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Synthesis of Iodine monochloride Using a Chlorine Solution in Glacial acetic acid with Simultaneous Disinfectant Generation

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Iodine monochloride is an interhalogen compound that acts as an iodinating reagent for aromatic compounds, a halogenating agent for unsaturated compounds and for cleavage of carbon-metal bonds [1]. The direct synthesis of solid iodine monochloride from elements is a very hazardous procedure in the laboratory due to the high toxicity of chlorine and iodine.

In this paper, a safer method for obtaining a solution of iodine monochloride in glacial acetic acid, which is used as a reagent for determination of the iodine value of fats and oils, is presented. Laboratory preparation of iodine monochloride solution in glacial acetic acid is described in AOAC Official Method 993.20 - Iodine Value of Fats and Oils [2]: chlorine gas passes through the iodine solution in acetic acid until a change in the colour of the solution is observed. If excess of chlorine is present in the resultant solution, it must be neutralised by adding of iodine solution in acetic acid. The main disadvantage of this method is the barely noticeable change in colour from brown to reddish brown and the lack of a procedure for the safe removal of chlorine excess after preparing the reagent. Considering the fact that chlorine gas is soluble in glacial acetic acid [3], we have overcome the mentioned deficiencies of AOAC Official Method 993.20 by introducing chlorine gas into the glacial acetic acid at 298K. The figure shows the process to obtain a chlorine solution in glacial acetic acid. The necessary volume of concentrated hydrochloric acid is added to the solid potassium permanganate in the reactor vessel (A) and the container is immediately closed. Chlorine gas is released, which flows through concentrated sulphuric acid (B) to remove moisture. After that, the chlorine is introduced into a vessel filled with glacial acetic acid (C). The excess chlorine is then dissolved in a 10% (w/v) sodium hydroxide solution (D) to produce a mixture of sodium hypochlorite and sodium hydroxide, which requires dilution with an appropriate volume of water to obtain an alkaline hypochlorite solution, which has strong disinfectant properties [4].

The chlorine content in the glacial acetic acid solution is determined by iodometric titration [5]; the same technique is used for determining the hypochlorite content after absorbing the excess chlorine in the sodium hydroxide solution. The final solution of iodine monochloride is prepared simply by adding a calculated volume of chlorine solution in glacial acetic acid to a specified volume of iodine in the same solvent. The results of our study demonstrate that the reaction of 0.12 mol potassium permanganate with 80 cm^3 concentrated hydrochloric acid produce 200 cm^3 of 0.85 mol/dm^3 chlorine solution in glacial acetic acid and 250 cm^3 of 0.34 mol/dm^3 alkali sodium hypochlorite solution. This amount of chlorine solution in glacial acetic acid is sufficient to prepare approximately 3 dm^3 of 0.1 mol/ dm^3 iodine monochloride solution in the same solvent.

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