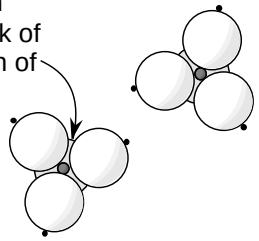
Silicon in aqueous solution

In most solutions at most values of pH, Si^{4+} is dissolved as a hydroxocomplex. $Si(OH)_4$ is the formula that best represents the nature of the complex, but H_4SiO_4 (silicic acid) is commonly used to indicate that the complex can surrender H^+ ions and thus behave as an acid.

$Si(OH)_4$ and/or H_4SiO_4 are commonly called "silicic acid", but more formally they are "orthosilicic acid", in contrast to the other substances discussed in the box below.

$Si(OH)_4^0 = H_4SiO_4^0$

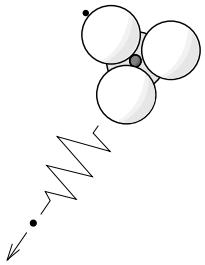
Note fourth OH^- at back of tetrahedron of OH^-s.



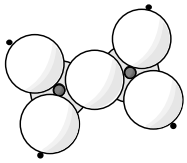
$SiO(OH)_3^- = H_3SiO_4^-$

At higher pH, one H^+ ion dissociates.

$SiO_2(OH)_2^{2-} = H_2SiO_4^{2-}$



At still higher pH, a second H^+ ion dissociates.



$Si_2O(OH)_6^0 = H_6Si_2O_7^0$

At high concentration, $Si(OH)_4^0$ tetrahedra combine to make a polynuclear complex or dimer, as opposed to the mononuclear complex or monomer shown above. The bridging O^{2-} is bonded to two Si^{4+}s and so loses its H^+. The loss of that H^+ and one OH^-, and thus in summation one H_2O, means that formation of the dimer is a dehydration reaction.

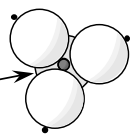
In chemical analyses of natural waters, dissolved Si^{4+} is commonly listed as $SiO_{2(aq)}$. In converting such analyses from a weight basis (e.g., in ppm) to a molar basis, one must use a formula weight of 60 (that of SiO_2). However, the entity in solution is $Si(OH)_4^0$, with a formula weight of 96.

A minor note:

Geochemists can seemingly assume that dissolved silica exists as orthosilicic acid or one of its derivatives shown on this page. Chemists additionally identify *meta*silicic acid (H_2SiO_3), where Si^{4+} is in three-fold, rather than four-fold, coordination. Metasilicic acid is thus the silicic analog of carbonic acid (H_2CO_3). It can be viewed as a less hydrous form of silicic acid ($H_4SiO_4 = H_2SiO_3 + H_2O$). Disilicic acid ($H_2Si_2O_5$) is the dimer of metasilicic acid.

Orthosilicic acid (H_4SiO_4)

Note fourth OH^- at back of tetra-hedron of OH^-s.



Metasilicic acid (H_2SiO_3)