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Exposure assessment of VOCs in an indoor workplace environment of a university building in Germany

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An indoor air quality survey was conducted, on selected floors at the Institute of Environmental Physics (IUP), University of Bremen during the summer of 2005. Continuous measurements were carried out during 14 consecutive days without any disturbance to the functioning of the building. PTR-MS and a newly developed method for methanol measurement were used to monitor VOC (Volatile Organic Compound) and carbonyl levels in different indoor environments at IUP. A regression model was also used to interpret the measurements. The characteristics and mixing ratio of 20 targeted compounds varied widely in the microenvironments. The mean indoor/outdoor (I/O) ratios of pollutants appears to be higher than 1.0, except for benzene. Furthermore, apart from direct emission from indoor materials and infiltration of outdoor air, other anthropogenic sources like tobacco smoke also contributed significantly to the indoor pollution. Almost all compounds showed distinct peaks during the indoor smoking hours. These results suggest that active smoking was a major source of exposure to the carcinogens and styrene. Pollutants, which were likely to be associated with cleaning products/materials showed higher mixing ratios at lower ventilation rates. Indoor concentration of all compounds were found to be 2-10 times higher in weekdays compared to the weekend days, exhibiting a strong correlation with human activities. A range of pollutants (such as C8 aromatics) was emitted from office printers even in the idle mode; most of which can act as respiratory irritants. Preliminary estimate and comparison with previous studies on the health risks due to carbonyls and VOCs indicate that long-term exposure to the peak values reported in this study for TVOCs (total VOCs) have a probability of 1/10000 for developing serious health problems. Though

the TVOC mixing ratios in comparison with the individual MAC (maximum allowable concentration) values are 2 orders of magnitude below the threshold, the average lifetime cancer risk due to an ~8 hr exposure per day could be even higher within a certain subgroup of population! The results also suggest that source control measures, in addition to adequate ventilation, are required to limit concentrations of VOCs and carbonyls in office environments. The characterization of indoor air pollutants hence, demand a comprehensive survey of non-industrial workplace sites and remediation measures to improve air quality in the offices. The results hence give an insight in to the personal exposure levels and pollutant transport in a typical non-industrial workplace.