

Tikrit University
The College of Petroleum Processes
Engineering
Petroleum and Gas Refining Engineering
Department

An Introduction to Petroleum Technology

First Class

Lecture (15)

By

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15-1 Well completion

Completion: is the operation used to prepare the well

(production, injection , exploration , monitoring or observation).

15-1-1 The main objectives for which wells are drilled

- 1- Explration wells.
- 2- Production wells.
- 3- Injection wells.
- 4- Monitoring or observation or evaluation wells.

It may transform one type to another, such as a production well that turns into an injection well when it is drained.

15-1-2 The most important factors effect on the well completion:

1- Target of drilling the well.

2- Reservoir rock types:

- In terms of the presence of incoherent layers such as Sandstone, it greatly affects the production, or the layer contains the fracturing and as a result the production is greater because the volume of the pores is larger.
- The number and properties of the reservoir units in a single field. If we have several layers with the same pressure, one tube can be used for production. Shows figure (4)
But if the pressures of these layers are different; We need more than one tube.

3- Reservoir fluid types.

4- Estimation reservoir behavior while production:

Where the future behavior of the reservoir can be evaluated based on the productivity index(PI)

$$PI = \frac{Q}{\Delta P}$$

Where :

Q: Flow rate.

ΔP : pressure difference.

5- Nature of surface gathering system :

That is, after oil and gas separator from wells.

6- Present and future requirements for artificial lifting:

artificial lifting is used when the reservoir pressure is unable to raise hydrocarbons to the wellhead. Shows figure (1) and (2).

