NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF PETROLEUM ENGINEERING
AND APPLIED GEOPHYSICS

Contact during exam:
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Exam results are due in week x, 2008.

EXAM IN COURSE
TPG4145 RESERVOIR FLUIDS

Monday December 17, 2007

Time: 0900 – 1300

Permitted aids:
C:
ONLY (1) SPE *Phase Behavior* monograph volume 20 in original book form; handwritten notes written within the original book allowed. (2) Project Solution, up to maximum of six (6) single-sided pages.

General Description

Problem 1: Calculate all missing numbers in Table 1. Write answers within Table 1.

Problem 2: Using results from Problem 1 and Table 2, answer the following:

a. Pressure at 900 m below sea level.
b. Pressure at 1200 m below sea level (WOC).
c. Initial surface gas in Reservoir Gas Zone, IGIP(RG).
d. Initial surface oil ("condensate") in Reservoir Gas Zone, IOIP(RG).
e. Initial surface gas in Reservoir Oil Zone, IGIP(RO).
f. Initial surface oil in Reservoir Oil Zone, IOIP(RO).

Assuming an idealized surface process, where "surface gas" is C1 and "surface oil" is (n-C5 + n-C10), calculate and compare with values in Table 2:

g. Initial solution OGR (r_s) in Reservoir Gas Zone.
h. Initial gas formation volume factor (B_{gd}) in Reservoir Gas Zone.

Problem 3: Based on information in Table 3, calculate the following *at the end of plateau* for two minimum flowing tubing pressures, 100 and 500 psia:

a. Minimum number of wells needed to produce *Plateau Field Gas Rate*.
b. Gas recovery factor.
c. Average reservoir pressure.
d. Flowing tubing pressure.

TABLE 1 – Problems 1&2 – Gas-Oil Reservoir.

Component	Molecular Weight	Liquid Specific Gavity
C1	16.04	
N-C5	72.15	0.6375
N-C10	142.28	0.7329

Two Phases at Temperature = 100 C, Pressure = 100 bar:

Molar Amounts:

Component	Overall	Liquid	Vapor	K-Value
C1			0.94748	
N-C5	0.20000	0.25350	0.04759	
N-C10		0.40359		
Moles:	1.0000			
Mol. Weight:	65.137	81.216		
Z-Factor:		0.4645	0.9261	
Density (g/cc):				

TABLE 2 – Problems 1&2 – Gas-Oil Reservoir.

Initial Reservoir Pressure (bara) at Gas-Oil Contact	100
Initial Reservoir Temperature (^oC)	100
Gas-Oil Contact (m below sea level)	1000
Water-Oil Contact (m below sea level)	1200
Top Gas Reservoir Zone (m below sea level)	900
Bottom Water Zone (m below sea level)	1300
Hydrocarbon Pore Volume, Reservoir Gas (m^3)	1E8
Hydrocarbon Pore Volume, Reservoir Oil (m^3)	1E8
Initial solution OGR (r_s) in Reservoir Gas Zone (Sm^3/Sm^3)	3.6173E-5
Initial solution GOR (R_s) in Reservoir Oil Zone (Sm^3/Sm^3)	94.3
Initial gas formation volume factor (B_{gd}) in Reservoir Gas Zone (m^3/Sm^3)	0.01222
Initial oil formation volume factor (B_o) in Reservoir Oil Zone (m^3/Sm^3)	1.434

TABLE 3 – Problem 3 – Dry-Gas Reservoir.

Assume Ideal Gas Law and Straight-Line Gas Material Balance ($M=c_w=c_f=0$)

Initial Reservoir Pressure (psia)	1500
Initial Gas in Place (scf)	1E12
Plateau Field Gas Rate (MMscf/D = 10^6 scf/day)	137
Plateau Period (years)	10
Gas Static Column Gravity Term ($p_{reservoir}/p_{surface}$)	1.1
Wellhead Backpressure Deliverability Equation* Constant C	400
Wellhead Backpressure Deliverability Equation* Exponent n	0.8

* $q_g = C(p_c^2-p_t^2)^n$ with p(psia) , q_g(scf/D)