June 21st, 2015, Boulder, Colorado, USAl

Minutes of the 15th IATP Meeting

1. INTRODUCTION

The meeting was opened by the Chairman, Prof. Sir William Wakeham, who welcomed all present and thanked Dr Richard Perkins for the excellent arrangements as the local organiser of the meeting. The meeting was in honor of the late Dr Anthony Goodwin, a very active member of IATP, and Prof. Wakeham expressed our deep sorrow and sadness for his loss; colleagues spoke of their memories of Dr. Goodwin

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. Thermophysical Properties of $[C_4mpyr][DCA] + H_2O$ and $[P_{6,6,6,14}][DCA] + H_2O$
M.C. Melgarejo, L.C.S. Nobre, A.F. Santos, I.M.S. Lampreia, M.S.C.S. Santos, F.J.V. Santos, H. Segura, C.A. Nieto de Castro (Portugal).

2.2. Dynamic Light Scattering for the Determination of Thermal and Mass Diffusivities of Binary and Ternary Fluid Mixtures in Chemical and Energy Engineering.
A. Heller, Th.M. Koller, M.H. Rausch, A. Leipertz, A.P. Fröba (Germany).

2.3. On the Enhancement of the Apparent Thermal Conductivity of Liquids Containing Multi-Wall and Double-Wall Carbon Nanotubes.
G. Tertsinidou, S.K. Mylona, M.J. Assael (Greece), W.A. Wakeham (U.K.).

2.4. Reference Correlation of the Viscosity of Toluene from the Triple Point to 675 K and up to 500 MPa.
S. Avgeri, M.J. Assael (Greece), M.L. Huber, R. Perkins (USA).

2.5. Viscosity and Density of Krytox Fluids at Pressure up to 200 MPa
J.P.M. Trusler, M. Malami (U.K.)

2.6. On the Viscosity Behaviour on Krytox GPL102: Effect of Temperature and Pressure.
M.J.P. Comuñas, F.M. Gaciño, J. Fernandez (Spain), J.-P. Bazile, Ch. Boned, G. Galliero (France), K.R. Harris (Australia), S.K. Mylona, M.J. Assael (Greece).

2.7. Proposing TOTM as an Industrial Reference Fluid for Viscosity at High Temperatures and High Pressures
F.J.P. Caetano, J.C.F. Diogo, H.M.N.T. Avelino, J.M.N.A. Fareleira (Portugal), W.A. Wakeham (UK)

2.8. Update on the High Pressure Viscosity and Thermal Conductivity Measurements at UWA with Pure Fluids and Mixtures
E. May (Australia)

2.9. Rheology and Morphology Analysis of Water in Oil Emulsions
O. Pérez-Sandoval, J.S. Rodríguez-León, S.E. Quiñones-Cisneros (Mexico)

2.10. Thermophysical Property Research at the Helmut-Schmidt-University in Hamburg
K. Meier (Germany)

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

- C.A. Nieto de Castro discussed the ecotoxicity of ionic liquids and proposed two good candidates with [DCA] anions ([C_4mpyr][DCA] + H_2O and [$P_{6,6,6,14}$][DCA] + H_2O), for applications in absorption refrigeration. Measurements of density, viscosity, surface tension and water content were presented.
- Dynamic Light Scattering (DLS) was presented by A.P. Fröba as versatile technique for the investigation of thermal and mass diffusivities of different binary and ternary fluid mixtures in chemical and energy engineering. Results for mixtures of dibenzyltoluene and hydrogenated dibenzyltoluene as well as for mixtures of n-alkanes with CO, H2, and H2O as a function of temperature were discussed.
- W.A. Wakeham discussed the "hot" subject of the thermal conductivity enhancement when MWCNT are added to liquids. By comparing measurements from different authors, he pointed out that no extraordinary behavior is observed, while on the other hand too many "bad" measurements are reported.
- A new reference viscosity correlation for toluene from the triple Point to 675 K and up to 500 MPa, was presented by M.J. Assael.
- S.E. Quiñones-Cisneros discussed problems associated with the removal of water from oil emulsions.
- K. Meier presented the research areas on thermophysical properties at the Helmut-Schmidt-Univerisity in Hamburg, Germany.

In the field of high-viscosity liquids:

- J.P.M. Trusler presented new preliminary measurements of the viscosity and density of Krytox GPL102 up to 200 MPa pressure.
- S.K. Mylona presented two correlations for the viscosity of Krytox GPL102, one as a function of density and temperature (based on the hard-spheres theory), and the other as a function of pressure and temperature (based on the VFT equation). The correlations included measurements performed by M.J.P. Comuñas, F.M. Gaciño, J. Fernandez (Spain), J.-P. Bazile, Ch. Boned, G. Galliero (France), K.R. Harris (Australia), and S.K. Mylona, M.J. Assael (Greece)
- W.A. Wakeham discussed new high-viscosity measurements of Tris(2-Ethylhexyl) Trimellitate (TOTM), a fluid that is currently considered as a possible high-viscosity reference liquid candidate.
- An update on the high-pressure viscosity and thermal conductivity measurements on pure fluids and mixtures at UWA, was given by E. May.

3. BUSINESS SESSION

3.1. PROJECTS CONCLUDED

1. 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. Fröba, U. Hammerschmidt, B. Rathke (Germany), J. Fernandez (Spain), R. Perkins (USA), K. Harris (Australia), M.J. Assael (Greece)

   Project stopped.

3.2. PROJECTS CONTINUED

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

2. Reference correlations for the viscosity and thermal conductivity of fluids over extended temperature and pressure ranges.
   C.-M. Vassiliou, S. Avgeri, S.K.Mylona, M.J. Assael (Greece), M.L. Huber, R.A. Perkins (USA)

a) Prof. M. Assael informed the group that so far, through the excellent cooperation of his laboratory and Dr M.L. Huber and Dr R. Perkins (NIST), the following reference correlations over extended temperature and pressure conditions, have been published in JPCRD
   - Thermal conductivity: n-H_2, p-H_2, SF_6, CO_2, *n*-hexane, *n*-heptane, benzene, toluene, *o-, m-, p*-xylene, ethylbenzene, methanol, ethanol (*n*-pentane*, iso*-pentane, and cyclopentane submitted, and cycloohexane on the way)
   - Viscosity : *n*-hexane, *n*-heptane, benzene (toluene submitted)

b) Prof. V. Vesovic and Dr N. Riesco informed IATP, by email, that they were also producing reference correlations for
   - Viscosity : Cyclohexane just published in JPCRD (and n-hexadecane, p-xylene on the way)

c) Prof. E. Vogel's group had informed IATP, by email, that his group was also producing reference correlations for
   - Viscosity : ethane (submitted), propane, and *n*- and *i*-butane.

This ongoing workis recorded here so that members will avoid unnecessary overlap of effort.

Some discussion took place in relation to the difficulties associated with IATP reviewers. According to the established procedures, for a paper to be published "under the auspices of IATP", at least one of the executive members had to review the paper; to ensure maintenance of standards. It was not intended as a full review of the paper, nor to delay publication. The system was under some pressure because the number of Executive members was diminishing and everybody was busier. **For this reason the Chairman had invited Prof. A. Fröba, Prof. J.M. Trusler, Dr M.L. Huber, Prof. E. May, and Dr K. Marsh, to participate in the review process**, in addition to the Executive Members and they had agreed. Members of IATP wishing to have the endorsement of IATP for their work should submit it to the Secretary in the first instance to arrange a rapid review.

3. 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. Lei-pertz, B. Rathke (Germany), K.R. Harris (Australia), A.R.H. Goodwin, A. Laesecke (USA), J. Fernandez (Spain), K. Schmidt (Canada), Chr. Boned (France)

A sample of Krytox GPL 102 has been circulated to many members of the group, and Prof. J. Fernandez presented the progress so far (see also presentation 2.6 by Dr S.K. Mylona). A discussion followed whereby it was thought that maybe Krytox GPL 202 is not the answer to such a standard, because its viscosity seemed to depend significantly on polydispersity of a particular sample, and thus on the production LOT employed. Two arguments were made; first Dr A. Laesecke stated that the company who had originally asked for this high-pressure standard would not have needed it if its viscometer would have a physics-based working equation. Since this could not be definitely confirmed and others did not agree, there was the suggestion that the viscosity ratios at atmospheric and elevated pressures for the two lots available should be evaluated. If they were very nearly equal, then Krytox could still be used by measuring the visocity at 0.1 MPa for a particular lot and then applying the 'standard' ratio for the high pressure value.

An alternative liquid to consider is tris (2-ethylhexyl) trimellitate TOTM (has an estimated value of 10 mPa s at 200 MPa) and several members have shown interest to proceed the study of this fluid. Others were requested to study this material after the work by Prof. J.M.N.A. Fareleira and his group and that of Dr S. Bair. It was agreed that Prof. J. Fernandez would lead an email discussion of how to proceed with both the Krytox standard and TOTM among the project group.

Results for Krytox will be included in the IUPAC project report on "International standard for viscosity at temperatures up to 473 K and pressures below 200 MPa" (Dr A. Goodwin, Prof. JPM.Trusler, Prof. R.M. Enick, Prof. J. Fernandez, and Prof. M.J. Assael).

4. Three new volumes on experimental thermodynamics series were to 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)

   - Vol. IX: Prof. Sir William A. Wakeham informed everyone that is already published as, "Experimental Thermodynamics Volume IX: Advances in Transport Properties of Fluids", Assael M.J., Goodwin A.R.H., Vesovic V. and Wakeham W.A. Eds., RSC Press., London U.K. (2014) - 408 pages.
     ISBN-13: 978-1849736770
   - Vol. X (Non-Equilibrium Thermodynamics): Prof. J.V. Sengers informed everyone that galley profs should be ready by August 2015.
   - Vol. XI (Industrial Applications): The Chairman raised several issues about the format and style of this final volume which was aimed at industrial practice. There were many inputs covering various aspects of the problem. Prof. J.V. Sengers was beginning to be concerned about the future of printed volumes as the manner in which IUPAC dissimenated its output. The number of downloads of the first volume in the series rather than hard copy sales supported his argument. Others were concernt that trying to cover all industries produced a volume that would struggle to find an audience. Prof. A. Nagashima thought a handbook style would be most useful to industry. Dr M. Banish thought that the metals industries had their own practices that would be usefully recorded and that he could identify authors.
     The Chairman thanked colleagues on behalf of the editors for their input and he agreed to discuss the matter further following this input with his fellow editors and with IUPAC. IUPAC would have to be comfortable with any proposed format and that included comfort with nomenclature and symbols, units etc.