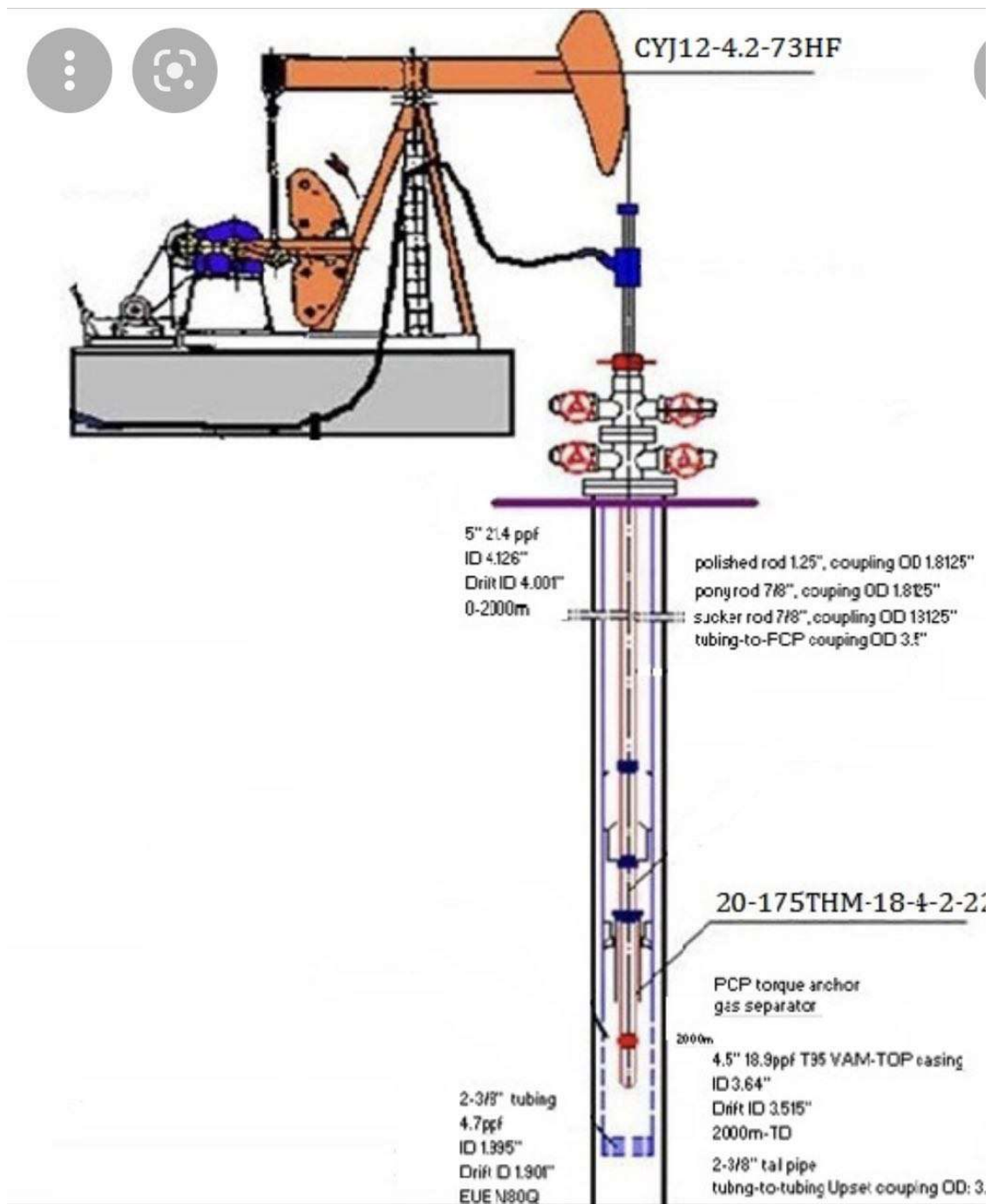


Figure (1)

