

Choosing the method of analysis

Selection of an analysis method requires a consideration of the strengths and weaknesses of each potential method.

Q1: What general criteria would you consider when selecting an appropriate analysis method?

Metal cations are one important set of species in water samples. There are a number of ways that metals can be analyzed. The most common are Atomic Absorption (AA), Ion chromatography (IC), Ion-selective electrodes (ISE), and Inductively Coupled Plasma Spectroscopy (ICP).

The following links provide general background on each of the methods:

- Heavy Metals in Lake Nakuru – Atomic Spectroscopy
<http://community.asdlib.org/activelearningmaterials/nakuru-heavy-metals/>
- Ion Chromatography
[Analytical Chemistry 2.0: Chromatographic and Electrophoretic Methods](#)
- A Beginners Guide to Ion-Selective Electrode Measurements
<http://www.nico2000.net/Book/Guide1.html>
- Inductively Coupled Plasma Spectroscopy
<http://www.asdlib.org/learningModules/AtomicEmission/index.html>

The limit of detection is an important figure of merit that can be used to compare the sensitivity of methods for the analyte of interest. For metals, Table 1 gives a general rule of thumb as to the methods that may be pertinent for different concentrations.

Table 1. Suggested analyte classification table for common cation analysis. See *Analytical Chemistry 2.0 (Chapter 3 – Section 3D)* on the Analytical Sciences Digital Library website for additional information.

Analyte Classification	Concentration Range (%(w/w) & (ppm))	Appropriate Analytical Methods	Analyte Amount (mg) Based on 25 mL sample size
Major	1 - 100 (10000 - 1000000)	Titrimetry, Gravimetry	25 - 2500
Minor	0.01 – 1.00 (100 - 10000)	Titrimetry, Potentiometry, Spectroscopy,	0.25 – 25

Trace	$1 \times 10^{-7} - 0.01$ (10 ppb – 100 ppm)	Potentiometry (to low ppm) Spectroscopy (entire range)	$2.5 \times 10^{-6} - 0.25$
-------	---	---	-----------------------------

Homework Question:

Your group will be assigned a particular analyte from a list that we wish to analyze. Your group will explore appropriate analysis methods found in the literature and make a decision about which would be preferable for the analysis we want to perform. As you read literature articles and compare methods, consider the following questions:

Q2: What analytical methods are best suited to provide the information about your analyte?

Q3: Of these, which techniques/instruments are available for the analysis?

Q4: Are there cost or timing issues that will influence the choice of method?

You may want to think about how long each analysis takes and whether it is amenable to the number of samples you need to analyze. Another consideration may be whether the technique is capable of analyzing several ions simultaneously.

Q5: Do the available methods have sufficient selectivity for the type of sample that will be analyzed?

A good example in thinking about selectivity is the difference in determining water hardness (generally the concentration of Ca^{2+} and Mg^{2+} combined) versus just the concentration of Ca^{2+} . When one wants to determine just the concentration of Ca^{2+} , a method that can differentiate between Ca^{2+} and Mg^{2+} is needed; whereas if one wants to determine water hardness, there is no need to differentiate between the two cations.

Q6: What sample pretreatment will be required?

Q7: What sample size (mass or volume) is needed, and can that be feasibly collected?

Q8: What is the anticipated range of analyte concentrations?

Q9: What is the limit of detection of the method and is its dynamic range appropriate for the range of concentrations of the analyte?

Q10: What is the precision of the method?

Q11: Is there a target concentration that is important for regulatory purposes?

Q12: Is the analyte in a form (solid, liquid, gas) suitable for the analytical method that you have selected?

Q13: How will the method be validated?

Q14: What type of calibration will be used?

Q15: Do any of the reagents used need to be standardized?

Q16: Can a reference standard be used to ensure accuracy?

As you identify the answer to each of these questions, you will need to balance each key attribute of a method to decide, or prioritize which method you ultimately will choose to pursue the analysis.