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Evaluation Of The Overall Particle Emission Reduction Efficiencies Of Commercially Available Laser Printer Filters

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The performance of three commercially available filter systems [improved DEXWET filter system Modular Professional 2000 (DW), Filter A and Filter B], specially assigned for office machines was investigated. Therefore, the overall particle emissions evolving from a standard b/w laser printer during a print job were investigated, using a specially designed exposition test chamber with a volume of 0.4 m³. Measurements with and without mounted filter systems were performed.
During the measurements, special attention was paid to investigate the overall reduction of the particle emissions by the installed filter system.

The test chamber comprises eight stainless steel dilution air inlets as well as a conical shaped sample dome on the top of the chamber. Temperatures and relative humidities were measured and monitored at four positions in the setup (see Fig.1). The values obtained at the chamber inlet (purified dilution air T_1, RH_1), chamber outlet (emission sample T_2, RH_2), inside the chamber near the printer fan (T_3, RH_3) and inside of the printer housing near the toner cartridge (T_4, RH_4) were recorded. Additionally, an anemometer was installed at the printer fan outlet to evaluate the streaming velocity of the airflow exiting the printer and thereby the pressure drop caused by an installed filter.

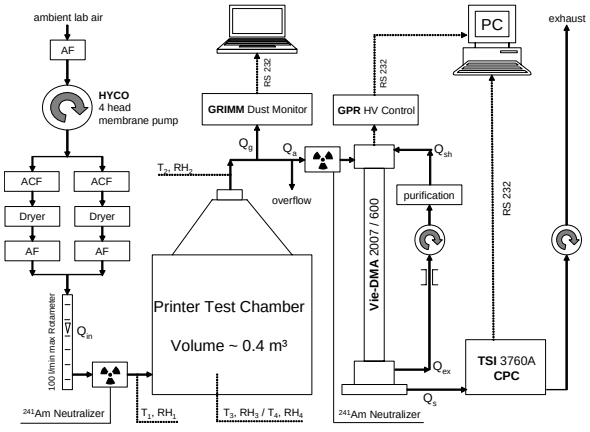

Fig. 1. Experimental Setup

To determine the Number Size Distribution (NSD) of the emitted particles in the size range below 300 nm, Electrostatic Mobility Spectrometry (EMS) with its core part a Differential Mobility Analyzer (DMA) and a Condensation Particle Counter (CPC) as sensor was applied. To minimize charge effects of potentially highly charged aerosols on the sampling and evaluation, the chamber was flushed with bipolar ions produced by an ^{241}Am neutralizer. A second size analyzing system, based on optical aerosol classification (GRIMM Dust Monitor) was installed inline with the outlet of the sample dome to determine the NSD for particles larger than 300 nm.

One print job was defined by a series of five blocks of consecutively printing 50 sheets with a delay of 15 seconds between the individual blocks. An achromatic template according to Blauer Engel RAL-UZ122:2006-04 with 5% coverage served as test page. Exclusively original toner material from the printer manufacturer and paper brands suggested by the printer manufacturer were used throughout the study.

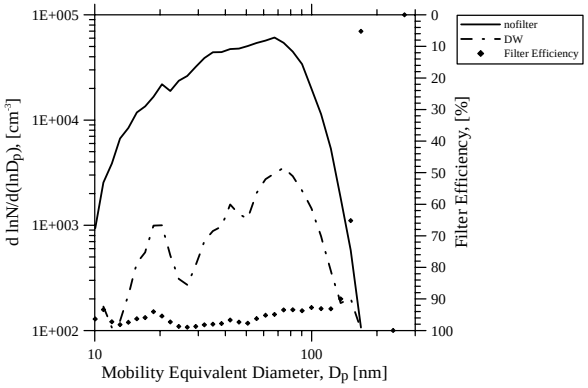

Fig. 2. Example for a typical number size distribution of laser printer emissions; unfiltered (nofilter) and filtered using the Dexewet filter system (DW).

This study shows that the overall retention efficiency of individual filter systems mounted on the air exit of the laser printer strongly depends on their pressure drop. A larger pressure drop causes particulate matter bypassing the filters through the remaining openings of the printer (eg. paper collection tray) and thereby deteriorating the overall filtration efficiencies evaluated by the chosen method.