A COMPARATIVE STUDY ON AQUALUMINESCENCE, CHEMICAL EFFECTS AND PHOTOANNEALING OF $\gamma$-IRRADIATED NaCl AND K$_2$SO$_4$

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Dissolution of $\gamma$-irradiated sodium chloride and potassium sulphate powders in pure water and aqueous sodium nitrate solution results in the emission of light in the former, and the formation of nitrite in the latter case. Appropriate mechanisms have been suggested for the luminescence and NO$_2$ formation in the light of the known radiolytic products formed in the salts during the irradiation. The photoannealing of the irradiated sodium chloride under the influence of visible light and K$_2$SO$_4$ by visible ultraviolet and laser lights has been studied by monitoring the changes in the NO$_2$ yield with annealing times. The observed changes in the nitrite yields have been correlated with the bleaching of the radiolytic products during the photoannealing of these salts.

INTRODUCTION

In our earlier paper we have reported$^1$ on the chemical effects induced by $\gamma$-irradiated chlorides and sulphates of alkali metals in aqueous nitrate solutions. Although
nitrite is the product formed due to the dissolution of these salts in the solution, the mechanism proposed is different due to the fact that altogether different radiolytic products are formed in these salts during irradiation. While defect centers\(^2\) are formed in alkali halides, in sulphates the radiolytic products viz. \(\text{SO}_4^{2-}\), \(\text{SO}_3^-\), \(\text{SO}_2^-\) and \(\text{O}_3^-\) are formed during irradiation\(^3-^6\), which react differently with \(\text{NO}_3^-\) ions to give \(\text{NO}_2^-\) in aqueous medium. It was therefore interesting to investigate and distinguish the other aspects like aqualuminescence and photoannealing which have been scarcely studied\(^7,^8\) in alkali sulphates as compared to chlorides\(^9-^{18}\).

**EXPERIMENTAL**

All the chemicals used were of AnalaR grade and triply distilled water was used for preparing the solutions.

Fixed amounts of dry and powdered samples (200 mesh) of NaCl and anhydrous K\(_2\)SO\(_4\) were transferred into air tight bottles, which were wrapped by aluminium foils to protect them from light. These were \(\gamma\)-irradiated by a 2.5 kCi \(^{60}\)Co source to a desired dose, and the dose rate /3.0 x 10\(^{19}\) ev g\(^{-1}\) h\(^{-1}\)/ was measured by a Fricke dosimeter.

For aqualuminescence studies 0.5 g of the irradiated samples were dissolved in 10 cm\(^3\) water. The intensity of light emitted on instantaneous dissolution and hence the emission spectrum were recorded using a set of interference filters /15 nm width/ along with a photomultiplier coupled with a fast scaler, adopting the same procedure reported by others\(^6\).

In order to study the chemical effects a definite amount of irradiated salt was dissolved in 10 cm\(^3\) of 0.4M NaNO\(_3\) solution and the \(\text{NO}_2^-\) formed was estimated by modi-