d'utiles discussions et l'intérêt qu'ils ont porté à ce travail.

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The Radioiodide Sequestering Action of the Silver Halides

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PREVIOUSLY the author indicated the use of silver iodide and silver chloride as a sequestering agent for radioiodide in solution, in the case of contaminated drinking water and for the purification of radioiodine compounds.[1,2]

This work was performed to study the behavior of both silver halides as radioiodide sequestering agents under different conditions of temperature, pH,

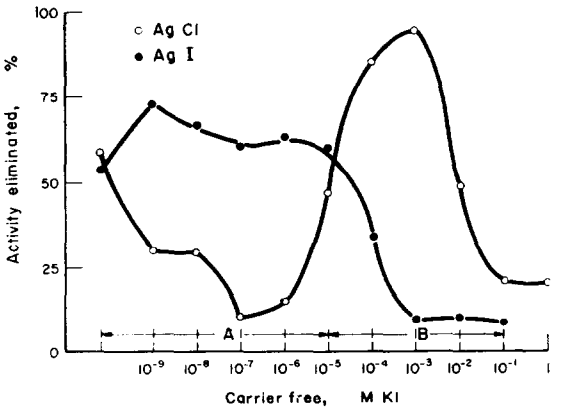

FIG. 1. Effect of different iodide concentrations.

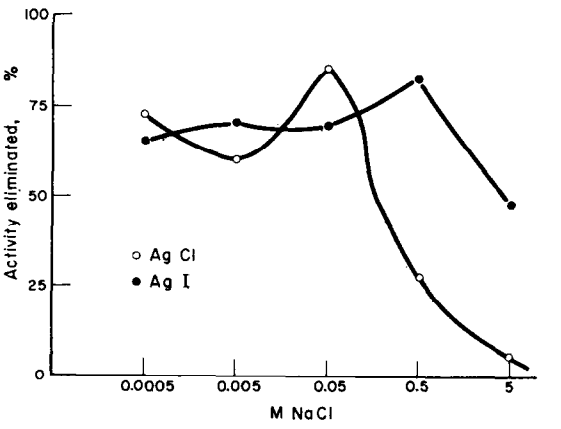

FIG. 2. Effect of different NaCl concentrations.

and concentration, of iodide, NaCl or an organic colloid (gelatin).

Experimental

The sequestering material was prepared by impregnation of kieselguhr (or other porous materials such as Hyflo Supercel, Celite, etc.) with a 10 per cent solution of Ag NO_3. The excess of this solution was eliminated by gentle suction, and the impregnated material was then immersed in a 10 percent solution of NaCl or NaI, to form AgCl or AgI in the inert matrix. Subsequently it was washed with distilled water, until the washing water gave a negative reaction with $AgNO_3$. Finally the material was dried by heating (max temp. 80°C).

The carrier-free NaI^{131} solution used, was brought to pH 1.0 with HCl and after a few minutes, to neutrality (pH 7.0) with NaOH and then tested for iodate by electrophoresis, using KUNKEL's method[3]. Under these conditions iodate was not found. For 10 min 20 ml of this carrier-free solution of NaI^{131} (approx. 0.1 m/c) was stirred with 50 mg of the silver halide preparation using a magnetic stirrer. The experimental conditions with regard to temperature, pH and salt concentration were as shown in Figs. 1–5. After stirring, the liquid was centrifuged for 5 min at 2500 rev/min. A sample of the supernatant was taken and the radioactivity counted. Triplicate assays were made, all glassware being washed before and after with a 5 percent solution of NaI and enough water to prevent adsorption of activity on the glass. It was intended originally to separate the suspended material by filtration, but this was found to be impractical due to the adsorption of activity on the filter paper (Figs. 6 and 7). To minimize absorption, plastic centrifuge tubes were used, previously treated with NaI solution as described above.

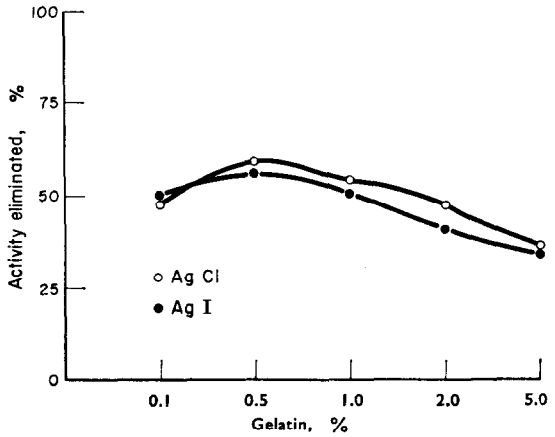

FIG. 3. Effect of different gelatin concentrations.

Results

As shown in Fig. 1, with carrier-free iodide, both halides behave similarly (possibly due to similar adsorption phenomena), but when the KI concentration is increased to 10^{-4} M the sequestering action of AgI is higher than that of AgCl. AgCl shows a maximum sequestering action at a concentration of 10^{-3} M, but after this point it rapidly decreases for both AgCl and AgI, but higher for AgCl than for AgI.

