Effect of iso-propanol on the radiolysis of aqueous solutions of periodate

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The γ-radiolysis of $IO_4^-$ in aqueous solution and binary solutions containing iso-propanol has been studied as a function of reactant concentration and absorbed dose. The disappearance of periodate ion in the presence of alcohol is found to be higher as compared to that observed in the pure system. The trend in the G-values determined at various combinations of the reactant concentrations suggests the occurrence of a chain reaction in the radiolytic process.

Introduction

We have reported earlier the γ-radiolysis of solutions containing oxidizing and reducing ions. $^1-^5$ Both components in the solutions were competing with the appropriate species of primary radiolytic products (prps) of water. Reaction mechanisms consistent with the observed results were proposed. Survey of literature reveals that the radiation chemistry of binary aqueous solutions containing oxidants such as periodate and alcohol do not seem to have been investigated, apart from the work of Gaikwad $^6$ from this laboratory.

It is of interest to study the radiolysis of binary solutions of periodate and iso-propanol in water, wherein one component ($IO_4^-$) acts as a scavenger of reducing species while the other as a scavenger of oxidizing species such as OH. The present communication deals with the radiolysis of pure periodate solutions as well as aqueous periodate solutions containing iso-propanol as a function of reactant concentrations and absorbed dose.

Experimental

All chemicals used were of AR grade. Iso-propanol was distilled before use. Synthetic (binary) solutions of periodate and iso-propanol were prepared in doubly distilled water. By keeping one of them constant and varying the other in the range of 1 to 100 mM, a continuous variation of composition was effected. A fixed amount
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of solution was irradiated in a 7.4 TBq $^{60}$Co gamma-source (dose rate 0.75 Gy · s$^{-1}$) for different time periods. The geometry of the source provides a uniform dose in the irradiation cavity. After irradiation, the concentration of periodate ion was determined iodometrically$^7$ in sodium bicarbonate solution. Iodine liberated was extracted with carbon tetrachloride in 4–5 aliquots and absorbance of CCl$_4$ layer was measured spectrophotometrically at $\lambda_{max}$ of 520 nm.

Results and discussion

The decomposition of pure periodate and binary solutions containing iso-propanol varies linearly with the absorbed dose (Figs 1 and 2). The radiolytic yields of residual periodate $G(-IO_4)$, computed from the slopes of linear plots are tabulated in Tables 1 and 2. The dependence of radiolytic decomposition of periodate on its initial concentration is shown in Fig. 1b from which it is seen that the decomposition increases initially with concentration of IO$_4^-$ and then attains a steady value with increasing concentration.

The important observations derived from the tabulated results are summarized below.

![Graphs](image)

Fig. 1. Radiolysis of periodate solution (a), variation of $G(-IO_4)$ with the initial periodate concentration (b)