

Underwater cryotrap - membrane inlet system (CT-MIS) for improved in situ analysis of gases by mass spectrometry

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Membrane inlet mass spectrometer (MIMS) allows online, real time, onsite and simultaneous analysis of trace gases during investigations of terrestrial as well as aquatic environments. For applied as well as pure research investigations of gases like methane, higher hydrocarbons or CO₂ are of specific interest.

The large quantity of water vapor passing the membrane inlet downgrades the detection limit, affects the ionization efficiency, or could cause condensation of water within the sensor section. These effects can be reduced by application of cryotraps. Whereas a wide range of cryotraps are available for application in the laboratory, for field measurements or deployments of underwater mass spectrometers there seems to be still a demand for compact and robust cryotrap systems. Required features of such a system are a small size and weight as well as energy consumption below 10 Watt.

Especially for application of underwater mass spectrometers (UWMS), we designed a cryotrap system that reduces the water vapor in the analytical line significantly and build a security system to protect the sensor unit in case of membrane rupture. The in situ cryotrap is a robust system within a self-contained pressure housing and is operated at -85°C.

We present the results of the assessment of the systems, in terms of the waste heat to cope with, the efficiency to trap water vapor, as well as side effects caused by trapping gases to be analyzed. Improvements of detection limits as well as signal stability are discussed. Furthermore the design of the MIS is considered. Beside the system assessment, field results derived by the underwater cryotrap system coupled to the UWMS InSpectr200-200 are presented.