June 24th, 2012, Boulder, Colorado, USA

Minutes of the 12th IATP Meeting

1. INTRODUCTION

The meeting was opened by the Chairman, Prof. Sir William Wakeham, who welcomed all present and thanked Dr Rich Perkins for the excellent arrangements as the local organiser of the meeting.

The meeting was divided into the usual scientific session and business session. The proceedings are recorded here in that order.

2. SCIENTIFIC SESSION

2.1. Reference data for the density and viscosity of liquid cadmium, cobalt, gallium, mercury, indium, silicon, thallium, and zinc.
M.J. Assael, I.J. Armyra (Greece), J. Brillo (Germany), S. Stankus (Russia), J. Wu (P.R. China), W.A. Wakeham (UK).

2.2. Recommended data for the density, viscosity and surface tension of $C_6mimTf_{2t}N$. Revision of IUPAC project 2002-005-1-100.
E. Langa, F.J.V. Santos, C.A. Nieto de Castro, M. Soledade C.S. Santos, A.M. Maynard (Portugal).

2.3. New international formulation for the thermal conductivity of H_2O.
M.L. Huber, R.A. Perkins, D.G. Friend, J.V. Sengers (USA), M.J. Assael, I.N. Metaxa (Greece), E. Vogel (Germany), K. Miyagawa (Japan).

2.4. Correlation of the thermal conductivity of toluene from the triple point to 1000 K and up to 1000 MPa.
M.J. Assael, S.K. Mylona (Greece), M. Huber, R. Perkins (USA).

2.5. Correlation of the thermal conductivity of benzene from the triple point to 725 K and up to 500 MPa.
M.J. Assael, E.K. Mihailidou, (Greece), M. Huber, R. Perkins (USA).

2.6. Mutual diffusion in liquids with dissolved gases by dynamic light scattering (DLS).
M.H. Rausch, A. Heller, T. Koller, A. Leipertz, and A.P. Fröba (Germany).

2.7. Rheology of heavy oils.
S.E. Quinones-Cisneros, R.G. de la Torre Sánchez (Mexico).

2.8. Excess hard-sphere model for viscosity.
J.P.M. Trusler, F. Ciotta, F. Ijaz, G. Maitland, V. Vesovic (UK).

2.9. Perfluoropolyether oils as candidates for the deepwater viscosity standard of 20 mPas at 260 °C and 240 MPa.
H. Baled, R. Enick, W. Burgess, J. Jain, B. Morreale, Y. Soong, D. Tapriyal, Y. Wu, B. Bamgbade, M. McHugh, S. Bair, V. Krukonis (USA)

Each presentation engendered discussion and a few points of special interest are noted here:

a) In the case of reference correlations:
   - Dr R. Perkins presented the new reference correlation for the thermal conductivity of water, a project under the auspices of IUPAC and IATP. The new correlation has been adopted by IUPAC and has already been submitted for publication in JPCRD.
   - Ms I.J. Armyra presented new reference correlations for the density and viscosity of liquid cadmium, cobalt, gallium, mercury, indium, silicon, thallium, and zinc. This work in essensc concludes the work on the liquid metals as not enough measurements are available to justify work for the remaining liquid metals. The work has been accepted for publication in JPCRD.
   - Prof. M.J. Assael presented new reference correlations for the thermal conductivity of toluene and benzene over wide range of conditions. The work on toluene has just been published in JPCRD, while the work on benzene will be submitted soon at the same journal.
   - Finally Dr F. Santos presented recommended data for the density, viscosity and surface tension of $[C_6mim][Tf_2N]$ which has been proposed by IUPAC as a new standard. Work still continues in that area.

b) Other topics presented and discussed were the following:
   - Prof. A. Froeba presented new developments in the dynamic light scattering (DLS) technique and showed measurements of diffusivity of CO_2 absorbed in [EMIM] [NTf2].
   - Prof. J.P.M. Trusler presented a very interesting extension of the hard sphere scheme developed by Assael and Dymond for the correlation of the viscosity of alkanes. The new scheme exteneded $1/V^* > 0.75$ up to 0.9 and behaved better at $1/V^* < 0.6$, thus incorporating the zero density range (the universal curve was expanded but V_o and R_n were kept exactly as in the original Assael-Dymond scheme).
   - Prof. S.E. Quinones-Cisneros stated that Mexico has substantial resource of fossil fuels (17 new fields discovered). Hence he discussed the need for methodologies for non-Newtonian fluids as heavy-oils are non-Newtonian (density about 21 'API).
   - Finally, Prof, R. Enick discussed progress in finding a new viscosity standard fluid with a viscosity of about 20 mPas at 260 ^oC and 240 MPa. Possible candidates he looked at were Krytox 101 and 102 GPL.

