

Lesson plan – Hardness of tap water – Worksheet

Introduction

Water described as "hard" means it is high in dissolved minerals, specifically calcium and magnesium. Hard water is not a health risk but it requires more soap and synthetic detergents for home laundry and washing. Hard water contributes to scaling in boilers and industrial equipments and scales are often removed by also chemicals...

The hardness of water is reported in German degrees (*Deutsche Härte*, °dH). One degree German is defined as 10 milligrams of calcium oxide per litre of water. (This is equivalent to 17.848 milligrams of calcium carbonate per litre of water, or 17.848 ppm.)



According to the standards the water is:

- Very soft: < 4 °dH (German degree)
- Soft: 4-8
- Moderate hard: 9 -18
- Hard: 19-30
- Very hard: >30

Description of the exercise:

In this exercise we will display the hardness of tapwaters around Barcs. Barcs – a small town of ten thousand inhabitants – is situated on the Hungarian-Croatian border river, the Drava. The Drava river is the final recipient of household wastewaters in the region.

The Drava river and its floodplain area has been one of the most valuable parts of the Danube-Drava National Park since 1996, therefore it is very important to protect its water quality.

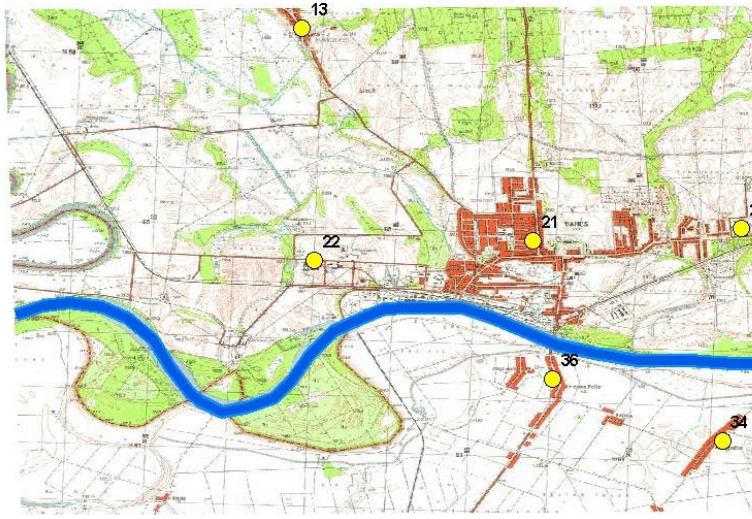
The hardness was measured by simple indicator papers given to detergents.

<i>number</i>	<i>instruction</i>	<i>iNotes</i>	<i>Teachers' / Trainers' activity</i>	<i>Pupils' / participants' activity</i>
	First, we will open a map of Barcs.			
1	Open ArcMap from the MS Windows start menu		<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	Add the raster map " <i>Barcsmap.tif</i> "	1	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	Now we will generate a new information layer for the river and a dBase Table for the measuring points			
3	Open ArcCatalog and create the information layer and the dBase Table 1. File – New – Shapefile - Drava river (polyline) 2. File – New – dBase Table	20		
		25		

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	- hardness (dBase table)																																	
4	Add the information layer and dBase Table in ArcMap	1																																
The next step is to draw the Drava river																																		
5	<p>Open the Editor toolbar – Start editing, then click on the Sketch Tool and choose the pencil (Sketch tool). Check the following data:</p> <p>Task: choose Create New Feature Target: Drava river</p> <p>Start to draw the river from the left end of the map. Left-click each time you want to add a vertex and add a new segment. When finished, double click to draw the feature (river).</p>	12																																
6	<p>Change the line symbol of the layer ‘Drava river’ Right click on the symbol and choose the following:</p> <p>Category: ‘Navigable river’ Color: dark blue Width: 10</p> <p>Then OK.</p>	13																																
Now we will generate data fields in the data tables for hardness																																		
7	<p>Add the following data fields :</p> <ul style="list-style-type: none"> • “X” (for X coordinate, choose ‘double’ as data type) • “Y” (for Y coordinate choose ‘double’ as data type) • “hardness” (for indicating the measured values choose ‘short integer’ as data type) 	7	□	x																														
8	<p>Fill in the information about the sampling places in the attribute table: Open Editor - Start Editing</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Field 1</th> <th colspan="2">Sampling points</th> <th rowspan="2">Hardness (German degree)</th> </tr> <tr> <th>X</th> <th>Y</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>17,420409</td> <td>45,994650</td> <td>13</td> </tr> <tr> <td>2</td> <td>17,459169</td> <td>45,961037</td> <td>21</td> </tr> <tr> <td>3</td> <td>17,492057</td> <td>45,962963</td> <td>23</td> </tr> <tr> <td>4</td> <td>17,421247</td> <td>45,956186</td> <td>22</td> </tr> <tr> <td>5</td> <td>17,462062</td> <td>45,938945</td> <td>36</td> </tr> <tr> <td>6</td> <td>17,489103</td> <td>45,929169</td> <td>34</td> </tr> </tbody> </table>	Field 1	Sampling points		Hardness (German degree)	X	Y	1	17,420409	45,994650	13	2	17,459169	45,961037	21	3	17,492057	45,962963	23	4	17,421247	45,956186	22	5	17,462062	45,938945	36	6	17,489103	45,929169	34	30	□	x
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Now we are ready to visualize the measuring points on the map																																		

9	Draw the locations of the sampling points by using the tool “add XY data”. (Or right click on ‘hardness’ and Display XY data.) You will have a new layer: “Hardness Event”	24	<input type="checkbox"/>	x
10	Change the point symbol of the layer “Hardness Event”	13	<input type="checkbox"/>	x
We will display the hardness values of the sampling points on the map				
11	Right click on “Hardness Event”- Properties - Labels Click on “Label features...” and choose “Hardness” to display on the map at “Label Field”	26	<input type="checkbox"/>	x
			<input type="checkbox"/>	x
12	Export your map showing the points as Chemistryyourname.pdf and save it in your portfolio on Moodle.	42	<input type="checkbox"/>	x
GIS analysis				
13	If you look at your map can you see significant differences in the water hardness? Where are the highest hardness values? What is the correlation between hardness and the amount of detergents? What do you think: the amount of detergents affect the surface and subsurface water quality in the Danube-Drava National Park?		x	x

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