

DEMONSTRATION OF A NEW COUNTING INSTRUMENT FOR MEASURING AMBIENT PARTICLE NUMBER DISTRIBUTIONS RESULTING FROM ROAD TRAFFIC

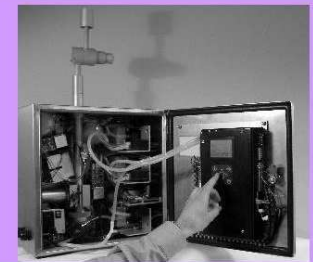
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INTRODUCTION

Studies of the impact of fine and ultrafine particles on health have gained significant importance in recent times. Particle mass fraction PM_{2.5} has been identified as 'High risk respirable fraction' as per ISO 7708. Research suggests that the number concentration of these fractions may be far more significant for health than their mass concentration. Currently, many monitoring instruments, for example, the TEOM and Partisol are based on particle mass. Emissions from diesel vehicles in particular release high number concentrations of particles of size typically in the ultrafine region. This work reports on a newly developed real-time particle counter and preliminary results of its application are presented. The instrument is based on light scattering & condensation nucleus techniques and measures particles from 10 µm down to 10 nm. Initial results from laboratory evaluation of the instrument and real-time measurements of urban atmospheric particles are presented. Measurements of particle concentrations have been made at roadside and background sites in Bedford, UK and at an urban site in Birmingham, UK. The number distributions of the particles at these selected sampling sites are examined in terms of meteorological parameters and traffic sources. The mass distribution of the particles is compared with the real-time data from TEOM data at Birmingham, UK.

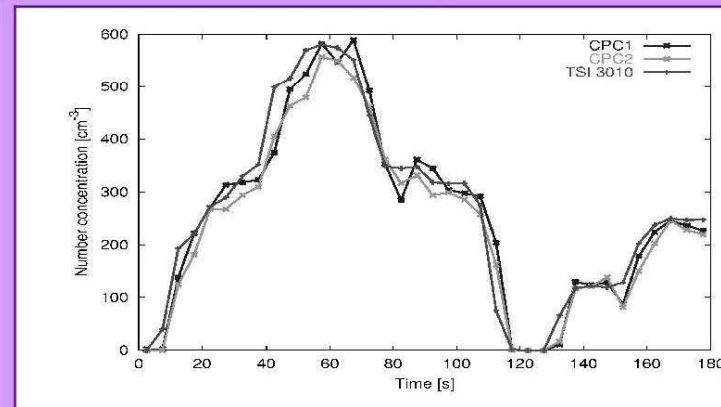
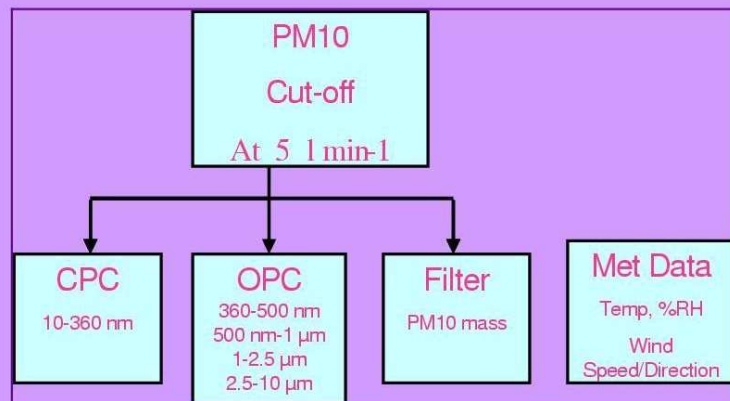
New Particle Counter



FEATURES

- Size classification between 10 nm and 10 µm
- Concentration range: 0.1 to 400,000 cm⁻³
- Calculated mass concentration
- Additional gravimetric mass concentration

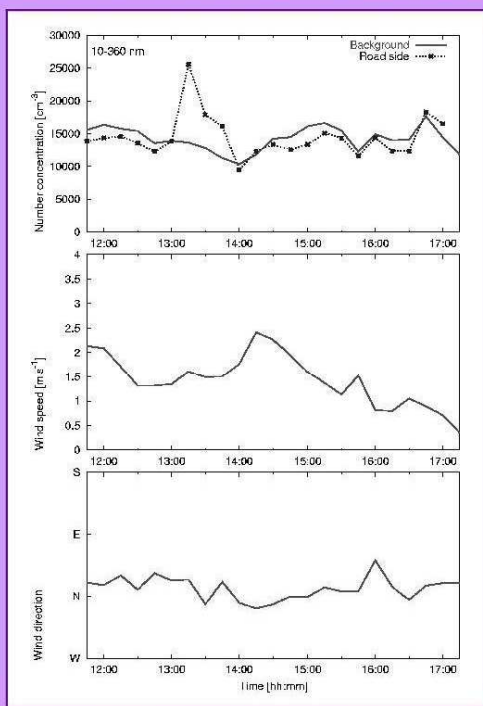
Instrument Overview



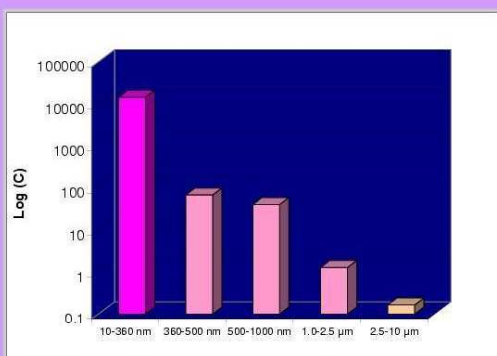
Calibration results

Comparison between the CPC performance of two replicas of the new instrument and a TSI CPC. Good agreement with TSI CPC was observed.

