iemisc: Comparing Saturated Vapor Pressure Formulas to the Reference

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Replicate the R code

Note: If you wish to replicate the R code below, then you will need to copy and paste the following commands in R first (to make sure you have all the packages and their dependencies):

```
install.packages(c("install.load", "iemisc", "units"))
# install the packages and their dependencies
```

```
# load the required packages
install.load::load_package("iemisc", "units")
# load needed packages using the load_package function from the install.load
# package (it is assumed that you have already installed these packages)

import::from(fpCompare, "%==%")
```

Fraction (or Mixed number) to a Decimal (Numeric Vector)

```
install.load::load_package("iemisc", "data.table")
```

```
# reference vapor pressures
reference <- sort(c(611.655, 2339.32, 7384.94, 19946.4, 47414.5, 101418))
```

```
T <- sort(c(0.01, seq(from = 20, to = 100, by = 20)))

# hydraulics
hydraulics_svp <- hydraulics::svp(T = T, units = "SI")


# iemisc
iemisc_sat_vapor_pressure_huang <- sat_vapor_pressure(T = T, units = "SI", formula = "Huang")

iemisc_sat_vapor_pressure_buck <- sat_vapor_pressure(T = T, units = "SI", formula = "Buck")

iemisc_sat_vapor_pressure_iapws <- sat_vapor_pressure(T = T, units = "SI", formula = "IAPWS")



# aiRthermo

# create a numeric vector with the units of degrees Celsius
T_C <- set_units(T, "degree_C")
T_C
```

```
## Units: [°C]
## [1] 1e-02 2e+01 4e+01 6e+01 8e+01 1e+02
```

```
# create a numeric vector to convert from degrees Celsius to Kelvin
T_K <- T_C
T_K
```

```
## Units: [°C]
## [1] 1e-02 2e+01 4e+01 6e+01 8e+01 1e+02
```

```
# create a numeric vector with the units of Kelvin
units(T_K) <- make_units(K)

aiRthermo_saturation_pressure_H2O <- aiRthermo::saturation_pressure_H2O(drop_units(T_K))


# Note: If you want to alter the display of the calculated values, you can
# remove scientific notation using options(scipen = 999) & set the number of
# decimal places with options(digits = 7). Refer to Source 1.

options(scipen = 999)
options(digits = 7)

comparePress <- data.table(Reference_Pressure = reference, Hydraulics_Pressure = hydraulics_svp,
    Huang_Pressure = iemisc_sat_vapor_pressure_huang, Buck_Pressure = iemisc_sat_vapor_pressure_buck,
    IAPWS_Pressure = iemisc_sat_vapor_pressure_iapws, aiRthermo_Pressure = aiRthermo_saturation_pressur

comparePress[, `:=`(mreHydraulics = mapply(mre, Hydraulics_Pressure, Reference_Pressure) *
    100, mreHuang = mapply(mre, Huang_Pressure, Reference_Pressure) * 100, mreBuck = mapply(mre,
    Buck_Pressure, Reference_Pressure) * 100, mreIAPWS = mapply(mre, IAPWS_Pressure,
    Reference_Pressure) * 100, mreaiRthermo = mapply(mre, aiRthermo_Pressure, Reference_Pressure) *
    100)]  # Source 1
```

```
# which row(s) has the maximum value
max_row <- pmax(comparePress$mreHydraulics, comparePress$mreHuang, comparePress$mreBuck,
    comparePress$mreIAPWS, comparePress$mreaiRthermo)

# which row(s) has the minimum value
min_row <- pmin(comparePress$mreHydraulics, comparePress$mreHuang, comparePress$mreBuck,
    comparePress$mreIAPWS, comparePress$mreaiRthermo)

# which rows are TRUE
max_row2 <- comparePress == max_row


# which rows are TRUE
min_row2 <- comparePress == min_row

comparePress[, max_mre := c(rep("mreaiRthermo", 3), rep("mreBuck", 3))]

comparePress[, min_mre := c("mreBuck", rep("mreHydraulics / mreHuang", 4), "mreIAPWS")]

setnames(comparePress, c("Reference Pressure (Pa)", "Hydraulics Package Pressure (Pa)",
    "Huang Pressure (Pa)", "Buck Pressure (Pa)", "IAPWS Pressure (Pa)", "aiRthermo Pressure (Pa)",
    "MRE % (Hydraulics Package vs. Reference)", "MRE % (Huang vs. Reference)", "MRE % (Buck vs. Referen
    "MRE % (IAPWS vs. Reference)", "MRE % (aiRthermo vs. Reference)", "Maximum MRE % Formula",
    "Minumum MRE % Formula"))

comparePress
```

```
##    Reference Pressure (Pa) Hydraulics Package Pressure (Pa) Huang Pressure (Pa)
## 1:                611.655                          611.6894            611.6894
## 2:               2339.320                         2339.3207           2339.3207
## 3:               7384.940                         7384.9328           7384.9328
## 4:              19946.400                        19946.1044          19946.1044
## 5:              47414.500                        47415.0409          47415.0409
## 6:             101418.000                       101416.9949         101416.9949
##    Buck Pressure (Pa) IAPWS Pressure (Pa) aiRthermo Pressure (Pa)
## 1:           611.6541            611.6571                611.4438
## 2:          2338.3400           2339.1937               2335.1919
## 3:          7382.3596           7385.1105               7382.3596
## 4:         19945.1455          19947.3825              19945.1455
## 5:         47410.2673          47415.7843              47410.2673
## 6:        101307.7809         101417.9938             101307.7809
##    MRE % (Hydraulics Package vs. Reference) MRE % (Huang vs. Reference)
## 1:                            0.00563197037               0.00563197037
## 2:                            0.00003204599               0.00003204599
## 3:                            0.00009734185               0.00009734185
## 4:                            0.00148213892               0.00148213892
## 5:                            0.00114082496               0.00114082496
## 6:                            0.00099107460               0.00099107460
##    MRE % (Buck vs. Reference) MRE % (IAPWS vs. Reference)
## 1:               0.0001454261              0.000338383649
## 2:               0.0418934370              0.005397439309
## 3:               0.0349413144              0.002308409900
## 4:               0.0062894746              0.004925809162
## 5:               0.0089270646              0.002708595989
## 6:               0.1086780481              0.000006095636
##    MRE % (aiRthermo vs. Reference) Maximum MRE % Formula
## 1:                     0.034528683          mreaiRthermo
## 2:                     0.176464156          mreaiRthermo
## 3:                     0.034941314          mreaiRthermo
## 4:                     0.006289475               mreBuck
## 5:                     0.008927065               mreBuck
## 6:                     0.108678048               mreBuck
##       Minumum MRE % Formula
## 1:                  mreBuck
## 2: mreHydraulics / mreHuang
## 3: mreHydraulics / mreHuang
## 4: mreHydraulics / mreHuang
## 5: mreHydraulics / mreHuang
## 6:                 mreIAPWS
```

```
# Return to your default settings using the following call in R:
default_opts <- callr::r(function() {
    options()
})
options(default_opts)
# Source 2
```

R Sources

Source 1
r - How do I reset all options() arguments to their default values? - Stack Overflow answered by stevec on Jul 27 2020 and edited by stevec on Feb 27 2022. See https://stackoverflow.com/questions/36848785/how-do-i-reset-all-options-arguments-to-their-default-values

Source 2
R data.table apply function to rows using columns as arguments - Stack Overflow answered by mlegge on Apr 13 2017 and edited by mlegge Jul 4 2019. See https://stackoverflow.com/questions/25431307/r-data-table-apply-function-to-rows-using-columns-as-arguments

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