

Methodologies to Obtain the Isobaric Thermal Expansions for Simple Fluids and Biodiesels

Geraldine A. Torín-Ollarves^{C, S}

*Department of Chemical Engineering, Imperial College London, London, United Kingdom
Research Group TERMOCAL-Thermodynamics and Calibration, Escuela de Ingenierías Industriales, University
of Valladolid, Valladolid, Spain
Institute of Chemistry of Clermont-Ferrand, Blaise Pascal University, Aubière Cedex, France
g.torin-ollarves@imperial.ac.uk*

José Juan Segovia and M. Carmen Martín

Research Group TERMOCAL-Thermodynamics and Calibration, University of Valladolid, Valladolid, Spain

Emmerich Wilhelm

Institute of Physical Chemistry, University of Wien, Vienna, Austria

Jean-Pierre E. Grolier

Institute of Chemistry of Clermont-Ferrand, Blaise Pascal University, Aubière Cedex, France

In the quest for efficient, reliable and abundant low-cost automotive fuels, knowledge of thermophysical properties of new fuels is of paramount importance in applications, e.g. for the design of engine injectors to be used at higher temperatures and pressures as well as in fundamental research focusing on developing models for an accurate thermodynamic description of such fuels. Due to the importance of the isobaric thermal expansion α_p in engineering applications, in this work we used two methods for determining α_p of simple liquids (toluene and 1-butanol) and two biodiesels (obtained from wasted oils). The experimental techniques used were an automated vibrating tube densimeter^[1] measuring densities with an uncertainty of $\pm 0.2\%$ at temperatures up to 423 K and pressures up to 140 MPa and a scanning transiometer^[2] to directly determine α_p with an estimated uncertainty of $\pm 2\%$ through temperature scans in the range (273 to 423) K and pressure scans up to 170 MPa. From the experimental densities α_p may be obtained either numerically or by differentiating, with respect to temperature, appropriate analytical equations correlating the densities. However, we note that in the case of the biodiesels α_p cannot be obtained with good precision by using the Tammann-Tait equation. The methods used in this work permit a satisfactory check of the internal consistency of the different experimental techniques and data reduction for different types of fluids. Comparing the experimental results obtained via transiometry with those determined via density measurements, differences of about 5% are found. This indicates that the α_p data determined indirectly from densities are in overall good agreement with the data measured directly by transiometry. Typically, the single crossing region of isotherms of the isobaric thermal expansion plotted as functions of pressure is satisfactorily reproduced with both methods.

References

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[2] S. L. Randzio. *Thermochim. Acta*, 355, 107-113 (2000).