Table 4-24. Composition of Natural Gases Used for Viscosity Measurements of Fig. 4-105

Natural Gas *G*		Natural Gas *H*		Natural Gas *J*	
Gas	*Mole %*	*Gas*	*Mole %*	*Gas*	*Mole %*
Methane. .	73.5	Methane. .	73.1	Methane. .	95.6
Ethane. . . .	25.7	Ethane. . . .	6.1	Ethane. . . .	3.6
Nitrogen. .	0.6	Nitrogen. . .	15.8	Nitrogen. . .	0.3
Propane. . .	0.2	Propane. . .	3.4	Propane. . .	0.5
		Helium. . . .	0.8		
		n-Butane. .	0.6		
		Isobutane.	0.2		

SOURCE: Carr (4-105).

stituents plotted from the values correlated by the API (1-15). Hocott and Buckley (4-112) presented measurements of the viscosity of crude oils containing dissolved gases (Fig. 4-110). The analyses of the four saturated oils are given in Table 4-25. Sage and Lacey (4-125, 4-126, 4-128) and others (4-138a) have measured the viscosity of liquids under pressure.

Beal presented correlations of viscosity data on crude oils. Figure 4-111 is a plot of viscosity of gas-free crude oils against gravity, and Fig. 4-112 shows the influence of dissolved gas on viscosity. When pressure is increased on the reservoir oil into the undersaturated zone, Fig. 4-113 gives the increase in viscosity of the constant-composition liquid per 1,000 psia of pressure increase.

Sometimes viscosities of oils are given as Saybolt seconds at a given temperature. These viscosities are kinematic values and may be converted to centistokes using Table 4-26 (4-2). The kinematic viscosity in centistokes times the density in grams per cubic centimeter gives the viscosity in centipoises.

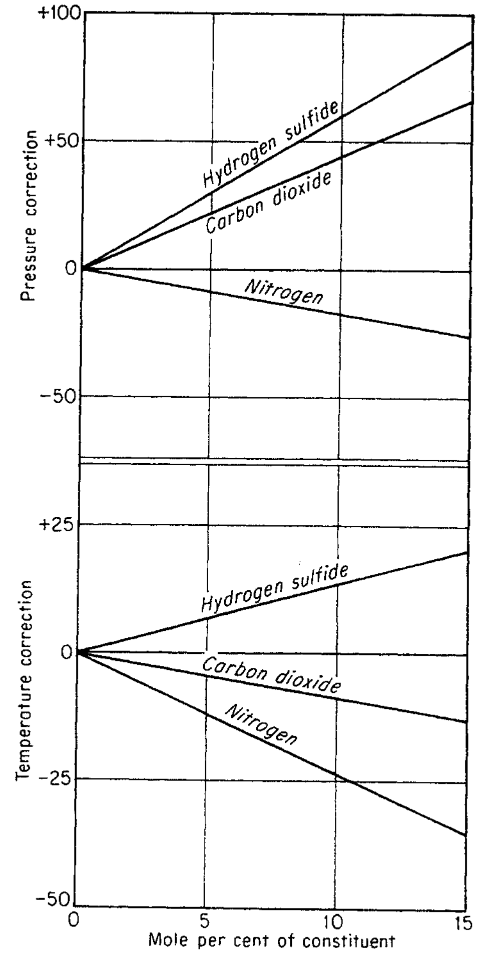

Fig. 4-108. Corrections to pseudocritical conditions as read from Fig. 4-22, to be used when finding viscosity of gases containing N_2, CO_2, and H_2S.

Table 4-25. Hydrocarbon Analyses of Subsurface Oil Samples

Component	Viscosity curve *D*			Viscosity curve *C*			Viscosity curve *B*			Viscosity curve *A*		
	Wt %	Sp gr	Mol. wt	Wt %	Sp gr	Mol. wt	Wt %	Sp gr	Mol. wt	Wt %	Sp gr	Mol. wt
Methane.	7.93	. . . . . .	. . .	1.50	. . . . . .	. . .	4.38	. . . . . .	. . .	0.83		
Ethane.	1.65	. . . . . .	. . .	0.93	. . . . . .	. . .	1.05	. . . . . .	. . .	1.41		
Propane.	1.80	. . . . . .	. . .	3.42	. . . . . .	. . .	0.35	. . . . . .	. . .	0.71		
Isobutane.	0.84	. . . . . .	. . .	0.83	. . . . . .	. . .	0.11	. . . . . .	. . .	0.47		
n-Butane.	1.42	. . . . . .	. . .	3.51	. . . . . .	. . .	. . . . . .	. . . . . .	. . .	0.92		
Isopentane.	1.07	. . . . . .	. . .	1.40	. . . . . .	. . .	0.05	. . . . . .	. . .	1.17		
n-Pentane.	1.23	. . . . . .	. . .	2.24	. . . . . .	. . .	. . . . . .	. . . . . .	. . .	0.28		
Hexanes.	3.64	. . . . . .	. . .	4.02	. . . . . .	. . .	0.34	. . . . . .	. . .	1.64		
Heavier fraction.	80.42	0.8076	147	82.15	0.8418	215	93.72	0.8974	250	92.57	0.8896	229
	100.00	. . . . . .	. . .	100.00	. . . . . .	. . .	100.00	. . . . . .	. . .	100.00		
	Viscosity oil at 0 psig, 158°F = 0.950 centipoise			Viscosity oil at 0 psig, 128°F = 1.84 centipoises			Viscosity oil at 0 psig, 164°F = 5.4 centipoises			Viscosity oil at 0 psig, 100°F = 8.25 centipoises		

SOURCE: Hocott and Buckley.