

Utilization of Oxygen Flask Combustion Method for the Determination of Volatile Hazardous Elements in Coal and Ashes

Wenhua GENG

1. Introduction

Coal contains various elements including hazardous trace elements. Among these hazardous elements, especially volatile elements, such as F, Hg, and As, are in great concern, because those elements are likely to be released into air when coal is burned; and/or they may be once volatilized and then deposited on ash. One of the most important things in the studies on the matter of hazardous elements in coal is the development of precise and easy determination method for the elements.

Oxygen flask combustion (OFC) method has been popularly used for the decomposition of organic compounds to determine sulfur and halogens in medicines. The OFC method has a great advantage in terms of low initial cost and easy operation, compared to the conventional methods, such as the heat-vaporization method and the microwave-acid digestion (MW-AD) method. In this dissertation, the application of OFC method to the determination of trace elements in coal and ash was described.

2. Results and Discussion

The determination of F in coal was developed by use of the combination of OFC method and ion-selective electrode. Various conditions for the OFC method (number of combustion, kind of catalyst, particle size of coal, etc.) were examined, and the optimum conditions were established. Combined use of WO_3 and powdery Sn was the most effective for the catalyst. For many coals which are practically used in Japan, the OFC method gave about the same results as the conventional pyrohydrolysis method.

The determination of Hg in coal was also developed

by use of the OFC method followed by cold-vapor atomic absorption spectrometry. Various conditions for the OFC method (composition of adsorbent, sample amount, standing time, etc.) were examined, and the optimum conditions were established. The use of proper oxidizing agent, such as $KMnO_4$ was needed for the preparation of adsorbent in the combustion flask. The result suggests that Hg is released from coal as elemental Hg form, when the combustion is performed. The OFC method provided about the same results as the conventional MW-AD method, when many practically used coal samples were tested. By use of the OFC method with the same adsorbent followed by ICP-AES, the determination of S in coal was favorably carried out.

When a proper combustion agent was used, the determination of Hg in coal ash was attained. For the combustion agent, naphthalene, phenanthrene, and cellulose acetate were tested, and these compounds could not give satisfactory results. A graphite, which had been treated for the removal of Hg, provided a good result. The comparison between the present method and the conventional MW-AD method resulted in the confirmation of the availability of OFC method for the samples of coal ash, waste incineration ash, and soil.

By use of the OFC method followed by hydride-generation atomic absorption spectrometry, the determination of As in coal was favorably performed. This method could be applied to wood samples with an arsenic-containing preservative.

3. Conclusions

The OFC method could be effectively applied to the determination of F, Hg, and As in coal as well as that of Hg in coal ash. The optimum conditions of the method were established, and the application range was clarified.