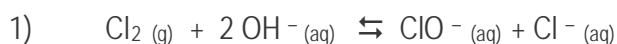




Suspected danger in the preparation of chlorine

Following the notice which appeared in the April 1983 issue of *Education in Science*, the Laboratory Safeguards Sub-committee received this letter from A. D. Page, Safety Officer with Northumberland County Council.

The possible production of chlorine(I) oxide reported by Messrs. Antczak and Crocombe in the April edition of *Education in Science* may be avoided by adding acid to a solution of a domestic hypochlorite bleach instead of adding bleach to a strong acid. The liquid bleaches containing chlorine (e.g. Domestos) are essentially chlorine gas dissolved in sodium hydroxide to form a solution of sodium chlorate (I) and sodium chloride.



A reasonable rate of evolution of chlorine gas is obtained by the slow addition of concentrated hydrochloric acid which drives the equilibrium in reaction 1) to the left. By carrying out the reaction in an alkaline medium the formation of chlorine(I) oxide will not arise, since the concentration of acid will not rise appreciably until the sodium hydroxide is neutralised and most of the available chlorine has been released. By that time the volume of the reaction mixture is great enough to avoid the high concentration of acid necessary for the production of the golden yellow colour attributed to chlorine(II) oxide formed in reaction 2)



A reply from the Chairman of the Laboratory Safeguards Sub-committee:

We welcome this letter from Mr. Page. In recent years it has become common to prepare chlorine by the action of concentrated hydrochloric acid on potassium manganate(VII) (permanganate). We *know* that this method of preparation has resulted in several accidents or near-misses, usually as a result of the inadvertent use of concentrated sulphuric acid (intended for drying the gas) in place of hydrochloric acid.

Despite publication of the letter in April *Education in Science* warning about a possible hazard when preparing chlorine by the action of acid on chlorate(I) (hypochlorite), this Committee has not actually received any reports of accidents occurring when using this method of preparation. Thus it may well be safer than HCl/KMnO₄. We would endorse the suggestion from the Northumberland Safety Officer that any risk of forming chlorine(I) oxide is reduced by adding acid to chlorate (I), rather than the reverse. We do suggest, however, that it is preferable to use laboratory solutions of chlorate (I) rather than domestic bleach, since the latter often contains additives, and at best may be an expensive way of buying water. Use of the laboratory reagent normally results in a satisfactory rate of chlorine generation even with fairly dilute acid.

The Preparation of Chlorine

Following the correspondence which appeared in this section of the April 1983 and January 1984 issues of *Education in Science*, the Editor received this letter from D. C. Cursons of St. Christopher School, Letchworth. I would not normally wish to take issue with the Laboratory Safeguards Sub-committee, which provides us with much valuable information. However in the last *Education in Science* its chairman asserts that chlorine may well be more safely prepared from chlorate(I) and dilute acid than from manganate(VII) and concentrated hydrochloric acid. The reason: when teachers have stupidly used concentrated sulphuric acid by mistake the expected explosions have occurred.

If we start to assert that one reaction is unsafe because another may explode we open up all manner of possibilities. We mustn't, for example, heat copper oxide with iron filings in case someone uses magnesium or aluminium; phosphorus is no longer to be stored under water in case someone tries to do the same with potassium; we mustn't add dilute acid to zinc powder in case some clot tries concentrated nitric: the possibilities are endless!

For my part, I like the opportunity when preparing chlorine to underline the need for care when reading labels. Having told pupils the consequence of using the wrong acid we can then check not only the label but that the acid fumes and forms a smoke with ammonia, a practical use of an important test. Later, when we come to prepare chlorine from sodium chloride, manganese(IV) oxide and sulphuric acid, they can appreciate the need to use manganese(IV) oxide rather than potassium manganate(VII).

Safety is not about neutralising the environment; it is about learning to take care in a potentially hazardous one. I shall continue to prepare chlorine by the time-honoured method and think it as safe as ever; if other people can't tell the difference between sulphuric and hydrochloric acids they shouldn't be teaching chemistry!

A reply from the Chairman of the Laboratory Safeguards Sub-committee:

I have much sympathy with the view expressed in this letter: I am sure that with an experienced, competent chemistry teacher, in calm surroundings, no problems need arise. Nevertheless, I would still argue that when making chlorine it is probably safer to avoid the reaction between manganate(VII) (permanganate) and concentrated hydrochloric acid. One frequently wants to dry the chlorine, and many teachers continue to use concentrated sulphuric acid for that purpose, although there are safer alternatives (SSR, 1982, 224, 63, 564). With the two concentrated acids on the bench at the same time it is all too easy to pick up the wrong bottle, especially if distracted by unruly pupils, or if rushing to finish before the bell goes.

If the KMnO_4/HCl reaction is to be used, then the suggestions in Mr. Curson's third paragraph are excellent as a safety check - and the high density and viscosity of concentrated sulphuric acid are also worth watching for.