Preparation of potassium iodate

Potassium iodate forms white crystals slightly soluble in water. Heated over 550 °C decomposes eliminating gaseous oxygen.

$$2\ KIO_3(s) \xrightarrow{\Delta T} 2\ KI(s) + 3\ O_2(g)$$

Iodates, the salts of iodic acid, can be prepared similarly to chlorates or bromates by dissolving iodine in hot solutions of alkali hydroxides.

$$3\ I_2(s) + 6\ KOH(aq) \longrightarrow KIO_3(aq) + 5\ KI(aq) + 3\ H_2O(l)$$

Iodates are weaker oxidation agents in comparison to bromates. In potassium hydroxide solution, potassium iodate can be oxidized with chlorine to pentapotassium iodate.

$$KIO_3(aq) + Cl_2(aq) + 6\ KOH(aq) \longrightarrow K_5IO_6(aq) + 2\ KCl(aq) + 3\ H_2O(l)$$

In laboratory we prepare potassium iodate by the redox reaction of potassium iodate with small excess of potassium permanganate, according to the equation

$$\mathbf{KI(aq) + 2\ KMnO_4(aq) + H_2O \longrightarrow KIO_3(aq) + 2\ MnO_2(s) + 2\ KOH(aq)}$$

Note: Slightly soluble potassium iodate (9,22 g / 100 g of water) crystalizes from the saturated solutions as the first. The other product of the reaction, potassium hydroxide, is much more soluble (121 g / 100 g of water), but still less soluble than common potassium salts. When we carefully acidify the solution with acetic acid we obtain very well soluble potassium acetate (269 g / 100 g of water), which does not crystallize with potassium iodate. There is also another reason to use acetic acid. If we acidify the solution too much, the excess of acetic acid does not react with our product, potassium iodate, because weak acetic acid ($K_a = 1{,}74 \cdot 10^{-5}$) is unable to replace the stronger iodic acid ($K_a = 0{,}17$) from its salt.

Work

Prepare potassium iodate by the redox reaction of potassium iodate with potassium permanganate.

Chemicals

- potassium iodate, KI, white crystalline,
- potassium permanganate, $KMnO_4$, deep purple crystalline,
- ethanol, C_2H_5OH, colourless volatile liquid,
- acetic acid, CH_3COOH, 99% aqueous solution.

Procedure

Prepare the 4,70 % aqueous solution by dissolving 4,90 g (0,031 mol) of potassium permanganate in hot water. Similarly, prepare the 20,0 % aqueous solution by dissolving 2,50 g (0,015 mol) of potassium iodide in water. Slowly add the solution of potassium iodide to the solution of potassium permanganate and stir the mixture shortly. Heat the resulting solution for 30 minutes on a water bath. Then add ethanol dropwise to the solution to remove the excess of potassium permanganate, until it is colourless. Filter the solution through a fluted filter. Acidify the filtrate with concentrated acetic acid and let it evaporate on a water bath. Measure the temperature of the saturated solution and cool it to room temperature. Filter out the white product using Büchner funnel, wash them with 5 cm^3 of ethanol. Dry the crystals of potassium iodate in an oven heated to 60 °C.

Safety instructions

***Potassium iodide* – KI**

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***Potassium permanganate* – $KMnO_4$**

R8	Contact with combustible material may cause fire.
R22	Harmful if swallowed.
R50/53	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S60	This material and its container must be disposed of as hazardous waste
S61	Avoid release to the environment. Refer to special instructions/safety data sheet

***Potassium iodate* – KIO_3**

R8	Contact with combustible material may cause fire.
R36/37/38	Dráždi oči, dýchacie orgány a pokožku.
S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice