Energy Production Systems
(에너지생산시스템) (G17702)

- 2022 Final Examination -

Student ID: **Student Name:**

Notice

- Fill your name in the following:

  "I, _____, swear I solve all problems by myself in this final examination.

  I will take any disadvantages if any dishonesty such as cheating is acted on my solution."

  5 points will be deducted from your total score if you do not fill in your name above.

Problem 1.

Define each formation volume factor and draw the corresponding graph as a function of reservoir pressure.

1.1 Under steady-state flow conditions in a well, the mass flow rates of oil and gas (pseudo) components do not change over the depth of the well. However, the volume flow rates of the oil and gas phase rates will change. Why?

1.2 A well produces 12,000 STB/D of oil at a gas/oil ratio (GOR) of 1,500 scf/STB. The oil gravity is 38°API and the gas gravity is 0.82. What are the oil and gas production rates and densities in SI units?

Problem 2.

2.1 What is the difference between the solution GOR and the producing GOR in an oil well?

2.2 Why do we use pseudoreduced pressures and temperatures (and not just reduced values) to compute the Z factor of hydrocarbon mixtures?

Problem 3.

3.1 What is the physical meaning of the Reynolds number?

3.2 What are the dominant pressure drop mechanisms in (a) a vertical oil well and (b) a horizontal gas pipeline?

3.3 Consider a gas well that produces at such a high rate that the acceleration component cannot be completely neglected. How do the friction, gravity, and acceleration components of the pressure drop in the well change with depth? Sketch a typical profile. Explain the physical mechanisms.

Problem 4.

4.1 Is the liquid holdup in a production well typically larger or smaller than the liquid fraction? Why?

4.2 What is the difference between superficial phase velocities and in-situ phase velocities?

4.3 A tubing intake curve for single-phase flow displays a monotonically increasing relationship between flow rate and FBHP. This is intuitively correct: An increase in flow rate, at a given FTHP, requires an increase in FBHP. However, a tubing intake curve for multiphase flow typically displays a minimum. At low flow rates, an increase in rate corresponds to a decrease in FBHP. Explain this seemingly counterintuitive behavior.

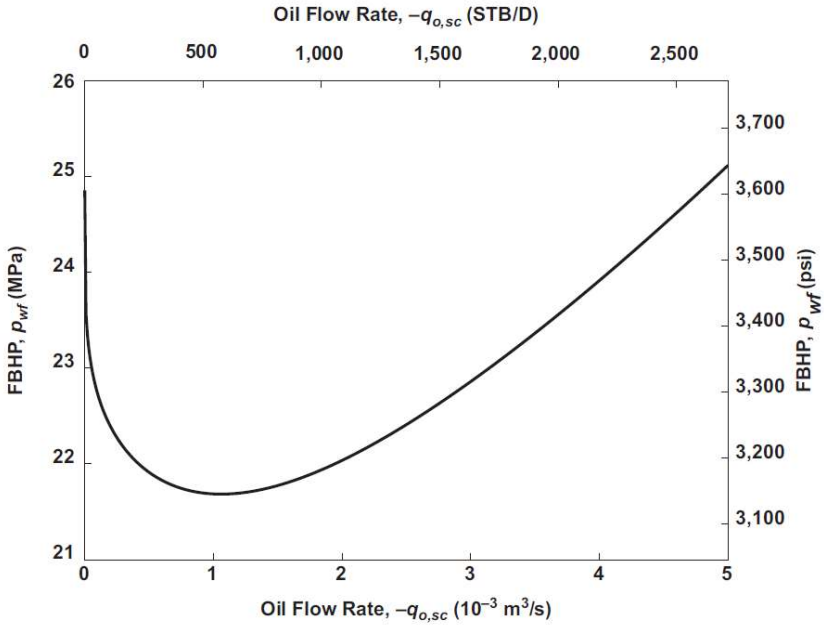

Fig. 4.8—Tubing intake curve for varying production rate.

Figure: Example of a tubing intake curve for multiphase flow.

Problem 5.

5.1 What are the units of the skin factor S in a well inflow equation?

5.2 What is the most common reason for crossflow between two zones after closing in a well that has been completed in multiple reservoir zones?

Problem 6.

6.1 What causes the occasional appearance of two intersections between upstream and downstream performance curves? Which of the corresponding operating points is the physically realistic one? Why is nodal analysis not of any help in indicating which of the points is physically realistic?

6.2 Considering the intersection of an IPR and a tubing intake curve, what is the practical rule to avoid unstable flow? Why is this different from the theoretical stability result?

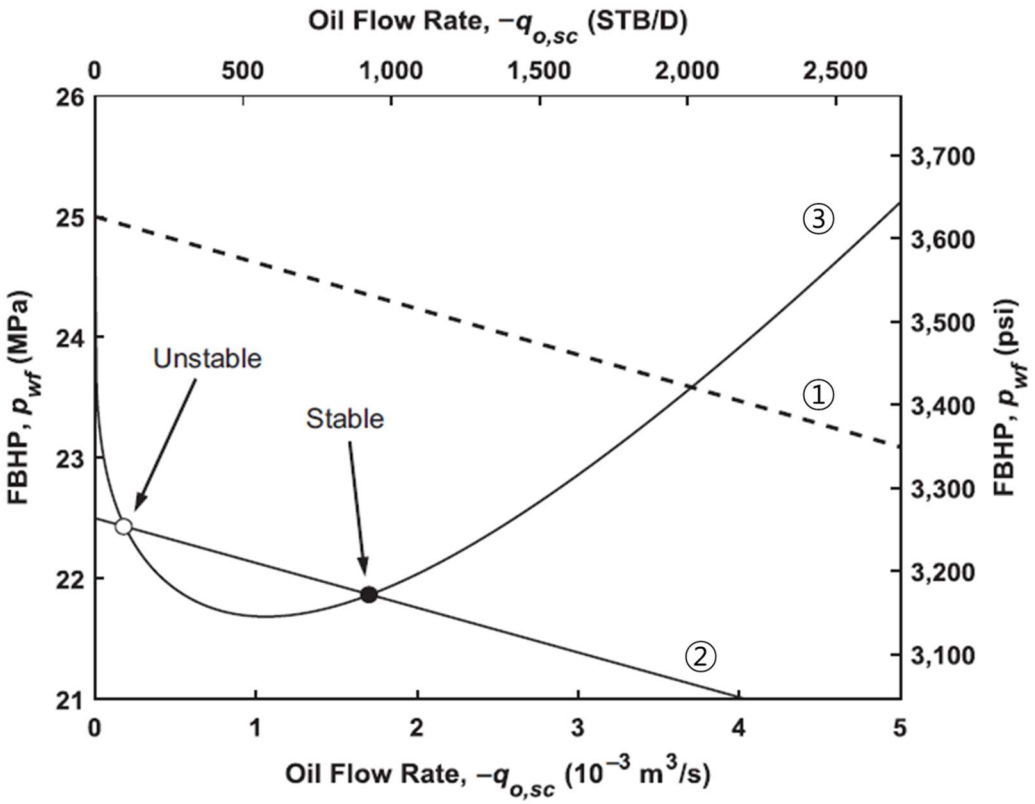

Figure: Example of upstream and downstream performance curves.

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