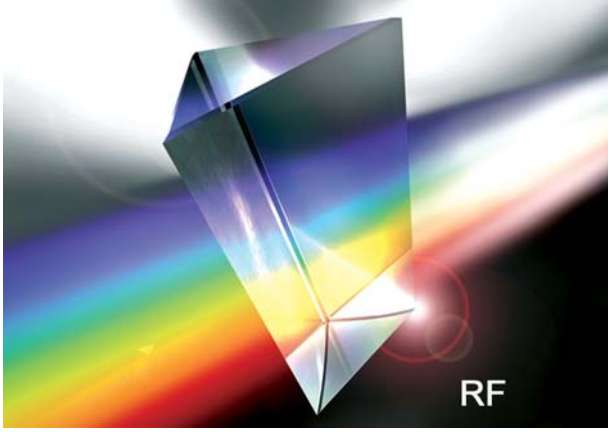
Application Note

Determination of Mercury in Water using Fluorescence Spectroscopy



Compound containing mercury are theme of hazardous materials in environmental field because of their high toxicity. With this application will be shown the determination of mercury in water, reason is that the sensitivity of fluorescence spectroscopy is high enough to meet the detection limits of a trace analysis. To detect elemental mercury using fluorescence it must be chemically bound into a fluorescence active complex. Fluoresceine is used as corresponding complex generator. The water samples have to be treated wet chemical because they cannot be used as found.

Mercury and Fluoresceine in Water[1]

The base of the determination is a reaction from Hg^{2+} Ions with Bromide and Fluoresceine in water. The ion pair resulting from it is the Tribromomercurate and protonated Fluoresceine which will be extracted using n-Butylacetate. The extract shows an excitation wavelength at 452 nm and emission at 476 and 510nm.

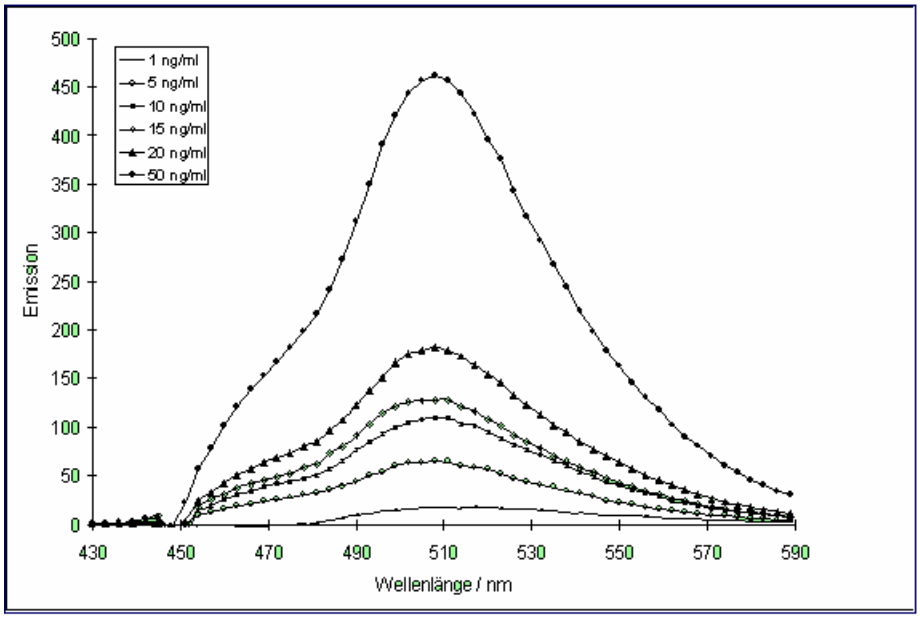


Fig. 1: Emission spectra showing Hg^{2+} in Fluoresceine, containing 1 to 20 ng/ml Hg^{2+}

In Figure 1 are presented the spectra of a measurement series based on solution of 1 ng to 50 ng/ml of Mercury content. Easily to see are both maxima at 510 nm and a shoulder at 476 nm. To get view of these spectra the spectrum of the reference solution of the solvent had to be subtracted from the sample spectrum. It is fluorescence from the solvent because the bromine ion and the protonated fluoresceine generate an own fluorescence active complex. Six standards were created to build a quantification model. The measurement results were calibrated using the classical method of least square (CLS). The regression coefficient was found with R=0.9987. [2] The calibration curve is shown in figure 2.

Hg^{2+}-Konz. ng/ml	Emission 476 nm	Emission 510 nm
1	4,01	20,16
5	29,4	61,22
10	46,13	103,99
15	55,45	132,06
20	75,13	180,52
50	186,64	463,51

Table 1: Emission values from the two analytical wavelength 476 and 510 nm for the 6 mercury based standards

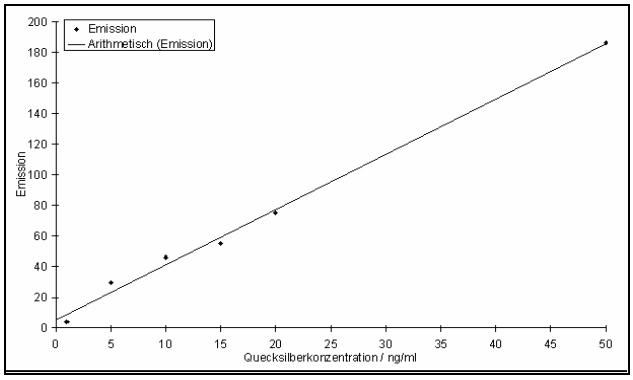


Fig. 2: Presentation of the calibration curve showing a regression coefficient from R= 0.9987 with the emission values using wavelength 510 nm for the concentration range from 1 to 50 ng/ml Mercury (II) ion.

Instrument:
RF-5001PC Serie installed with Standard cell holder for 10x10mm cells
Resolution 3nm fort he Excitation and Emission measurement

Fig. 3: Shimadzu Fluorescence spectrophotometer RF-5301PC

Analysis result

Using this procedure 1ng/ml Hg^{2+} with Fluoresceine in water is possible to detect easy [2]. The shown method is valid for water and waste water analysis. Depending on the selectivity of fluorescence spectroscopy in combination with this specific fluorescence complex it was not found any other ion which disturbed the analysis
[1]. The linearity of this working curve was found in this application with 1 to 50 ng/ml of mercury in water.

Literature:

[1] M. D. Mariscal, J. Galban, M. L. Urarte, J. Aznarez,
Fresenius J. Anal. Chem. 342 (1992), 157-162

[2] Andrea Scholz, Instrumentelle Analytik, UNI-GH-Duisburg, September 1995