Aerosol Particles in the Indoor Environment of the Týn Church in Prague

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Particulate matter inside cultural heritage buildings possesses different degrees of risk to materials. Particles not only cause soiling but are abrasive, provide sites for surface reactions and have a potential to damage artifacts due to their hygroscopic nature (Hachtfield, 2005, Nazaroff *et al.*, 1990). The aim of this study was to investigate concentrations and sources of airborne PM in the indoor environment of the Týn Cathedral in Prague.

Measurement was performed during the exhumation of remains of the astronomer Tycho Brahe (5 days intensive campaign in November 2010). The measurements included particle number concentrations and size distributions determined by a Scanning Mobility Particle Sizer (TSI, USA) and an Aerodynamic Particle Sizer (TSI, USA), covering the size range 10 – 20,000 nm. During the campaign the traditional Christmas markets took place in front of the cathedral. The markets started every day at 9 AM a finished around 8 PM. On 15 November the tomb was opened and the remains were exhumed. During the next 3 days the church was closed for public. On 19 November the remains was deposited back into the tomb during a celebration.

Time behaviour of coarse particles (> 2.5 μm) showed work at opening of the tomb and visitors as a source. The time behaviour of submicron particles concentration (< 200 nm) showed periodical increase starting at about 9 AM, with maxima at about 8 PM, followed by subsequent decrease to initial values. It indicates outdoor origin with close markets as the most probable source. During the celebration significant contribution of submicron particles from burning candles and incense was observed (Fig. 1).

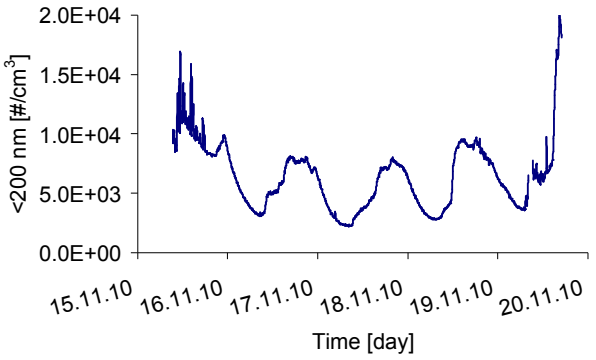

Figure 1. Time series of indoor number concentration of particles < 200 nm.

To describe in detail sources of fine particles in the indoor environment measurements of spatial and temporal variation of those particles were performed during the Easter markets (April 2011). The measurements were done by a P-TRAK (TSI, USA) during three periods in a day: (a) early morning (8 AM) – before markets and visiting hours started; (b) in the beginning of visiting hours and markets (10 AM); (c) during the full operation of markets and visiting hours (12 AM). Scheme of the church with average values recalculated to spatial distributions of concentrations during these periods is shown in Fig. 2a,b,c. The results revealed that in early morning the indoor concentration is homogeneous (2a) and started to grow close doors (points A, C, E, G) after the beginning of the markets (2b). Another source of fine particles is lighting of candles by visitors (point J in Fig. 2c).

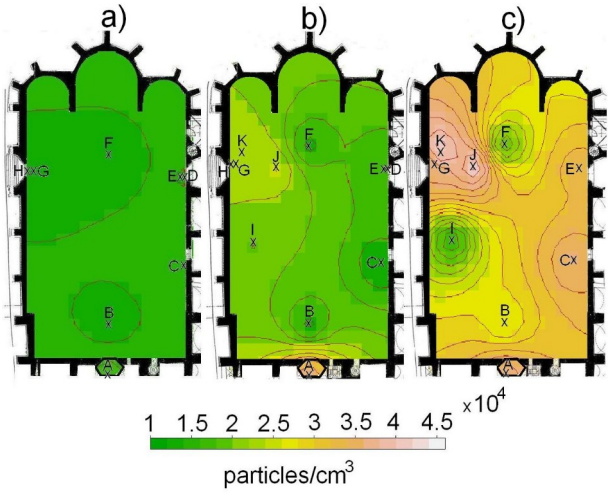

Figure 2. Scheme of the cathedral with measuring points and average values recalculated to spatial distributions of concentrations during the three periods of the measurement.

Hatchfield, P. B. (2005) *Pollutants in the Museum Environment.* Archetype Publications, London.
Nazaroff, W. W., Salmon, L. G. and Cass, G. R. (1990) *Environ. Sci. Technol.*, 24, 66-77.