FEDERAL UNIVERSITY OF TECHNOLOGY OWERRI
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY
DEPARTMENT OF PETROLEUM ENGINEERING

Course: Drilling Fluid Technology **Session:2019/2020**
Course Code: PET 302 Unit: 4 units **Semester: Rain**
Time: 3 hours **Date: 01/07/2021**
Instructions: Answer Five Questions Only

SECTION A

1(a) State Herschel- Buckley model. What are the two merits of Herschel-Buckley over Bingham model and Power law model?

(b)Calculate how much barite in metric tons (Mt) is required to increase the density of 2000 bbl of 12.5 lb gal mud to 13.5 lb gal. Assume the average specific gravity of barite to be 3.95.

2(a)List the solids control equipment applicable during drilling operations. If the solids in the mud are not controlled, what are the three problems likely to occur?

(b) A retort test was carried out and the following results were obtained: Volume of water – 10ml, Volume of oil – 30ml. Assume that the total capacity of the retort is 50ml, Calculate the oil/water ratio. If the total volume of mud in the active system is 1500bbls, how much oil is required to increase the oil/water ratio from its current state to 85/15?

SECTION B

3(a). The properties of a Mud circulated with duplex pump at 400 gpm was used in drilling a $9\text{-}^{7}/_{8}$ inch hole of 13,000 feet are: Mud Weight = 12.4 ppg, yield point of 62 lb/100 ft^2 and plastic viscosity of 43 cp. Calculate the bottom hole pressure at 13,000 ft and the equivalent circulating density if the drill collar is 645 ft with $7\,^{3}/_{5}$ inch outside diameter and $4\,^{2}/_{3}$ outside diameter of drillpipe. **(15 marks)**

(b). With the aid a diagram describe shear rate Vs shear ~~rate~~ stress relationship of both Bingham Plastic and Power Law models. **(4 marks)**

(c). Explain the plastic viscosity of a Power Law model **(1 mark)**

4(a) Data (Table B1) was generated while drilling FERGU 38C well for DUGAL Oil & Gas: Determine the hydrostatic pressure and equivalent mud weight. **(6 marks)**

Table B1

Mud weight lb/gal	Measured Depth (ft)	True Vertical Depth (ft)
11.7	11,300	11,300
16.9	13,400	10,400
9.0	9,800	9,800

(b) Discuss the three (3) major functions of Drilling Fluid **(3 marks)**

(c) State ten (ten) reasons for drilling mud hydraulics **(5 marks)**

(d) A casing string will be run into a well that contains 11.7-lb/gal mud. Assume the casing will be filled with mud as it is run. If the engineer uses a derrick safety factor of 2, will the 1,000,000-lb derrick capacity be satisfactory? Assume: Casing Weight, lb/ft of 47.0, 53.0, 47.0 and Section length, ft 4,500, 5,500, 3,000 respectively. **(6 marks)**

SECTION C

5(a) Given Table C1, find the Equivalent Circulating Density, ECD?

Table C1

S/N	Parameter	Value
1	Mud weight	10.5 ppg
2	ϕ_{600}	60
3	ϕ_{300}	36
4	ϕ_6	13
5	ϕ_3	9
6	Flow rate, Q	400 gpm
7	Hole diameter	8 ½ in.
8	Drill pipe OD/ID	5.0/4.276 in.

S/N	Parameter	Value
9	Drill pipe length	9,300 ft
10	Drill collar OD/ID	6.5/2.25 in.
11	Drill collar length	700 ft
12	True vertical depth, TVD	10,000 ft
13	Yield stress, τ_y	$2\phi_3 - \phi_6$
14	n	$3.32\log_{10}\left(\frac{\phi_{600} - \tau_y}{\phi_{300} - \tau_y}\right)$
15	k	$\frac{(\phi_{300} - \tau_y)}{511^n}$

(b) Find the displacements of the drill pipe and drill collar sections respectively in bbl/ft and bbl.

(c) Different water based muds (Table C2) are stored in three different mud pits. All 3 pits should be mixed into one tank and water added until the density becomes 1.55 kg/l. How much volume of water must be added?

Table C2

PIT 1	V_1=15m^3	ρ_1=1.5kg/l
PIT 2	V_2=25m^3	P_2=1.6kg/l
PIT 3	V_3=8m^3	P_3=1.9kg/l

6(a) To build 650 bbl of 11.5 ppg drilling fluid with 21 ppb bentonite, 0.5 ppb caustic soda and 3 ppb lignite, Table C3 has been provided.

Table C3

Material	Barite	Water	Bentonite	Caustic soda	Lignite
Specific Gravity	4.2	1.0	2.6	2.1	1.5

(i)Find the amount of each material, in barrels and pounds? *Please confirm final results!*

(ii)What is the function of each material in the mud formulation?

(b)1 m^3 of mud has a density of 1.5 kg/l. Adjust to 1.92 kg/l by adding 100 liters mud of density 1.8 kg/l, 40 kg bentonite (to adjust rheology) of density 2.3 kg/l and x kg of barite of density 4.3 kg/l? Note: give answer in kilogram.

NOTE: All questions carry equal marks