Properties of Aliphatic and Aromatic Aldehydes under High Pressure

Compressibility and Viscosity Determination

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Compressibility and viscosity measurements have been made on seven aliphatic and three aromatic aldehydes at pressures up to 20,000 p.s.i.g. The viscosity data have been correlated by means of an empirical equation. Experimental data are presented in graphical form for the pressure range investigated.

DATA on the viscosity and compressibility of liquids are generally scarce. Previous investigations have concentrated mainly on organic compounds. The work on high pressure physical properties was pioneered by Bridgman (*1*).

Almost no work has so far been reported on aldehydes, possibly because they are difficult to work with. The aliphatic aldehydes are low boiling liquids with a disagreeable smell and are harmful to the human system. The aromatic aldehydes have a tendency to be oxidized to their corresponding acids.

EXPERIMENTAL

Concurrent measurements of the physical properties were conducted in a compact apparatus (*3*). Compressibility was measured by a piston displacement device (2) in conjunction with viscosity measurement, which was performed by a falling cylinder method (*4, 5*).

Pressure was generated in the equipment by means of manually operated hydraulic pump. The pressure was measured by a Bourdon gage. The precision of pressure measurement was within ±0.2%. The temperature was measured by calibrated thermometers to an accuracy of ½° F.

The compressibility meter consisted of a 16-inch long, ¼-inch I.D. stainless steel tube with cap-collar-gland assembly at both ends. Inside the tube there was a piston-magnet assembly soldered together. Outside the compressibility meter was a magnet-pointer assembly. The pointer indicated the position of the piston to one tenth of millimeter.

The viscometer consisted of a fall tube, 152.5294 cm. long with 0.4710 cm. inside diameter. The tube was of stainless steel. The plummet used was a thin hollow cylinder of a uniform outside diameter of 0.43688 cm. with hemispherical ends. Bridgman had used plummets with three projecting lugs to keep the plummet coaxial during its fall. The lugs introduced some error in the measurements and were omitted in the present setup. Modified electrical contacts, with specially designed plugs, made the use of lugs unnecessary. The coaxial fall of the plummet through the viscometer tube was confirmed by means of a stethoscope.

METHOD OF OPERATION

Before starting experiments with the aldehydes, several test runs were made with various liquids of known viscosity to examine the accuracy of the apparatus. Plummets of different dimensions were tried to find the optimum plummet size. The authors discovered that plummets with

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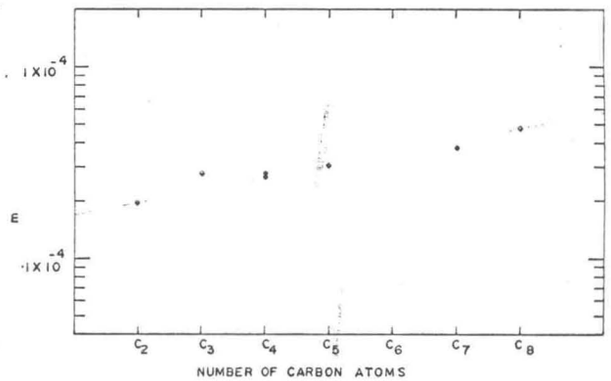

Figure 1. *m* against number of carbon atoms

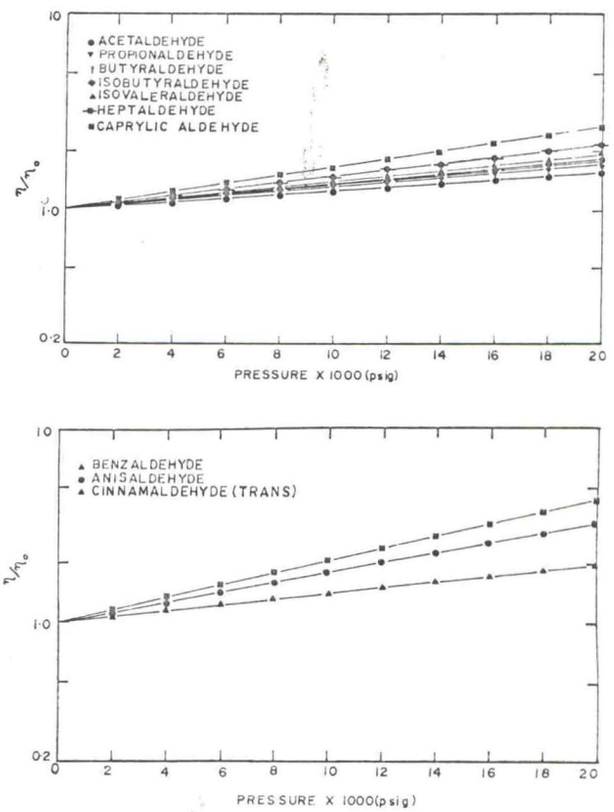

Figure 2. Viscosity-pressure diagrams