The effect of NaCl concentration shown in Fig. 2, indicated that between 5×10^{-4} and 5×10^{-2} M, the sequestering action is almost the same, but at a concentration of 0.05 M, it drops suddenly for AgCl and has a maximum for AgI.

In presence of an organic colloid (gelatin), the sequestering action decreases slowly for both halides with increasing colloid concentration (Fig. 3).

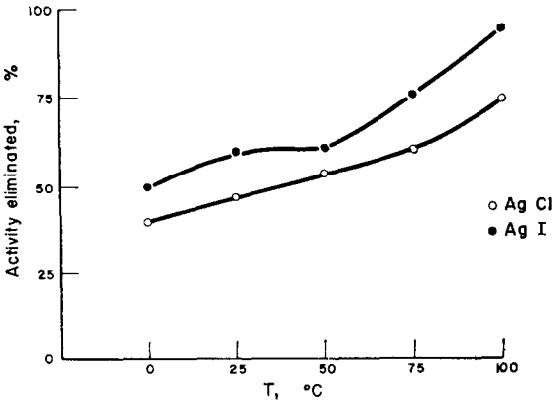

FIG. 4. Effect of different temperatures.

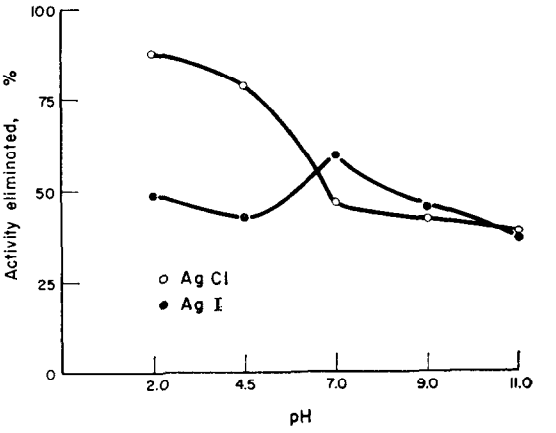

FIG. 5. Effect of different pH.

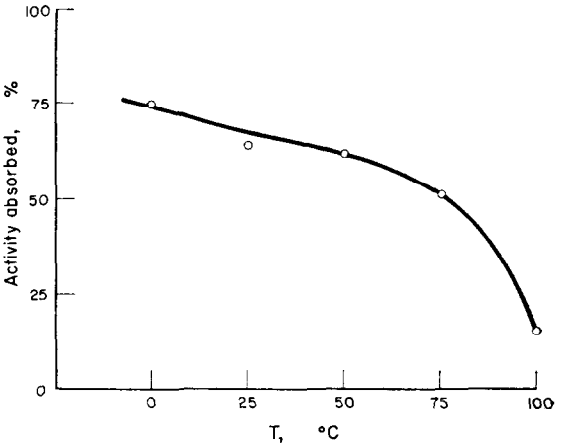

FIG. 6. Activity adsorbed on filter paper—effect of different temperatures.

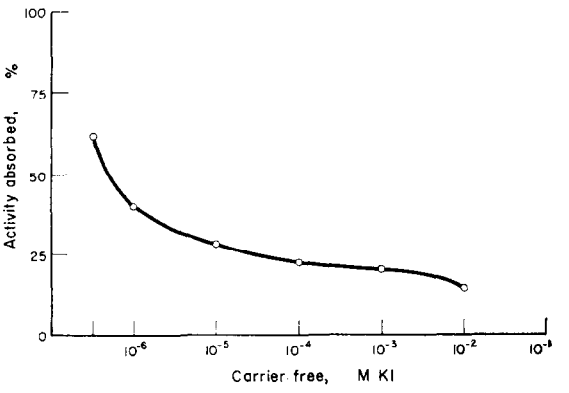

FIG. 7. Activity adsorbed on filter paper—effect of different carrier concentrations.

The sequestering action increases almost uniformly with increase of temperature. AgI is always slightly higher than AgCl (Fig. 4).

The sequestering action for AgI is almost the same over a wide range of pH (Fig. 5), but AgCl shows maximum activity at pH 2.0.

Conclusions

According to Fig. 1, and under these experimental conditions, the mechanism of radioiodide elimination by silver halides seems to be different under different concentrations of carrier iodide. The two possible reactions involved in the sequestering process are:

Displacement $AgCl + I^- \rightarrow AgI + Cl^-$ (a)

Isotopic exchange $AgI + I^* \rightleftharpoons AgI^* + I^-$ (b)

where I^* is the radioactive isotope of iodine.

If the concentration is below 10^{-5} M (zone A) it is a poor yield for the reaction (a) for the AgCl and a higher yield for the reaction (b) for the AgI, and vice versa if the concentration is over 10^{-5} M (zone B).

The decrease observed at high KI and NaCl concentrations shown in Figs. 1 and 2 respectively, may be due to the formation of a more soluble complex, especially in the case of AgCl. The possible reactions are:

$$AgCl + 2Cl^- \rightleftharpoons [AgCl_3]^=$$

and

$$AgI + 2I^- \rightleftharpoons [AgI_3]^=.$$

According to these conclusions, when the concentration of the carrier-iodide is unknown, it is reasonable to use a mixture of both halides.

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