ELECTRICAL CONDUCTIVITY, VISCOSITY AND DENSITY OF THE SYSTEM $SnBr_4 - CH_3COOH$

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Stranathen and Strong [1] studied the electrical conductivity and viscosity of the system $SnCl_4 - CH_3COOH$ and deduced the existence of the compound $SnCl_4 \cdot 3CH_3COOH$. M. Usanovich and E. Kalabanovskaya [2, 3], assuming that, together with the compound $SnCl_4 \cdot 3CH_3COOH$, the compound $SnCl_4 \cdot 2CH_3COOH$ must exist, repeated the viscosity and electrical conductivity measurements in a wider temperature range. However, no specific points corresponding to the compound $SnCl_4 \cdot 2CH_3COOH$ were produced on the curves. Continuing to assume that the compound $SnCl_4 \cdot 2CH_3COOH$ must exist, the authors attempted to isolate it in the crystalline state. And actually, a compound $SnCl_4 \cdot 2CH_3COOH$ with a m. p. of 19.5° was isolated.

In connection with these data, it was of interest to study the behavior of $SnBr_4$ with respect to CH_3COOH. For this purpose the electrical conductivity, viscosity and density of the system $SnBr_4 - CH_3COOH$ were studied.

The acetic acid and the stannic bromide were carefully purified and their constants corresponded to the literature values. Measurements of the electrical conductivity, viscosity and density were made at 25, 60 and 70°.

Stannic bromide, like stannic chloride, mixed limitedly with acetic acid. In the system $SnCl_4 - CH_3COOH$ separation set in at 40 mole % of $SnCl_4$ at 0°, but in the system $SnBr_4 - CH_3COOH$ at 25° the region of separation lay between 70-20 mole % of $SnBr_4$. Stannic bromide mixed in all proportions with acetic acid at 60 and 75°; therefore, incomplete curves were obtained at 25°.

The results of the measurement of the viscosity, electrical conductivity and density are given in Figs. 1, 2 and 3, respectively. On addition of acetic acid to the stannic bromide, the viscosity of the latter decreased a little at first. A further increase of the acetic acid concentration led to a viscosity increase. This viscosity increase was very sharply expressed at 25°. The viscosity isotherms passed through a maximum which occurred at ~ 15-20 mole % $SnBr_4$. With an increase of the temperature, the viscosity of the system decreased strongly, especially in the region of the maximum. While the viscosity isotherm at 25° passed through a sharp maximum, on the viscosity isotherm at 75° the maximum was weakly expressed.

Such a course of the viscosity isotherms, on the one hand, indicates that interaction occurs in the system, and on the other, shows that the compound which forms is apparently thermally unstable.

The specific electrical conductivity isotherms (Fig. 2), which pass through a maximum at 10 mole % $SnBr_4$, also indicated the presence of interaction. It is interesting to observe the unusual relationship of the electrical conductivity of the system to the temperature. The electrical conductivity isotherm at 75° was located between the 25 and 60° isotherms. Such a position of the electrical conductivity isotherm was related to the change of the viscosity with temperature. It is obvious from Fig. 1 that the viscosity at 25° in the region of the maximum is approximately 5 times larger than that at 60°, but the viscosity at 75° differs relatively little from that at 60°; therefore, if a correction is made for viscosity, the electrical conductivity isotherms are arranged regularly (Fig. 4). The corrected electrical conductivity decreases sharply with an increase of temperature, which, in our opinion, also indicates the thermal instability of the complex compounds which form in the system.

The study of the system $SnBr_4 - CH_3COOH$ showed that $SnBr_4$ differed from stannic chloride in its behavior. It was established by the works of many investigators that $SnBr_4$ had much less of a tendency toward formation of complex compounds than did $SnCl_4$. The compounds of $SnBr_4$ were less stable than were the corresponding compounds of $SnCl_4$. It is evident from the data cited that stannic bromide reacts with acetic acid; the presence of electrical conductivity in the system shows that this reaction is of an acid-base nature. However, the curves of the physico-chemical analysis of the liquid phase gave no indication of the composition of the complex compounds which formed in the system.

