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| **COURSEWORK**  **DUE DATE** | 12/04/2022 |
| **MATRIC No** | **203346** |
| **SURNAME** | **OSAWARU** |
| **FIRST NAME(S)** | **FELIX EHIS** |
| **COURSE TITLE** | **IT for Oil and Gas Industry** |
| **MODULE NUMBER**  **& TITLE** | **ENM502 PART B – Practical Engineering Problem Solving Exercise** |
| **LECTURER ISSUING COURSEWORK** | **Dr Gbenga Oluyemi/Dr Mohamed Amish** |

**TITLE PAGE**

**(Part B Course Work Submission)**

**Lithology identification in a log**

**Graphical user interface, application, table

Description automatically generated**

**Sand**

**Shale**

Zone of interest

**Sand**

**Gas zone**

**Uniform deposit/deltaic deposit**

**Uniform deposit and fining upward sequence**

**Coarsening upwards sequence/barrier bars**

**Shale**

**Oil zone**

OWC

GOC

**Water zone**

**Sand**

**Sandy shale**

**SECTION 1**

**Question 1: GAMMA-RAY INDEX**

|  |  |
| --- | --- |
| **QUANTITY** | **VALUE/UNIT** |
| cementation | 2m |
| Water resistivity | 0.05ohm |
| Saturation exponent | 2n |
| Tortuosity | 1.2 |
| Formation value factor (Bo) | 1.45 |
| Area (A) | 5050 ACRE |
| Matrix density(Pma) | 2.65g/cm3 |
| Fluid density (Pf) | 1.0 g/cm3 |

IGR is calculated using the following equation:

**= 12%**

**Question 2: DENSITY POROSITY**

ØD =

ØD =

**ØD = 0.2**

**Question 3: NEUTRON POROSITY**

ØN =

ØN =

ØN =

**ØN =0.17**

**Question 3: VOLUME OF SHALE**

For unconsolidated rock

**0.046**

**Question 4: CALCULATE WATER SATURATION**

Water saturation can be calculated using the Archies equation.

=

=

**= 0.2545 = 25%**

**That is 75% of oil saturation**

**Question 5: OIL INITIALLY IN PLACE (OIIP)**

Using the oil initially in place formula

Volume = 7758.A.h.Φ. (1-Sw) bbls

Volume = 7758 ×5050×25× 0.17× (1-0.24)

**Volume = 126,544,617 bbls**

**Question 5: STOCK OIL INITIALLY IN PLACE (STOIIP)**

Volume = 7758.A.h.Φ. (1-Sw)/Bo bbls

Volume = 7758 ×5050×h× 0.17× (1-0.24)/1.45

**Volume = 87,272,149 bbls**

**SECTION 2**

**Question 1: Mud Weight**

Calculate the mud weight

Mud weight =?

Formation pressure = 65000 psi

Depth =10000 ft TVD

Overbalance margin =300 psi

Hydrostatic pressure = 0.052

MW = (PF + POB) ÷ (PH × TVD)

MW = (65000 + 300) ÷ (0.052 × 10000)

MW = 6800 ÷ 520

**MW = 13.08 ppg**

**Question 2: Calculate Leak-off Test**

Leak off test pressure = 1400 psi

Casing shoe = 8500 ft

Mud weight = 11 ppg

Firstly calculate the formation breakdown pressure at the casing shoe and fracture gradient

Max breakdown pressure = ((leak off test + (Mud weight × PH × CASING))

Leak-off test ÷ (PH × Casing) + MW

((1400 ÷ (0.052 ×8500)) + 11

**Max allowable weight = 14.17 ppg**

Max breakdown pressure = 14.17 × 0.052 × 8500 = **6,263 psi**

**Calculate the fracture gradient**

Fracture gradient= breakdown ÷ casing shoe

Fracture gradient = 6263 ÷8500

**Fracture gradient = 0.736 psi/ft**

**Question 3: Calculate the length of drill collars for 15% weight of bit**

|  |  |
| --- | --- |
| **QUALITY** | **VALUE/UNITS** |
| Weight on bit | 25000 Ib |
| Safety factor | 15% |
| Density of steel | 65.5 ppg |
| Weight of drill collars | 150 Ib/ft |
| Drill collar outside diameter | 6 inch |
| Drill collar inside diameter | 2.5 inch |
| Mud weight | 13.08 ppg |

**Firstly calculate for buoyancy factor**

Length, ft = (WOB ×SF) ÷ (WDC× BF)