3. BUSINESS SESSION

3.1. PROJECTS CONCLUDED

The following projects were concluded:

1. Reference data for the density and viscosity of liquid antimony, bismuth, lead, nickel, and silver.
   M.J. Assael, A.E. Kalyva, K.D. Antoniadis, M. Banish, I. Egry, J. Wu, E. Kaschnitz, W.A. Wakeham, High Temp. High Press. **41**:161-184 (2012).
   Project concluded.

2. Reference data for the density and viscosity of liquid cadmium, cobalt, gallium, mercury, indium, silicon, thallium, and zinc.
   M.J. Assael, I.J. Armyra, J. Brillo, S. Stankus, J. Wu, W.A. Wakeham, J. Phys. Chem. Ref. Data. (in press)
   Project concluded.

3. Correlation of the thermal conductivity of toluene from the triple point to 1000 K and up to 1000 MPa.
   M.J. Assael, S.K. Mylona, M. Huber, R. Perkins, J. Phys. Chem. Ref. Data 41: 023101:1-12 (2012).
   Project concluded.

4. Thermal conductivity of water/steam.
   M.J. Assael (Greece),E. Vogel, J. Millat (Germany), A. Nagashima (Japan), D. Friend, J.V. Sengers (USA),
   Project concluded. Paper submitted.

5. Reviews of modern viscosity measurement techniques.
   A.H.R. Goodwin(USA), W.A. Wakeham(UK), M.J. Assael (Greece).
   Project concluded as it has been superseded by the work on the new three IUPAC volumes.

6. Evaluation of the viscosity effect upon the vibrating U-tube densimeter.
   J.P.M. Trusler (UK) - Coordinator, J. Fernandez, M.J.P. Comunas, L. Lugo (Spain), Caetano, J.M.N.A. Fareleira (Portugal), A. Goodwin (USA), K. Harris (Australia), B. Rathke (Germany), S. Quinones-Cisneros (Mexico).
   Prof. J.P.M. Martin proposed that the project stops because the availabledensimeters are sufficiently accurate while at the same time on the theoretical part nobody has come with a bright idea as to how to calculate the correction..

3.2. PROJECTS CONTINUED

The following projects were discussed and it was agreed to continue them:

1. High-temperature, high-pressure viscosity standards.
   J.M.N.A. Fareleira, F. Caetano (Portugal), W. A. Wakeham, J.P.M. Trusler (UK), A.P. Froba, A. Leipertz, B. Rathke (Germany), K. Harris (Australia), A.R.H. Goodwin, A. Laesecke (USA), J. Fernandez (Spain), K. Schmidt (Canada), Chr. Boned (France)
   In a European level, it was decided that the COST proposal will be resubmitted by Dr K. Antoniadis with the hep of Prof. C.A. Nieto de Catro and Prof. J. Fernandez.
   In a USA level Prof. R. Enick proposed to submit a joint proposal to NETL. Discussions will continue with the people involved above and they will report back to the group.
   Finally, the possibility of submitting a small proposal to IUPAC for high-temperature high-pressure viscosity standard was also discussed. Prof. J.P.M. Trusler will coordinate the effort. The funding will facilitate meetings aiming at developing a co-ordinated strategy to the provision of viscosity standards for both the ‘deep water’ and the ‘heavy oil’ applications.

2. Density and viscosity of liquid metal eutectics (Al+Sii, Pb+Bi, Pb+Sn).
   M.J. Assael, I.J. Armyra (Greece), W.A. Wakeham (UK), S.S.V. Stankus (Russia), J. Brillo, A Thess (Germany), J.T. Wu (R.P. China), E. Kaschnitz (Austria), M. Banish (USA).
   Ms I.J. Armyra presented a report on the data availability for developing a reference correlation for various eutectic liquid metal mixtures. It was argued that work can only continue for eutectic liquid mixtures Al+Si, Pb+Bi and Pb+Sn, as for the rest vey little is published on density and viscosity. Work continues.

