**Surge & Swab Pressures**

**Method 1**

1. Determine n :

2. Determine K :

3. Determine velocity (ft/min):

For plugged flow :

For open pipe :

4. Maximum pipe velocity :

Vm = 1.5 x v

5. Determine pressure losses :

**Nomenclature :**

N = dimensionless  
 K = dimensionless  
 Ɵ600 = 600 viscometer dial reading  
 Ɵ300 = 300 viscometer dial reading  
 v = fluid velocity (ft/min)  
 Vp = pipe velocity (fi/min)  
 Vm = maximum pipe velocity (ft/min)  
 Ps = pressure loss (psi)  
 L = pipe length (ft)  
 Dh = hole diameter (inch)  
 Dp = drill pipe or drill collar OD (inch)  
 Di = drill pipe or drill collar ID (inch)

Sample Case 1 : Determine surge pressure for plugged pipe :

Data : Well depth = 15,000 ft  
 Hole size = 7-7/8 in.  
 Drill pipe OD = 4-1/2 in.  
 Drill pipe ID = 3.82 in.  
 Drill collar = 6-1/4” O.D. x 2-3/4” ID  
 Drill collar length = 700 ft  
 Mud weight = 15.0 ppg

Viscometer readings :

Ɵ600 = 140  
Ɵ300 = 80  
Average pipe running speed = 270 ft/min

1. Determine n :

2. Determine K:

3. Determine velocity (ft/min):

4. Determine maximum pipe velocity (ft/min) :

Vn = 252 x 1.5

= 378 ft/min

5. Determine pressure loss (psi):

Therefore, this pressure is added to the hydrostatic pressure of the mud in the wellbore.

If, however, the swab pressure is desired, this pressure would be subtracted from the hydrostatic pressure.

Sample Case 2 : Determine surge pressure for open pipe :

1. Determine velocity (ft/min):

2. Maximum pipe velocity (ft/min):

Vm = 149 x 1.5

= 224 ft/min

3. Pressure loss (psi):

Therefore, this pressure would be added to the hydrostatic pressure of the mud in the wellbore.  
If, however, the swab pressure is desired, this pressure would be subtracted from the hydrostatic pressure of the mud in the wellbore.

**Method 2**

Surge and swab pressures

Assume : 1. Plugged pipe  
 2. Laminar flow around drill pipe  
 3. Turbulent flow around drill collars

These calculations outline the procedure and calculations necessary to determine the increase or decrease in equivalent mud weight (bottomhole pressure) due to pressure surges caused by pulling or running pipe. These calculations assume that the end of the pipe is plugged (as in running casing with a float shoe or drill pipe with bit and jet nozzles in place), not open ended.

**A. Surge pressure around drill pipe :**

1. Estimated annular fluid velocity (v) around drill pipe :

2. Maximum pipe velocity (Vm):

Vm = v x 1.5

3. Calculate n :

4. Calculate K :

5. Calculate the shear rate (Ym) of the mud moving around the pipe :

6. Calculate the shear stress (T) of the mud moving around the pipe :

7. Calculate the pressure (Ps) decrease for the interval :

**B. Surge pressure around drill collars :**

1. Calculate the estimated annular fluid velocity (v) around the drill

Collars :

2. Calculate maximum pipe velocity (Vm):

Vm = v x 1.5

3. Convert the equivalent velocity of the mud due to pipe movement to

equivalent fìowrate (Q):

4. Calculate the pressure loss for each interval (Ps):

C. Total surge pressure converted to mud weight :

Total surge (or swab) pressures :

psi = Ps (drill pipe) + Ps (drill collars)

D. If surge pressure is desired :

SP (ppg) = Ps ÷ 0.052 ÷ TVD (ft) “+” MW (ppg)

E. If swab pressure is desired :

SP (ppg) = PS ÷ 0.052 + TVD (ft) “—“ MW (ppg)

Sample Case : Determine both the surge and swab pressure for the data

Listed below :

Data : Mud weight = 15.0 ppg  
 Plastic viscosity = 60 cps  
 Yield point = 20 lb/lOO sq ft  
 Hole diameter = 7-7/8 in.  
 Drill pipe OD = 4-1/2 in.  
 Drill pipe length = 14,300 ft  
 Drill collar OD = 6-1/4 in.  
 Drill collar length = 700 ft  
 Pipe running speed = 270 ft/min

**A. Around drill pipe :**

1. Calculate annular fluid velocity (v) around drill pipe :

2. Calculate maximum pipe velocity (Vm):

Vm = 253 x 1.5

= 379 ft/min

NOTE : Determine n and K from the plastic viscosity and yield point as

Follows :

PV + YP = Ɵ300 reading

Ɵ300 reading + PV = Ɵ600 reading

Sample Case : PV = 60  
 YP = 20  
 60 + 20 = 80 (Ɵ300 reading)  
 80 + 60 = 140(Ɵ600 reading)

3. Calculate n :

4. Calculate K :

5. Calculate the shear rate (Ym) of the mud moving around the pipe :

6. Calculate the shear stress (T) of the mud moving around the pipe :

T = 0.522(269.5)0.8069

= 0.522 x 9l.457

= 47.74

7. Calculate the pressure decrease (Ps) for the interval :

**B. Around drill collars :**

1. Calculate the estimated annular fluid velocity (v) around the drill

collars :

2. Calculate maximum pipe velocity (Vm):

Vm = 581 x 1.5

= 871.54 ft/min

3. Convert the equivalent velocity of the mud due to pipe movement to

equivalent flowrate (Q):

4. Calculate the pressure loss (Ps) for the interval :

**C. Total pressures :**

psi = 672.9 psi + 368.6 psi

= 1041.5 psi

**D. Pressure converted to mud weight (ppg):**

ppg = 1041.5 psi ÷ 0.052 ÷ 15,000 ft

= 1.34

**E. If surge pressure is desired :**

Surge pressure (ppg) = 15.0 ppg + 1.34 ppg

= 16.34 ppg

**F. If swab presure is desired :**

Swab pressure (ppg) = 15.0 ppg — 1.34 ppg

= 13.66 ppg