Chemistry 112
Workshop: Equilibrium Calculations with phases and solubility

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Solubility Equilibrium
After the 2004 Tsunami in the Indian Ocean that devastated much of Sri Lanka, India and Indonesia, Proctor and Gamble sent packets of $Fe_2(SO_4)_3$(s) that also contained $Ca(OCl)_2$ (or bleach) to the region for use as a water purifier. To see how these packets of "Pur" work lets solve the following problems.

1. When $Fe_2(SO_4)_3$(s) is dissolved in water what solute(s) do(es) the water contain? Hint: are sulfates on the list of soluble salts?

2. When $Fe(OH)_3$(s) precipitates from a solution of water containing suspended debris, the solid traps the debris as it forms so that they precipitate out of the water with the $Fe(OH)_3$(s). Use the table of solubility products in Chapter 13 to calculate the molar solubility of $Fe(OH)_3$. What is the concentration of OH^- ions in a saturated solution of $Fe(OH)_3$(s)?

3. If 3.2 g of $Fe_2(SO_4)_3$(s) (the amount in one packet) is dissolved in enough water to make 10.0 L and the pH is high enough so that the $[OH^-]$ is 10^{-6} M, what mass of $Fe(OH)_3$(s) will precipitate?

4. The packets also contain $Ca(OCl)_2$ which is used as a disinfectant since OCl^- (hypochlorite) is the active ingredient in bleach. If the packets contain 1.8 g $Ca(OCl)_2$ and 3.2 g $Fe_2(SO_4)_3$ is there any chance that $Ca(OH)_2$ will precipitate before all the iron(III) has been precipitated as $Fe(OH)_3(s)$?

5. Use the tables in appendix 2A and the fact that the heat of formation for iron(III) hydroxide is -823 kJ/mol to determine whether the packets would work better in cold water or warm.

6. Use the value of K and the value of $\Delta H°$ calculated in 5 to find the standard state change in entropy for the solubility of $Fe(OH)_3(s)$ at 298 K.