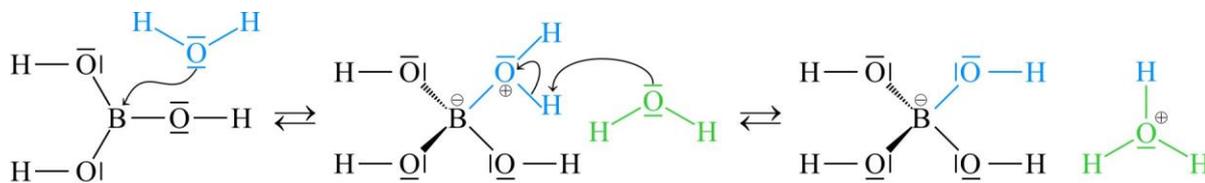
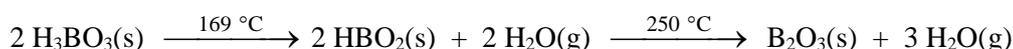


Preparation of boric acid

Boric acid H_3BO_3 is white crystalline forming small flakes. It is only slightly soluble in water, but its solubility sharply increases with increasing temperature. In crystalline form are the planar molecules of H_3BO_3 ordered to layers (Fig. 1) with weak hydrogen bridges. Boric acid is very weak acid ($K_a = 5,8 \cdot 10^{-10}$). It is not Brønsted acid (proton donor), but Lewis acid (acceptor of lone electron pair). Therefore, the oxonium cations in acidic solution originate from water.



When heated above $169\text{ }^{\circ}\text{C}$, boric acid dehydrates forming metaboric acid HBO_2 . Further heating above $250\text{ }^{\circ}\text{C}$ leads up to hygroscopic diboron trioxide.



Boric acid can be prepared by the protolytic reaction of tetrahydroxido-pentaoxidotetraborate octahydrate (borax) with hydrochloric acid.



Work

Prepare 0,100 mol of boric acid by the reaction of borax with hydrochloric acid.

Chemicals

- sodium tetrahydroxido-pentaoxidotetraborate octahydrate (borax), $\text{Na}_2[\text{B}_4\text{O}_5(\text{OH})_4] \cdot 8 \text{H}_2\text{O}$, white crystalline
- hydrochloric acid, HCl , concentrated, $w(\text{HCl}) = 0,36$

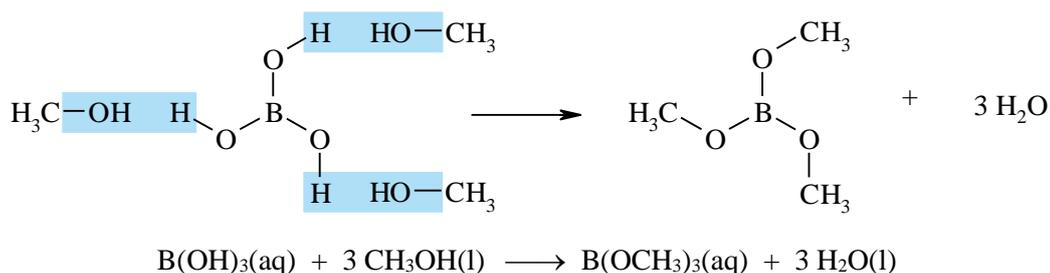
Procedure

Dissolve the calculated amount of borax in warm water in a beaker. Use calculated volume of water to prepare the saturated solution of boric acid at $80\text{ }^{\circ}\text{C}$. Add hydrochloric acid in small portions using a glass rod and always stir the solution. After adding entire volume of hydrochloric acid, check the pH of the final solution. If the solution is not sufficiently acidic ($\text{pH} < 3$), add another small portions (dropwise) to tune the pH.

After cooling to room temperature filter out the shiny white crystals of H_3BO_3 on the Büchner funnel, wash them with icy water directly on the funnel and dry them between clean filter papers until dry. Do not put the crystals to an oven, because boric acid could be decomposed!

Preparation of methyl ester of boric acid

Great ability of boric acid to form esters by the reaction with alcohols is often used for its qualitative proof. Put small amount of just prepared and dried boric acid into a crucible and add few drops of methanol. Using a glass rod stir the mixture and then light it with wooden rod or a safety match in tweezers. Volatile fumes of methyl ester (trimethyl borate) change the colour of flame to green, what indicates the presence of boron compound.



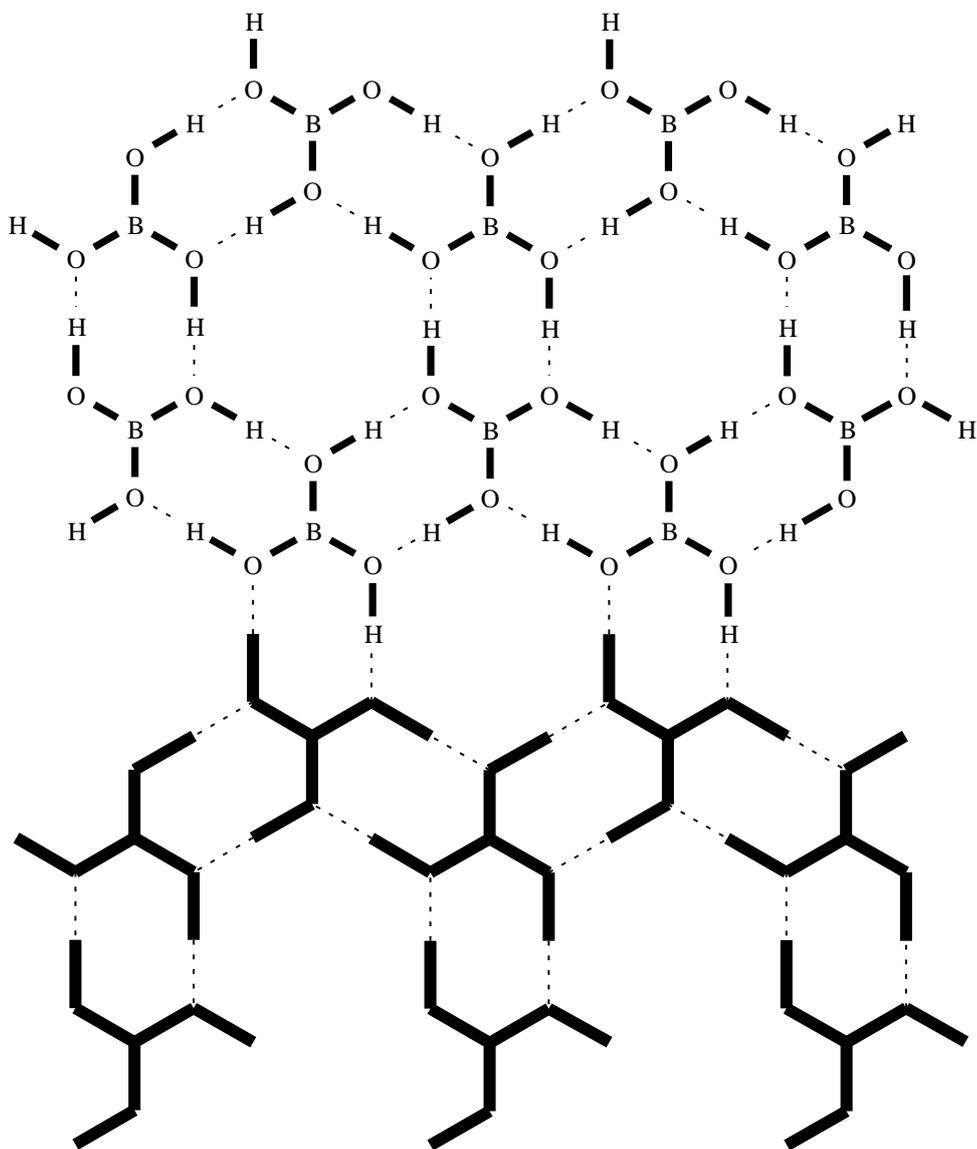


Fig. 1 Structure of crystalline boric acid.
 $\ell(B-O) = 1,36 \text{ \AA}$, $\ell(O-H-O) = 2,71 \text{ \AA}$, distance between layers $d = 3,18 \text{ \AA}$.

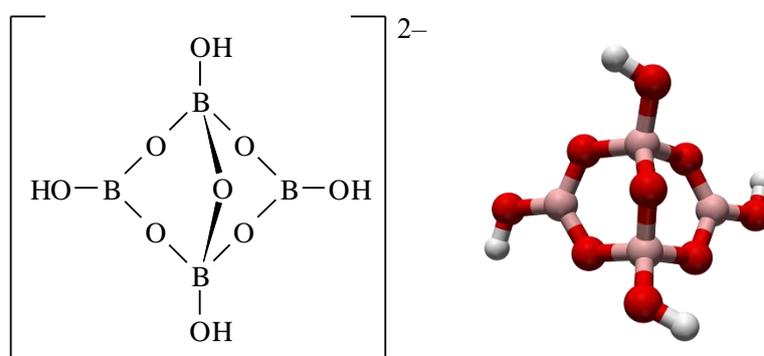


Fig. 2 Structure of tetrahydroxido-penta(μ -oxido)tetraborate anion.

Safety instructions

Sodium tetrahydroxido-pentaoxidotetraborate octahydrate – Na₂[B₄O₅(OH)₄] · 8H₂O

- R22** Harmful if swallowed.
- R36/37/38** Irritating to eyes, respiratory system and skin.
- S26** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
- S36** Wear suitable protective clothing

Hydrochloric acid – HCl

- R34** Causes burns.
- R37** Irritating to respiratory system.
- S2** Keep out of the reach of children
- S26** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice

Boric acid – H₃BO₃

- R20/21/22** Harmful by inhalation, in contact with skin and if swallowed.
- R36/37/38** Irritating to eyes, respiratory system and skin.
- R40** Limited evidence of a carcinogenic effect.
- S22** Do not breathe dust
- S26** In case of contact with eyes, rinse immediately with plenty of water and seek medical advice
- S36** Wear suitable protective clothing

Methyl alcohol – CH₃OH

- R11** Highly flammable.
- R23/25** Toxic by inhalation and if swallowed.
- S2** Keep out of the reach of children
- S7** Keep container tightly closed
- S16** Keep away from sources of ignition – No smoking
- S24** Avoid contact with skin