WETTING CONTACT ANGLES OF CERTAIN SYSTEMS

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The wetting contact angles of a number of systems are determined experimentally. The measurements are carried out in air at temperatures of 20-70°C by a variety of methods.

While designing an experimental apparatus for studying the temperature dependence of the wetting contact angle [1, 2], a large number of experiments were carried out on various systems. In view of the fact that information regarding contact angles is extremely limited in the reference literature and that the determination of the contact angle θ by computation is as yet only qualitative, experimental data regarding the θ values of various solid — liquid — gas systems may prove to be of practical interest.

Table 1 gives the experimental values of the inflow (numerator) and outflow (denominator) contact angles θ_{in} and θ_{out} for systems frequently encountered in practice. Figure 1a, b shows the dependence of the contact angles on the concentration of aqueous solutions of ethyl alcohol and glycerin. These results were obtained in a variety of ways: by calculation from the characteristic geometrical dimensions of the drop or meniscus [3, 4], by the tangent method, and by the method of the inclined plate [5]. The average error in measuring the angles θ by the various methods is no greater than ±2.5°.

The experiments were carried out in an air atmosphere at 20-70°C. Over this temperature range no temperature dependence of the contact angle was observed for the systems studied subject to the θ measuring

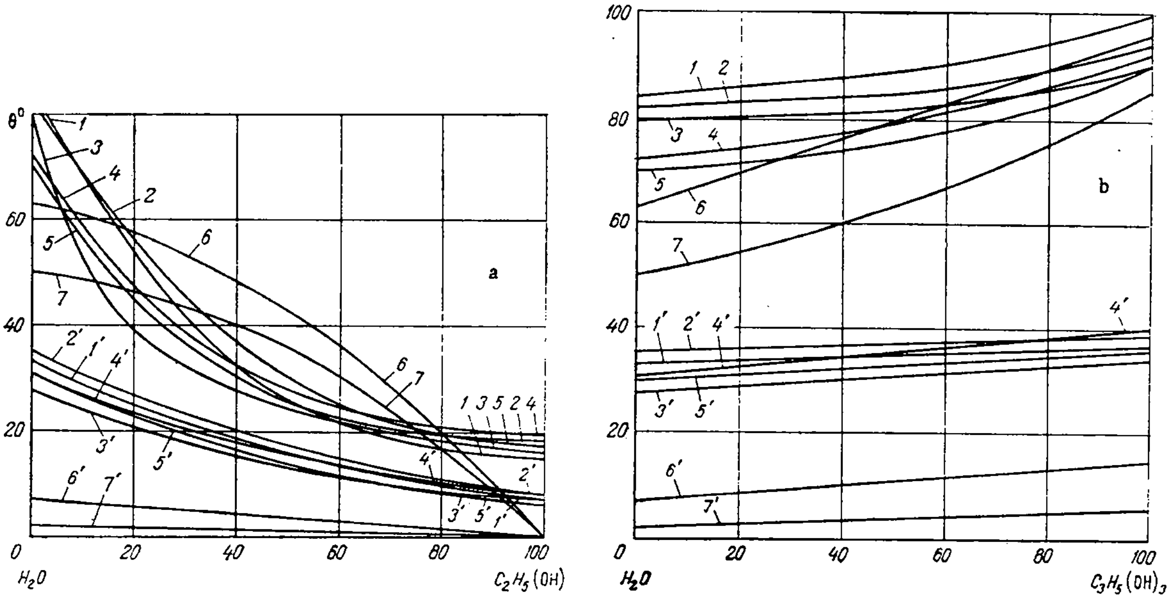

Fig. 1. Inflow and outflow contact angles θ_{in} and θ_{out} as functions of the concentration (in vol. %) of aqueous solutions of ethyl alcohol (a) and glycerin (b) for various systems: 1,1') copper; 2,2') brass; 3,3') nickel; 4,4') 1Kh18N9T steel; 5,5') Duralumin; 6,6') beryllium; 7,7') beryllium alloy ABM-3. Curves without primes, θ_{in}; with primes, θ_{out}.

