

## SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

**This report is submitted for approval by the STSM applicant to the STSM coordinator**

**Action number:** CA17136 - Indoor Air Pollution Network

**STSM title:** Analysis of selected non-volatile and semi-volatile organic pollutants in the indoor environment.

**STSM start and end date:** 01/02/2020 to 30/04/2020

**Grantee name:** Tiago Faria

### **PURPOSE OF THE STSM:**

(max.200 words)

The proposed work was the analysis of selected non-volatile and semi-volatile organic compounds in samples of PM<sub>2.5</sub> (29 residences and their respective outdoor areas). More specifically, an assessment of children's exposure to perfluoroalkylated substances (PFAS) and polybrominated diphenyl ethers (PBDEs) in homes of Lisbon, Portugal, was planned. This work allows a deep characterization of the exposure situation in this microenvironment and the writing of a scientific paper.

Other purposes of this STSM were the opportunity to increase knowledge in this area, learn new techniques and enhance the data of my PhD thesis. It was also proposed to contribute to WG3 and WG4 of CA17136, through a complete characterization of microenvironments, personal exposure, and dose assessment and source identification, making it possible to understand the pollutants and to identify the most relevant pollutants to be measured in the future (GT3) and the best techniques to be applied (GT4). In addition, the STSM has built a network between C2TN/IST and researchers at ENVSAU; it has enhanced synergies between institutions for a complete characterization of particulate matter already sampled in microenvironments (and analysed for chemical elements) and understand the best way to characterize the air pollution in different microenvironments: what is relevant to measure and obtain data that help interdisciplinary research in innovative science.

### **DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS**

(max.500 words)

The quartz filters were extracted and analysed for Perfluoroalkylated substances (PFASs) and polybrominated diphenyl ethers (PBDEs).

For PFAS, the filters are cut into a 15 ml polypropylene (PP) vial and spiked with the internal standard and sonicated for 30 minutes with 5 ml of methanol (MeOH) added. The mixture was centrifuged at 3000 rpm for 20 minutes, the supernatant is transferred to a new PP vial, and the extraction is repeated again with 5 ml of MeOH. The supernatants were combined, and the resulting extract was concentrated to dryness, reconstituted in 500 µl of MeOH/ammonium acetate, filtered through to 0.2 µm nylon syringe filter. Quantification was performed by liquid chromatography tandem-mass spectrometry with electrospray ionization in negative mode. Chromatographic separation was performed using a C18 Kinetex column (2.1 × 150 mm, Phenomenex, Torrance, CA, USA) and an Agilent 1200 Series HPLC (Agilent, Palo Alto, CA, USA). The data were run in the Analyst software, which was learned and allows to obtain the concentrations of each samples.

Regarding to de PBDEs, the filters were spiked with the internal standards <sup>13</sup>C-BDE-209 and <sup>13</sup>C-BEH-TEBP and the recovery standards CB-198 and <sup>13</sup>C-trans-chlordane and extracted by pressurized liquid extraction (ASE 200, Dionex) at 125 °C using dichloromethane:hexane (1:1) (both Rathburn, Walkerburn, Scotland).

After addition of syring standards, all samples were concentrated to 1 mL and analysed by gas chromatographic separation (model HP 6890) with mass spectrometric detection (MS, model HP 5973), using electron capture negative ionisation (ECNI) and methane as the ionisation gas at a pressure of  $1.9 \times 10^{-4}$  Torr. The compounds were analysed on a J&W Scientific DB-5 capillary column (length 60 m, 0.25 mm i.d., 0.25  $\mu$ m film thickness), with the exception of BDE-209, which was analysed on 15 m capillary column. Quantification was always based on a duplicate 10-point calibration. The data run was in the Instrument 1 Data Analysis software, which was learned and allows to obtain the concentrations of each samples.

An "easy-to-use" document in English of the Instrument 1 Data Analysis software was written so that more students can use it in the future.

An abstract was written with the title "Assessment of children's exposure to perfluoroalkylated substances and polybrominated diphenyl ethers in homes in Portugal" and submitted for oral presentation at the European Aerosol Conference (EAC2020) that will take place between August 30th and September 4th, 2020 in Aachen, Germany.

During this STSM, and due to the restrictions caused by the coronavirus (Campus closed a month and a half), part of the work had to be done at home. During this quarantine period in Denmark, the following work was carried out:

- Writing of a PhD article (exposure and inhaled dose) that will be linked to the data produced in STSM;
- Analysis of the data already obtained during the STSM;
- Research bibliography and start writing a scientific article that will be published with the results obtained within the scope of the STSM.

Meetings were held via Skype with my supervisors during this period, to discuss the work plan, data produced and the work to be developed at home.

Due to the corona-related delays with the laboratory work, my stay in Denmark was extended for another 2 weeks extra STSM, until May 15th, to finalize some samples. This extension was authorized by the institutions involved (C2TN/IST and ENV5/AU).

### **DESCRIPTION OF THE MAIN RESULTS OBTAINED**

(max.500 words)

Perfluorobutanesulfonic acid (PFBS) was the only perfluorosulfonic acid (PFSA) found in the samples, with an average concentration of 0.86  $\text{pg/m}^3$  in indoor and 0.41  $\text{pg/m}^3$  in the outdoor samples. Regarding perfluorocarboxylic acids (PFCAs), the compounds found were perfluorohexanoic acid (PFHxA) with an average indoor and outdoor concentration of 1.45 and 0.53  $\text{pg/m}^3$ , respectively, followed by perfluorooctanoic acid (PFOA) (1.34 and 0.48  $\text{pg/m}^3$ , respectively) and perfluorononanoic acid (PFNA) (0.77 and 0.18  $\text{pg/m}^3$ , respectively). Average concentrations of the four compounds were higher in indoor samples than in outdoor samples. Similar results were found in a study conducted in 57 Finnish homes (Winkens et al., 2017).

The PBDE analyses are ongoing and will include lower brominated compounds as well as BDE-209. BDE-209 is a major PBDE congener in the indoor environment (Vorkamp et al., 2011). It is present in the commercial formulation DecaBDE, which was the last of the PBDE products to be banned.

The results present in the report are provisional due to the coronavirus that delayed the laboratory part, being only possible to present part of them at the moment. In relation to PFAS, the laboratory part has already been completed, and the data from the last two batches has now been processed. The remaining data is presented above. In relation to PBDEs, the laboratory part is on going. The results obtained so far still need analysis and treatment, having been reviewed just to improve the laboratory procedure.

It is expected that the laboratory and data processing will be completed at the end of May/beginning of June. All results will be published in a scientific article to be written after the STSM. The results will also be presented (if accepted) at EAC2020.

Winkens, K., Koponen, J., Schuster, J., Shoeib, M., Vestergren, R., Berger, U., Karvonen, A.M., Pekkanen, J., Kiviranta, H. and Cousins, I.T. (2017) Environ. Pollut. 222, 423–432.

Vorkamp, K., Thomsen, M., Frederiksen, M., Pedersen, M. and Knudsen, L.E. (2011) Environ. Int. 37, 1-10

**FUTURE COLLABORATIONS (if applicable)**

(max.500 words)

- Continuation of laboratory work/treatment of delayed results due to coronavirus
- Continuation of the writing of a scientific article with the data produced within the scope of this STSM
- Possibility to carry out different analyses in order to have an even more complete characterization of the houses under study (non-target compounds, pesticides, etc). These analyses would be analysed in Denmark with the filters already sampled.