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PREPARATION OF SOME NEW INORGANIC ION EXCHANGERS

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SUMMARY

The tellurates of titanium and chromium were investigated. The method of preparation of titanium tellurate is given. Chromium tellurate could not be obtained by the usual methods. Based on various experiments, the composition, solubility and ion-exchange data of amorphous titanium tellurate were obtained.

INTRODUCTION

Some years ago, experiments were carried out on the preparation of zirconium tellurate and during these investigations other ion exchangers based on tellurates were synthesized for comparison. The data concerning zirconium tellurate were reported earlier[1,2]. This paper deals with the results obtained for titanium and chromium tellurates.

EXPERIMENTAL

Titanium tellurate was prepared as follows. Titanium tetrachloride in 15% hydrochloric acid and 2 *M* telluric acid were mixed with vigorous stirring. The mixture was evaporated on a water-bath with continuous stirring and the residue was cooled to room temperature, washed with re-distilled water to pH 4 and dried over phosphorus pentoxide.

Chromium tellurate was prepared in the same way as zirconium tellurate[1], except that hydrazine hydrate solution was used for the reduction of chromium and tellurium.

The titanium content was determined gravimetrically as titanium oxide, while chromium and tellurium were determined spectrophotometrically.

X-ray measurements were carried out using a Philips PW 1050 high-angle powder diffractometer with Cu K_α (Ni filter) radiation ($\lambda = 1.5418$ Å).

The thermoanalytical investigations and the ion-exchange capacity measurements were carried out using methods described earlier[3,4]. Solubility was controlled by a static method at room temperature.

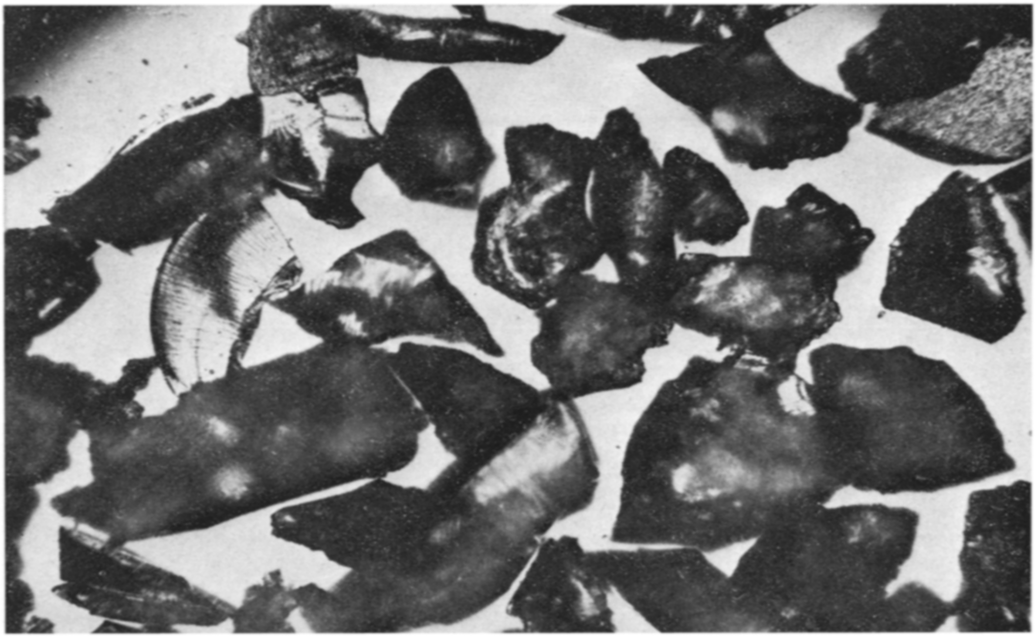
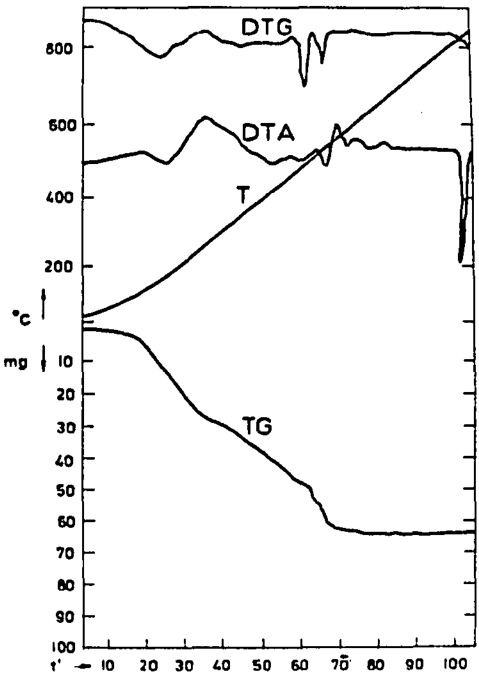


Fig. 1. Microscope photograph of the titanium tellurate.



