Answer on the Question #67257, Chemistry / Inorganic chemistry

5.95g of cobalt(II) carbonate were added to 40cm3 of hydrochloric acid, concentration 2.0mol/dm3
[I] Calculate the maximum yield of cobalt(II) chloride-6-water and show that the cobalt(II) carbonate was in excess.
CoCO3 + 2HCl → CoCl2 + CO2 + H2O
CoCl2 + 6H2O → CoCl2.6H2O
} maximum yield:
} number of moles of HCl used =
} number of moles of CoCl2 formed =
} number of moles of CoCl2.6H2O formed =
} mass of one mole of CoCl2.6H2O = 238g
}maximum yield of CoCl2.6H2O = ……..…..g
to show that cobalt(II) carbonate is in excess:
number of moles of HCl used = …… (use your value from above)
mass of one mole of CoCO3 = 119g
number of moles of CoCO3 in 5.95g of cobalt(II) carbonate = ……
(ii) Explain how these calculations show that cobalt(II) carbonate is in excess.

Solution:

(i) Maximum yield of $CoCl_2 \cdot 6H_2O$:

Number of moles of HCl used:

$$n(HCl) = \frac{c(HCl) \cdot V(HCl)}{1000} = \frac{2.0 \cdot 40}{1000} = 0.08\ mole$$

Number of moles of $CoCl_2$ formed:

$$n(CoCl_2) = \frac{1}{2} n(HCl) = 0.04\ mole$$

Number of moles of $CoCl_2 \cdot 6H_2O$ formed:

$$n(CoCl_2) = n(CoCl_2 \cdot 6H_2O) = 0.04\ mole$$

Maximum yield of $CoCl_2 \cdot 6H_2O$:

$$m(CoCl_2 \cdot 6H_2O) = n \cdot M = 0.04 \cdot 238 = 9.52\ g$$

To show that Cobalt (II) carbonate is in excess:

Number of moles of HCl used = 0.04 mole

Number of moles of $CoCO_3$ in 5.95g of cobalt(II) carbonate:

$$n(CoCO_3) = \frac{m(CoCO_3)}{M(CoCO_3)} = \frac{5.95}{119} = 0.05\ mole$$

(ii) Cobalt (II) carbonate is in excess because of mole number of this compound is more than HCl.