

Empirical Correlations for Estimating Liquid Heat Capacity & Liquid Thermal Conductivity of Siloxane Materials

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Siloxanes appear in numerous applications such as in personal care products, biomedical materials, heat transfer fluids, and as working fluids in organic Rankine cycles and in extreme-temperature hydraulic pressure transmitters. This paper presents two correlations for predicting constant-pressure liquid heat capacity (LCP) and liquid thermal conductivity (LTC) and compares the results with available literature data. Very similar fits have been used to help review properties of the linear and cyclic dimethylsiloxane oligomers in AIChE's DIPPR 801 database. The amazing feature of these correlations is that they have been developed using properties of linear polydimethylsiloxanes (PDMS), yet they appear to be applicable to both linear & cyclic dimethylsiloxane oligomers and to give reasonably accurate (~10%) predictions for siloxane materials with non-Methyl substituent groups such as Phenyl-, and Ethyl-. The only input parameter needed to use these correlations is a kinematic viscosity (ν_{25}) that is measured or estimated at about 25 °C. Use of a viscosity variable, $x = 1/\ln(\nu_{25} + 1)$, in a generalized polynomial fit of the form $Y = (a_{00} + a_{01}x + a_{02}x^2) + (a_{10} + a_{11}x + a_{22}x^2)t$, where t represents the temperature, appears to give a "reasonable" extrapolation to viscosities as high as 10^6 cSt. This form may have some problems in representing LTC of low-viscosity fluids, in part because of the scarcity & scatter in available data. In testing 273 LCP data points, the average absolute deviation (AAD) was 4%. A similar test using a preliminary LTC correlation gave an AAD of 6%. In both cases, the data spanned a wide temperature range.