Petroleum and Mining Engineering College

Department of Petroleum Reservoir Engineering

Third stage

Petroleum Product Engineering

Prof. Dr. Nabil Yousif Albanna

14/1/2021

10:30 Am

SELECTION OF THE FLOW CONDUIT BETWEEN THE RESERVOIR AND SURFACE

There are a number of optional methods by which fluid which enters the wellbore will be allowed to flow to surface in a production well, or to the formation in an injection well. In the selection of the method, a range of considerations may influence the choice including: cost, flow stability, ability to control flow and ensure well safety or isolation; ensuring that the integrity of the well will not be compromised by corrosion or erosion. In the case of multizone reservoir, the zonal characteristics will determine to a large extent the flow system selected.

However, for a single zone completion, the following alternatives exist:

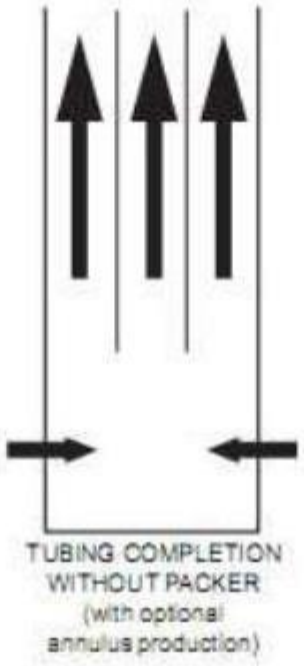
- ✓ Tubingless casing flow.
- ✓ Casing and tubing flow.
- ✓ Tubing flow without annular isolation.
- ✓ Tubing flow with annular isolation.

- **Tubingless Casing Flow**: This type of completion use in wells produces with high production rates and medium or low closed, flowing pressures.

TUBINGLESS COMPLETION

- **Casing and Tubing Flow**: In this type of completion the well produce through annulus and tubing in same time, but the production rate in this type being less than in type of producing through production casing. Valid reasons for tubing may include:

1- Better flow efficiency.
2- Permit circulation of kill fluids, corrosion inhibitors or paraffin solvents.
3- Provide multiple flow paths for artificial lift system.
4- Protect casing from corrosion, abrasion, or pressure.
5- Provide indicate of monitoring bottom-hole flowing pressure.

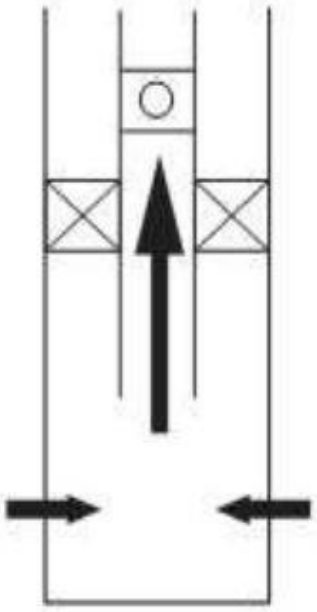


Casing and Tubing Flow

Tubing flow without Annular Isolation: In situations where annular flow in a casing-string completion would result in excessive phase slippage with consequent increased flowing pressure loss and potential instability, the consideration could be given to merely closing the annulus at surface and preventing flow. However, in reservoirs where the flowing bottomhole pressure is at or below the bubble point, gas as it flows from the formation to the tubing tailpipe will migrate upwards under buoyancy forces and some gas will accumulate in the annulus. This will result in an increase in the casing head pressure at surface. In this type of completion the casing is exposed continuously to produce fluid with the possibilities of erosion or corrosion. This, coupled with the potential for annular heading, suggests that unless annular flow is required then the annulus should not be left open to production, despite its simple design.

- **Tubing Flow with Annulus Isolation**: For cases where a large cross sectional area for flow is not necessary, then an open annulus can cause complications as discussed above. Therefore, in the majority of cases where tubing flow will take place, the annulus is normally isolated by the installation of a packer. The packer has a rubber element which when compressed or inflated will expand to fill the annulus between the tubing and the casing. The packer is normally located as close to the top of the reservoir as possible to minimize the trapped annular volume beneath the packer and hence the volume of gas which could accumulate there. However, if the packer is installed, the ability to U-tube or circulate fluid between the tubing and annulus is removed. If such a circulation capability is required then it is necessary to install a tubing component which will allow annulus communication or alternatively rely upon the ability to perforate the tubing which consequently would necessitate tubing replacement prior to the recommencement of production. In both cases, the circulation point is normally as deep in the well as possible, but above the packer. This completion system is by far the most widely used and offers maximum well security and control.

production. In both cases, the circulation point is normally as deep in the well as possible, but above the packer. This completion system is by far the most widely used and offers maximum well security and control.



Tubing Flow with Annulus Isolation

Completion String

For any completion string we can define a range of operations or capabilities which may be required. Some of the capabilities are considered to be essential, such as those providing operational security or safety, whilst others can provide improved performance or flexibility. However, as the degree of flexibility provided by the completion is increased, the more complex is the design process and normally a sophisticated design will result which includes a large number of string components.

Basic completion string functions and facilities

The basic facilities provided by a completion string must allow it to continue the production or injection of fluids over as long a period as possible without major intervention to conduct well repairs. Further, at all times, the design must ensure the safe operation of the well and reliably allow for its shutdown in a variety of situations.

The completion string, production casing and wellhead must act as a composite pressure system which prevents formation fluids and pressure escaping from the reservoir except via the production tubing and the Xmas Tree into the surface processing facilities.

The following are considered to be the essential attributes for the majority of completion string installations:

A. The ability to contain anticipated flowing pressure and any hydraulic pressures which may be employed in well operations and conduct fluid to surface (production) or the reservoir (injection wells) with minimal flowing pressure loss and optimal flow stability.
B. The ability to isolate the annulus between the casing and the production tubing if flow instability is likely or it is desirable to minimize reservoir fluid contact with the production casing.
C. The ability to affect downhole shut-in either by remote control or directly activated by changing well flowing conditions, in the event that isolation at surface is not possible.
D. A means to communicate or circulate (selectively when required) between the annulus and the tubing.
E. A provision for physical isolation of the tubing by the installation of a plug to allow routine isolation e.g. for pressure testing of the tubing.

The figure below showing the general completion string components: