Oil Compressibility Below the Bubble Point (McCain, Standing)

Apparent oil compressibility below the bubble point including gas liberation, by McCain's correlation and by differentiating Standing's Rs and Bo.

Input parameters

Unit system: SI

Parameter	Value	Unit
Pressure (below the bubble point)	1,000.00	psi
Bubble-point pressure	2,500.0	psi
Temperature	200.00	°F
Oil gravity	35.000	
Solution GOR at the bubble point	600.00	scf/STB
Solution GOR at the pressure	330.00	scf/STB
Oil formation volume factor at the pressure	1.2200	
Gas formation volume factor at the pressure	0.002800	bbl/scf
Gas gravity (air = 1)	0.80000	

Calculated results

Parameter	Value	Unit
Oil compressibility (McCain, with p_b)	4.5190e-04	1/psi
Oil compressibility (Standing derivatives)	7.3134e-04	1/psi
Rate of gas liberation (Standing)	0.38744	
Slope of B_o (Standing), per psi	1.9259e-04	

Notes for this case

• Below the bubble point the apparent compressibility includes the gas coming out of solution, so it is ten or more times the liquid compressibility. Check consistency: ∂B_o/∂p must be smaller than B_g·∂R_s/∂p or c_o turns negative.

Formula and method

$$c_o = e^{A},\ A = -7.573 - 1.45\ln p - 0.383\ln p_b + 1.402\ln T + 0.256\ln API + 0.449\ln R_{sb},\quad c_o = -\frac{1}{B_o}\left(\frac{\partial B_o}{\partial p} - B_g\frac{\partial R_s}{\partial p}\right)$$

Variables

p	Pressure (below the bubble point)	Pa
p_b	Bubble-point pressure	Pa
T	Temperature	K
API	Oil gravity	-
R_{sb}	Solution GOR at the bubble point	m³/m³
R_s	Solution GOR at the pressure	m³/m³
B_o	Oil formation volume factor at the pressure	-
B_g	Gas formation volume factor at the pressure	m³/m³
γ_g	Gas gravity (air = 1)	-
$c_{o,McCain}$	Oil compressibility (McCain, with p_b)	1/Pa
$c_{o,Standing}$	Oil compressibility (Standing derivatives)	1/Pa

$\partial R_s/\partial p$	Rate of gas liberation (Standing)	-
$\partial B_o/\partial p$	Slope of B_o (Standing), per psi	-

Method and standards

McCain correlation and Standing derivatives (psia, °R, °F).

Assumptions and limits

- Black oil below the bubble point.

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/oil-gas/saturated-oil-compressibility

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Reopens the calculator with the inputs of this report.