MONITORING RESULTS - BEDFORD SITE

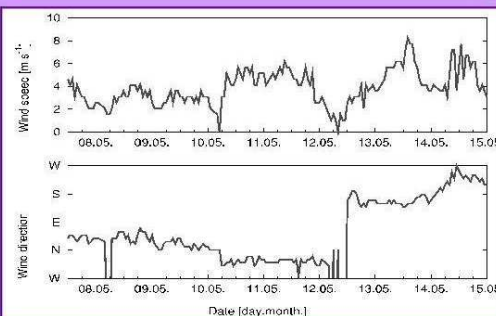
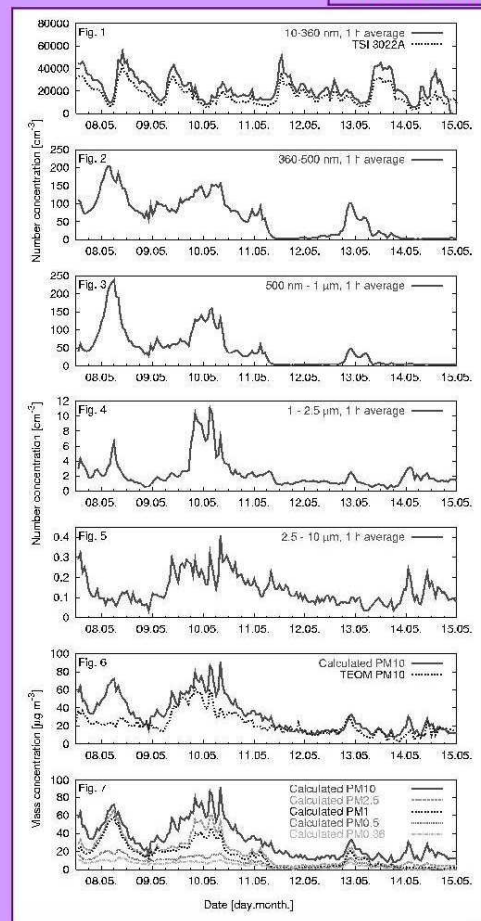


Particle number concentrations in the range of 10-360 nm recorded at the roadside and background sites in relation to Meteorological data. Ultrafine particles generated from vehicular traffic remain suspended and contributed to background site measurements.



Particle size distribution at roadside site. [C = particle concentration (cm⁻³)] Significant contribution from ultrafine particles due to vehicular traffic (mainly from diesel vehicles) was observed.

MONITORING RESULTS - BIRMINGHAM SITE



Meteorological Data observed at the monitoring site

METHODOLOGY

- Monitoring has been done from 30.04.2002 to 15.05.2002
- Number concentrations in the size ranges of 10-360 nm, 360-500 nm, 500 nm-1µm, 1-2.5µm, 2.5-10 µm have been monitored every second and 1 hour average concentrations were computed.
- Mass concentration was computed by smoothening the particle distribution and compared with TEOM data.
- Data was analysed with respect to Meteorological data.

OBSERVATIONS

- Fig 1 shows the number concentration of particles in the range of 10-360 nm. Close agreement with TSI 3022A CPC was observed.
- Figures 2-5 show the number concentration of particles in the ranges of 360-500 nm, 500 nm-1 µm, 1-2.5 µm, 2.5-10 µm.
- Fig 6 compares the calculated PM10 from number concentration measured by the instrument with TEOM PM10 measurements. Trends are consistently comparable at this monitoring site.
- Mass concentration of particles of various fractions is depicted in Fig 7. PM1.0 is the major part of PM10, contributing up to 80%. Further, PM1.0 contributed up to 90% to PM2.5 at this monitoring site.

RESULTS AND CONCLUSIONS

- The performance and accuracy of a new multi-channel ambient particle counter has been demonstrated. Good correlation has been observed with other CPCs. The trends of calculated mass concentration followed closely with TEOM measurements at the monitoring site.
- Smallest fraction of particles (10-360 nm) is the dominant contributor to the total number of particles. In many cases representing over 99% of sample.
- Ultrafine Particles generated by the vehicular traffic, mainly from diesel vehicles, remain suspended for a longer time and contribute towards high concentrations at far away places.
- Contribution from PM1.0 represented up to 90% of PM2.5. PM1.0 was the major contributor to PM10 at the monitoring site.

FUTURE DEVELOPMENTS

- Detailed investigations of the variations with TEOM measurements.
- Extensive participating in international monitoring campaigns.
- Measurement of additional size fractions in the ultrafine region.
- Real-time mass measurements.

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