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MEASUREMENT OF DYNAMIC VISCOSITY OF BINARY MIXTURES OF BUTYL ALCOHOL AND BUTYRALDEHYDE

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We present measured values of the viscosity of binary mixtures of butyl alcohol and butyraldehyde of various concentrations at temperatures from 288 to 500°K and pressures from 0.1 to 50 MPa.

Among the various materials of great practical importance for the chemical, petroleum refining, power, and gas industries, an important place is occupied by alcohols, aldehydes, and their binary liquid solutions.

We have measured the viscosity of binary solutions of n-butyl alcohol and n-butyraldehyde of various concentrations in the liquid state over a wide range of temperatures and pressures.

The n-butyl alcohol used in the mixtures was freed of contaminants by the method described in [1]. Particular attention was paid to the removal of moisture from the alcohol. The purity of the alcohol was 99.96% by weight. The butyraldehyde was also purified by the method of [1], and precautionary measures were taken to prevent contact of the butraldehyde with the air. The purified aldehyde was kept in a dark environment. We estimate its purity as 99.97% by weight. The binary liquid mixtures were made before the viscosity was measured.

The dynamic viscosity was measured by the capillary viscometer method developed by Golubev [2, 3] at temperatures from 288 to 500°K and pressures from 0.1 to 50 MPa.

The viscometer capillary had a radius $r = 1.724 \cdot 10^{-4}$ m, the volume of the measuring tank was $v = 206.607 \cdot 10^{-4}\ m^3$, and the length of the capillary was $l = 772.94 \cdot 10^{-4}$ m. The

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TABLE 1. Dynamic Viscosity of Mixtures of n-Butyl Alcohol and n-Butyraldehyde, $\eta \cdot 10^6$, Pa•sec

T, K	P, MPa						
	0,1	5,0	9,9	19,7	29,5	39,3	49,1
	10 % n-butyl alcohol + 90 % n-butyraldehyde						
292,93	1220	1260	1305	1408	1520	1636	1756
324,63	—	887	921	990	1060	1128	1192
371,93	—	—	905	959	1016	1058	1124
402,68	—	—	—	903	968	1011	1056
454,18	—	—	—	557	587	616	645
500,48	—	—	—	504	525	546	567
	60 % n-butyl alcohol + 40 % n-butyraldehyde						
294,63	5780	6013	6510	7380	8390	9500	10066
319,13	2552	2690	2480	3015	3098	3840	4210
339,03	1505	1575	1650	1806	1966	2133	2304
367,53	—	1005	1045	1180	1270	1360	1450
403,03	—	764	790	850	910	965	1003
426,53	—	660	685	730	780	770	880
444,53	—	615	630	680	720	768	810
477,98	—	550	570	600	640	675	710
	90 % n-butyl alcohol + 10 % n-butyraldehyde						
294,53	5490	6250	6560	7210	7900	8000	9340
320,13	2980	3120	3270	3570	3890	4210	4550
347,88	1800	1870	1895	2120	2300	2500	2690
369,68	—	1040	1460	1585	1710	1830	1960
403,78	—	930	963	1040	1120	1190	1270
440,53	—	695	725	775	830	885	940
464,83	—	600	625	665	715	756	800

TABLE 2. Dynamic Viscosity of n-Butyl Alcohol

T, K	$\eta \cdot 10^6$, Pa•sec	T, K	$\eta \cdot 10^6$, Pa•sec
223,13	34700	313,13	1780
233,13	22400	323,13	1410
243,13	14600	333,13	1140
253,13	10300	343,13	930
263,13	7400	353,13	760
273,13	5190	363,13	630
283,13	3870	373,13	540
293,13	2950	383,13	460
303,13	2280		

dimensions of the viscometer were measured with an MIR-12 microscope and a KM-8 cathetometer by the method of [3, 4].

During the measurements of the viscosity the temperature was determined by a PTS-10 platinum resistance thermometer and checked with a Chromel—Alumel thermocouple. The pressure was produced and measured by an MP-600 dead-weight test apparatus with an accuracy of 0.05. The viscometer was maintained at a temperature of 24°C to within ±0.05°C. The time of flow of the material under investigation through the capillary was measured automatically with a P14M timer with an error of ±0.01 sec. The error in the measurement of the viscosity was ±1% on the average.

To calculate the dynamic viscosity by the method indicated it is necessary to know the density of the mixtures in the ranges of temperatures and pressures investigated. These values were taken from [5].

The measured values are listed in Table 1.

The data on the dynamic viscosity of butyl alcohol (Table 2) were taken from [6], and of butyraldehyde from [7].

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USE OF PACKED THERMAL DIFFUSION COLUMNS TO DETERMINE THE SORET COEFFICIENT IN A BENZENE—CARBON TETRACHLORIDE MIXTURE

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Experimental results of the determination of the Soret coefficient of a benzene—carbon tetrachloride mixture in a packed column with reservoirs at the ends are presented.

The theory of thermal diffusion in a packed cylindrical column is presented and analyzed in [1, 2]. The virtual absence of parasitic convection in this type of column is one of the most important results, which permits using a packed column to determine the thermal diffusion constant. The expressions for the transport coefficients in a packed column differ from those in [3, 4] by their dependence on the parameters of the porous medium and contain corrections for the cylindrical geometry and the influence of sampling. An experimental check of the theory gave favorable results [1].

In what follows, the investigation of the C_6H_6—CCl_4 mixture was continued over the entire range of concentrations. The experimental setup and the technique remained as before [1], but in order to increase the accuracy of the experimental results, the results were processed on a computer using the method of least squares and, in so doing, the asymptotic solutions in [5], which describe the separation kinetics on the initial part of the curve of the transient separation process in the column, were used.

We will write this solution in the form

$$\Delta c = c_0(1-c_0)A\tau v(A\tau,\ by\omega), \tag{1}$$

where τ is the time from the beginning of the experiment; $A = H/M$; $b = 1 - 2c_0 - \Delta c$; v is a known (from [5]) function approaching 1 as $\tau \to 0$.

We form the functional

$$\Phi(A,\ y\omega) = \frac{1}{n}\sum_{i=1}^{n}[\overline{\Delta c}_i - c_0(1-c_0)A\tau_i v(A\tau_i,\ b_i y\omega)]^2, \tag{2}$$

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