Uranyl Soaps

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Abstract

Uranyl soaps (laurate, myristate, palmitate and stearate) were prepared by reaction of aqueous solutions of uranyl chloride and the corresponding sodium soaps. Viscosity and conductivity of the laurate, myristate and palmitate dissolved in dimethylformamide were measured.

Introduction

During our studies on organic compounds of uranium (1,2) we have reported the preparation of tetrasoaps of uranium (2). The tetrasoaps of uranium were prepared either by the reaction involving uranium tetrachloride and fatty acids in benzene or by the interaction of aqueous solution of uranium tetrachloride with sodium salts of fatty acids. There appears to be no reference available on the preparation of uranyl soaps. This paper, therefore, deals with the preparation of uranyl soaps and some of their physical properties, such as viscosity and conductivity in dimethylformamide.

The reaction between uranyl chloride and sodium salts of fatty acids in an aqueous medium can be represented by the following equation:

$$UO_2Cl_2 + 2NaCOOR \longrightarrow UO_2(OOCR)_2 + 2NaCl$$
(where R = $C_{11}H_{23}$, $C_{13}H_{27}$, $C_{15}H_{31}$ and $C_{17}H_{35}$)

The soaps are obtained as yellow insoluble precipitates when a requisite amount of sodium soap solution is added slowly with constant stirring to uranyl chloride solution in water. After mixing, the mixture is heated for some time and the precipitate is filtered and washed first with water and then with a little alcohol. In order to get soap free of water, it is kept in a convection oven at 40 C. Final drying is done under reduced pressure.

The soaps are all yellow powdery solids insoluble in benzene, alcohol and ether but soluble in dimethylformamide. The solubility in dimethylformamide decreases with increase in molecular weight of the soap, so much that uranyl stearate could not yield a solution suitable for measurement of viscosity and conductivity. These soaps are unaffected by moisture and air. Their melting points were found to increase as the molecular weight of the soap increased. (Table I).

Attempts to prepare the soaps by reacting uranyl nitrate with the fatty acids in benzene were unsuccessful although we have been successful in preparing uranium tetrasoaps by reacting uranium tetrachloride and fatty acids in benzene (2).

To examine the nature of the soaps in dimethylformamide, viscosity and conductivity measurements were made. Results of conductance measurements are plotted on Figure 1 and the viscosity values are plotted on Figure 2. The curves for specific conductivity versus concentration are almost straight, showing regular increase in conductivity with increase in soap concentration. The values of specific conductance at the same concentration are in the order palmitate > myristate > laurate. Figure 2 shows the variation of viscosity with concentration for uranyl laurate, myristate and palmitate. A linear relationship between viscosity and concentration is shown by the straight line nature of the curves. The variation of viscosity with concentration is, however, slightly different in comparison with variation in conductivity. Viscosity increase with concentration is in descending order: palmitate > myristate > laurate; it is probably related to the tendency of the soaps to aggregrate.

Experimental Procedures

Materials

Uranyl nitrate was a B.D.H. product. Uranyl chloride was obtained from Bhabha Atomic Research

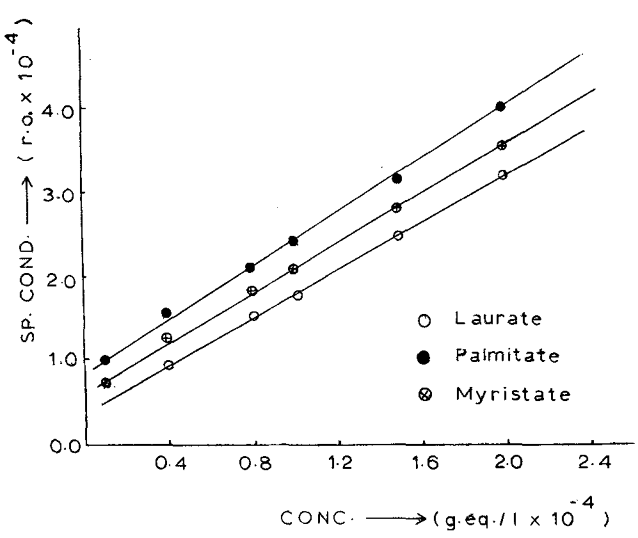

FIG. 1.

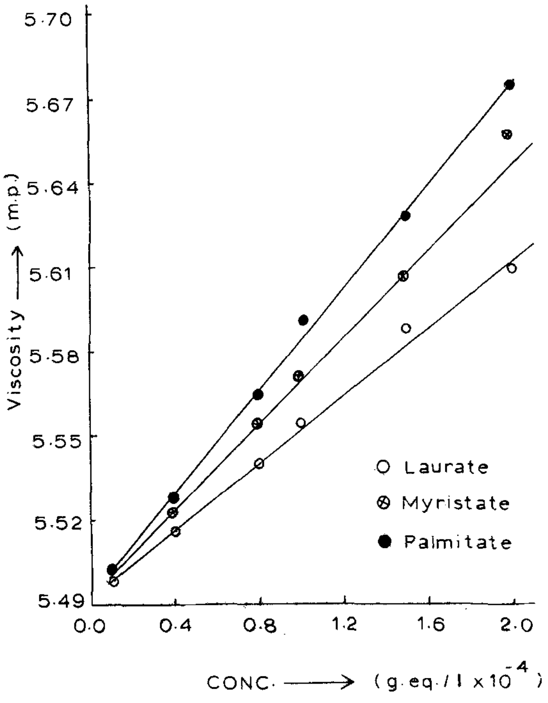

FIG. 2.

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TABLE I

Uranyl soap	Formula	Mp, C	Analysis, %			
			Uranium		Acid	
			Found	Calc.	Found	Calc.
Laurate	$UO_2(OOC\ C_{11}H_{23})_2$	116	35.48	35.61	60.00	59.63
Myristate	$UO(OOC\ C_{13}H_{27})_2$	128	32.66	32.85	62.16	62.74
Palmitate	$UO_2(OOC\ C_{15}H_{31})_2$	139	31.00	30.48	79.08	78.65
Stearate	$UO_2(OOC\ C_{17}H_{35})_2$	153	28.06	28.44	67.26	67.74

Center, Government of India. Lauric, myristic, palmitic and stearic acids were all B.D.H. products. Benzene (B.D.H.) was dried over sodium wire and carefully fractionated over a long column. All other reagents and chemicals used were either B.D.H. or Merck products.

Analytical Methods

Uranium was estimated gravimetrically as U_3O_8 by direct ignition of the derivatives. Fatty acids were estimated by decomposing the compound with dilute sulfuric acid and collecting the residue after washing thoroughly with cold water. The residue was dissolved in alcohol and titrated against sodium hydroxide solution using phenolphthalein as indicator.

Physical Measurements

Viscosity of the solutions was measured by means of Ostwald's viscometer at 30.0 + 0.5 C. The densities were measured using pycnometer and the conductivity with the help of a Philip Magic Eye conductivity bridge (Type PR 9500).

Preparation of Uranyl Laurate

A solution of sodium laurate prepared by neutralizing lauric acid (7.0 g) in alcohol by adding sodium hydroxide solution was added slowly and with constant stirring to uranyl chloride (6.0 g) in water. Immediately a yellow colored flocculent mass precipitated. After warming, the solid mass was filtered, washed and dried, first in an air-oven at low temperatures and then under reduced pressure using a low temperature oil bath. (Yield, 88%). Found: U, 35.48; acid, 60.00%, mp, 116 C. Calculated for $C_{24}H_{46}O_6U$, U, 35.61; acid, 59.63%.

Uranyl palmitate, myristate and stearate were prepared in a similar manner.

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