Material Balance Equation

For a solution-gas drive reservoir below the bubble point with the following assumptions:

m=0; no initial gas cap
No water influx
No change in pore volume due to formation compressibility
No change in water volume due to water compressibility

The material balance equation is written:

$$N_p(B_o + (R_p - R_s)B_g) = N((B_o - B_{oi}) + (R_{si} - R_s)B_g)$$

Underground withdrawal = Expansion of the oil plus originally dissolved gas

Rearranged:

$$\frac{N_p}{N} = \frac{(B_o - B_{oi}) + (R_{si} - R_s)B_g}{B_o + (R_p - R_s)B_g}$$

For a given reservoir at abandonment pressure, R_{si}, B_{oi}, B_o, B_g, and R_s will be constant. The material balance equation can be reduced to:

$$\frac{N_p}{N} = \frac{C_1}{C_2 + (R_p)C_3}$$

This demonstrates that oil recovery is dependant primarily on its cumulative produced gas-oil ratio (R_p).

Nomenclature:

N = Initial stock tank oil in place, (STB)
N_p = Cumulative oil produced at time t (abandonment), (STB)
B_{oi} = Oil formation volume factor at initial reservoir conditions, (RB/STB)
B_o = Oil formation volume factor at any given reservoir conditions (abandonment), (RB/STB)
R_{si} = Solution gas-oil ratio at initial reservoir conditions, (SCF/STB)
R_s = Solution gas-oil ratio at any given reservoir conditions (abandonment), (RB/STB)
R_p = Cumulative produced gas-oil ratio, (SCF/STB)
B_g = Gas formation volume factor at any given reservoir conditions (abandonment), (RB/SCF)
C_n = Constant

BEFORE THE
OIL CONSERVATION DIVISION
Case No. 11016,11017,11018 Exhibit No. 9
Submitted By:
Texaco Exploration & Production
Hearing Date: July 7, 1994

B. F. HARRISON 'B' # 5 - BLINEBRY
EFFECT OF VARIABLE PRODUCING RATES ON GOR

B.F. HARRISON 'B' #5 - BLINEBRY										
13, 14 & 15/64" CHOKE SETTINGS						8/64" CHOKE SETTING				
	BOPD	BWPD	MCFPD	GOR			BOPD	BWPD	MCFPD	GOR
1-May	30	0	922	30733		25-Jun	4	0	219	54750
2-May	30	0	918	30600		26-Jun	2	0	250	125000
3-May	32	0	897	28031		27-Jun	6	0	227	37833
4-May	30	0	880	29333		28-Jun	2	0	199	99500
5-May	28	0	923	32964		29-Jun	5	0	307	61400
6-May	28	0	920	32857						
7-May	28	0	923	32964						
8-May	28	0	918	32786						
9-May	28	3	927	33107						
10-May	28	0	929	33179						
11-May	28	0	962	34357						
12-May	32	0	972	30375						
13-May	28	0	970	34643						
14-May	20	0	951	47550						
15-May	30	0	940	31333						
16-May	27	6	953	35296						
17-May	28	0	971	34679						
18-May	33	0	1049	31788						
19-May	29	0	1042	35931						
20-May	28	0	1022	36500						
21-May	28	0	1011	36107						
22-May	28	2	1000	35714						
23-May	28	0	990	35357						
24-May	28	0	626	22357						
25-May	28	0	600	21429						
26-May	28	0	638	22786						
27-May	28	0	638	22786						
28-May	BAD TEST									
29-May	BAD TEST									
30-May	22	0	670	30455						
31-May	27	0	675	25000						
1-Jun	28	0	636	22714						
SUM	846	11	26473				19	0	1202	
AVG	28.2	1	882	***31292***			**3.8**	0	240	***63263***

BEFORE THE
OIL CONSERVATION DIVISION
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B. F. HARRISON 'B' WELL NO. 25
TUBB COMPLETION

Perfs:
06/17/94 - 6084'-6234'

Acidize:
06/18/94 - 4000 gallons 15% NEFE HCL

Flow Tests:
06/20/94 - Flow 27 BO, 21 BLW, 375 MCFG/24 hrs. GOR = 13,889, FTP = 75 psi 32/64" chk
06/21/94 - Flow 20 BO, 6 BLW, 383 MCFG/24 hrs. GOR = 19150, FTP = 100 psi 32/64" chk

Ran Pressure Bomb:
06/23/94: 24 hr. SIBHP = 2587 psi at 6159'

Fracture Treatment:
06/25/94 - 58,000 gallons XLG w/203,000 lbs sand

Flow Tests:
06/29/94 - Flow 25 BO, 41 BLW, 470 MCFG/3.5 hrs. GOR = 18,824; FTP = 1700 psi 20/64" chk
06/30/94 - Flow 122 BO, 69 BLW, 3412 MCFG/24 hrs. GOR = 27,967; FTP= 1575 psi 19/64" chk
07/01/94 - Flow 72 BO, 15 BLW, 3385 MCFG/24 hrs. GOR = 47,014; FTP = 1550 psi 19/64" chk

BEFORE THE
OIL CONSERVATION DIVISION
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