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TABLE 1. Contact Angles for Various Systems

Solid surface	Liquid											
	mercury	acetone	benzene	water D_2O	water H_2O	n-heptane	glycerin	dibutyl-phthalate	ethyl alcohol	toluene	Freon-113	carbon tetra-chloride
Metals												
Aluminum A1				72/33	73/34			36/7		9/0		
Beryllium		25/11			63/7		96/15		0/0			
Beryllium alloy ABM-3					50/2		85/6		0/0			
Duralumin AMG-6M		17/9		71/34	70/31		90/36		17/6		23/13	
Brass L62					82/35		94/39		18/8			
Molybdenum	132/—	14/6	14/7		64/28	3/0						12/5
Copper M1				85/32	84/33		100/37	41/14	15/7	6/0		
Nickel	150/121	16/7	15/6		79/34	3/0	90/34		16/7			10/5
Niobium				73/50	72/50				21/11			
Tin		10/5							0/0			
Silver				66/38	63/38				14/7			
St. 3 steel		15/6			69/—			35/10				
1Kh18N9T steel	144/114	14/6	10/4	70/30	72/40	3/0	92/40	33/8	19/8	12/3	16/5	14/4
Tantalum	136/95	13/6	19/8		75/43	3/0						8/3
Titanium VT1-2				75/39	73/40		90/41		18/8			
Nonmetals												
Quartz (crystalline)				24/8	14/6				11/3			
Quartz (fused)				10/4	8/3				10/3			
Paraffin		20/10	20/8		107/92				25/15			
Plexiglas	135/97	17/9	14/6		63/32	3/0	68/—	25/3		5/0		4/0
Polyethylene		32/15			46/20				28/12			
Sapphire				30/13	28/12				24/12			
Glass	149/111	4/0	8/3		11/4	—/5			8/2			3/0
Teflon	137/98	25/12	30/13		96/47	12/4			26/—			24/9
Cellophane					19/4				12/3			

accuracy indicated. The measurements were reproduced a large number of times and may accordingly be considered quite reliable.

The liquids studied were of the analytically pure category and the solid surfaces were machined to a surface finish of $\nabla 8$, $\nabla 9$.

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INVESTIGATION OF THE THERMAL CONDUCTIVITY AND DENSITY OF ISOAMYLBUTYRATE IN A BROAD RANGE OF TEMPERATURES AND PRESSURES

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Results of an experimental determination of the coefficient of thermal conductivity λ and density ρ of isoamylbutyrate in the 1-490 bar pressure and 295.3-578.2°K temperature ranges are presented. The interrelation between the coefficient of thermal conductivity and the density is investigated.

Taking account of the broad technical application of complex esters of butyric acid — butyrates — we determined λ and ρ experimentally for different temperatures and pressures.

The method of a cylindrical, regular-cooling bicalorimeter was used to investigate λ as a function of P and T. The λ of formates had earlier been determined on this apparatus [1]. Liquid isoamylbutyrate, whose purity was not less than 99.4% according to a chromatographic analysis (chromatograph of the brand "PAI"), was used in the investigation.

The temperature drop in the fluid layer was 0.6-1.2°. The temperature was determined by a Chromel–Alumel thermocouple with a 0.05° error, and the pressure was produced and measured by an MP-600 piston manometer of the accuracy class 0.05.

A correction for radiation of the medium [2] in the gas phase (2-3%) was taken into account in evaluating λ from the test results, and we took the liquid phase of isoamylbutyrate as being a strong absorber of the infrared radiation of the medium.

The measurements were conducted by means of isotherms. In all, 84 test values of λ, referring to the liquid and gas phases, were obtained on 12 isotherms. These values of λ are presented in Table 1.

The error in the λ data for isoamylbutyrate is estimated at 2.5% in the whole range of temperatures and pressures studied.

Isoamylbutyrate was investigated in the gas phase at atmospheric pressure for T = 472-578°K. In contrast to butyrates of normal configuration, no influence of thermal pyrolysis on λ was observed in measuring the λ of isoamylbutyrate (P = 1 bar). The values of λ obtained for the vapor phase are described well by the equation

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