April 15, 2001

PETE 203: Drilling Engineering

Exercise # 5

Drilling Hydraulics

1. Given that the frictional pressure drop in a drill string is 1,200 psi, the flow rate is 300 gal/min. the mud density, 10 lbm/gal and the well depth 10,000 ft. calculate the pressure at the bottom of the drill string if the internal diameter of the drill collars at the bottom of the drill string is 2.0 in. and the pressure increase developed by the pump is 2500 psi.

2. A certain drilling fluid of weight 10 lbm/gal is flowing through a bit having three 13/32-in. nozzles at a rate of 300 gal/min. Determine the pressure drop across the bit.

3. (a) Calculate the hydraulic horsepower being developed by the pump discussed in Question # 1.
   (b) Determine how much of this power is being lost due to viscous forces in the drill string.

4. There is a 1cm gap between an upper plate and a stationary plate in a viscometer. If the upper plate is 22 cm^2 in area, calculate the viscosity in centipoise of a fluid between the plates if a force of 120 dynes is required to move the upper plate at a constant velocity of 12 cm/s.

5. Using the same plate (upper and lower) arrangement as in Qn # 4, calculate (a) the yield point (b) the plastic viscosity of a fluid between the plates if a force of 180 dynes is required to cause any movement of the upper plate and a force of 300 dynes is required to move the upper plate at a constant velocity of 8 cm/s.

6. Again using the same plate configuration given in Qn # 4, calculate the consistency index and flow behavior index if a force of 50 dyne is required to move the upper plate at a constant velocity of 5 cm/s and a force of 120 dyne is required to move the upper plate at a constant velocity of 10 cm/s.

7. In a viscosity measurement of a non-Newtonian fluid, a rotational viscometer gives a dial reading of 12 at a rotor speed of 300 rpm and a dial reading of 22 at a rotar speed of 600 rpm. Calculate the consistency index and flow behavior index of the power-law model for this fluid.

8. A Newtonian fluid of weight 8.5 lbm/gal and viscosity 12 cp is being circulated in a 10,000 ft well containing a 7-in-ID casing and 5-in-OD drill string at a rate of 80 gal/min. Calculate the static and circulating hole pressure by assuming that a laminar flow pattern exist.

9. Calculate the frictional pressure loss for the annulus discussed in Qn # 8, using a lot flow representation of the annulus. Assume laminar flow pattern.