# Title: Using HVAC filters as a sampler for indoor and outdoor air

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**Introduction**: Organic compounds like flame retardants (FRs), polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and polycyclic aromatic hydrocarbons (PAHs) are consistently found in both indoor and outdoor environments. There are many possible matrices for measurement of these compounds (e.g. indoor dust, air – passive and active air samples), but all methods have limitations, like the heterogeneous distribution of the indoor dust, or noisy and expensive active air sampler. In this study we used filters from building-wide heating, ventilation and air conditioning (HVAC) units to evaluate levels of FRs, PCBs, OCPs and PAHs in indoor and outdoor environment, and to evaluate whether this method is feasible for screening of organic compounds levels in indoor and near-building outdoor environments. The advantages of this matrix are (1) sampling homogeneity, as the whole building is sampled and (2) samples are easy and cheap to collect. The disadvantages are that (1) broad aggregation of data, e.g., individual rooms and timepoints cannot be isolated, and (2) HVAC filters are not designed for analytical chemistry and thus can have strong matrix effects during analysis.

**Materials and Methods**: The filters from HVAC units were collected during years 2014 and 2015 in half year period. Filters were selected from the incoming air pathway (air entering the HVAC system from outdoors) and the outgoing air pathway (indoor air exiting the building). The HVAC filters are from a university building at Masaryk University in Brno, Czech Republic which contains laboratories and offices. The filters were extracted three times via sonication in 1:1 hexane:acetone (v/v). The extracts were split 3:7 by weight and cleaned. The 30% aliquot of the extract was cleaned on activated silica and sodium sulphate, eluted with 20 ml dichloromethane (DCM). The 70% fraction was cleaned on sulfuric acid-modified silica and eluted with 30 ml of hexane:DCM (v/v). Samples were analyzed for polybrominated diphenyl ethers (PBDEs), novel flame retardants (NFRs), PCBs, OCPs and PAHs.

**Results:** Most of the target PCBs, OCPs, PAHs and FRs were detected in the samples. Differences between incoming and outgoing filters were observed. Higher molecular weight PAHs (e.g., benzo(a)pyrene) had higher levels in incoming filters, suggesting higher concentrations entering the building, which can reflect higher levels in outdoor compared to indoor environments. In contrast, low molecular weight PAHs (fluorene) had higher concentration in outcome filters, as did PCBs, OCPs and most FRs. This suggests higher indoor concentrations of all these compounds and net indoor to outdoor transfer, e.g., contamination of the outdoor environment by indoor air. BDE 183, BDE 209 and 1,2-bis(2,4,6-tribromophenoxy)ethane (BTBPE) had similar levels in incoming and outgoing filters, while bis(2-ethylhexyl) tetrabromophthalate (BEH-TEBP) had higher levels in income filters. Seasonality in incoming filters was also observed; most of PAHs and PBDEs had higher levels in winter compared with summer. The method is possible to use for screening of indoor and near-building outdoor levels of organic compounds, and to evaluate the net contribution of indoor environments as a source to outdoor air.

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