5. Diffusion nomenclature in the IUPAC Definitions of Symbols & Units

   During the preparation of Volume IX discussed above, it became clear that the literature was confused about nomenclature and symbolism in the field of diffusion particularly for multicomponent and ionic systems. The current IUPAC section on this topic in the Green Book on nomenclature was entirely inadequate. An IUPAC project proposal had been submitted to the IUPAC Physical Chemistry Division by Dr. A Goodwin and the Chairman with an hypothetical project team. The proposal has been funded. Dr. Goodwin had selected Prof. Lobo from Portugal, an expert in diffusion to lead the rεal project team and he had been expected to assemble a team and complete the work. There appeared to be no progress at all despite pressure from the Chairman (acting for Dr. Goodwin and Prof. K. Harris). Dr. Banish volunteered to lead a team if the first selected person was withdrawn and the Chairman undertook to investigate Prof. Lobo's situation and likelihood of completion, to write to IUPAC about the project and to enquire if Dr. Banish would be a suitable substitute leader for IUPAC.

3.3. NEW COLLABORATIVE PROJECTS

6. Reference correlations for the viscosity and thermal conductivity of D_2O over extended temperature and pressure ranges.
   S.K.Mylona, M.J. Assael (Greece), M.L. Huber, R.A. Perkins, J.V. Sengers (USA), Robert Hellmann (Germany)

   New collaborative project between IATP and IAPWS, made possible as a new EoS for D_2O is finally available.

4. MEMBERSHIP

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:
- Prof. Karsten Meier (Germany)
- Dr Sebastian Herrmann (Germany)

5. FUTURE MEETINGS

5.1. 16th IATP Meeting, 2016

The 16th IATP Meeting will take place in Imperial College, London, UK. Prof. J.P. Martin Trusler will be the local organiser. The exact date will be announce in due course.

5.2. 17th IATP Meeting, 2017

The 17th IATP Meeting will take place on Sunday September 3rd in Gratz, Austria, in 2017, just prior to the 21st ECTP (September 3rd – 8th 2017). Details will be announced in due course.

5.3. 18th IATP Meeting, 2018

The 18th IATP Meeting will take place in Boulder, Colorado USA, prior to the 20th Symposium of Thermophysical Properties. Details will be announced in due course.

6. LIST OF ATTENDEES

List of people that attended the meeting:

1) Prof. Sir William A. Wakeham (UK), Chairman
2) Prof. Marc J. Assael (Greece), Secretary

3) Prof. Alfred Leipertz (Germany)
4) Prof. Akira Nagashima (Japan)
5) Prof. Carlos A. Nieto de Castro (Portugal)
6) Prof. Jan V. Sengers (USA)
7) Dr Michael Banish (USA)
8) Prof. Josefa Fernandez (Spain)
9) Prof. Andreas Fröba (Germany)
10) Dr Daniela S. Gaal (USA)
11) Dr Peter Gaal (USA)
12) Dr Robert Hellmann (Germany)
13) Dr Marcia A. Huber (USA)
14) Dr Arno Laesecke (USA)
15) Prof. Maria Jose V. Lourenco (Portugal)
16) Prof. Kenneth N. Marsh (Australia)
17) Prof. Agilio A.H. Padua (France)
18) Dr Rich A. Perkins (USA)
19) Prof. Sergio E. Quinones-Cisneros (Mexico)
20) Dr Bernd Rathke (Germany)
21) Prof. J.P. Martin Trusler (UK)
22) Prof. Jiangtao Wu (P.R. China)

23) Ms Ana Filipa Cristino (Portugal)
24) Mr Ahmed El-Hawary (Germany)
25) Dr Laura Fedele (Italy)
26) Miss Dan Fang (P.R. China)
27) Dr Daniel Friend (USA)
28) Mr Andreas Helles (Germany)
29) Dr Sebastian Herrmann (Germany)
30) Dr Thomas Hughes (Australia)
31) Mr Benjamin Jäger (Germany)
32) Mr Tao Jia (P.R. China)
33) Mr Thomas Koller (Germany)
34) Miss Ying Li (P.R. China)
35) Prof. Eric May (Australia)
36) Prof. Karsten Meier (German)
37) Dr Sofia Mylona (Greece)
38) Dr Stefan Pollak (Germany)
39) Mr Herman Quiroz Villarreal (Mexico)
40) Dr Paul Stanwix (Australia)
41) Mr Deepak Taprival (USA)
42) Miss Christine-Marie Vassiliou (Greece)
43) Ms Salome Vieira (Portugal)
44) Prof. Jadran Vrabec (Germany)