Consider a water sample containing 85 μg/L of Ni and 8 mg/L DOM in the form of fulvic acid. Calculate the concentration of complexed ([Ni-FA]) and uncomplexed ($[Ni]_{free}$)nickel ion. Use a typical concentration of carboxylates for fulvic acids of $C_{CO2^-} = 5$ mmol/g.

$$Ni^{2+}_{(aq)} + FA_{CO_2^-(aq)} \rightleftharpoons Ni\text{-}FA_{CO_2^-(aq)}$$

$$K_f' = \frac{[Ni\text{-}FA_{CO_2^-}]}{[Ni^{2+}]_f [FA_{CO_2^-}]_f} = 1.6 \times 10^4 \quad (K_f' \text{ value at pH 5})$$

$$[FA_{CO_2^-}]_T = \frac{8\ mg\ FA}{L} \times \frac{5\ mmol\ CO_2^-}{g} \times \frac{1\ g}{10^3\ mg} = 40 \times 10^{-3}\ \frac{mmol\ CO_2^-}{L}$$

or 40 μM

$$[Ni^{2+}]_T = \frac{85\ \mu g}{L} \times \frac{1\ mol}{58.7\ g} \times \frac{1\ g}{10^6\ \mu g} = 1.4 \times 10^{-6}\ \frac{mol}{L} \text{ or } 1.4\ \mu M$$

Note; $[FA_{CO_2^-}]_T >> [Ni^{2+}]_T$ ∴ most $FA_{CO_2^-}$ is not complexed w Ni^{2+}

let 'x' represent conc of complexed $Ni\text{-}FA_{CO_2^-}$

then $$K_f' = \frac{x}{(1.4 \times 10^{-6} - x)(40 \times 10^{-6} - x)} = 1.6 \times 10^4$$

and since $x << 40 \times 10^{-6}$, this simplifies to,

$$K_f' = \frac{x}{(1.4 \times 10^{-6} - x)(40 \times 10^{-6})} = 1.6 \times 10^4$$

Solving for x yields, $x = 5.6 \times 10^{-7}\ \frac{mol}{L}$ $([Ni\text{-}FA_{CO_2^-}])$

& $[Ni^{2+}]_f = 1.4 \times 10^{-6} - 5.6 \times 10^{-7} = 8.8 \times 10^{-7}\ \frac{mol}{L}$

i.e. $\frac{5.6 \times 10^{-7}}{1.4 \times 10^{-6}} \times 100\% = 40\%$ of Ni^{2+} is complexed to FA