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VALIDATION OF ANALYTICAL INSTRUMENTATION FOR CONTINUOUS ONLINE MONITORING OF LARGE SPECTRA OF VOCS IN CLOSED HABITAT DURING SIMULATION OF SPACE FLIGHT

Abstract

Toxicology monitorisation of closed habitats aims to protect astronauts' health by assessing possible hazardous impacts during space travel and establishing safe limits to protect astronauts from chemical effects. An important issue in this task is to provide a robust instrumentation and proper methodology for long term monitoring and detection of known (expected) or unexpected volatile organic compounds (VOC) in ppb concentration range giving almost immediate results. In this work we report the results of the first pilot study on environmental air toxicology monitoring during the 17-day simulated space flight condition under SIRIUS (Scientific International Research in a Unique Terrestrial Station) experiment in Ground-based Experimental Complex at the Institute of Biomedical Problems (IBMP) of the Russian Academy of Sciences, Moscow, Russia from 7th to 24th of November 2017. This experiment had six human participants isolated and confined in a mock-spacecraft habitat. Toxicology monitorization of the air inside of the 100 m3 closed habitat were performed by a GC-IMS instrument BreathSpec® based on ion mobility spectroscopy (IMS) technology with very high sensitivity (low ppb range) and good selectivity provided by 30-meter gas chromatography column. Apparatus worked in automatic on-line status under supervision and operation by one of the six crew-members. A total of 23 measurement sets, with 5 replicates each, were collected during 12 of the 17 days of the experiment. Developed sampling method and experimental protocol allows the detection of 33 different peaks corresponding of the 29 VOCs of interest. The results VOC analysis of the air obtained with the BreathSpec are compared with the parallel measurements of air toxicity obtained by GC-MS standard methods during the SIRIUS-17 experiment. From the analysis of 115 GC-IMS spectra we can observe a good stability of analytical measurements and detect the increase of 7 VOCs concentrations in the air of module 100 on the last days of isolation. This were probably originated from VOC's released by due to the structural materials, such

as wood or wood agglomerate or outgasing from electronic devices, as well as cleaning procedures of the module or even biological origins related to the human microbiome. This pilot SIRIUS-17 experiment shown that GC-IMS based technology can be useful in automatic long-time monitoring of toxicology levels aboard the ISS, spacecrafts or any other closed spaces.