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		Dirck Demeyer, R&D Engineer	
translation :			

The presence of silica

The earth's mass exists for 26% of the element Si - silica. In analogy with the element C - carbon, it forms chemical chains but in much less varieties due to the fact that the Si elements are only interconnected by O - oxygen bridges.

Pure silica is a half-metal with diamond structure. It forms substances with metals and halogens, which are used in the chemical industry. In nature, Si is found as insoluble quartz, which exists out of chains of SiO_2 . Sand and gravel are weathered quartz, coloured by the presence of incorporated metal traces. Next to quartz, Si is found in many rocks as complex silicates.

In water it is present as dissolved silicic acid, mostly not ionized or as ortho (SiO_4^{4-}) and meta (SiO_3^{2-}) silicate.

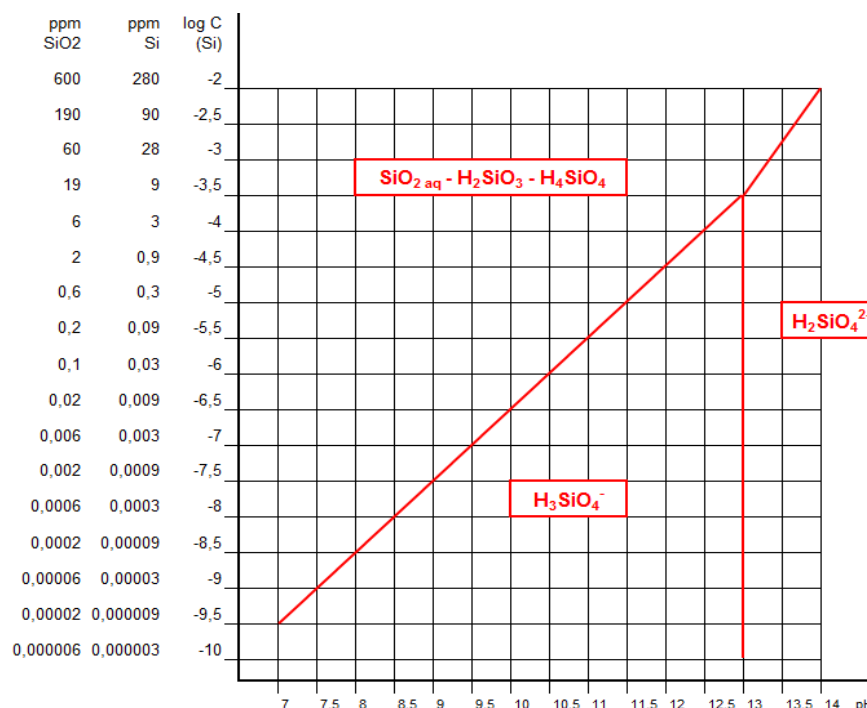
In general, $\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ (ortho) and $\text{SiO}_2 \cdot \text{H}_2\text{O}$ (meta) silicic acid are called simply silica. Very often, the silicic acid is interconnected to form long chains, known as colloidal silica.

Zeolites are complex structures of silica and aluminium, interconnected by oxygen bridges. They have typical crystalline structures through which there is a certain affinity to attract other ions.

The removal of dissolved silica

Silicic acid is almost not dissociated in the ionized form and is present in the well dissolved molecular state. The ionized part is removed by anion exchange and by the automatic re-establishment of the equilibration, the other part of the silicic acid is finally removed as well. In demineralization plants, actions are taken by use of an anion resin type I, which has better affinity for weakly ionized elements and regeneration with higher NaOH level to optimize the exchange capacity. Addition in partial flow of a mixed bed polisher for the production of ultra pure water (i.e. Lewatit UP1294), may reduce the silica further to acceptable low levels.

In analogy of the removal of dissolved carbonic acid by RO, it is possible to transform the not ionized part into the ionized form by increasing the pH (up to 14 !), as given in the Pourbaix diagram below. It is important to verify whether this would interfere by undesired precipitations of other parameters at these high pH levels.



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The removal of colloidal silica

Colloidal silica has no ion dissociation at all and if present, demineralization units and RO units will show the passages of Si. Especially when the treated water is transformed into steam, the insoluble SiO_2 is released, producing glassy depositions.

Colloidal substances are in fact not recognized as dissolved matter, but is due to the very fine dispersion well behaving as dissolved. Colloidal silica might be removed by :

- flocculation at controlled pH, followed by coadsorption on $\text{Mg}(\text{OH})_2$ or $\text{Al}(\text{OH})_3$ or $\text{Fe}(\text{OH})_3$ and final filtration over fine filtration medium like Turbidex. Precise formulations are to be set-up according the water analysis.
- Ultra Filtration, after pre-treatment to the required quality