

Trace element analysis of oil-related materials with the low-temperature ashing technique

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The information obtained from trace element concentrations in crude oil, residual oils, and related materials is useful to estimate oil genesis and classification in maturity. Atomic absorption spectrometry (AAS), inductively coupled plasma optical emission spectrometry and mass spectrometry (ICP-OES and ICP-MS) have been frequently applied for their determinations after sample decomposition prior to the analysis, as well as direct injection after dilution with xylene. In the case of organic samples, organic matter potentially causes carbon-induced spectral and non-spectral interferences, and pretreatment using the high-temperature ashing or microwave digestion has been conventionally used for the decomposition. In the former method, the loss of volatile elements due to high temperature and contamination from the surrounding environments are concerned. In the latter case, a large amount of dissolved organic components remaining in the solution could influence analytical results. In this study, the low-temperature plasma ashing method (LTA) was tested to determine the concentration of metal elements in the petroleum-related substances. Hydrocarbons are oxidized by oxygen radicals in oxygen plasma generated by glow discharge under reduced pressure, and finally being removed into the gas phase.

Recovery yields for metal elements in the resultant ashes by LTA were evaluated first. An oil-based organometallic standard solution with known concentrations was ashed and then the ash was dissolved by acid treatment for quantification by ICP-MS. Optimized ashing parameters were then applied to a heavy oil reference material, NIST-SRM 1634c. Several trace elements (Co, Zn, As, Mo, Ba, and Pb) with V and Ni were quantified, and almost consistent values were obtained compared to previous studies [1-4] and its certification report.

References:

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