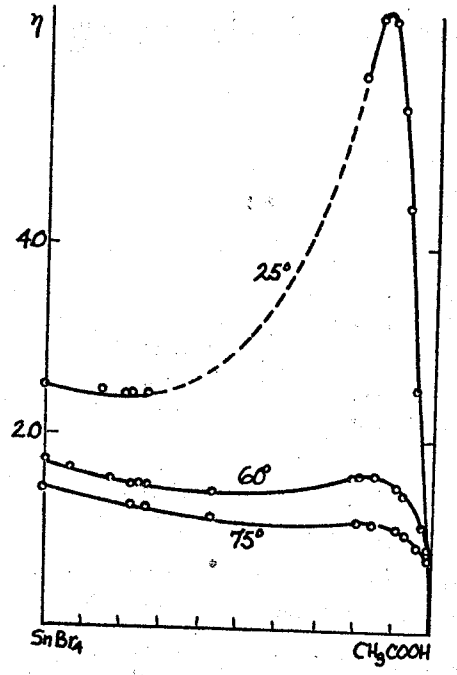

Fig. 1. Viscosity of the system $SnBr_4 - CH_3COOH$ (in centipoises).

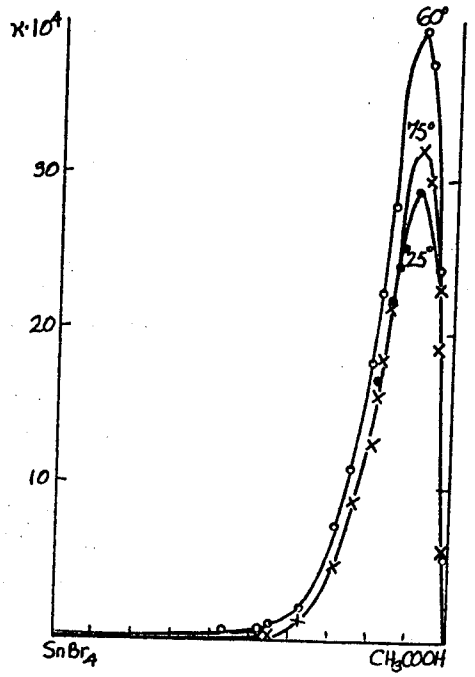

Fig. 2. Specific electrical conductivity of the system $SnBr_4 - CH_3COOH$.

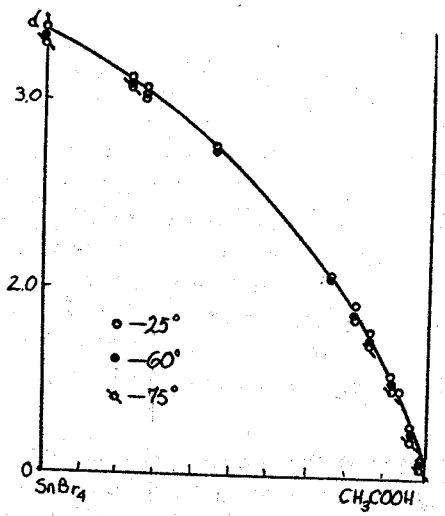

Fig. 3. Density of the system $SnBr_4 - CH_3COOH$.

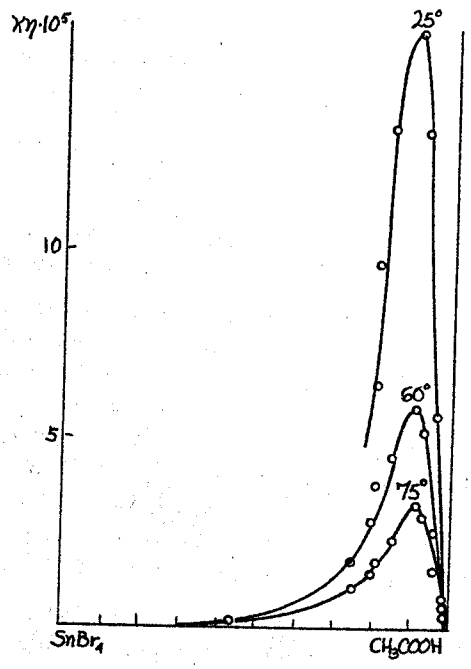

Fig. 4. Corrected electrical conductivity of the system $SnBr_4 - CH_3COOH$.

SUMMARY

1. The electrical conductivity, viscosity and density of the system $SnBr_4-CH_3COOH$ were studied at 25, 60 and 75°.

2. By the curves of the physico-chemical analysis of the liquid phase, it was established that stannic bromide reacts with acetic acid. The presence of electrical conductivity in the system showed that this interaction was of an acid-base nature.

LITERATURE CITED

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[3] M. I. Usanovich and E. I. Kalabanovskaya, Bull. Sect. of Platinum Acad. Sci. USSR, 21, 228 (1948).

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