***Chlorine in water***

Because chlorine is widely used as a disinfectant for drinking water, swimming pools, and sewage treatment, it is worth looking at its stability diagram. Note that the effective bactericidal agent is not Cl2 itself, but its oxidation product **hypochlorous acid HOCl** which predominates at pH values below its pKa of 7.3. Note also that

* **Cl2 is unstable in water except at very low pH; it decomposes into HOCl and Cl–.**
* **Hypochlorous acid and its anion are stronger oxidants than O2 and thus subject to decomposition in water. The only stable chlorine species in water is Cl–**
* **Decomposition of HOCl occurs very slowly in the dark, but is catalyzed by sunlight. For this reason the chlorine in outside swimming pools must be frequently renewed.**
* **Decomposition of Cl2 and HOCl by reaction with organic material in municipal water supply systems sometimes makes it necessary to inject additional chlorine at outlying locations.**

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|  | **Stability diagram for chlorine in water**  Each solid line represents a combination of E and pH at which the two species on either side of it can coexist; at all other points, only a single species is stable.  Note that equilibria between species separated by diagonal lines are dependent  on both *E* and pH, while those separated by horizontal or vertical lines are  affected by pH only or *E* only, respectively. |

Cl2 + 2e === 2Cl- E0 = 1.36

Acidic H+ + HClO + e === ½ Cl2 + H2O E0 = 1.83

Basic ClO- + H2O + 2e ===Cl- + 2OH- E0 = 0.84

HClO == H+ + ClO- pKa~7.3

O2 + 4H+ +4e === 2H2O E0 = 1.23