The distribution of the components of binary solutions (H_2O–organic solvent) between the anion-exchange resin, chiefly in the halide form, and the solution has been studied by a number of authors [1–3]. It is of theoretical and practical interest to study the distribution of the components of aqueous organic solutions of mineral acids. This communication presents data on the distribution of acid aqueous organic solutions between the anion-exchange resin AV-17 \times 8 in the corresponding salt form and the external solution. Some data on binary solutions that are not available in the literature are also cited.

**EXPERIMENTAL**

Aqueous acetone and aqueous methanol solutions, as well as solutions of H_2SO_4, HCl, and HNO_3 in the aqueous organic solvents, were studied. The anion-exchange resin AV-17 \times 8 with grain size 0.1–0.25 mm was washed free of the organic and inorganic impurities by the well-known methods. The ion-exchange resin was additionally washed with methanol. The acids and organic solvents used were cp grade. All the experiments were conducted according to the following procedure.

Into a flask with a ground stopper we placed 0.5 g air-dried ion-exchange resin (in the case of high fractions of the organic solvent, absolutely dry ion-exchange resin) and 20 ml of the mixed solvent. The flask was exposed at 22–23°C for two days with periodic mixing. During this time the solution was decanted two to three times from the ion-exchange resin and replaced with a new portion of solution of the same composition. The ion-exchange resin, swollen in this aqueous organic solution, was transferred to a beaker with a mesh bottom, which was placed in a hermetically sealed polyethylene test tube and centrifuged at 5000 rpm for 45 min. To determine the total amount of absorbed components, we took a sample of ion-exchange resin brought to the surface-dried state in this way, and dried it to constant weight in a weighing bottle at 105°C. In the experiments with acid solutions, before drying, the remainder of the centrifuged ion-exchange resin was weighed to determine the amount of organic component and mineral acid absorbed by the ion-exchange resin phase, and was placed in weighed flasks with water (20 ml) for two days for extraction of the organic solvent and acid. Then the ion-exchange resin was separated from the solution, and the fraction of the organic solvent in the initial solution was high, the ion-exchange resin was additionally washed with water. The volume of the solution obtained was brought up to 50 ml in a volumetric flask. The acid concentration was determined in aliquot portions by titration with alkali, the methanol concentration with bichromate [4], and acetone by an iodometric method [5].

From Figs. 1–3 it is evident that the curves of the dependence of \( \bar{N}_0 \) and \( N_0 \) are more asymmetrical with respect to the diagonal of the square for aqueous acetone solutions than for aqueous methanol solutions, which is determined by the nature and structure of these solutions [6]. In aqueous methanol solutions, on account of the smaller deviation from ideality, the salt form of the ion-exchange resin has no great influence on the distribution, the distribution curves differ little from one another (see Figs. 1 and 2), and a large asymmetry of the curve is observed in sulfuric acid solutions (see Fig. 3). On the contrary, in aqueous acetone solutions the shape of the distribution curves depend to a substantial degree on the salt...
Fig. 1. Distribution curves of the organic component in the case of sorption from aqueous organic solution and hydrochloric acid aqueous organic solution by AV-17 × 8-Cl: 1) water—methanol; 2) water—acetone. a) Without HCl; b) 0.5 N HCl; c) 1.0 N HCl; d) 2 N HCl. Here and henceforth, \( \bar{N}_o \) is the mole fraction of the organic solvent in the phase of the solution.

Fig. 2. Distribution curves of the organic component in sorption from aqueous organic solution and nitric acid aqueous organic solution by AV-17 × 8-NO₃: 1) water—methanol; 2) water—acetone. a) Without HNO₃; b) 0.5 N HNO₃; c) 1.0 N HNO₃; d) 2.0 N HNO₃. Dotted curve) values without taking account of acid.

Fig. 3. Distribution curves of the organic component in sorption from aqueous organic solution and sulfuric acid aqueous organic solution by AV-17 × 8-SO₄: 1) water—methanol; 2) water—acetone. a) Without H₂SO₄; b) 0.5 N H₂SO₄; c) 1.0 N H₂SO₄; d) 2.0 N H₂SO₄. Dotted curve) values without taking account of acid.

Fig. 4. Curves of total sorption (Q) of the components: 1) water—methanol; 2) water—acetone. a) SO₄-form; b) NO₃-form; c) Cl-form.

Fig. 5. Curves of partial sorption (Q) of the organic solvents water—methanol, water—acetone: 1, 2, 3) methanol; 4, 5, 6) acetone. 1, 6) SO₄-form; 2, 5) Cl-form; 3, 4) NO₃-form.

form of the anion-exchange resin (see Figs. 1–3). The asymmetry of the curves increases in the series \( \text{NO₃}^- < \text{Cl}^- < \text{SO₄}^2^- \). The total swelling also increases in this series (Fig. 4), as does the partial absorption of water (Tables 1 and 2). As is well known, the energies of hydration of the ions increase in this direction (\( \text{NO₃}^- 69, \text{Cl}^- 79, \text{SO₄}^2^- 227 \text{ kcal/} \text{ion} [7] \)). The nitrate ion is characterized by negative hydration [8]; below 30° the chloride ion also shows negative hydration, while above this temperature it acquires the properties of an ion with positive hydration [9]. The more pronounced the positive hydration, the more asymmetrical the distribution curve, the greater the partial absorption of water and the swelling of the ion-exchange resin.