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Application of PDHID detector in gas chromatographic method of continuous hydrogen concentration measurements in air

I. Grombik, I.Śliwka

The Department of Physicochemistry of Ecosystems, The Institute of Nuclear Physics, Polish Academy of Sciences,

Iwona.Grombik@ifj.edu.pl / Phone: +48 012 662 8453

The globally averaged hydrogen concentration in 2002 was about 0,5 ppm (parts per milion). An average annual increase of $0{,}6 \pm 0{,}1\%$ hydrogen per year is observed. The application of hydrogen technology may cause higher growth of hydrogen concentration in atmosphere because hydrogen is easy diffusing gas through different materials and it may escape to the atmosphere both from vehicles and from the production installations. In result the additional hydrogen may lead to reduction of hydroxyl radicals (OH), influenced on methane concentration in the atmosphere, which is the third greenhouse gas after water vapor and carbon dioxide. On the other hand the using fuel cells in motorization will restrict the emission of nitrogen oxides, carbon monoxide or carbon dioxide, what will reduce the air pollution.

Photochemical reactions, which can follow in the troposphere after the introduction of hydrogen economy, are not enough known to unequivocally define the direction of changes. That is why the emergency of continuous hydrogen concentration measurements in the air.

In the Department of Physicochemistry of Ecosystems localized in the Institute of Nuclear Physics Polish Academy of Science in Krakow the gas chromatographic (GC) method of hydrogen concentration measurements in the air (with the use of a Fisons GC) was developed. The air sample is analysed in two chromatographic columns filled

with a molecular sieve of type 5A working in the “back-flush” mode. To the hydrogen detection Pulsed Discharge Helium Ionisation Detector (PDHID) has been used. The sensitivity of the detector is about 0,5 mVs/pg at the detection limit 2 pg/cm^3 of hydrogen and the detector is linear in the range of mass 20 pg – 420 pg H_2.

Quantitative measurements of hydrogen concentration in air are carrying out continuously. Measurements of hydrogen in the air are done alternate with secondary standard in one-hour system, in sequence of injections: standard-sample-standard-sample. The observed temporary hydrogen concentration in the air of Kraków are calculated by the 5-point Lagrange interpolation method. We observed higher concentrations of hydrogen in April 2007 - about 0,65 ppm. By the end of July 2007 the concentration of hydrogen in the air decreased to about 0,55 ppm. The same phenomenon is observed at the other stations on the world, because the hydrogen shows a tendency of seasonal changes. Sometimes episodes are observed, which can be result of local anthropological source of hydrogen in Kraków or the inflow of air masses with higher concentration of hydrogen from outside Kraków region.

These continuous hydrogen concentration measurements in the air conducted in long time interval enable to define the background of seasonal and twenty-four hours changes of hydrogen concentrations in Poland (Central Europe) and the impact of the hydrogen economy on the environment in the future.

Keywords: Pulsed-discharge helium ionisation detector (PD-HID), gas chromatography, hydrogen concentration in the air