Answer on Question #43191 - Chemistry - Inorganic chemistry

Question:

1 gram of a mixture of $CaCO_3$ and NaCl reacts completely with 120ml of 0.1N HCl. What is the percentage of NaCl?

Solution:

HCl reacts only with one component ($CaCO_3$) of the two components of mixture ($CaCO_3$ + NaCl) according to the equation:

$$CaCO_3 + 2HCl = CaCl_2 + CO_2 + H_2O$$

If we calculate the mass of $CaCO_3$ that reacts with HCl, we can determine the mass and percentage of NaCl.

Our path:

volume of HCl solution	1 →	equivalents of HCl	2 →	moles of HCl	3 →	moles of $CaCO_3$	4 →	mass of $CaCO_3$	5 →	mass and percentage of NaCl

1. 0,1N HCl means that is 0,1 equivalents of HCl per 1 liter of solution,
   0,1 eq HCl/1 l,
   120 ml = 0,12 l,
   0,12 ~~l~~ × 0,1 eq HCl/1 ~~l~~ = 0,012 eq HCl
2. In case of HCl 1 equivalent = 1 mole,
   then 0,012 equivalents = 0,012 moles
3. From the balanced equation we see that 1 mole of $CaCO_3$ reacts with 2 moles of HCl:
   1 mol $CaCO_3$/2 mol HCl;
   then 0,012 moles of HCl react with:
   0,012 ~~mol HCl~~ × 1 mol $CaCO_3$/2 ~~mol HCl~~ = 0,006 mol $CaCO_3$;
4. Mass of 1 mole of $CaCO_3$ is 40 +12 + 16 × 3= 100 g
   100g $CaCO_3$/1 mol $CaCO_3$;
   mass of 0,006 moles of $CaCO_3$ is
   0,006 ~~mol $CaCO_3$~~ × 100g $CaCO_3$/1 ~~mol $CaCO_3$~~ =0,6 g $CaCO_3$;
5. Mass of NaCl = (mass of mixture) – (mass of $CaCO_3$)
   1-0,6=0,4 g
   percentage of NaCl = (mass of NaCl)/(mass of mixture) × 100%
   w_{NaCl}= 0,4/1 × 100% = 40%

Answer: The percentage of NaCl is 40%.