UNIVERSITY OF MISKOLC

FACULTY OF
EARTH AND ENVIRONMENTAL
SCIENCES AND ENGINEERING

WELL CONTROL LAB

MSc in Petroleum Engineering

MFKOT730014

COURSE DESCRIPTION

University of Miskolc
Faculty of Earth Science and Engineering
Petroleum and Natural Gas Institute

Course Data Sheet

Course Title: Well Control Lab. **Instructor:** Dr. Gabriella FEDERER-KOVACS, associate professor	**Code:** MFKOT730014 **Responsible department/institute:** DPE/MEI (OMTSZ/BEI) **Course Element: Compulsory**
Position in curriculum* **(which semester)**: 2 (3)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 0+3	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 3	**Course:** full time

Course Description:

1. Causes of kicks, warning signs of kicks
2. Pressure balance in the hole
3. Behavior of gas in the well
4. Shutting-in procedures
5. Shallow gas problems
6. Stripping operation
7. Well control methods: Driller's method
8. Well control methods: Wait & Weight method
9. Well control equipment
10. BOP stack arrangements
11. Manifolds and valves systems, other devices
12. Accumulator units
13. Pressure testing of well control equipment
14. Regulations and standards.

Competencies to evolve:
Knowledge: T1, T2, T3, T11
Ability: K1, K6, K7, K8, K11
Autonomy and responsibility: F1, F2, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance	10 %
Final Test	45 %
Practical Test	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5(excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- T. Bell, D. Eby, J. Larrison, B. Ranka: Blowout Prevention, 4th Ed. ISBN 0-88698-242-1. 2009.
- R. Baker: Practical Well Control, 4th Ed. ISBN 0-88698-183-2. 1998.
- R. Grace: Blowout and Well Control Handbook, Gulf Publishing Company, ISBN: 0750677082. R. D. Grace: Advanced Blowout & Well Control, Gulf Publishing Company, 1994, ISBN 0-88415-260-X
- Well control and blowout prevention, training manual, Petroleum Engineering Department

Course Schedule for 2023/24 school year

Date	Topic
12.febr	Causes of kicks, warning signs of kicks
19.febr	Pressure balance in the hole
26.febr	Behavior of gas in the well
04.márc	Shutting-in procedures
11.márc	Shallow gas problems
18.márc	Stripping operation Well control methods: Driller’s method
25.márc	Test writing.
08.ápr	Well control methods: Wait & Weight method
08.ápr	Well control equipment
15.ápr	BOP stack arrangements
22.ápr	Manifolds and valves systems, other devices
29.ápr	Accumulator units
06.máj	Pressure testing of well control equipment Regulations and standards.
13.máj	Test writing.

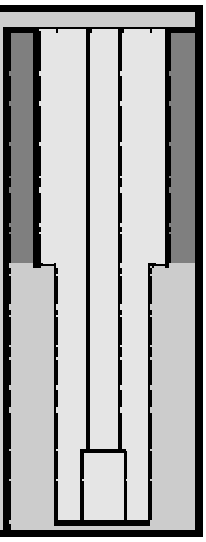
Test Example

DATA SHEET

Hole size		8 1/2"
Hole depth		3048 m TVD/MD
Casing		9-5/8 inch, set at 2286 m TVD/MD Burst pressure: 217 bar
Drill pipe		5 inch, Capacity = 9.16 l/m
Drill collars		6-1/2 inch, 228 m long, Capacity = 4.01 l/m
Mud pump output		18.5 l/stroke
Kill rate & pressure		25 bar @ 30 SPM
Max. allowable pump pressure		297 bar
Cap. open hole - DC		15,2 l/m
Cap. open hole - DP or HWDP		23,3 l/m
Cap. casing - DP		24,9 l/m
Mud weight		1.63 kg/l
Leak-off pressure (1.27 kg/l)		105 bar
Pit gain		1500 liter
SIDPP		35 bar
SICP		50 bar

1. WELL DATA

Hole Size		in(mm)
Original Mud Density		
OMD		kg/l
Casing Shoe		
Size		in(mm)
M. Depth		m
T.V. Depth		m
MAASP		bar
Hole Depth		
M. Depth		m
T.V. Depth		m



