Package 'Rpvt'

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Type Package

Title Estimate the PVT Properties of Reservoir Fluids

Version 0.1.1

Date 2020-05-15

Description Generate the PVT (Pressure-Volume-Temperature) properties of dry gas, wet gas, black oil, and water samples in a tabular format at a constant temperature from the atmospheric pressure up to the pressure of interest using correlations. Spivey, J. P., McCain Jr., W. D. and North, R. (2004) <doi:10.2118/04-07-05>. Sutton, R. P. (2007) <doi:10.2118/97099-PA>. Vasquez, M., and Beggs, H. D. (1980) <doi:10.2118/6719-PA>.

License GPL-3

URL https://susaenergy.github.io/Rpvt_ws/

Imports Rcpp (>= 1.0.3), Rdpack

RdMacros Rdpack

LinkingTo Rcpp, RcppArmadillo

Suggests testthat, knitr, rmarkdown, ggplot2, magrittr, ggpubr

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LazyData TRUE

VignetteBuilder knitr

RoxygenNote 7.1.0

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R topics documented:

`pvt_gas` *Create a matrix of PVT properties for dry- and wet-gas samples*

Description

The pvt_gas() generates a table of gas PVT properties at reservoir temperature and pressures from the atmospheric condition up to the initial reservoir pressure. The estimated properties are compressibility factor, formation volume factor, density, compressibility, viscosity, and pseudo-pressure.

Usage

```
pvt_gas(
  input_unit = "Field",
  output_unit = "Field",
  fluid = "wet_gas",
  pvt_model = "DAK",
  visc_model = "Sutton",
  t = 300,
  p = 5000,
  gas_spgr = 0.69,
  nhc_composition = c(0, 0, 0),
  cgr = 3,
  cond_api = 42,
  warning = "yes"
)
```

Arguments

`input_unit`	input unit system for parameters, a character string either 'SI' or 'Field'
`output_unit`	output unit system for properties, a character string either 'SI' or 'Field'
`fluid`	fluid type, a character string either 'dry_gas' or 'wet_gas'
`pvt_model`	PVT model, the character string 'DAK'
`visc_model`	viscosity model, the character string 'Sutton'
`t`	temperature, a numeric value either in 'C' or 'F' depending on the 'input_unit'
`p`	pressure, a numeric value either in 'kPag' or 'Psig' depending on the 'input_unit'
`gas_spgr`	gas specific gravity (Air = 1.0)

nhc_composition
: a vector of mole fractions for nitrogen, hydrogen sulfide, and carbon dioxide, respectively

cgr
: condensate to gas ratio, a numeric value in 'm3/m3' or 'STB/MMSCF' depending on the 'input_unit'

cond_api
: condensate API

warning
: a charater string either 'yes' or 'no'

References

Sutton RP (2007). "Fundamental PVT Calculations for Associated and Gas/Condensate Natural-Gas Systems." *SPE Reservoir Evaluation \& Engineering*, **10**(03), 270–284. ISSN 1094-6470, doi: 10.2118/97099PA, https://doi.org/10.2118/97099-PA.

Wichert E, Aziz K (1972). "Calculation of Z's for Sour Gases." *Hydrocarbon Processing*, **51**(5), 119–122.

Examples

```
pvt_gas_results_1 <- pvt_gas(input_unit = "Field", output_unit = "Field",
fluid = "dry_gas", pvt_model = "DAK", visc_model = "Sutton",
t = 400, p = 20000, gas_spgr = 0.65, nhc_composition = c(0.05,0.02,0.04),
cgr = 0.0, cond_api = NULL, warning = "yes")

head(pvt_gas_results_1)

pvt_gas_results_2 <- pvt_gas(input_unit = "Field", output_unit = "Field",
fluid = "wet_gas", pvt_model = "DAK", visc_model = "Sutton",
t = 300, p = 20000, gas_spgr = 0.75, nhc_composition = c(0.02,0.05,0.08),
cgr = 10.0, cond_api = 42.4, warning = "yes")

head(pvt_gas_results_2)
```

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pvt_oil *Create a matrix of PVT properties for black oil samples*

Description

The pvt_oil() generates a table of oil and gas PVT properties at reservoir temperature and pressures from the atmospheric condition up to the initial reservoir pressure. The estimated oil properties are solution gas-oil ratio, formation volume factor, density, compressibility, and viscosity. Estimated PVT properties for the associated gas are compressibility factor, formation volume factor, density, compressibility, viscosity, and pseudo-pressure.

