# Answer on the question #67111, Chemistry / Other

**Question:**

An impure sample of barium hydroxide of mass 1.6524 g was allowed to react with 100cm3 of 0.200 mol/dm3 HCL. When the excess acid was titrated against NaOH, 10.9cm3 of NaOH solution was required. 25.0cm3 of the NaOH required 28.5cm3 of the HCL in a seperate titration. Calculate the percentage purity of the sample of barium hydroxide.

**Solution:**

The percentage purity of the sample is the ratio of the mass of barium hydroxide to the mass of the sample:

$$\omega = \frac{m_{Ba(OH)_2}}{m_{sample}} \cdot 100\%.$$

The mass of barium hydroxide is a product of number of the moles and its molar mass:

$$m(Ba(OH)_2) = n(Ba(OH)_2) \cdot M(Ba(OH)_2) = n(Ba(OH)_2) \cdot 171.34\ (g\ mol^{-1}).$$

The number of the moles of barium hydroxide in the sample can be found through the number of the moles of HCl reacted. The reaction between barium hydroxide and hydrogen chloride is:

$$2HCl + Ba(OH)_2 \rightarrow BaCl_2 + 2H_2O.$$

As one can see from the reaction, the number of the moles of barium hydroxide and hydrogen chloride relate as:

$$n(Ba(OH)_2) = \frac{n(HCl)}{2}.$$

The number of the moles of HCl reacted is:

$$n(HCl) = n(HCl)_{added} - n(HCl)_{exc},$$

where $n(HCl)_{added}$ is the total number of the moles of HCl added to the sample and $n(HCl)_{exc}$ is the quantity of HCl titrated with NaOH. The former is:

$$n(HCl)_{added} = c(HCl) \cdot V(HCl) = 0.2(mol\ L^{-1}) \cdot 0.1(L) = 0.02mol.$$

The latter depends on the concentration of NaOH:

$$HCl + NaOH \rightarrow H_2O + NaCl$$

$$n(HCl)_{exc} = n(NaOH).$$

To find the number of the moles of sodium hydroxide, we must know its concentration that can be calculated from the separate titration:

$$c(HCl)V(HCl)' = c(NaOH)V(NaOH)'$$

$$c(NaOH) = \frac{c(HCl)V(HCl)'}{V(NaOH)'} = \frac{0.2(mol\ L^{-1}) \cdot 0.0285(L)}{0.0250(L)} = 0.228(mol\ L^{-1}).$$

So, we can find the excess of hydrogen chloride:

$$n(HCl)_{exc} = n(NaOH) = c(NaOH) \cdot V(NaOH) = 0.228(mol\ L^{-1}) \cdot 0.0109(L) = 0.002485mol\ .$$

And the quantity of hydrogen chloride reacted with the sample:

$$n(HCl) = n(HCl)_{added} - n(HCl)_{exc} = 0.02mol - 0.002485mol = 0.0175mol$$

Thus, the number of the moles of barium chloride and its mass is:

$$n(Ba(OH)_2) = \frac{n(HCl)}{2} = \frac{0.0175mol}{2} = 0.00876\ mol$$

$$m(Ba(OH)_2) = n(Ba(OH)_2) \cdot 171.34\ (g\ mol^{-1}) = 0.00876\ (mol) \cdot 171.34\ (g\ mol^{-1}) = 1.500(g).$$

Finally, we can find percentage purity of barium hydroxide:

$$\omega = \frac{m_{Ba(OH)_2}}{m_{sample}} \cdot 100\% = \frac{1.500(g)}{1.6524(g)} \cdot 100\% = 90.81\%.$$

**Answer:** Mass percentage of barium hydroxide in the sample is 90.81%.