of dioxins.

In addition, although not belonging to SOC10, the perfluorooctane sulfonates (PFOS), which are kinds of fluorine compounds, have many excellent properties, such as heat resistance, chemical resistance, etc., but on the other hand, toxicity, including carcinogenesis, has been pointed out in some, and as a result, trace analysis of those substances has become necessary. JFE Techno-Research has the capability to perform such analyses, including analogous compounds of PFOS, which virtually no other companies possess. JFE Techno-Research has also established several kinds of analytical technologies by chromatographic methods, etc., for example, trace determination of nonylphenol, which is regulated in Water Pollution Control Law, as well as analysis of hexamethyline tetramine, which has become a problem because it forms harmful formaldehyde, and others. Among substances that will become a focus of attention in the future, ingredients used in medical products (antibiotics, antimycotics, antiviral agents) may be mentioned. These substances are contained in pharmaceuticals and personal care products (PPCPs) which accumulate in sea areas, rivers, lakes, and marshes, and other bodies of water and have effects similar to the endocrine disruptors. JFE Techno-Research is also successively creating analytical technology which enable analysis of these substances.

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## 3. Analytical Technologies for Safety Evaluations

A technology which is particularly strong in JFE Techno-Research is environmental monitoring related to the disposal of abandoned chemical weapons. This company performs integrated safety evaluations, including confirmation of safety during transfer of chemical artillery munitions, checks for leaks into the surrounding environment during disposal, checks for the spread of pollution after disposal, etc.

Recently, chemical substances generated from furniture and household appliances have also emerged as a familiar problem. In some cases, lawsuits have been lodged in connection with medical conditions such as eye irritation, etc. caused by purchased furniture. Because the degree of release of the substances that cause such conditions is affected by the surrounding environment, for example, indoor temperature, humidity, etc., it is important to investigate their release behavior in the use environment. JFE Techno-Research performs safety evaluations of furniture and appliances by building an environment which simulates the actual use environment and measuring the release behaviors of chemical substances in that environment. The company also performs third-party verification tests of environmental purification appliances such as deodorizers, antimicrobial devices, and by confirming their effectiveness in the use environment.

## 4. Conclusion

Analytical and evaluation technologies are increasingly important in the environmental field. In the future, JFE Techno-Research will continue to introduce new state-of-the-art technologies and devices and respond to requests from within and outside the company quickly and accurately.

### References

1) JFE Technical Report. 2007, no. 9, Special Issue on Analytical Sciences and Microstructural Characterization.

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