Usage

```
pvt_oil(
  input_unit = "SI",
  output_unit = "SI",
  fluid = "black_oil",
  pvt_model = "Standing",
  visc_model = "Beggs_Robinson",
  t = 85.4,
  p = 35000,
  oil_api = 38,
  gas_spgr = 0.67,
  nhc_composition = c(0, 0, 0),
  rsi = NULL,
  pb = 29500,
  warning = "yes"
)
```

Arguments

input_unit	input unit system for parameters, a character string either 'SI' or 'Field'
output_unit	output unit system for properties, a character string either 'SI' or 'Field'
fluid	fluid type, the character string 'black_oil'
pvt_model	PVT model, a character string. 'Standing', 'Vasquez_Beggs', 'Farshad_Petrosky', 'Al_Marhoun', and 'Glaso' models are currently available
visc_model	viscosity model, a character string. 'Beggs_Robinson', and 'Al_Marhoun' models are currently available
t	temperature, a numeric value either in 'C' or 'F' depending on the 'input_unit'
p	pressure, a numeric value either in 'kPag' or 'Psig' depending on the 'input_unit'
oil_api	API gravity of oil
gas_spgr	gas specific gravity (Air = 1.0)
nhc_composition	a vector of mole fractions for nitrogen, hydrogen sulfide, and carbon dioxide, respectively
rsi	initial solution gas oil ratio in 'm3/m3' or 'SCF/STB' depending on the 'input_unit'. It is either NULL or a numeric value. If 'rsi' is NULL, then a numeric value must be assigned to 'pb'
pb	bubble point pressure, a numeric value either in 'kPag' or 'Psig' depending on the 'input_unit'. it is either NULL or a numeric value. If 'pb' is NULL, then a numeric value must be assigned to 'rsi'
warning	a charater string either 'yes' or 'no'

References

Standing MB (1947). "A Pressure-Volume-Temperature Correlation For Mixtures Of California Oils And Gases."

Vasquez M, Beggs HD (1980). "Correlations for Fluid Physical Property Prediction." *Journal of Petroleum Technology*, **32**(06), 968–970. ISSN 0149-2136, doi: 10.2118/6719PA, https://doi.org/10.2118/6719-PA.

Glaso O (1980). "Generalized Pressure-Volume-Temperature Correlations." *Journal of Petroleum Technology*, **32**(05), 785–795. ISSN 0149-2136, doi: 10.2118/8016PA, https://doi.org/10.2118/8016-PA.

Petrosky Jr. GE, Farshad F (1998). "Pressure-Volume-Temperature Correlations for Gulf of Mexico Crude Oils." *SPE Reservoir Evaluation \& Engineering*, **1**(05), 416–420. ISSN 1094-6470, doi: 10.2118/51395PA, https://doi.org/10.2118/51395-PA.

Al-Marhoun MA (1988). "PVT Correlations for Middle East Crude Oils." *Journal of Petroleum Technology*, **40**(05), 650–666. ISSN 0149-2136, doi: 10.2118/13718PA, https://doi.org/10.2118/13718-PA.

Beggs HD, Robinson JR (1975). "Estimating the Viscosity of Crude Oil Systems." *Journal of Petroleum Technology*, **27**(09), 1140–1141. ISSN 0149-2136, doi: 10.2118/5434PA, https://doi.org/10.2118/5434-PA.

Al-Marhoun MA (2004). "Evaluation of empirically derived PVT properties for Middle East crude oils." *Journal of Petroleum Science and Engineering*, **42**(2), 209–221. ISSN 0920-4105.

Spivey JP, Valko PP, McCain WD (2007). "Applications of the Coefficient of Isothermal Compressibility to Various Reservoir Situations With New Correlations for Each Situation." *SPE Reservoir Evaluation \& Engineering*, **10**(01), 43–49. ISSN 1094-6470, doi: 10.2118/96415PA, https://doi.org/10.2118/96415-PA.

