Investigation of Low-Cost-Dryer Installed on the Low-Cost-Sensors used for Measuring the Particulate Matter in the Ambient Air

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In the field of air pollution control, sensors have been increasingly used for emission measurements for a long time, in addition to the usual emission measuring devices. On the other hand, for ambient air measurements, sensors were not sensitive enough to detect the usually very low concentrations of airborne contaminants in the outside air. Therefore, they were not used for air quality measurements for a long time. In recent years, however, there has been a development in various sensors, which makes them suitable also for ambient air measurements. Currently in many cities, different air quality sensor networks are emerging, some of them with several hundred sensors to determine the air quality, mainly the Particulate Matter (PM) components such as PM10 and PM2.5.

The network operators generally do not put much effort into quality assurance, either because lack of awareness to the need for quality assurance or due to the lack of resources and technology. An important influencing factor on the quality of the results of the PM sensors is humidity. In the presence of high humidity, the particles, due to the hygroscopic effect, grow which in turn lead to false results. Previous studies have shown that the hygroscopic growth is pronounced from around 70% of humidity; this is of big relevance considering that Germany is in a cold region with presence of moisture content in the ambient air most of the year.

The current work focuses on the comparison of PM sensors with a professional aerosol spectrometer and the application of self-made low-cost dryer. The results of comparative measurements of cost-effective sensors from different companies with professional aerosol spectrometers showed that all sensors require a calibration with a reliable standard. After calibration, one type of sensor gave satisfactory results for small particles ranging from 0.3 to 2.5 µm (PM2.5 signal). For coarser particles in the range of 2.5 to 10 µm (PM10-PM2.5 signal), this sensor did not provide satisfactory results. Another sensor type provided satisfactory results for all PM channels, PM10, PM2.5 and PM1. This sensor type also provides reliable results for 16 channels between 0.38 and 17 µm for particle number concentration. The results for the measurements done by using the low-cost dryer show that the dryer works really good and it reduces the effect of humidity.

In summary, the measurement results, obtained from low-cost sensors can be used after the application of quality assurance measures. For QA measures comparison measurements with expensive professional measuring instruments need to be done. Not all sensors deliver the same data quality. Some are even unsuitable for use in the ambient air.
The actual stage of the research with sensors at IFK will be presented.