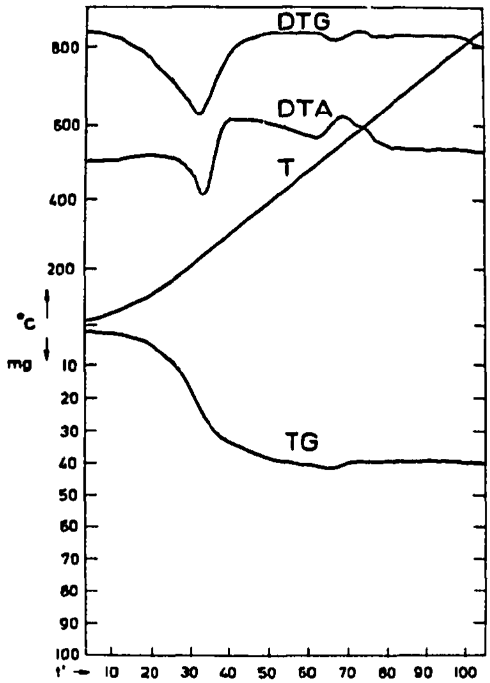


Fig. 2. Thermogram of titanium tellurate. T = Temperature (°C); TG = weight loss (mg) curve; DTG = differential thermogravimetric curve; DTA = differential thermoanalytical curve; t' = time (min).

Fig. 3. Thermogram of chromium tellurate.

RESULTS AND DISCUSSION

The preparation methods used earlier by us and other workers for the synthesis of other ion-exchange materials failed in the case of titanium tellurate. The X-ray diffractograms reveal no peaks for either material. The microscope photograph (Fig. 1) indicates that titanium tellurate is a transparent vitreous material (chromium is not), while both ion exchangers have a shell-like fracture. Based on these observations, we assume that amorphous materials were formed by the methods described.

Based on the analytical data, ratios of Te:Ti = 2.06 and Te:Cr = 0.2 were found.

It was found that chromium tellurate has a good solubility in all acids; titanium tellurate is virtually insoluble in alkalis and in various acids; thus it is insoluble in concentrated hydrofluoric and sulphuric acids and can be dissolved very slowly only in hot concentrated hydrochloric acid.

On the thermogram for titanium tellurate (Fig. 2), endothermic processes following weight loss were found with peaks at 170, 335, 500 and 560°. Exothermic peaks were found at 280, 370, 470, 525 and 545°. The first endothermic process is due to the loss of water of crystallisation. The weight losses up to 470° correspond to the release of structural water and the processes above this temperature are due to the reduction $Te^{6+} \rightarrow Te^{4+}$.

In Fig. 3 the thermogram for chromium tellurate is shown. Endothermic processes were found at 200 and 495°. The other processes found at 516, 547 and 832° are connected with reactions of tellurium. Comparing the curves found with those in the literature[5], it can be postulated that we have chromium(III) oxide (Cr_2O_3) with some tellurium oxide adsorbed on the surface. This is supported by the rather weak processes above 500°.

In Fig. 4 the ion uptake data are shown. With titanium tellurate, the character of the curves and the approach of the capacity value to the maximum shows that this material is a real ion exchanger containing functional groups ($HTeO_4^-$) capable of exchanging H^+.

With chromium tellurate, we obtained curves typical of oxyhydrates. Comparing these and the thermoanalytical data, it can be stated that the residue is a mixture of chromium and tellurium oxides.

From the above, it follows that the method described for the preparation of

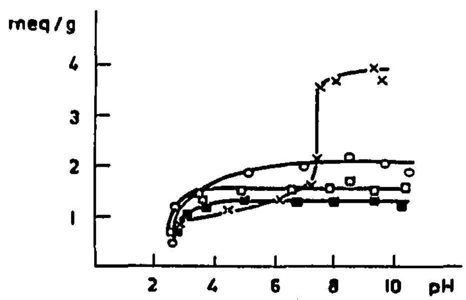


Fig. 4. Exchange capacity data of titanium tellurate: ×, Na^+; ○, K^+; ■, Rb^+; □, Cs^+.

titanium tellurate is successful, but further investigations are necessary in order to clarify all details and to obtain crystalline titanium tellurate.

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