

Trace element analysis of waste water and eluate samples by total reflection X-ray fluorescence spectrometry

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Total reflection X-ray fluorescence (TXRF) spectrometry has been considered as an alternative to induced couple plasma atomic emission spectrometry (ICP-OES) and ICP-mass spectroscopy (ICP-MS) for liquid sample analysis. Compared to such chemical analysis methods, TXRF is advantageous in that measurements are fast and quantification can be performed by internal standard addition method without the need to set up calibration curves. The simple sample preparation only requires pipetting the liquid onto a carrier reducing time for analysis and consumption cost. In this study, waste water and eluate samples were analyzed by the benchtop TXRF spectrometer NANOUHUNTER II (Rigaku). The spectrometer is equipped with a fine focus 600 watt Mo target X-ray tube, a double-stacked synthetic multilayer mirror and large area silicon drift detector (SDD) for high-sensitivity analysis.

Table 1 shows the analysis results for a waste water sample. High concentration level of the original solution and low concentration level at 1:100 dilution were evaluated since waste waters frequently contain a wide concentration range of complex components depending on for example treatment process and sampling environment. Y and Ag standard solutions were added as internal stand. An aliquot was pipetted onto a quartz glass carrier and dried for sample preparation. The dried diluted sample residue containing fewer components than the original sample reduced background intensity of the TXRF spectrum and has lower LLD values compared to the original sample. The analysis values are in good agreement with standard values for both original and diluted samples demonstrating the method's applicability for analysis of wide concentration ranges of toxic components in environmental water. The wide dynamic range and direct analysis of TXRF technique is therefore well suited for screening analysis. In the poster presentation, results of eluate sample analysis are also discussed.

Table 1 Analytical results of EnviroMAT-waste water

(a) Original waste water				(b) Waste water diluted 100 times			
Unit: mg/L				Unit: mg/L			
Element	Standard value	Analyzed value	LLD	Element	Standard value	Analyzed value	LLD
V	4.84	2.6	0.021	V	0.0484	0.037	0.0021
Cr	6.12	3.7	0.026	Cr	0.0612	0.053	0.0033
Mn	12.1	7.9	0.020	Mn	0.121	0.11	0.0025
Co	8.05	5.1	0.013	Co	0.0805	0.070	0.0016
Cu	10.7	7.0	0.0092	Cu	0.107	0.099	0.0011
Zn	2.92	2.1	0.0077	Zn	0.0292	0.046	0.0005
As	7.92	7.4	0.0034	As	0.0792	0.076	0.0006
Se	2.65	2.0	0.0044	Se	0.0265	0.032	0.0006
Cd	2.29	2.1	0.070	Cd	0.0229	-	-
Pb	4.13	4.4	0.0083	Pb	0.0413	0.043	0.0014