UNIVERSITY OF CANTABRIA
DEPARTMENT OF SCIENCE AND TECHNIQUES OF WATER AND THE ENVIRONMENT

Water quality

EXAMPLE 1

Given the following chemical analysis, which corresponds to mineral water "Bronchales":

- **a)** Check anions and cations balance
- **b)** Obtain total, temporary and permanent hardness
- **c)** Obtain alkalinity
- **d)** Draw hardness bar chart
- **e)** Compare estimated dry residue with measured value
- **f)** Make all the possible comments about these water

	Content (mg/L)
Bicarbonate	8
Chloride	2.52
Sulfate	9.97
Calcium	2.71
Magnesium	2.75
Potassium	1.21
Sodium	1.05
Silica	8
Dry residue	35

Solution:

	Formula	Content	MW	n	EW	Content	Content
		mg/L	g/mol	eq/mol	mg/meq	meq/L	mg $CaCO_3$/L
Bicarbonate	HCO_3^-	8	61	1	61	0,13	6,56
Chloride	Cl^-	2,52	35,5	1	35,5	0,07	3,55
Sulfate	SO_4^{2-}	9,97	96,1	2	48,05	0,21	10,37
Calcium	Ca^{2+}	2,71	40,1	2	20,05	0,14	6,76
Magnesium	Mg^{2+}	2,75	24,3	2	12,15	0,23	11,32
Potassium	K^+	1,21	39,1	1	39,1	0,03	1,55
Sodium	Na^+	1,05	23	1	23	0,05	2,28
Silica	SiO_2	8	60	4	15	0,53	26,67
Dry residue	-	35					

Sum of anions	20,5	mg $CaCO_3$/L	Other anions could be nitrates (NO_3^{2-}), fluoride (F^-) or sulfur (S^{2-})
Sum of cations	21,9	mg $CaCO_3$/L	Other cations could be aluminum (Al^{+++}), ammonium (NH_4^+), ferrous cation (Fe^{2+}), …
			The values are quite similar, it does not seem that an important ion is not present in the chemical analysis

Hardness (TH)	18,1	mg $CaCO_3$/L	(0 - 75)
Alkalinity (TAC)	6,6	mg $CaCO_3$/L	(< < 30)
Temporary hardness (CH)	6,6	mg $CaCO_3$/L	36,28%
Permanent hardness (NCH)	11,5	mg $CaCO_3$/L	63,72%

Loss of mass due to heating

$2\ HCO_3^-\ (aq) \Rightarrow CO_3^{2-}\ (aq) + CO_2\ (g) + H_2O\ (g)$

0,508 g loss per g HCO_3^-

Dry residue (calculated)

32,1	mg/L	Value very similar to the measured one	35	mg/L

COMMENTS
The water has a very low mineralization
The water is very soft
Permanent hardness is higher than temporary hardness (most hardness is permanent)
It has a very low potential to form precipitates of calcium and magnesium, cooking will take less time and no problems to hair and skin are expected.
The salt with the highest concentration is magnesium sulfate
It has a very low value of alkalinity, below the typical value for domestic drinking water This means that it has a very low capacity to neutralize acids.

Bar chart