D4.5.1.3	Requirements for in-door aerosol sensors	Report	48	Report (TUT/Pegasor)

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Background

Generally commonly used techniques and existing standards for indoor aerosol concentration measurements are based on mass related PM2.5 (mass concentration of particles smaller than D_p = 2.5 μm). Practically bigger particles (D_p > 1 μm) dominates the PM2.5 result. However, according to the present understanding the smaller particle-size range usually dominates the health risk caused by exposed particles. Especially the role of ultra-fine particles (UFP) has been emphasized. Because the lower size limit of traditional low-cost optical particle sensors is approx. 300 nm, they cannot yield health relevant information on exposures.

The main needs of indoor aerosol sensors are related to monitoring the indoor air concentration, monitor the condition of ventilation system and efficiency of particle filters.

Indoor particle sources and factors affecting indoor concentrations

Smoking and cooking are most significant indoor sources of indoor aerosols. Their size range extends down to the UFP range. However, in polluted cities the outdoor contaminant usually dominates indoor particle concentrations. Outdoor air penetrate indoor through the ventilation system and by infiltration. Majority of this source is traffic origin primary and secondary ultra-fine particles.

The indoor particle concentration can be reduced by filters in the ventilation /HVAC system or by separate filtration units in rooms. The weakest filtration efficiency is in submicron particle size range. This fact also emphasize the importance of monitoring the ultra-fine range.

Basic alternatives for ultra-fine particle monitoring techniques are based electrical methods and condensation nucleus counters (CNC). Electrical methods are based on charging sampled aerosol particles and subsequent measurement of the electric current carried by the charged particles. The instruments based on electrical method can be constructed to be robust, and their operation is stable. In condensation nucleus counter (CNC) the sampled particles are grown up to size capable to be detected optically. This is realized by condensation in supersaturated vapour (typically butanol), requiring handling of toxic chemicals. The required warm-up time is also an unwanted feature in the case of short measuring events. The long term stability of this kind of instruments are generally not good.

There are no general agreement, what kind of single measurement result is most relevant when the health effect is considered. Quite commonly so-called active surface area is proposed to be the best compromise for the metrics. The reading of electrical monitors gives directly a reading proportional to the active surface area. On the other hand, the active surface area seems to be quite difficult understand as metrics among other people than aerosol experts. The number concentration is simpler metrics in that sense. The CNC counts the sampled single particles giving directly the reading as number concentration.

General requirements indoor quality instruments according to different customer groups

- Short warm-up time,
- automatic long term operation with long cleaning and service interval (> 1 year),
- capability to stand-alone operation,
- data storage capabilities,
- continuous data transfer capabilities,
- self-diagnostic features.