Technology Offer

Ozone scrubber

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Scientists in the group of Atmospheric Chemistry at the Max Planck Institute for Chemistry in Mainz have developed a novel thiosulfate based ozone scrubber to ensure accurate measurements of trace analytes. It is known from the literature that commercial potassium iodide (KI) containing ozone scrubbers can cause errors in the measurement of carbonyl compounds such as aldehydes and ketones due to byproducts formed from the oxidation of KI. Commercial ozone scrubbers based on sodium thiosulfate on quartz filters can ad- and absorb trace analytes and thereby cause measurement errors.
Thus a novel ozone scrubber based on a thiosulfate coated tubular stainless steel element was developed.

Background

The removal of ozone in atmospheric air samples is crucial to ensure accurate measurements of many analytes, e.g. volatile organic compounds (VOCs), which would be otherwise oxidized by ozone thereby altering their real concentrations. It is therefore highly desirable to remove ozone selectively before samples collection or on-line measurements.A variety of ozone scrubbers containing potassium iodide (KI) are available on the market. When the air sample containing ozone is drawn through the KI based ozone scrubber, the iodide (I^-) is oxidized to iodine (I_2), consuming the ozone. However it is reported that the presence of byproducts formed from the oxidation of KI can cause errors in the measurement of carbonyl compounds such as aldehydes and ketones in air using active sampling onto 2,4-dinitrophenylhydrazine (DNPH)-coated solid sorbent cartridges (1). Interferences with ozone have also been reported for various terpenes and terpenoids when trapped on cartridges (2).

Ozone scrubbers also use sodium thiosulfate ($Na_2S_2O_3$) coated quartz filters (3). The drawback of this method is that all the analytes need to flow through the quartz filter perpendicularly, thus some compounds of interest are ad- and absorbed on the $Na_2S_2O_3$ quartz filter. Furthermore, the surface areas of commonly used quartz filters are rather large, which provides a large number of active sites for the analytes to interact, possibly causing losses and hysteresis effects.

Technology

The technology described herein solves the issues of the commonly used ozone scrubbers by coating with $Na_2S_2O_3$pentahydrate the inner surface of a tubular element made of inert material such as stainless steel.

The method of coating includes melting Na_2S_2O3pentahydrate in an oven and then quickly applying it to a stainless steel surface, as it quickly recrystallizes at room temperature. Alternatively, the $Na_2S_2O_3$ pentahydrate could be applied with a device that keeps the melt at a constant temperature during the application process to ensure uniform application. If analytes loss and ad-/absorption and hysteresis effects are not of primary concern, the same process could be used to coat other surfaces, e.g. silica gel, for industrial processes.

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The effectiveness of the ozone scrubber of the invention was tested by flowing synthetic air through an UV lamp generating ozone and monitoring the ozone levels before and after passing through the ozone scrubber. The results were compared with an identical stainless steel ozone scrubber without a thiosulfate coated surface as shown in Fig. 1.

After use, the exhausted thiosulfate coating could be regenerated or, alternatively, it could be replaced with a new layer.
The tubular elements coated with $Na_2S_2O_3$ pentahydrate can be also part of devices for cleaning air such as air filters for industries that need to eliminate ozone emissions from exhaust gases, for printing and photocopying equipment using UV lamps and for semiconductor production facilities where the presence of ozone affects the yield of semiconductor devices.

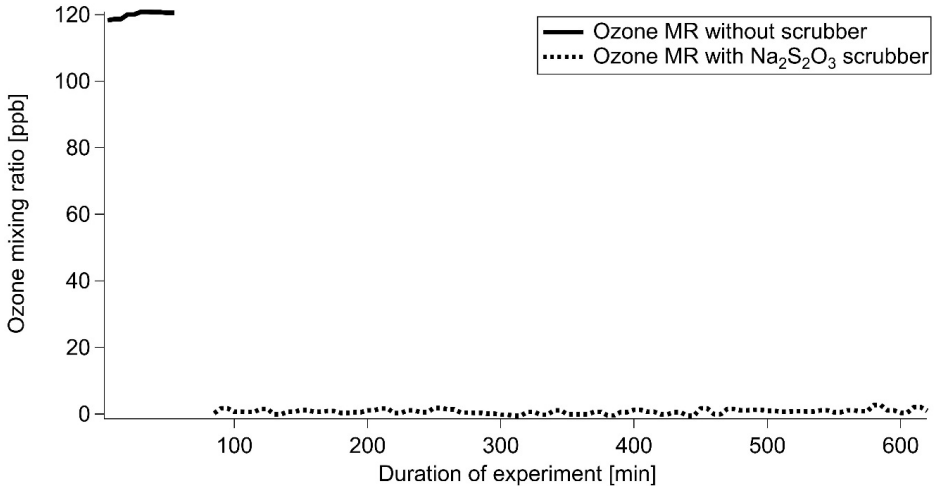

Fig. 1: shows the efficiency of a stainless steel ozone scrubber comprising a thiosulfate coated surface as described herein versus the efficiency of an identical stainless steel ozone scrubber without a thiosulfate coated surface.

Patent Information

European patent application filed in July 2018

Literature

1. Concerns on the Use of Ozone Scrubbers for Gaseous Carbonyl Measurement by DNPH-Coated Silica Gel Cartridge, *Aerosol and Air Quality Research*, 13: 1151–1160, 2013
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