the available density data for oils at high pressure appear to be adequate for present needs. The fact that all of the oils studied show the same compressibility indicates the desirability of constructing standard density-pressure curves. The practical means adopted by the writers to express these curves in a form convenient for calculation of density at high pressure is an empirical equation that reproduces the standard curves that were drawn as averages of the experimental data. Interpolation and extrapolation were used, as explained later, to amplify and extend the range of usefulness of the equation.

Details of Computation

The pressure-density data of Hyde,[1] Dow,[2] and Dow and Fenske[3] were plotted on graph paper of large enough scale that the coordinates of any point could be read to four significant figures. To facilitate computation, density ratios ρ/ρ_0 were plotted against pressure. ρ is the density in g/cm^3 at any fixed temperature and pressure and ρ_0 is the corresponding density at the same temperature and atmospheric pressure. Temperature is expressed in degrees Fahrenheit and pressure in pounds per square inch gage. Curves were constructed for temperatures of 77°, 104° and 167°F. They were found to have the same general shape as those obtained by Bridgman[5] for many pure liquids; i.e., the density increases quite rapidly as pressure is first applied but at a slower rate at higher pressures. For example, in the case of oils at 104°F the density increases by about 5.3 percent for the first 15,000 lb./in.^{2} but only by an additional 3.2 percent for the next 15,000 lb./in.^{2}.

The distribution of points with reference to the curves is of importance in determining the relative precision of the data. The three studies gave density values for twenty oils at various temperatures and pressures. Four of the oils had been studied at all three temperatures, five at 104° only, and eleven at 104° and 167°F. It is evident that the data are not enough for a critical study of accuracy by the method of least squares. Consequently, curves were drawn in such a way that they passed through the averages of all the plotted points. At 77° the maximum deviation of any point from the average was 0.? percent; at 167°, 0.7 percent; and at 104°F, the most representative since data from all three studies were available, 0.9 percent.

Table I illustrates the distribution of the

Table I. *Density ratios of twenty oils at 10,650 lb./in.^{2} and 104°F.*

Oil	Observer	Density Ratio ρ/ρ_0
1	Dow and Fenske	1.035
2	Dow	1.035
3	Dow	1.037
4	Dow	1.037
5	Dow	1.037
6	Dow and Fenske	1.037
7	Dow and Fenske	1.037
8	Dow and Fenske	1.038
9	Dow and Fenske	1.038
10	Dow and Fenske	1.038
11	Dow and Fenske	1.038
12	Hyde	1.039
13	Dow and Fenske	1.039
14	Hyde	1.040
15	Dow and Fenske	1.040
16	Dow and Fenske	1.040
17	Hyde	1.041
18	Hyde	1.042
19	Dow and Fenske	1.043
20	Hyde	1.045
	Average	1.039

densities measured at 10,650 lb./in.^{2} for a temperature of 104°F. Three investigators, working with twenty different oils, are represented by the data. The arithmetic average is seen to be 1.039 as compared with 1.040 obtained graphically, indicating that the graphic method of averaging is sufficiently accurate. The average deviation from the mean of a single observation is seen to be ±0.002 and the percentage deviation of the mean is ±0.04.

The absolute error involved in the measurements is probably somewhat greater than the precision might seem to indicate. Both the piston displacement and the sylphon methods of measuring volume change are quite complicated in comparison with the simple and accurate method of weighing with a specific gravity bottle at atmospheric pressure. Furthermore, the measurement of the absolute pressure in the system introduces errors which are not involved in ordinary atmospheric gravity determinations. Bridgman[5] indicates that the absolute error involved in the measurement of density under pressure might generally be expected to be 2 or 3

[5] P. W. Bridgman, Proc. Am. Acad. A & S **66**, 185 (1931).

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