EVALUATION OF EDXRF DETECTION LIMITS OF AIR SAMPLES WITH CUSTOM LOW-LOADED MULTI-ELEMENTAL REFERENCE MATERIALS

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Twenty one identical multi-elemental reference materials (MEs) on PTFE filters with mass loadings as close to estimated Method Detection Limits (MDLs) as possible, containing 31 elements are generated using aerosol deposition system at the University of California-Davis (UCD)[1,2,3]. The derived EDXRF (Panalytical Epsilon5, Almelo, The Netherlands) MDLs based on MEs (MDL_{ME}) and calculated laboratory blanks-based MDLs (MDL_{LB}) are reported and compared based on the following methodology:

1. The laboratory blanks-based MDL (MDL_{LB}) is initially calculated using Eq.1:

$$MDL_{LB} = \overline{X_{LB}} + t_{(n-1,1-\alpha=0.99)} \times SD_{LB} \quad (1)$$

where, $\overline{X_{LB}}$ is the mean of n laboratory blanks, SD_{LB} is sample standard deviation of those results, and $t_{(n-1,\ 1-\alpha\ =\ 0.99)}$ is the student's *t* value appropriate for a 99% confidence level with *n*-1 degrees of freedom.

2. Multiple MEs are generated at loadings 3 to 5 times higher than MDL_{LB}. These MEs are analyzed on different days, and ME-based MDL (MDL_{ME}) is calculated using Eq.2:

$$MDL_{ME} = t_{(n-1,\ \ 1-\alpha=0.99)} \times SD_{ME} \quad (2)$$

3. The higher value of MDL_{LB} and MDL_{ME} is reported as MDL.

The similar values for MDL_{LB} and MDL_{ME} (abs. relative difference ≤ 25%) were obtained for K, Ca, Cr, Co, Se, Rb, Cd, Sn, Sb, Ba, Ce, and Pb. Absolute relative difference between MDL_{LB} and MDL_{ME} was between 25 and 50% for Al, Si, Mn, Fe, Cu, Sr, Zr, Ag, In, and Cs. For the rest, MDL_{LB} are at least 2 times lower than MDL_{ME}.

In addition, the capability of generating "identical" MEs was evaluated according to Eq. 3:

$$Var_{cham} = Var_{ME} - Var_{XRF} \quad (3)$$

where, Var_{cham} is the variance of chamber when collocated samples generated (n=21), and Var_{ME} is the variance of collocated samples analyzed by XRF, and Var_{XRF} is the variance of the XRF, where Var_{ME} and Var_{XRF} are independent variables. The ratios of Var_{cham} and c_{ME} were within 1%, element and c_{ME} dependent.

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