Fun with fluid properties

By Nicholas W Fette, 2015-02-11

# Water (R-718)

## Original sources

Prus and Wagner’s publications have a typographical error, but I am not sure where.

Let’s compare [1] and [2]. The book [1] is cited by 14 articles (according to scholar.google.com as of 2015-02-11) including [3], which in turn is cited by 76 articles (according to scitation.aip.org as of 2015-02-11) and is used in REFPROP9. The journal publication [2] was published seven years later and was cited by 1151 articles (according to scitation.aip.org as of 2015-02-11).

We should observe and clarify the discrepancy between these two sources. Most likely the more recent publication takes precedence. The discrepancy is in the two columns in a table of coefficients.

|  |  |  |
| --- | --- | --- |
|  | Book [1] | IAPWS Article [2] |
| Equation (page) | 7.5 (81) | 6.6 (429) |
| Table (page) | 7.2 (83) | 6.2 (430) |
| Coefficient appearing in |  |  |
| Coefficient appearing in |  |  |
| Values of | 28  32 | 0.2  0.2 |
| Values of | 0.2  0.2 | 28  32 |

# Ammonia (R-717)

## Commentary

REFPROP fluid property database [4] includes documentation for the ammonia EOS that notes that the Helmholtz equation of state as reported by Tillner-Roth et al. [5] contains a typographical error.

# Software implementations for comparison

## FLUIDS

This package was found by searching for sources that cite Tillner-Roth et al. [5]. A paper describing it was published by Bakker [6]. The author’s website also lists the software package for download [7].

## REFPROP

NIST’s reference database [4] includes {ammonia+water} mixtures based on [3]. To access the data, a user can open the GUI, or download the wrapper for the language of choice. Also, CoolProp can be used as a wrapper for calling REFPROP.

## CoolProp

Ian Bell’s open source project includes incompressible data fits for a large number of practical fluids [8], including some Dowtherm, Paratherm, Therminol, Syltherm, and aqueous salts such as LiBr [9].

Python usage:

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| --- |
| >>> import CoolProp.CoolProp as CP  >>> amm = lambda(x):'REFPROP::water[{}]&ammonia[{}]'.format(1-x,x)  >>> f1 = amm(0.302385)  >>> print f1  REFPROP::water[0.697615]&ammonia[0.302385]  >>> print CP.PropsSI('D','T',300,'P',101325,f1)  892.6941934015523  >>> print CP.PropsSI('C','T',300,'P',101325,'INCOMP::LiBr[0.23]')  3101.436382304021  >>> Psat = CP.PropsSI('P','T',300,'Q',0,'INCOMP::LiBr[0.23]')  >>> print Psat  2951.14613672 |

## EES

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| EES libraries [10]:  Old, backward compatible, includes NH3 in water:  C:\EES32\Userlib\BrineProp\Brineprop2.LIB  C:\EES32\Userlib\BrineProp\BrineProp2.chm  From Ibrahim and Klein [11]. (This is a DLL)  C:\EES32\Userlib\EES\_System\nh3h2o.dlp  C:\EES32\Userlib\EES\_System\NH3H2O.chm  Old, backward compatible for Herold, Radermacher, and Klein text:  C:\EES32\Userlib\Libr\LIBR.dll  C:\EES32\Userlib\Libr\Libr.chm  Newer, better:  Patek and Klomfar [9]  C:\EES32\Userlib\Libr\LiBrH2O.LIB  C:\EES32\Userlib\Libr\LiBrH2O.chm |

Python usage:

Please see the openACHP source code.

# Bibliography

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