2. MUD PUMP DATA

	Pump 1.	Pump 2.
Pump capacity m^3	l/stk	l/stk

Kill rate	Kill rate pressure (KRP) Pump 1.	Pump 2.
spm	bar	bar
spm	bar	bar

Barite mixing capacity	kg/min

3. PRE-RECORDED DATA

	Length m		Capacity l/m		Volume l		Pump strokes stks	Time min
Drill Pipe		x		=		+	volume	pump stks
Heavy DP		x		=		+	---------------	-----------
Drill Collar		x		=		+	pump cap.	SPM
(A) Drill string volume						l	(A_1)	
							(A_2)	
DC-OH		x		=		+		
DP-OH		x		=		+		
(B) Open hole volume						l	(B1)	
							(B2)	
(C) DP-CSG		x		=		+		
(D) Total annulus volume			B+C			l	(D1)	
							(D2)	
Total mud volume in hole			A+D			l	(1)	
							(2)	
Active surface volume						l		

4. KICK DATA

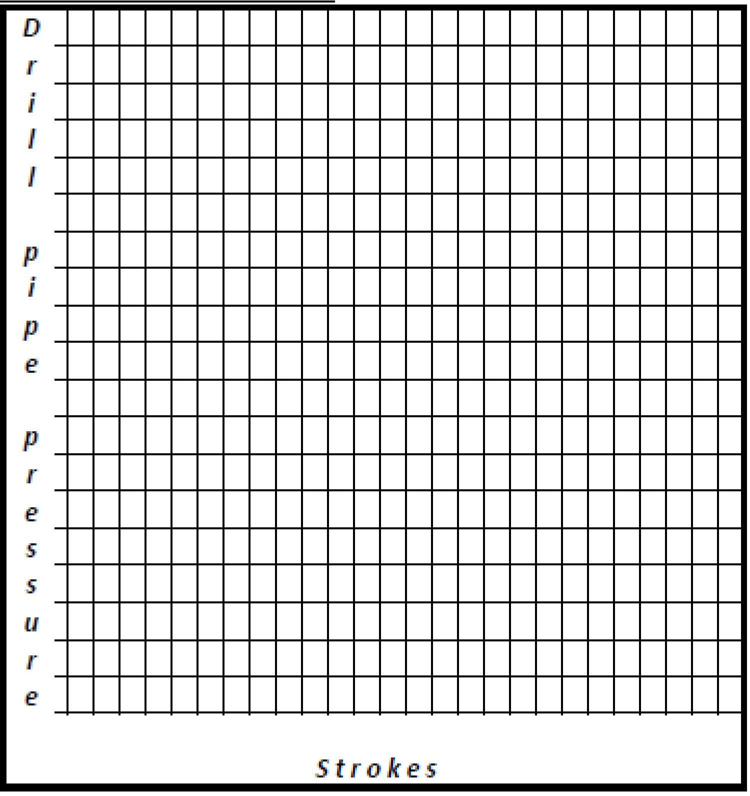
SIDPP	-	Shut-in drill pipe pressure		bar
SICP	-	Shut-in casing pressure		bar
	-	Pit gain		l
SP	-	Safety pressure at formation	0	bar

5. KICK CALCULATION

KMD - Kill mud density	$= OMD + \frac{(SIDPP + SP)}{TVD * 0{,}0981} = \quad + \frac{\quad}{*0{,}0981} = \quad kg/l$
ICP - Initial circulating press.	**= SIDPP + KRP + SP =** **bar**
FCP - Final circulating pressure	$= KRP * \frac{KMD}{OMD} =$ *bar*
(E) = ICP-FCP = - =	bar $\frac{(E)}{(A)} = \frac{\quad}{\quad} = \frac{bar}{stks} = \frac{bar}{...stks}$

6. STATIC AND CIRCULATING PRESSURE BEHAVIOUR:

Pressure	Strokes



Answer the following nine questions from the data above. The attached kill sheet may be used to assist you with your calculations.

1. What is the kill mud density?

A. __________ kg/l.

2. How many strokes are required to pump kill mud from surface to bit?

A. __________ strokes.

3. How many strokes are required to pump from the bit to casing shoe?

A. __________ strokes.

4. What is the total annular volume?

A. __________ litres.

5. What is the MAASP at the time the well was shut in?

A. __________ bar.

6. What is the Initial Circulating Pressure?

A. __________ bar.

7. What is the Final Circulating Pressure when kill mud is at the bit?

A. __________ bar.

8. What is the MAASP after circulation of the kill fluid?

A. __________ bar.

9. What is the drill pipe pressure reduction per 100 strokes as kill mud is being pumped to the bit?

A. __________ bar/100 strokes.

10. Calculate the New Pump pressure:
Old mud density = 1.32 kg/l
New mud density = 1.51 kg/l
Old Pump Pressure = 21 bar

A. __________ bar.

11. A pump pressure of 83 bar was recorded at a pump speed of 35 SPM. What would the approximate pump pressure be at a speed of 30 SPM?

