Converting Carbonate Alkalinity from mg/L as CaCO$_3$ to mg/L as CO$_3^{2-}$

CaCO$_3$ has a molecular weight of 100 g/mol

The CO$_3^{2-}$ anion has a molecular weight of 60 g/mol

Therefore, each milligram of CaCO$_3$ contains 60/100 = 0.6 mg of CO$_3^{2-}$

The conversion is as follows:

\[
\text{Carbonate Alkalinity as CO}_3^{2-} \text{ (mg/L) = 0.6 } \times \text{Carbonate Alkalinity as CaCO}_3 \text{ (mg/L)}
\]

Converting Bicarbonate Alkalinity from mg/L as CaCO$_3$ to mg/L as HCO$_3^{-}$

Consider the following reaction:

\[
\text{CaCO}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{Ca(HCO}_3\text{)}_2
\]

CaCO$_3$ has a molecular weight of 100 g/mol

The HCO$_3^{-}$ anion has a molecular weight of 61 g/mol

Therefore, each mol of Ca(HCO$_3$)$_2$ corresponds to one mol of CaCO$_3$ (100 g) and contains 2 x 61 g = 122 g of HCO$_3^{-}$ and the conversion is as follows:

\[
\text{Bicarbonate Alkalinity as HCO}_3^{-} \text{ (mg/L) = 1.22 } \times \text{Bicarbonate Alkalinity as CaCO}_3 \text{ (mg/L)}
\]

Converting Hydroxide Alkalinity from mg/L as CaCO$_3$ to mg/L as OH$^{-}$

Consider the following reactions of CaCO$_3$ and hydroxide ions with protons (acid):

\[
\text{CaCO}_3 + 2 \text{H}^+ \rightarrow \text{Ca}^{2+} + \text{H}_2\text{CO}_3
\]

\[
2 \text{OH}^- + 2 \text{H}^+ \rightarrow 2 \text{H}_2\text{O}
\]

In terms of consumption of protons, 2 moles of hydroxide ions (OH$^-$) are equivalent to one mol (100 g) of CaCO$_3$. Since the molecular weight of OH$^-$ is 17 g/mol, the conversion is as follows:

\[
\text{Hydroxide Alkalinity as OH}^- \text{ (mg/L) = } 2 \times 17/100 \times \text{Hydroxide Alkalinity as CaCO}_3 \text{ (mg/L)}
\]

or:

\[
\text{Hydroxide Alkalinity as OH}^- \text{ (mg/L) = 0.34 } \times \text{Hydroxide Alkalinity as CaCO}_3 \text{ (mg/L)}
\]