OC and EC analyzed in PM$_{10}$, PM$_{2.5}$ and PM$_{1}$ using thermographic and thermo-optical method at Melpitz site in Germany – a two year comparison

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Since 2003 organic (OC) and elemental carbon (EC), in sum total carbon (TC), were quantified at quartz-fibre filters (HV) with an analyzer, C/S-Max, Seifert Instruments, Germany using a variation of the Guideline VDI2465 (Part 2). This thermographic method (TGVDI) is suitable for quartz filters from high-volume-samplers and also for samples on aluminum foils (melting point $\approx 660^{\circ}$C) using in BERNER-impactors because the maximum temperature doesn’t exceed $650^{\circ}$C. Charring processes cannot be accounted here (Spindler et al 2012). A thermo-optical method (TO) using the Lab OC-EC Aerosol Analyzer by Sunset Laboratory Inc. U.S.A. was introduced in 2012 together with temperature protocol EUSAAR2 (Cavalli et. al 2009), transmittance detection and charring correction (TOTEUSAAR2). In European networks, EMEP$^1$ and ACTRIS$^2$ this method is the preferred technique for quartz fibre filters (final temperature $850^{\circ}$C). The TC detected by TGVDI represents therefore about 84% of TC from TOTEUSAAR2. For a transformation of measurements from the past, avoidance of parallel analysis of quartz-filters with both methods and for a consequent use of charring correction in future, were derived empirical conversion equations for PM at Melpitz site for daily PM measurement in 2012 and 2013 (Equation 1).

\[
[\text{OC}; \text{EC}; \text{TC}]_{\text{TGVDI}} = m \times [\text{OC}; \text{EC}; \text{TC}]_{\text{TOTEUSAAR2}} + n \quad (1)
\]

Because there was no dependence from the particle size but from the season, conversion equations were calculated for twelve months over all sizes in both years. For OC and TC a correlation exists with $r^2$ of about 0.88 and 0.95, respectively. As EC has a low absolute concentration and a higher spreading in detection ($r^2$ is about 0.69), it was calculated as EC=TC-OC. Carbonaceous fractions for TOTEUSAAR2 can be estimated now from TGVDI. The results for OC, EC and TC in PM$_{10}$ are 103, 124 and 103% in 2012 and 96, 121 and 82% in 2013, respectively. For impactors estimations cannot be controlled because there are particle sizes smaller than PM$_{1}$ and the carrier material is aluminum. A comparison with AMS measurements (OC derived from OM) indicated that OC in PM$_{1}$ from TOTEUSAAR2 can represent the best compliance (sites in Germany and Italy) compared to TGVDI or TOREUSAAR2 (detection by reflectance).


1) Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe

2) Aerosols, Clouds, and Trace gases Research InfraStructure network