

Direct Zeeman AAS Determination of the Mercury Concentration in Natural Hydrocarbon Gases of Complex Composition

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Natural hydrocarbon gas is a complex mix of various organic and inorganic compounds, many of which have strong absorption lines in the spectral region of the 254-nm mercury resonance line. Therefore, the conventional AA and AF gas analysis techniques necessarily involve the stage of mercury accumulation on a sorbent to exclude the nonselective absorption and to reduce the detection limit (DL). The accumulation stage significantly increases the analysis duration and labor content. The developed technique is based on the direct continuous AAS determination of mercury in gas flow using RA-915+ analyzer. The use of Zeeman correction for nonselective absorption provides elimination of the stage of mercury accumulation and real-time measuring with the effect of interfering compounds reduced to a minimum. The DL for methane gas is 2-5 ng/m³. The presence of interfering impurities can result in the DL increasing. However, even at a very high content of H₂S in the gas (up to 20 %), the mercury concentration can be measured with a DL of 50 ng/m³. The differential absorption caused by benzene in the spectral interval of the Zeeman shift that is used in the RA-915+ leads to the linear signal dependence on the benzene concentration (a signal from 5 mg/m³ of benzene corresponds to that from 10 ng/m³ of mercury). Though the selectivity of the analysis with respect to benzene is as high as 500,000, a special sorption filter is used for gases with a high concentration of benzene, which makes it possible to analyze natural gas not only for the mercury content, but for the benzene content as well. For a field analysis of the gas in the high-pressure wells, pipelines, and gas cylinders, a proper setting of the gas flow rate is essential. It follows from our experience that a significant drop in the mercury concentration at the flow rates lower than 5 l/min is due to the mercury loss in a sampling valve and inlet gas transportation ducts of a measuring system. Real-time measurements with RA-915+ make it possible to choose the necessary sampling flow rate to avoid the sorption effects.