CENTRIFUGATION OF SOLUTIONS OF YTTRIUM IN TRACE CONCENTRATIONS*

P. POLANSKÝ[a] and J. BÁR[b]

[a] *A. Zápotocký Military Academy, 600 00 Brno and*
[b] *First Brno Engineering Works, ZKG, Nuclear Techniques Department, 600 00 Brno*

Received October 25th, 1974

The behaviour of trace quantities of yttrium ($\sim 10^{-11}$—10^{-12}M) in aqueous solutions was investigated using the centrifugation techniques at the radial acceleration 3 500 *g*. The dependence of the fraction of separated ^{91}Y on pH of the solution shows a pronounced maximum at pH 3·5 to 4·6, where the formation of largest pseudocolloidal particles occurs. At higher pH values the formation of smaller pseudocolloidal particles as well as the formation of the particles of the true colloid — the hydroxide $^{91}Y(OH_3)$ may be assumed while at pH < 3·5 non-colloidal forms of ^{91}Y may be expected. This paper is a continuation of our previous communications[1-3] on the study of trace quantities of ^{91}Y in aqueous solutions. The importance of the centrigufation method in the investigation of forms of trace quantities of radionuclides in aqueous solutions is explained in detail in Starik's monography[4].

EXPERIMENTAL

The chemicals used, the radionuclide and its solutions as well as the devices and procedures applied in the determination of activities and pH of solutions have been described in our previous paper[1]. Solutions of the radionuclide were subjected to centrifugation in a laboratory centrifuge "Chirana" (mean value of the radial acceleration 3 500 *g*). After adjusting pH of the radionuclide solution, samples of 10 ml of the solution were transferred into eight test-tubes of the centrifuge. Four test-tubes were centrifuged until a constant volume activity of the solution at its surface was reached. After that the upper layer of the solution at the surface was carefully sampled and its activity A_z determined under standard measurement conditions. To eliminate the influence of the ^{91}Y radionuclide adsorption on the glass walls of the centrifuged test-tubes (the maximum adsorption occurs between pH 4 and 5 — see ref.[1]) solution samples were taken from the four testtubes not subjected to centrifugation, and its activity A was determined under the same standard conditions. These non-centrifugated samples were kept for the same time at the same temperature as the centrifugated samples. The remaining solution of the samples in all the eight test-tubes was used to determine the pH value. The deviation from the mean value — as plotted in the graph — were within $\pm 0{\cdot}05$ pH units. The activity K_{0i} of the centrifuged radionuclide in the particular test-tubes was calculated using the relation

$$K_{0i} = 100(A - A_z)/A, \% . \qquad (I)$$

* Part IV in the series Traces of Yttrium and Lanthanides Radionuclides in Aqueous Solutions; Part III: This Journal *39*, 1025 (1974).

Of the four values of K_{0i} the mean value K_0 was determined which was then plotted into the graph. The K_{0i} values were within $\pm 12\%$ of the K_0 value.

RESULTS AND DISCUSSION

Fig. 1 shows the percentage value of the activity of ^{91}Y centrifuged from aqueous solutions of approximately 10^{-11} to 10^{-12}M ^{91}Y (using the centrifuge with a radial acceleration 3500 ***g***) in dependence on pH of the solutions. The curve in Fig. 1 shows a pronounced maximum reaching up to 40% of the centrifuged ^{91}Y at pH 3·5–4·6. The ^{91}Y centrifugation in the strongly acidic, neutral, and basic pH region is relatively small. The maximum can be explained by the formation of a relatively abundant fraction of large adsorption pseudocolloidal aggregates[4] in that particular region of pH. It is definitely not accidental that in this pH region there lies also a maximum of ^{91}Y adsorption on glass[1]. The glass surface is usually formed by a microscopic layer of silicic acid gel, *i.e.* by the same sorbent as the overwhelming majority of the assumed non-active "carrier" which forms the main portion of the mass of the pseudocolloidal radionuclide particles. A relatively small radial acceleration (3500 ***g***) evidently does not make it possible to separate smaller pseudocolloidal particles. This is even more the case for yet smaller particles of the true colloid of the hydroxide $^{91}Y(OH)_3$ whose existence has to be expected at pH > 9 (see ref.[1]).

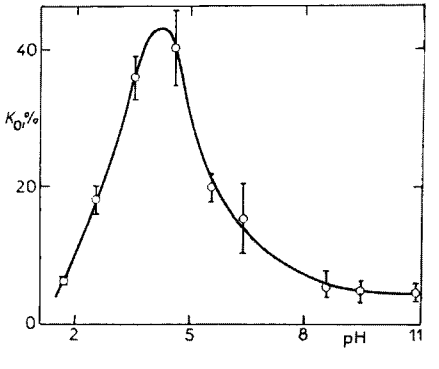

FIG. 1

Dependence of Activity K_0 of ^{91}Y on pH of the Solution

Concentration of ^{91}Y 10^{-11} to 10^{-12}M, radial acceleration 3500 ***g***.

REFERENCES

1. Polanský P., Bár J.: This Journal *37*, 3024 (1972).
2. Polanský P., Bár J.: This Journal *38*, 1145 (1973).
3. Polanský P., Bár J.: This Journal *39*, 1025 (1974).
4. Starik I. J.: *Osnovy Radiokhimii*, p. 39, 62, 134, 244. Izd. Nauka, Leningrad 1969.

Translated by Z. Herman.