A. 71 bar.
B. 96 bar.
C. 61 bar.
D. 48 bar.

12. Match each of these statements to one of the answers below by entering the statement number in the space provided.
1. A uniform column of mud in the hole.
2. Potential loss at shoe.
3. Leak-Off Test.
4. Formation Integrity Test.
A. ______ Is likely to occur if MAASP is exceeded.
B. ______ Is a pressure test up to a chosen pressure without leak off occurring.
C ______ Is required to improve accuracy of calculated leak off.
D ______ Is the operation to find the surface pressure at which mud starts to leak into the formation.

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13. Which of the following affect Maximum Allowable Annular Surface Pressure (MAASP)? (THREE ANSWERS)
A. The maximum allowable pump pressure.
B. The fracture pressure of the formation at the shoe.
C. The mud density.
D. The depth of the last casing shoe.
E. The diameter of the last casing string.
F. The water loss of the mud.

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14. Calculate the Maximum Allowable Mud Weight using the following information:
WELL DATA: Casing Shoe Depth; 2740 m. T.V.D.
Leak Off Test Pressure at Pump; 124 bar
Density of drilling mud in hole; 1.37 kg/l A. __________ kg/l

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15. What is meant by abnormal pressure (over-pressure) relating to fluid pressure in the formation?
A. Heavy density mud used to create a large overbalance.
B. The excess pressure that needs to be applied to cause 'leak-off' into a normally pressured formation.
C. The excess pressure due to circulating mud at high rates.
D. The formation fluid pressure that exceeds formation water hydrostatic pressure.

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16. When drilling TOP HOLE, formation strengths are comparatively weak and total losses a common occurrence.
How can the risk of total losses be minimised?
A. By keeping the circulating rate low to reduce the pressure loss in the circulating system.
B. By keeping the penetration rate under control to prevent loading of the annulus with cuttings.
C. By using a high overbalance.

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17. Select the good operating practices in the list below that can help to avoid well control problems while drilling the top hole section.
(THREE ANSWERS)
A. Control the drilling rate to avoid overloading the annulus with cuttings
B. Circulate at a maximum rate to create highest possible equivalent circulating density.
C. Maintain the drilling mud density as low as possible to prevent formation fracture.
D. Maintain as high an overbalance in the drilling mud as possible to avoid going under balanced.
E. Continue to circulate when picking up for connection.
F. Maintain drilling rate high.

18. Gas cut mud may reduce the bottom hole pressure enough to cause a well kick, but when is bottom hole pressure reduced most?
A. When the gas is at or near the bottom.
B. When the gas is near the surface.
C. All are about the same.
D. When the gas is about halfway up the well bore.

19. Does a kick always occur in the event of a total loss of circulation?
A. Yes, losses will always occur above any potential kick zone.
B. No, it depends on the drill string density reduction noted on the density indicator.
C. No, it depends on the mud level in the annulus and the formation pressure.

20. Which of the following conditions increase surge pressures when running in?
(TWO ANSWERS)
A. Small annular clearance.
B. Low viscosity and gel strength of the drilling mud.
C. High viscosity and gel strength of the drilling mud.
D. Large annular clearance.
E. Running-in speed greatly reduced.
F. Large sized nozzles in the drill bit.

21. Which one of the following would be the immediate effect of swabbing?
A. Lost circulation.
B. An increase in bottom hole pressure.
C. A reduction in bottom hole pressure.
D. A kick.

22 WELL DATA:
Mud density; 1.20 kg/l
Metal Displacement; 3.9 l/m
Pipe Capacity; 9.3 l/m
Casing Capacity; 39.7 l/m
Stand Length; 29 m
Calculate the drop in Mud Hydrostatic Pressure if ten stands of pipe are pulled 'wet' from the well (no returns from inside of pipe back to the well).

A. _______ bar

23 WELL DATA:
Mud density; 1.37 kg/l
Metal Displacement; 3.9 l/m
Pipe Capacity; 9.3 l/m
Casing Capacity; 39.7 l/m
Stand Length; 29 m
Calculate the drop in Mud Hydrostatic Pressure if ten stands of pipe are pulled 'dry' from the well.

A. _______ bar

Examination review questions

1. Causes of kicks,
2. Warning signs of kicks,
3. Shutting-in procedures,
4. The risk of shallow gas,
5. Stripping operation,
6. Pressure balance in the hole,
7. Behavior of gas in the well,
8. Well control methods,
9. Well control equipment, Bop stack arrangements,
10. Manifolds and valves systems, other devices,
11. The functions and capacity of the accumulator unit,
12. Pressure testing of well control equipment, regulations and standards.s