1 Methodology

Using the marching algorithm again this time running a compositional fluid model makes this assignment an extension to the previous two. The general form of this work is running the marching algorithm to find the tubing length bounded by two constant pressure points, updating average two-phase properties using flash calculation and determining pressure loss by the Beggs and Brill method. The procedure is assumed to be isothermal.

1.1 Computer Program Development

The well data are entered as given. The depth is assumed to be 4000 ft at first. It makes no difference, however, since the problem is to find the length of tubing between points 500 and 1000 psi but it is essential for the graphical representation of pressure profiles. The problem is solved for two cases of horizontal well (deviation angle equal to 0) and the vertical case (deviation angle equal to 90). Step size is considered 400 ft in order to save time, however, it can be reduced as the mesh in-dependency of the code has been tested.

The code for the Marching algorithm has been explained in previous two reports and is also used as before in the current work. The difference is that in this assignment flash calculation is used to determine gas and liquid rates which are then used to update two-phase properties at each increment of the pipe. The procedure for the implementation of flash calculation is explained in the second assignment and is represented here by calling the function *calcFlash*.

The pressure gradient is then calculated using the original Beggs and Brill method, the implementation for which has been explained in assignment #4.

The algorithm to solve assignment #5 is in the following manner:

1. Set initial pressure (i.e. pressure at the lowest grid in case of vertical pipe) to be equal to 1000 psi.
2. Guess the pressure for the above grid.
3. Calculate average pressure at the above grid.
4. Using average pressure and temperature find gas and liquid fractions and molecular weights of each phase.
5. Convert the feed (mixture) rate to gas and liquid rates using phase fractions and molecular weights.
6. Calculate two-phase properties using the liquid and gas rate at that grid.
7. Calculate frictional and hydrostatic pressure gradients based on original Beggs and Brill method using non-slip hold-up and average two-phase properties.
8. Find the difference between the guessed pressure for the above grid and the pressure at the previous one, and compare to the pressure difference obtained using the pressure gradient calculated at previous step.
9. Iterate until reaching the desired criteria and converging to the above grid's pressure.

10. Carry out steps 2 to 9 for the remaining grid points until reaching the top.

2 Results

The results appear as a message in the command window, and pressure and liquid hold-up profiles along the pipe's length. The message contains the pipe length that is bound between two pressure points of 1000 and 500 psi. This obtained pipe length for the case of vertical well is equal to 2378.5 feet and for zero deviation (horizontal case) is around 99555 feet.

The pressure and hold-up profiles are drawn only for lengths from 0 to 4000 ft. Figures 1 and 2 show the pressure profile and liquid hold-up for the vertical case, respectively. It should be noted that for both cases the dominant flow pattern was intermittent.

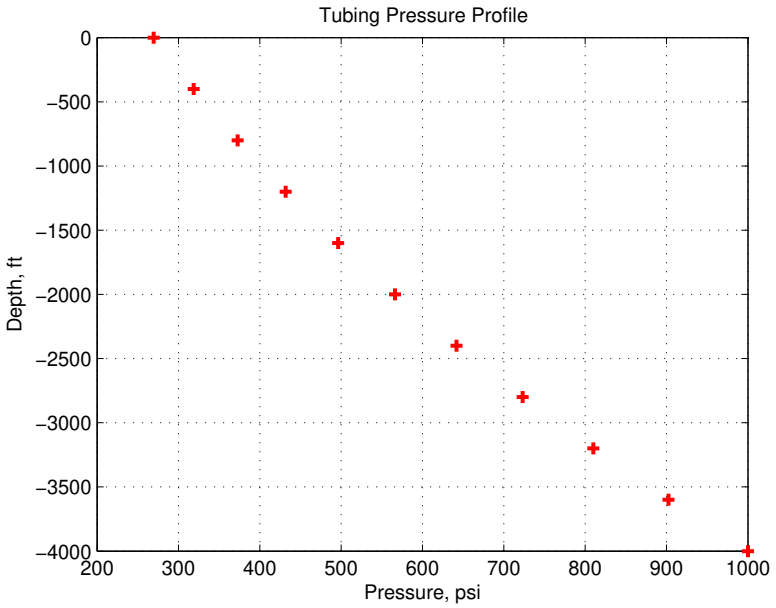

Figure 1: Pressure profile for the case of vertical pipe.

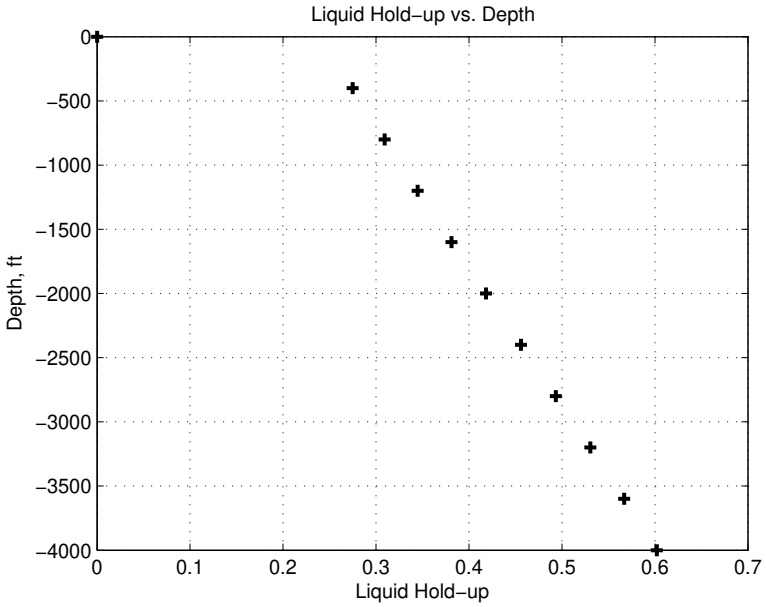

Figure 2: Liquid hold-up profile for vertical pipe.

References

Course notes, slides and sent documents.