BORON HYDRIDES

## 10.3 Preparations:

(i) Stock and his coworkers prepared a mixture of boron hydride ($B_2H_6$, $B_4H_{10}$, $B_5H_9$ etc.) by the reaction of magnesium boride and moderately concentrated hydrochloric acid.

$$Mg_3B_2 + 6HCl \quad {}_3 \longrightarrow MgCl_2 + B_2H_6 + \text{other hydrides}$$

The different boranes are separated by distillation method.

(ii) Diborane may also be prepared by the following reactions :

$$3NaBH_4 + 4BF_3 \longrightarrow 3NaBF_4 + 2B_2H_6$$

$$6LiH + 8BF_3 \longrightarrow 6LiBF_4 + B_2Hs$$

$$4BCl_3 + 3LiAlH_4 \longrightarrow 3LiCl + 3AlCl_3 + 2B_2H_6$$

Electric discharge

$$2BBr_3 + 6H_2 \longrightarrow 6HBr + B_2H_6$$

$$B_2O_3 + 2Al + 3H_2 \xrightarrow{AlCl_3} Al_2O_3 + B_2H_6$$

(iii) When diborane is decomposed in a silent electric discharge in the presence of an inert gas, it gives mixture of $B_4H_{10}$ (40%), $B_5H_9$ (20%), $B_5H_{11}$ (30%), $B_9H_{15}$ and other in small quantity.

(iv) Pentaborane-9 may be prepared by circulating a mixture of diborane and hydrogen through a glass tube at 200°-250°C.

$$B_2H_6 + H_2 \xrightarrow{200°\text{-}250°C} B_5H_9$$

While pentaborane-11 may be prepared by heating a mixture of diborane and tetraborane- 10.

$$B_2H_6 + 2B_4H_{10} \longrightarrow 2B_5H_{11} + 2H_2$$

## 10.4 Interconversion of boranes:

Different boranes may also be obtained by heating different boranes at specific temperature.

For example (a) $B_2H_6$ on heating at different temperatures gives higher boranes as shown below :

$$5B_2H_6 \xrightarrow{115°C} 2B_5H_{11} + 4H_2$$

$$5B_2H_6 \xrightarrow{200°\text{-}250°C} 2B_5H_9 + {}_6H_2$$

$$5B_2H_6 \xrightarrow{120mm/250°C} B_5H_9 + B_5H_{11} + 5H_2$$

(b) $B_4H_{10}$ may be converted into higher boranes as shown below:

$$B_4H_{10} \xrightarrow{95°C} B_{10}H_{14} \xrightarrow{200°C} B_5H_9 \xrightarrow{\text{silent electric discharge}} B_{10}H_{16}$$

$$B_4H_{10} \xrightarrow{60°C} B_5H_{11} \xrightarrow{25°C} B_{10}H_{14}$$

$$B_4H_{10} \xrightarrow{200°C} B_5H_9$$

(c) $B_5H_{11}$ on heating with $H_2$ at 100°C gives a mixture of $B_4H_{10}$ and $B_2H_6$.

$$2B_5H_{11} + 2H_2 \xrightarrow{100°C} 2B_4H_{10} + B_2H_6$$

$$2B_5H_{11} \xrightarrow{25^\circ C} B_{10}H_{14} + 4H_2$$

Non-volatile Boranes: Only the above mentioned hydrides of boron and some others are volatile. But several non-volatile solid hydrides have been prepared by the action of heat on the volatile hydrides. Spontaneous decomposition of hexaboranes at room temperature yields a yellow crystalline hydride of the formula $B_{26}H_{36}$.

Properties : (i) The boranes are volatile compounds.

(ii) All the hydrides of boron are decomposed to boron and hydrogen on red heat.

$$B_2H_6 \longrightarrow 2B + 3H_2$$

(iii) All the boranes are readily oxidised by air or oxygen and form explosive mixture.

$$B_2H_6 + 3O_2 \longrightarrow B_2O_3 + 3H_2O; \Delta H = -2165 \text{ kJ}$$

(iv) The boranes are decomposed by alkalies.

$$B_2H_6 + 6NaOH \longrightarrow 2Na_3BO_3 + 3H_2$$

But at 0°C it reacts with concentrated solution of KOH to give potassium hypoborate and metaborate.

$$B_2H_6 + 2KOH \longrightarrow K_2(B_2H_6O_2)$$

$$K_2(B_2H_6O_2) + 2H_2O \longrightarrow 2KBO_2 + 5H_2$$

Some other examples are :

$$B_4H_{10} + 4KOH + 4H_2O \longrightarrow 4KBO_2 + 11H_2$$

$$B_6H_{12} + 6KOH + 6H_2O \longrightarrow 6KBO_2 + 15H_2$$

(v) Boranes are easily decomposed by water liberating $H_2$. The rate of reaction varies widely. For example,

$B_2H_6$ is decomposed very rapidly.

$$B_2H_6 + 6H_2O \longrightarrow 2H_3BO_3 + 6H_2$$