

Total Hardness Lesson Plan

Key Understandings:

- What is “water hardness” in terms of chemical substances
- How Ca and Mg ions get in the water
- Some of the concerns with hard water
- Hard water is not a health hazard
- Some concerns with soft water / what MWRA does to adjust the hardness
- How Total Hardness (TH) is tested for / the significance of various TH values

Time needed:

We suggest taking one lesson to discuss TH and demo the test, and a second lesson to allow the students to perform the laboratory.

Discussion:

- Discuss as a whole class: “what does it mean when somebody says you have hard water?”
- How could you tell if your water was hard?
- What would happen to you if you drank hard water?
- Discuss what hardness stands for in terms of ions and where these ions can come from. Look at the hardness table in CBL handout
- Discuss the concerns associated with soft water (leaching of Ca from concrete pipes; also Pb and Cu from metal pipes)/ what MWRA does to address them
- Explain and demonstrate the test and the titration reaction

Lab:

- You may choose to have the students do a quick experiment trying to get foam out of a soap solution with tap water vs water with CaCO_3 added to demonstrate the action of hard water on soap.
- Follow the procedures in the CBL handout
- Perform one titration on tap water and another on a sample from a local water body; do the calculations – hand in one sheet of results per group; keep another copy for own records.

Homework:

#1:

- Read the CBL handout on Total Hardness
- Which areas of the US have the softest water / which have the hardest water?
- Suppose that you conducted a titration as described in the Total Water Hardness handout, and you used 5.5 ml of titrant to get to the equivalence point. What is the total hardness of this sample?

#2

Class data needs to be compiled & given to the students for this assignment

From the compilation of class TH data, answer the following questions:

- Calculate the average TH values for tap water and the lake or river sample used
- Were there significant differences between the two averages? How would you explain these?

Handouts:

Vernier Software: Water Quality with CBL – Total Hardness

Alternatives to this test, comments and further resources:

If you have access to a range of CBL probes, the Vernier manual also has a CBL probe test for Calcium Water Hardness which may be used instead. We chose the TH chemistry-based test because we felt that the students would benefit from seeing the indicator reaction and from learning to perform a titration.

Although all the reagents for this test may be ordered as a set (price is very reasonable – see Materials), they are also available separately from the Hach company. Should you opt to prepare your own EDTA solution for the titration, the CBL manual provides the necessary instructions.