

Development of an on-line method for the determination of I₂ by using time-of-flight aerosol mass spectrometry

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Over the past few years, the influence of iodine species on the marine atmospheric chemistry has been investigated. Recent studies show that iodine species are involved in the tropospheric ozone depletion, the formation of new particles in the marine boundary layer (MBL) and the enrichment of iodine in the marine aerosol. In their evolution marine aerosols can act as cloud condensation nuclei. Thus aerosols have an indirect effect on the Earth's radiative budget and consequently on the Earth's climate.

Molecular iodine (I₂) and biogenic iodocarbons (e.g. CH₃I, CH₂I₂) that are released into marine atmosphere by algae and phytoplankton are suggested to be the most important precursors for reactive iodine in the MBL. During daylight these compounds are rapidly photolyzed to I atoms which then react with ozone to produce IO. Further reactions of IO lead to the formation of higher iodine oxides. Due to their low vapour pressure higher iodine oxides play an important role in the formation of new particles in coastal marine environments.

However, it is still an analytical challenge to identify and quantify reactive iodine containing key compounds. In the present work we describe the development of an on-line method for the determination of molecular I₂ using time of flight aerosol mass spectrometry (ToF-AMS). Aerosol mass spectrometry (AMS) provides a real-time analysis of the particle size, the particle mass and the chemical composition of non-refractory aerosols.

Due to its high vapour pressure a direct measurement of I₂ by ToF-AMS is not possible. Therefore molecular iodine has to be transferred from the gas phase to the particle phase before entering the ToF-AMS. For this purpose α -cyclodextrin was used as a derivatization agent. α -cyclodextrin molecules consist of a hydrophilic surface and a hydrophobic cavity. Due to its hollow cone structure α -cyclodextrin is capable of forming an inclusion complex with I₂.

The derivatization reaction was carried out in a 10L reaction chamber made of glass. A fine aerosol of α -cyclodextrin, which had been generated by an atomizer, was continuously introduced into the chamber. Gaseous I₂ was added into chamber by using a temperature controlled and nitrogen flushed test gas source, which was based on an open tube diffusion technique. After exiting the reaction chamber, the aerosol was analysed by ToF-AMS.

At the beginning of 2009 Huang and coworkers (1) reported an α -cyclodextrin/ $^{129}\text{I}^-$ -denuder for the quantitative collection of gaseous I_2 in combination with an off-line gas chromatography ion trap mass spectrometry (GC-IT/MS) method.