

# Text Book Correction–Example 2.14, p. 43

CENG 340–Introduction to Environmental Engineering

Instructor: Deborah Sills

September 2, 2013

## Determination of a Water's Hardness

Water has the following chemical composition:  $[\text{Ca}^{2+}] = 15 \text{ mg/L}$ ;  $[\text{Mg}^{2+}] = 10 \text{ mg/L}$ ;  $[\text{SO}_4^{2-}] = 30 \text{ mg/L}$ . What is the total hardness in units of  $\text{mg/L}$  as  $\text{CaCO}_3$ .

## Solution

Find the contribution of hardness from each *divalent cation*. Anions and all monovalent cations do not contribute to hardness.

$$\frac{15 \text{ mg } \text{Ca}^{2+}}{L} \times \left( \frac{\frac{50 \text{ g } \text{CaCO}_3}{\text{eq}}}{\frac{40 \text{ g } \text{Ca}^{2+}}{2\text{eq}}} \right) = \frac{38 \text{ mg}}{L} \text{ as } \text{CaCO}_3 \quad (1)$$

$$\frac{10 \text{ mg } \text{Mg}^{2+}}{L} \times \left( \frac{\frac{50 \text{ g } \text{CaCO}_3}{\text{eq}}}{\frac{24 \text{ g } \text{Mg}^{2+}}{2\text{eq}}} \right) = \frac{42 \text{ mg}}{L} \text{ as } \text{CaCO}_3 \quad (2)$$

Therefore, the total hardness is  $38 + 42 = 80 \text{ mg/L}$  as  $\text{CaCO}_3$ . This water is moderately hard.

Note that if reduced iron ( $\text{Fe}^{2+}$ ) or manganese ( $\text{Mn}^{2+}$ ) were present they would be included in the hardness calculation.