3. Three new volumes on experimental thermodynamics series will be published under the auspices of IUPAC.
   W.A. Wakeham - Coordinator, V. Vesovic (UK), A. Goodwin, M. Huber, J. Sengers (USA), M.J. Assael (Greece)
   Prof. Sir W.A. Wakeham, Prof. V. Vesovic and Prof. J.V. Sengers presented in turn the progress on the development of the three new volumes on experimental thermodynamics series, and discussed the chapters and authors selected.. It was proposed that the following two sections might be included:
   - New developments in capillary viscometers – Dr A. Laesecke
   - Reduced algorithms for thermal diffusivity measurements – Prof. M. Bannish
   It was also proposed by Prof. J.V. Sengers to make sure that books were available when ‘out-of-print’ so they coud llater be “published on demand”.

4. Round Robin project on ionic liquids viscosity, and thermal conductivity measurements.
   J.M.N.A. Fareleira, C.A. Nieto de Castro (Portugal), A. Leipertz, A. Froeba, U. Hammer-schmidt, B. Rathke (Germany), J. Fernandez (Spain), R. Perkins (USA), and K. Harris (Australia).
   Project continues and a round robin sample will soon be circulated. Results are expected in a year and only those who can guarantee to return results in this time should engage..

5. Mexico research perspectives in the rheology of heavy oils.
   S.E. Quiñones-Cisneros (Mexico)

Project continues.

3.3. NEW PROJECT

The following new project was discussed and it was agreed to start

6. Reference correlations for the viscosity and thermal conductivity of fluids over extended temperature and pressure ranges.
   M.J. Assael (Greece), M.L. Huber, R.A. Perkins (USA)
   Prof. M.J. Assael proposed that work already carried out on the development of reference correlations for the viscosity and thermal conductivity of fluids, be under the auspices of IATP. It was also agreed that a proposal for funding (travelling and subsistence) will be submitted to IUPAC by Dr R.A. Perkins.

4. MEMBERSHIP

Dr A.R.W. Goodwin will substitute Prof. Dr H.A. Oye in the IATP Executive. Prof. Sir William. Wakeham thanked Prof. Dr H.A. Oye for his contribution so far.
Prof. M.J. Assael reminded everyone that all information about IATP activities, as well as the current list of members, can always be found at

http://transp.cheng.auth.gr/ -> I.A.T.P.

It was also decided that members who had not attended for some time, and where there was evidence that they would not have a continuing connection, would be removed form the list.

The following new members were approved:
- Dr M. Banish
- Dr Scott Bair
- Dr M.L. Huber
- Dr N. Riesco
- Dr. Michael H. Rausch
- Prof. Maria José Lourenço

5. FUTURE MEETINGS

5.1. 13th IATP Meeting, 2013

The 13th IATP Meeting will take place in Bremen on July 5-7, 2013, Germany. Dr Bernd Rathke will be the local organiser.

6. LIST OF ATTENDEES

List of people that attended the meeting:

1) Prof. William A. Wakeham (UK), Chairman
2) Prof. Marc J. Assael (Greece), Secretary
3) Ms Ivi Armyra (Greece)
4) Dr Scott Bair (USA)
5) Dr Michael Banish (USA)
6) Prof. Maria Jose Lourenço (Portugal)
7) Prof. Carlos Nieto de Castro (Portugal)
8) Prof R. Enick (USA)
9) Dr Dan Friend (USA)
10) Prof. Andreas Froeba (Germany)
11) Dr. Antony Goodwin (USA)
12) Dr. Robert Hellmann (Germany)
13) Dr Marcia Huber (USA)

14) Mr Benjamin Jager (Germany)
15) Dr Arno Laesecke (USA)
16) Prof. Alfred Leipertz (Germany)
17) Dr Richard Perkins (USA)
18) Prof. Nadejda Popovska-Leipertz (Germany)
19) Ms Carla Queiroz (Portugal)
20) Dr. Sergio Quinones-Cisneros (Mexico)
21) Dr. Michael H. Rausch (Germany)
22) Dr Fernando Santos (Portugal)
23) Prof. Jan V. Sengers (USA)
24) Prof. J.P. Martin Trusler (UK)
25) Dr. Bernd Rathke (Germany)
26) Dr Nikolas Riesco (UK)
27) Dr D. Vega-Maza (UK)
28) Prof. Velisa Vesovic (UK)
29) Prof. Stefan Will (Germany)
30) Prof Jiangtao Wu (R.P. China)
31) Ms Zhegxin Xue (R.P. China)
32) Mr Qiang Chen (R.P. China)