DENSITY OF LIQUID 4-METHYLPENTANE-1 AT HIGH PRESSURES AND VARIOUS TEMPERATURES

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Using the hydrostatic weighing method the density of liquid 4-methylpentane-1 is determined over the temperature range 302.55-450.80°K and pressure range 0.098-68.6 MN/m^2.

4-Methylpentane-1 is widely used in the petrochemical industry. It is employed as a solvent for synthesis in diparaffinization processes, and in production of thermostable plastics and isobutylketones.

This study presents the results of an experimental determination of 4-methylpentane-1 density over the temperature range 302.55-450.80°K at pressures of 0.098-68.8 MN/m^2.

Measurements were performed on a hydrostatic weighing apparatus developed by Golubev [1].

TABLE 1. Density of 4-Methylpentane-1 at High Pressure and Various Temperatures, kg/m^3

p, MN/m^2	Temperature, °K						
	302,65	322,45	347,60	374,54	398,15	423,15	450,80
0,098	0,6556	0,6345	0,6075	—	—	—	—
0,98	0,6564	0,6357	0,6094	0,5800	0,5493	0,5120	—
2,45	0,6581	0,6377	0,6122	0,5837	0,5547	0,5200	0,4728
4,90	0,6610	0,6410	0,6165	0,5890	0,5622	0,5315	0,4910
7,35	0,6636	0,6443	0,6205	0,5945	0,5687	0,5405	0,5055
9,80	0,6661	0,6474	0,6242	0,5994	0,5747	0,5487	0,5162
12,75	0,6686	0,6503	0,6277	0,6040	0,5802	0,5559	0,5257
14,70	0,6709	0,6533	0,6312	0,6080	0,5855	0,5625	0,5340
17,15	0,6731	0,6500	0,6345	0,6119	0,5906	0,5685	0,5417
19,60	0,6754	0,6587	0,6377	0,6156	0,5953	0,5740	0,5490
22,05	0,0775	0,6618	0,6407	0,6196	9,5995	0,5790	0,5553
24,50	0,6797	0,6638	0,6437	0,6226	0,6039	0,5838	0,5610
29,40	0,6839	0,6686	0,6496	0,6294	0,6115	0,5925	0,5712
34,30	0,6984	0,6734	0,6552	0,6355	0,6184	0,6002	0,5800
39,20	0.6927	0,6781	0,6605	0,6411	0,6245	0,6075	0,5882
44,10	0,6969	0,6827	0,6654	0,6462	0,6301	0,6139	0,5957
49,00	0,7012	0,6871	0,6701	0,6510	0,6353	0,6198	0,6025
53,90	0,7053	0,6914	0,6744	0,6556	0,6403	0,6250	0,6087
58,80	0,7093	0,6956	0,6786	0,6600	0,6450	0,6303	0,6145
63,90	0,7132	0,6997	0,6826	0,6644	0,6494	0,6354	0,6198
68,80	0,7170	0,7036	0,6865	0,6686	0,6536	0,6402	0,6256

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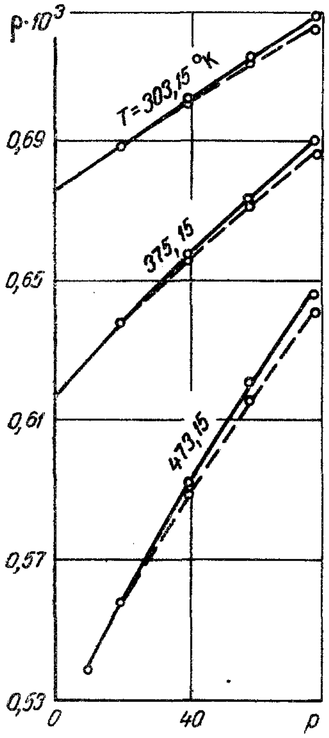

Fig. 1. Correction curves for compressibility of hollow float, determined from n-heptane density measurements, ρ, kg/m³; p, MN/m².

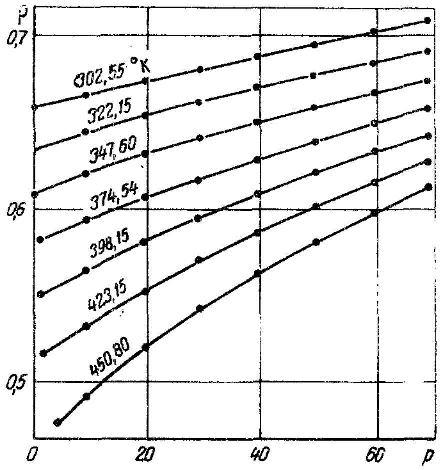

Fig. 2. Density of 4-methylpentane-1 vs pressure at constant temperatures.

The principle of the method employed consists of determining the liquid buoyant force acting on a float at various temperatures and pressures, using a class 2 ADV-200 analytical balance.

The experimental apparatus and method are described in detail in [2-4]. We thus present below a description of modifications in apparatus and technique employed in the present study. Knife-edge sealing was replaced by cone type, simpler and more reliable in operation.

The electronic system and sensor used for density measurements of nonpolar liquids were changed so that the apparatus was able to measure density of strongly polar liquids such as water, ethanol, phthalonic ether, etc.

An analysis was performed to determine the effect of pressure on the compressibility of the empty float. To do this the density of standard n-heptane was measured, for which the literature contains accurate reliable values [6, 7]. Measurements were performed first with a hollow float formed of a quartz tube with outer and inner diameters of 8/4 mm, 75 mm long, then with a solid float of the same dimensions.

Measurements were performed at three isotherms, 303.15, 373.15, and 473.15°K. Results are presented in Fig. 1. As is evident from the figure, with increase in pressure the n-heptane density isotherms measured with the hollow float lie below those measured with the solid float, the discrepancies increasing with increasing temperature and pressure to a value of 0.5%. This remarkable reduction in density values measured with a hollow float was observed earlier in [5], but was not considered further. To eliminate corrections for the hollow float our experiments employed a solid float of fused quartz.

The purity of the 4-methylpentane-1 employed, synthesized by the All-Union Scientific Research Institute for Olefins, was 99.8%. The absolute temperature of the experiments was measured by a specimen platinum resistance thermometer of VNIIFTRI construction to an accuracy of 0.02°C (thermometer coefficient $R_0 = 9.9296998$ abs. cm., $R_{100}/R_0 = 1.39260$).

The measurement and temperature control circuits used R-308 and R-309 potentiometers and standard resistors.

Experimental temperature was regulated by an electric furnace with coarse and fine adjustment controls and maintained by a regulating chromel—alumel thermocouple to an accuracy of ±0.003°.

Experimental pressure was generated and measured by loaded piston manometers type MP-60 and MP-2500, class 0.05.

Before actual measurements were performed, calibration experiments to determine the density of n-heptane and water at atmospheric pressure were conducted. Comparison showed these values to agree with the most reliable data available in the literature [8-9] within 0.05%, while the effect of polarity of the calibration liquid on the results of float volume determination proved to be significant, a fact also considered in [5].

Experiments were performed at isotherms every 25°K, with pressure change by steps of 2.45 MN/m^2. Control measurements on the 29.4 MN/m^2 isobar agreed within 0.05% with measurements on the isotherms. Maximum relative error in 4-methylpentane-1 density determination was ±0.05%, with reproducibility of 0.02%. Density was calculated from experimental data using equations presented in [1].

Results are presented in Fig. 2 and Table 1.

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