BF = (65.5 – 13.08) ÷ 65.5

**BF = 0.80**

**Calculate length of drill collars**

Length of drill collars = (25000 × 1.15) ÷ (150 × 0.80)

Length of drill collars = 28750 ÷ 120

**Length of drill collars = 240ft**

**Question 4: Calculate for power law index (n) and consistency index (k)**

Reading at 300RPM = 35

Reading at 3RPM = 8

**Calculate power law index (n)**

n = 0.50 × log (35 ÷ 8)

n = 0.50 × log 4.375

n =0.50 × 0,640

**n = 0.32**

**Calculate consistency index (k)**

K = (100 × 5.11 × 35) ÷ 5.11

K = 17885 ÷ 7.3569

**K = 2431**

**Question 5: Calculate pressure drop in drill pipe**

Hole size =8.5 inch

Depth = 10000 ft

Mud weight = 13.10 ppg

Drill pipe outside diameter = 5 inch

Drill pipe inside diameter = 4.275 inch

Drill collar outside diameter = 6 inch

Drill pipe inside diameter = 2.5 inch

Flow rate = 450 gpm

Length of drill pipe = 9760 ft

Length of drill collar =240 ft

Casing = 8500 inch

Casing inside diameter = 8.755 inch

Friction factor inside the string = 0.004

Friction factor around the string = 0.003

**To calculate pressure drop inside the drill pipe, you have to calculate velocity**

= = = **10.15ft/sec**

**Calculate Reynolds number in drill pipe**

=

= ||

**=**

**Pressure drop inside the drill pipe**

ΔP =

ΔP =

**ΔP = 476 psi**

**Question 6: Calculate pressure drop in drill collar**

**To calculate pressure drop inside the drill collar, you have to calculate velocity inside the drill collar**

= = = **30.205 ft/sec**

**Calculate Reynolds number in drill collar**

=

= ||

**=**

**Pressure drop inside the drill collar**

ΔP =

ΔP =

**ΔP = 133 psi**

**Question 7: Calculate pressure drop in drill collar and open Hole**

**To calculate pressure drop inside the drill collar and open Hole, you have to calculate velocity**

=

= =

**= = 5.10 ft/sec**

**Calculate Reynolds number in drill collar and open Hole**

=

= ||

**= 2084**

**Pressure drop in drill collar and open hole**

Δp = ||

Δp = ||

**= 11.86 psi**

**Question 8: Calculate pressure drop in drill pipe and open Hole**

Using the same velocity

**Calculate Reynolds number in drill pipe and open Hole**

=

= ||

**= 2321**

**Pressure drop in drill pipe and open hole**

Δp = ||

Δp = ||

**= 309 psi**

**Question 9: Calculate pressure drop in drill pipe and casing**

**Calculate Reynolds number in drill pipe and casing**

=

= ||

**= 2374**

**Pressure drop between drill pipe and casing**

ΔP = ||

ΔP = ||

= 281 psi

**Question 10: Calculate the total pressure drop in the system**

+ + + + +

476 + 133 + 11.86 + 309 + 281 + 20

**1230 psi**

**Question 11: Calculate hydraulic horsepower**

HP =

HP =

**HP = 322**

**Question 12: Calculate optimizing hydraulic horsepower from the total pressure drop**

= / 0.35

= 1230/ 0.35

**= 3,428 psi**

**Question 13: Calculate bottom hole pressure**

The bottom hole pressure, BHP can be calculated in pounds per square inch, psi

Calculate hydrostatic pressure first

BHP = +

Hydrostatic pressure =0.052 × 13.08 × 10000

**Hydrostatic pressure = 6,801.60 psi**

BHP = +

BHP = 6801.60 + 11.86 + 309

**BHP = 7,122 psi**

**Question 14: Calculate annulus pressure lose**

= +

= 11.86 + 309

**= 321 psi**

**Question 15: Calculate equivalent circulating density (ECD)**

The equivalent circulating density is determine base on the pressure drop in the annulus between the drill string

ECD = ( ÷ (0.052 × DEPTH)) + MW

ECD = 13.08 + 321 ÷ 520

**ECD = 13.69 ppg**

**Summary**

Based on the above calculations, the equivalent circulating density (ECD) of the formation is 13.69 ppg, which is less than the maximum allowable weight. Therefore there is no risk of formation rupture.

Note that the ECD is always higher than the mud weight.