

CHROM. 9932

Note

Lanthanum tellurate, a new inorganic ion exchanger

CONCEIÇÃO G. GONZÁLEZ and R. A. GUEDES DE CARVALHO

Centro de Engenharia Química, Faculdade de Engenharia, Porto (Portugal)

(Received January 14th, 1977)

We synthesized tellurates of yttrium and all lanthanoids (except Ce and Pm)¹ and, as zirconium tellurate^{2,3} and titanium and chromium tellurates⁴ had been reported as ion exchangers, it was decided to examine the ion-exchange properties of one of the lanthanoid tellurates we had synthesized, lanthanum tellurate.

EXPERIMENTAL

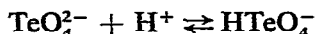
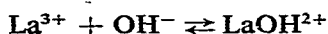
Lanthanum tellurate was synthesized as described elsewhere¹ by adjusting with aqueous ammonia to pH 4.5 a solution of LaCl₃ and Te(OH)₆ (La: Te = 2:3). The white flocculent precipitate was filtered, washed and dried *in vacuo* at 50°. Chemical analysis, solubility measurements, X-ray measurements and thermo-analytical investigations were performed¹.

Ion-exchange experiments were carried out in either column or batch experiments. Equilibrium of tellurate with NaCl solutions was attained quickly. H⁺ and Na⁺ were determined using glass and Na⁺-selective electrodes, respectively.

RESULTS AND DISCUSSION

According to the chemical analysis of lanthanum, tellurium and water (Karl Fischer method), the salt is anhydrous and agrees with the composition La₂(TeO₄)₃. Its solubility in water is very low (2 · 10⁻⁵ g · l⁻¹) and X-ray diffractograms revealed an amorphous material. The thermograms showed unusual behaviour, with evidence of isothermal volatilization at plateaus of 350–400° and 750–820°. A sharp decrease in weight was observed above 850°. An interpretation of this behaviour was attempted.

By analogy with titanium tellurate⁴, the ion-exchange functional group must be HTeO₄⁻. Although the initial product is an anhydrous salt, La₂(TeO₄)₃, the presence of HTeO₄⁻ may be justified by the hydrolysis of the salt according to the reactions



Equilibration of 1 g of La₂(TeO₄)₃ with 50 ml of NaCl solution (0.73–0.07 M, pH 7.0) gave solutions of pH 5, containing trace amounts (<5 ppm) of La and Te, which probably resulted from partial dissolution of the salt at this low pH.

Determination of the variation of exchange capacity with pH was performed

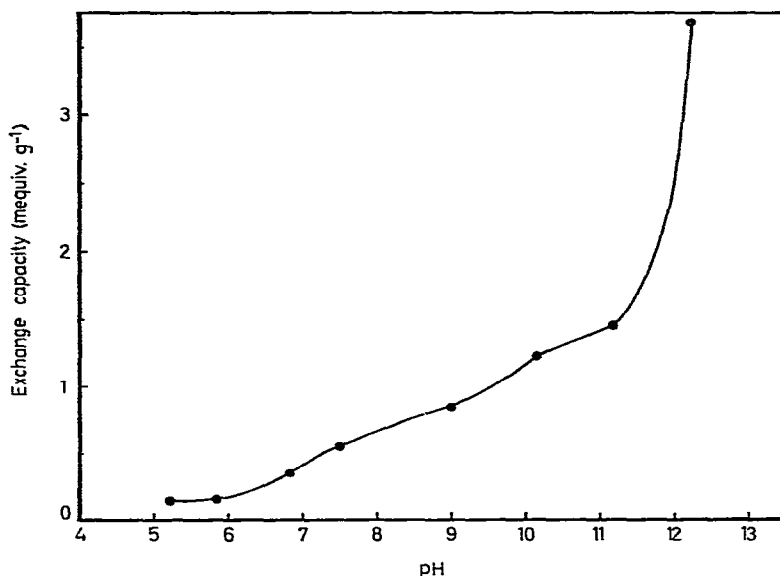
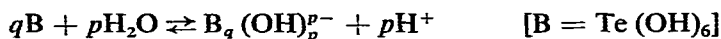


Fig. 1. Exchange capacity of lanthanum tellurate *versus* pH.

by batch experiments at different pH values of the equilibrium solutions. The fixation of Na^+ was determined by measuring the Na^+ concentration in the initial and final solutions with an Na^+ -selective electrode.

Fig. 1 shows three zones, the first, at $\text{pH} < 6$, where fixation of Na^+ is about $0.15 \text{ mequiv.} \cdot \text{g}^{-1}$. According to Szirtes *et al.*⁵, this may be attributed to the adsorptive properties of the substance. This hypothesis was confirmed observing that at $\text{pH} 5.8$ and using 0.07 M NaCl solution, the fixation of Na^+ was $0.16 \text{ mequiv.} \cdot \text{g}^{-1}$, while when 0.73 M NaCl solution was used the fixation increased to $1.61 \text{ mequiv.} \cdot \text{g}^{-1}$. The second zone of the curve, between $\text{pH} 6.5$ and 11 , is approximately a straight line with two slight inflections, and corresponds to the first steps of hydrolysis. This zone of the curve is identical with the curve for zirconium tellurate obtained by Szirtes and Zsinka². The third zone is observed at $\text{pH} > 11$, with a large increase that may be due to the complex chemistry of tellurates in aqueous solution, for which a general equation of hydrolysis can be written⁶:



According to Kaehler and Brito⁶, the formation of polynuclear species, B_2OH^- and $\text{B}_2(\text{OH})_2^{2-}$, is favoured by high pH values. Above $\text{pH} 8$, these two species predominante.

REFERENCES

- 1 C. G. González and R. A. G. de Carvalho, *J. Inorg. Nucl. Chem.*, submitted for publication.
- 2 L. Szirtes and L. Zsinka, *Proc. 2nd Symp. Ion Exchange, Balatonszeiplak, Hungary, 1969*, Vol. IIb, Magyar Kemikusok Egy., Budapest, 1969, p. 627.
- 3 L. Szirtes and L. Zsinka, *Radiochem. Radionol. Lett.*, 7 (1971) 61.
- 4 L. Szirtes and L. Zsinka, *J. Chromatogr.*, 102 (1974) 105.
- 5 L. Szirtes, L. Zsinka, K. B. Zaborenko and B. Z. Iofa, *Acta Chim. Acad. Sci. Hung.*, 54 (1967) 215.
- 6 H. C. Kaehler and F. Brito, *An. Real Soc. Esp. Fis. Quim.*, 67 (1971) 1185.