

Wastewater containing significant amounts of lead are generated during the production of picture tubes and automobile batteries. Lead is normally removed from such wastewaters by precipitating it in the form of a slightly soluble salt. One method used is the addition of trisodium phosphate to form lead phosphate. Lead phosphate is very insoluble under acid conditions and at pH = 3.5 the solubility of lead is approximately 0.0 mg/liter. The chemical reaction which describes this process is:

pH at which the reaction takes place - 3.5



Because of the low solubility of lead phosphate it can be assumed that the forward reaction goes to completion. For this situation, how many pounds (dry weight) of lead phosphate sludge are formed per million gallons of wastewater treated, if excess trisodium phosphate is added and the wastewater initially contains 20 mg/liter of Pb^{+2} ? Assume perfect settling.

Solution and discussion - Remember - WORK IN MOLES AND THEN CONVERT TO REQUIRED MASS UNITS

Examine equation to insure it is balanced, it is. Note that 3 moles lead gives rise to 1 mole lead phosphate sludge

$$\text{Pb}_{\text{wastewater}} := 20 \cdot \frac{\text{mg}}{\text{liter}} \quad \text{MW}_{\text{lead}} := 207.2 \cdot \frac{\text{gm}}{\text{mole}}$$

$$\text{moles_lead} := \frac{\text{Pb}_{\text{wastewater}}}{\text{MW}_{\text{lead}}}$$

$$\text{moles_lead} = 9.653 \times 10^{-5} \frac{\text{mole}}{\text{liter}}$$

From the chemical equation given, ratio of moles sludge produced to moles lead added is: 1/3: $\text{moles_sludge} := \frac{1}{3} \cdot \text{moles_lead}$

$$\text{moles_sludge} = 3.218 \times 10^{-5} \frac{\text{mole}}{\text{liter}}$$

$$\text{MW}_{\text{sludge}} := 811.6 \frac{\text{gm}}{\text{mole}}$$

$$\text{pounds_sludge_per_MG} := \frac{1}{3} \cdot \text{moles_lead} \cdot \text{MW}_{\text{sludge}}$$

$$\text{pounds_sludge_per_MG} = 217.926 \frac{\text{lb}}{10^6 \cdot \text{gal}}$$

This is the solution to the question asked