Sutton RP (2007). "Fundamental PVT Calculations for Associated and Gas/Condensate Natural-Gas Systems." *SPE Reservoir Evaluation \& Engineering*, **10**(03), 270–284. ISSN 1094-6470, doi: 10.2118/97099PA, https://doi.org/10.2118/97099-PA.

Examples

```
pvt_oil_results_1 <- pvt_oil(input_unit = "Field", output_unit = "Field", fluid = "black_oil",
pvt_model = "Standing", visc_model = "Beggs_Robinson",
t = 200, p = 3000, oil_api = 35, gas_spgr = 0.8,
nhc_composition = c(0.05,0.02,0.04), rsi = 650, pb = NULL, warning = "no")

head(pvt_oil_results_1)

pvt_oil_results_2 <- pvt_oil(input_unit = "SI", output_unit = "Field", fluid = "black_oil",
pvt_model = "Vasquez_Beggs", visc_model = "Al_Marhoun",
t = 80, p = 20000, oil_api = 34.4, gas_spgr = 0.65,
nhc_composition = c(0.0,0.0,0.0), rsi = NULL, pb = 11350, warning = "yes")

head(pvt_oil_results_2)
```

`pvt_water` *Create a matrix of PVT properties for reservoir water samples*

Description

The pvt_water() generates a table of water PVT properties at reservoir temperature and pressures from the atmospheric condition up to the initial reservoir pressure. The estimated water properties are solution gas-water ratio, formation volume factor, density, compressibility, and viscosity.

Usage

```
pvt_water(
  input_unit = "Field",
  output_unit = "Filed",
  fluid = "water",
  pvt_model = "Spivey",
  visc_model = "Spivey",
  t = 220,
  p = 6000,
  salinity = 10,
  gas_saturated = "yes",
  warning = "yes"
)
```

Arguments

input_unit	input unit system for parameters, a character string either 'SI' or 'Field'.
output_unit	output unit system for properties, a character string
fluid	fluid type, the character string 'water'
pvt_model	PVT model, a character string. 'Spivey', 'Meehan', and 'McCain' models are currently available
visc_model	viscosity model, a character string. 'Spivey', 'Meehan', and 'McCain' models are currently available
t	temperature, a numeric value either in 'C' or 'F' depending on the 'input_unit'
p	pressure, a numeric value either in 'kPag' or 'Psig' depending on the 'input_unit'
salinity	water salinity in weight percent TDS
gas_saturated	a charater string either 'yes' or 'no'
warning	a charater string either 'yes' or 'no'

References

Meehan DN (1980). "Estimating water viscosity at reservoir conditions." *Petroleum Engineer*, **35**, 117–118.

Meehan DN (1980). "A correlation for water compressibility." *Petroleum Engineer*, **56**, 125–126.

McCain Jr. WD (1991). "Reservoir-Fluid Property Correlations-State of the Art (includes associated papers 23583 and 23594)." *SPE Reservoir Engineering*, **6**(02), 266–272. ISSN 0885-9248, doi: 10.2118/18571PA, https://doi.org/10.2118/18571-PA.

Spivey JP, McCain WD, North R (2004). "Estimating density, formation volume factor, compressibility, methane solubility, and viscosity for oilfield brines at temperatures from 0 to 275 C, pressures to 200 MPa, and salinities to 5.7 mole/kg." *Journal of Canadian Petroleum Technology*, **43**(7), 52–61. ISSN 00219487, doi: 10.2118/040705, https://doi.org/10.2118/04-07-05.

McCain, Jr. WD, Spivey JP, Lenn CP (2011). *Petroleum Reservoir Fluid Property Correlations*. PennWell Corporation. ISBN 978-1-59370-187-1.

Examples

```
pvt_water_results_1 <- pvt_water(input_unit = "Field", output_unit = "Field",
fluid = "water", pvt_model = "McCain", visc_model = "McCain",
t = 300, p = 5000, salinity = 10, gas_saturated = "yes", warning = "no")

head(pvt_water_results_1)

pvt_water_results_2 <- pvt_water(input_unit = "SI", output_unit = "SI",
fluid = "water", pvt_model = "Spivey", visc_model = "Spivey",
t = 100, p = 15000, salinity = 0.0, gas_saturated = "no", warning = "no")

head(pvt_water_results_2)
```

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