Description for general public.

Fast development of certain industry branches, such as plastic materials production, leads to generation of significant amounts of harmful organic compounds. This however, led to sudden increase of interest in techniques allowing for detection and monitoring of their concentration in environment or work places. One of these methods is ion mobility spectrometry (IMS). It is a fast, simple and sensitive analytical technique used for investigations of gaseous samples. The principle of this method is ion separations based on differences in their movements in electric field. The range of applications of IMS is very wide thanks to its many advantages such as short time analysis, accuracy, low concentrations detectability, low costs of use or real-time analysis without necessity of samples transportation to the laboratory.

IMS method's sensitivity and limit of detection (LOD) are strictly related to analyte ions generation taking place in reaction region of the spectrometer. Ionization processes depends on composition of drift gas, temperature and construction of detector's reaction region. Introduction of some substances, called dopants, to the gases flowing through the detector allows with high effectiveness to control ion-molecule reactions occurring in spectrometer. Dopant's molecules form so-called alternative reactant ions, which interact with analyte in a different way than ions present in pure drift gas. However, the excess of ions generated from water vapor present in the carrier gas causes the significant decrease of the sensitivity or, even entirely, makes the detection impossible because of the concurrent reactions.

The main purpose of this project is to investigate the quantitative dependencies of effect of humidity on detection of aromatic compounds carried out with use of nitrogen oxides in IMS. Sample introduction system with SPME (solid phase microextraction) fiber will also be built. This should eliminate the negative water vapor effects. For some compounds, investigations will include different working parameters of IMS spectrometer, i.e. will be carried out for different temperatures and dopants (NO and NO_2). Precise quantitative effect of humidity on detection with use of nitrogen oxides as dopants will be determined, because the increase of humidity results in decrease of sensitivity in analyses carried out with use of IMS. As an outcome the three dimension spectra will be provided. Additionally it will be tested if SPME as sample introduction system could resolve the problem caused by higher humidity of the carrier gas. The courses of ion-molecule reactions taking place in the detector will be also proposed.

Nitrogen oxides allows for IMS detection of e.g. aromatic compounds with low proton affinity. However, there was no precisely determined relation between detected concentration of an analyte and the humidity of the carrier gas which additionally is doped with the nitrogen oxides (three component mixtures). This could widen the application of the method. It could be then used in analysis and control of food and pharmaceutical products. The results of the project would also significantly increase the range of medical diagnosis applications. Moreover, the SPME technique as an introduction method to spectrometer should eliminate the humidity issue in IMS. Therefore the results should not only widen the spectrum of possible applications but also should enable the ongoing development of the IMS experimental capabilities.