

Movable single photon ionization time-of-flight mass spectrometer for online monitoring of chlorinated organic compounds in waste incineration flue gas

Jichun Jiang, Wei Liu, Yachen Qi, Keyong Hou, Haiyang Li

Key Laboratory of Separation Science for Analytical Chemistry, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian, 116023, People's Republic of China

Polychlorinated dibenzodioxin and dibenzofuran (PCDD/F) and dioxin precursors contribute to environmental pollution and cause social problems. Waste incinerators are one of the major emissions of PCDD/F and their precursors. The occurrence of PCDD/F and their precursors is normally due to combustion conditions. Therefore, reliable on-line and real-time monitoring requires a stable and robust measurement system for pollutants from combustion. A home-made radio frequency-power (RF) discharge windowless krypton lamp ionization source was used as a soft ionization source to reduce the fragmentation and overlap of the spectrum. An unattended operated adsorption-thermal desorption sampling reflecting time-of-flight mass spectrometer for online monitoring of chlorinated organic compounds in waste incineration flue gas has been developed. An automatic adsorption-thermal desorption sampling system based on a tube filled with Tenax Ta adsorbent was designed to on-line enrich trace chlorinated organic compounds inside of the flue gas. The operation time for one cycle of the automatic sampling system is 29 min, including the adsorption time, the thermal desorption time and the cooling time. The whole system was used to analyze the dioxin precursors, monochlorobenzene (MCB), dichlorobenzene (DCB) and trichlorobenzene (TCB), the limit of detection of 1, 1.2 and 1.6 pptv were obtained, respectively, in 29 min. Moreover, MCB, DCB and TCB in an actual waste incineration flue gas have been continuously monitored for 3 months in one of the incineration destination in Beijing, China. During the 3 months, benzene was used to examine the stability of the whole system, and the relative standard deviation (RSD) was less than 20%. The concentration of MCB, DCB and TCB detected in waste incineration flue gas was 100~1200, 30~800, 10~300 pptv, respectively. The results show that this system has an exceeding robust performance and is able to achieve the high sensitivity and stability in analyzing chlorinated organic compounds for long time operation.