INDOOR AIR QUALITY IN MODERN OFFICES IN HUNGARY FROM BUILDING SELECTION TO DETERMINATION OF AIR POLLUTANTS: A CASE STUDY

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Indoor air quality has a high importance in the everyday life of people of the 21st century, as people spend a large proportion of their time indoors. **OFFICAIR** is a European collaborative project between 2010 and 2013 focusing on indoor air quality (IAQ) in modern office buildings including sampling locations in Greece, Finland, France, Hungary, Italy, The Netherlands, Portugal and Spain. Office buildings were selected according to strictly established selection criteria (i.e., buildings not older than 10 years equipped with HVAC systems where smoking was not allowed and refurbishment and/or renovation were not planned before end of 2013). Therefore, in Hungary a preliminary survey on working environment was made in 24 buildings, mainly from Budapest. Finally, 4 buildings were selected according to these strict criteria and 1 more taking into consideration the availability of the property management of the building.

In the first stage, organic and inorganic air pollutants were monitored by passive diffusive sampling in 4 offices and 1 outdoor location, preferably close to the air intake of the HVAC system in summer 2012 and winter 2012/2013. **Volatile organic compounds** (BTEX, n-hexane, trichloroethylene, tetrachloroethylene, a-pinene, limonene, 2-butoxyethanol, 2-ethylhexanol, styrene) and **aldehydes** (formaldehyde, acetaldehyde, acroleine, propionaldehyde, benzaldehyde, hexanal, glutaraldehyde) were determined after proper sample preparation (thermal desorption or extraction) by gas chromatography (GC-MS) and high performance liquid chromatography from the Radiello samplers. As **inorganic air pollutants** NO_2 and ozone were also determined by suitable spectrophotometric methods using Gradko and Radiello samplers, respectively. Simultaneously, with the passive

sampling, relative humidity and temperature values were recorded at each location. The fresh air input into the offices was estimated by air velocity measurements by using a thermoanemometer taking into consideration the size of the grills. Modelling of air exchange rate was performed during the summer campaign in 2 out of the 5 buildings by using perfluorocarbon sources and tracers analysed by GC-MS.

Moreover, $PM_{2.5}$ samples were collected onto quartz fiber filters with low-volume samplers in one office and one outdoor location during 4 days for gravimetric and oxidative potential analyses. This latter consisted of a 4-h incubation at 37 °C of 5-mm discs cut from the loaded filters in 0.5 mL of a model respiratory tract lining fluid containing the antioxidants of urate (UA), ascorbate (AA) and glutathione each at 200 µmol dm^{-3}. After centrifugation, the remaining amounts of UA and AA were determined by reversed-phase HPLC with electrochemical detection. Glutathione (GSX, GSSG, GSH) was determined by enzyme-linked 5,5'-dithio-bis(2-nitrobenzoic acid) (DTNB) assay by using a microplate reader.

Parallel to the physico-chemical measurements, detailed on-line questionnaire was filled in by office workers on a voluntary basis aiming not only at the evaluation of work-related stress, comfort perception at work but also symptoms like tear film stability by like self-reported break up time, ocular surface disease as well short-term memory tasks. Moreover, detailed building checklist was filled in at each sampling location for chemical and health data interpretation.

Outcomes of the investigation will be presented in the lecture.