Geophysical Research Abstracts
Vol. 18, EGU2016-4149, 2016
EGU General Assembly 2016

New experience in atmospheric monitoring in Moscow city on the base of WSN technology

Alex Asavin (1), Artur Litvinov (2), Sergey Baskakov (), and Elena Chesalova (2)

(2) Vernadsky Geological State Museum, RAS, Moscow, (1) Vernadsky Institute of Geochemistry and Analitical Chemistry RAS, geochemistry, Moscow, Russian Federation (aalex06@inbox.ru)

The aim of this report is to present the gas emission of H2 in the general composition of atmospheric pollution of Moscow city.
We start the project at the beginning of 2015 year in two Moscow academicals organization -Vernadsky Institute of Geochemistry and Analytical Chemistry and Moscow Geological State Museum. One place is in the center of Moscow, near the Kremlin and other one is in the most clear zone of Moscow – Moscow State University place, Vorobyevy Mountains (high point of Moscow). We plan to compare these regions by the concentration of H2 and other gases (CH4, SO_2) for green gas pollution.
Application network of monitoring is composed of gas sensors (H2, CH4), complex autonomous equipment for measurement temperature, pressure, humidity and network of telecommunications (used ZigBee protocol).
Our project offer the technical solutions for monitoring network on the base of WSN (wireless sensor network) technology and the high-sensitive sensors of hydrogen and methane, software and electronic equipment with a transmitter network. This work is the first project in Russia.
Gas sensors for monitoring system were developed on the base of MIS-structures (metal-insulator-semiconductor). MIS-sensors are suitable for measuring the concentrations of the following gases: hydrogen, hydrogen sulphide, nitrogen dioxide, ethylmercaptan, chlorine and ammonia. The basis of the sensor is MIS – structure Pd-Ta2O5-SiO_2-Si,), which capacitance changes when reaction with gases occurs.
The sensor fabrication technology is based on the microelectronics device fabrication technologies and the thin film laser deposition technique. Sensor can be used for measuring the concentration of any gas among noted before, in ambient temperature range –30..+40° and RH 30 90% (30°).Three gas sensors with analog interface were made for our experimental monitoring system.
Original calibration was made using calibration by special standard mixture of H2 and atmosphere. There are 10-15 points on the each calibration graphics with different H2 concentration in standard gas mixtures.
The graphics represent the power functions. The accuracy of the approximating functions is 3-18 %. At low concentrations (H2 <3 ppm) – error is rather high (about 20%).So we think that 2 ppm is the low limit of measurement. The essential factor is a temperature drift. We estimate this drift as 20mV per 1 degree and make corrections, because measurements were made in wide temperature range (+29 - -20). To take this factor we added our network by meteorological sensors.
Each sensor network node has a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. All nodes are equal and serve as routers, so there is no need to plan nodes placement in advance Mesh Network protocol. Every node maintains a local routing table with information about one or several neighbors. The signal transmission between nodes and router used radio channel 2.6 GHz.
Communication between router and IT server used two methods: cable RS486 and GPRS modem. GPRS connection is unstable and influence on operating stability. There are some problems in using of directional antenna because of the high level of city's radio noises and radio interferences. Nevertheless, a number of experiments with use of different technical solutions allowed us to perform continuous monitoring during 2 months. As a result about 3 million data records were obtained during experimental works. This information provided an opportunity to develop the structure of database management systems to store data and the technology of online data collection from remote sensors. Using the abilities of program software a periodical (12h) automatic export/import was realized. Access to file on remote computers is opened using FTP protocol. Database forms derived tables for each sensors. We use triggers to modify data, for example, to modify signal from gas sensors to gas concentration, in depend of unique sensor name. Additional table gives geographical coordinates of each node. We use GIS project for visualization and data analysis.
Experiences revealed the inverse relationship between H2 concentration and temperature and pressure. Also we

revealed periodicity of gas concentration with different harmonics.
We could not find in literatures the similar works of H2 monitoring in cites. Exclusion is the work of (Necki et al., 2014) to organize continue monitoring in Krakow and it neighborhood. Authors also note periodicity in gas concentration affected by the seasons (increase in wintertime), day time (auto traffic).
The received data we consider as first experiments in organization of long time monitoring of cites atmosphere, using new technologies (WSN). This results we consider to be the first methodological experiments in the field of monitoring the atmosphere of the city by WSN technic. It is planned to update the correctness of the analysis based on a comparison with other gas analysis methods.
Acknowledgements
This study was supported by the program 44 presidium RAS “Search basic research for the development of the Russian Arctic”

Reference
Necki, Jaroslaw M.; Chmura, Lukasz; Bielewski, Jaroslaw; et al. Variability of Molecular Hydrogen in the Urban Atmosphere Based on Continuous Measurements in Krakow //Polish Journal of Environmental Studies 2014, V.23, Iss. 2, P. 427-434.