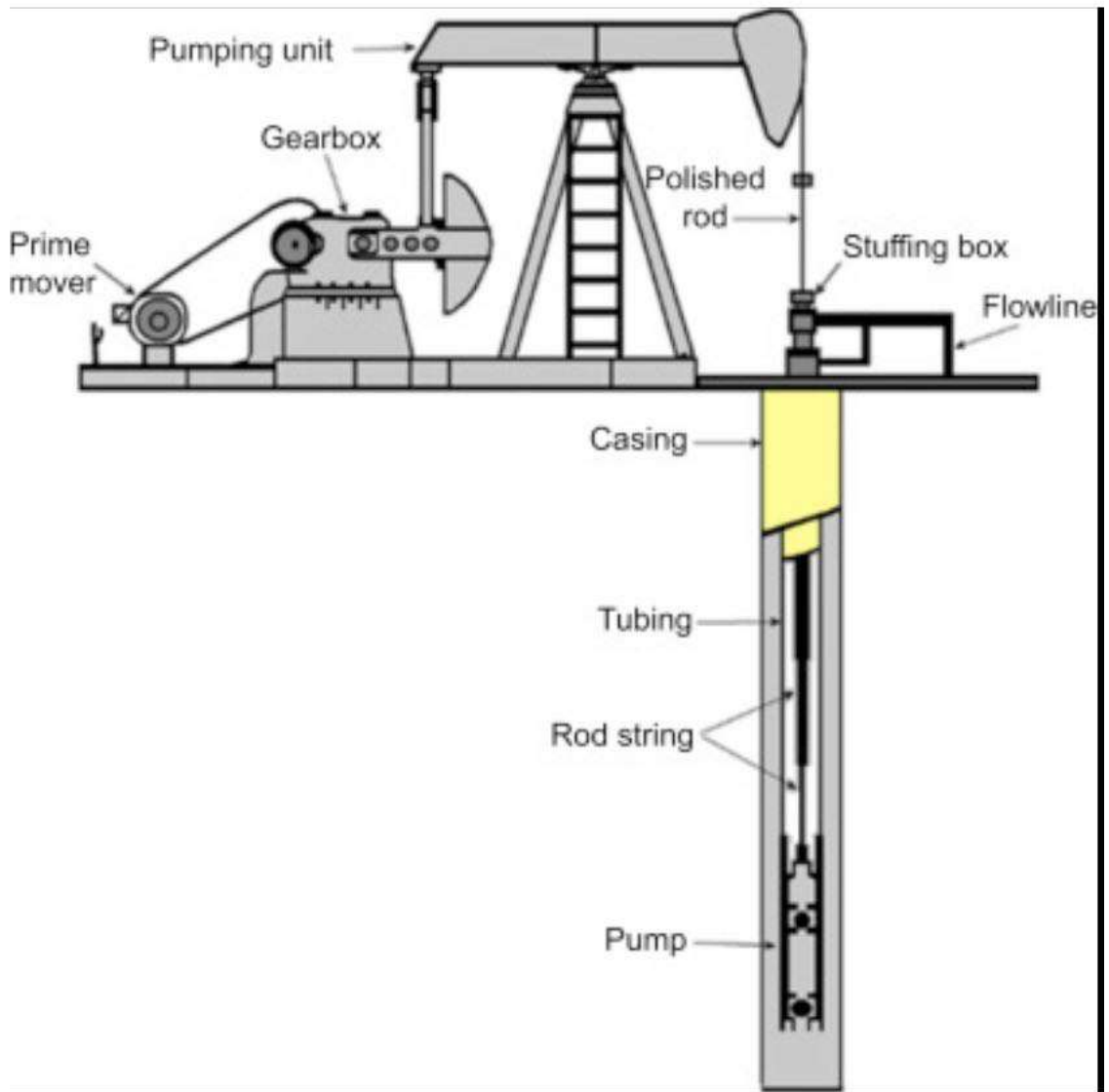


Figure (2)

When primary recovery fail to product hydrocarbon; Secondary recovery are used. And when Secondary recovery fail to product hydrocarbon; tertiary recovery are used.

Types of recovery:

- 1- Primary recovery: by water drive, gas cap drive, Gravity drive or combination drive.
- 2- Secondary recovery: consist of: water flooding, gas injection and thermal recovery.
- 3- Tertiary recovery.

15-1-4 Completion Equipment's:

1- **Tubing:** the function of tubing:

- For production.
- As kill string.
- For injection of chemicals.
- May accommodate gas lift valves which essentially gas assist well liquid to surface

2- **Packer:** is a ring made of metal and rubber that fits around the tubing.

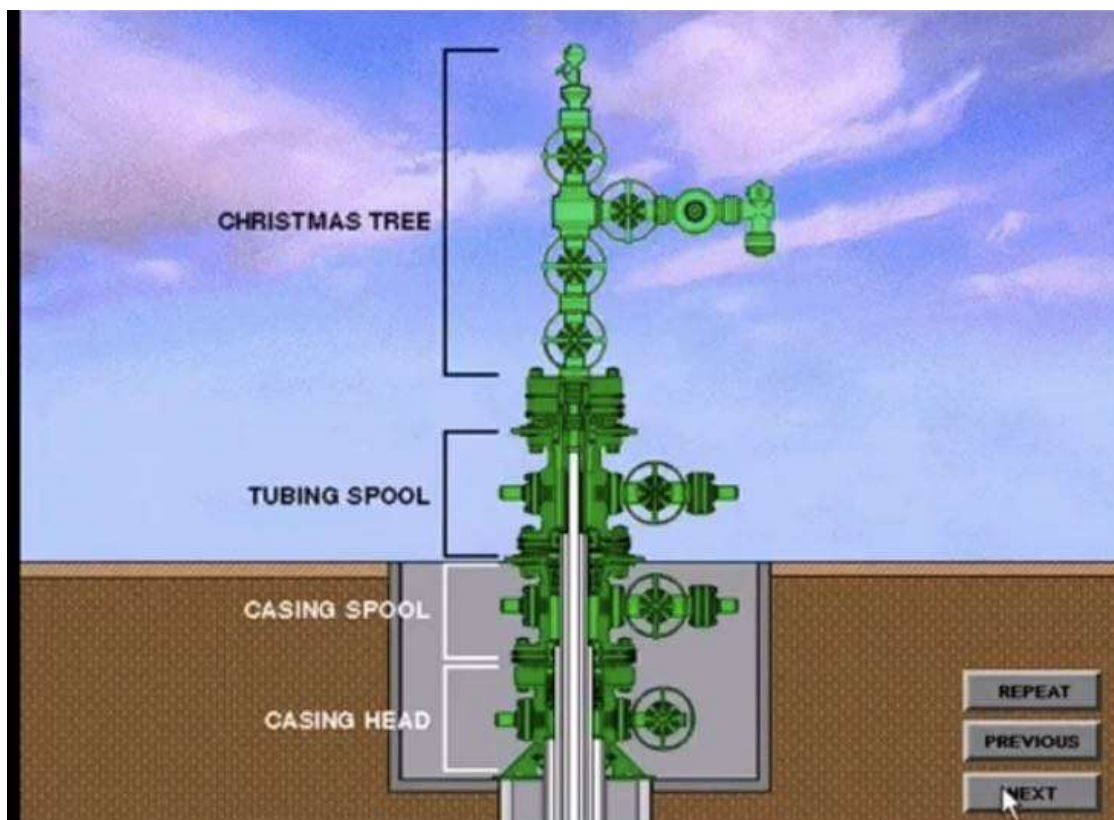
Function of packer:

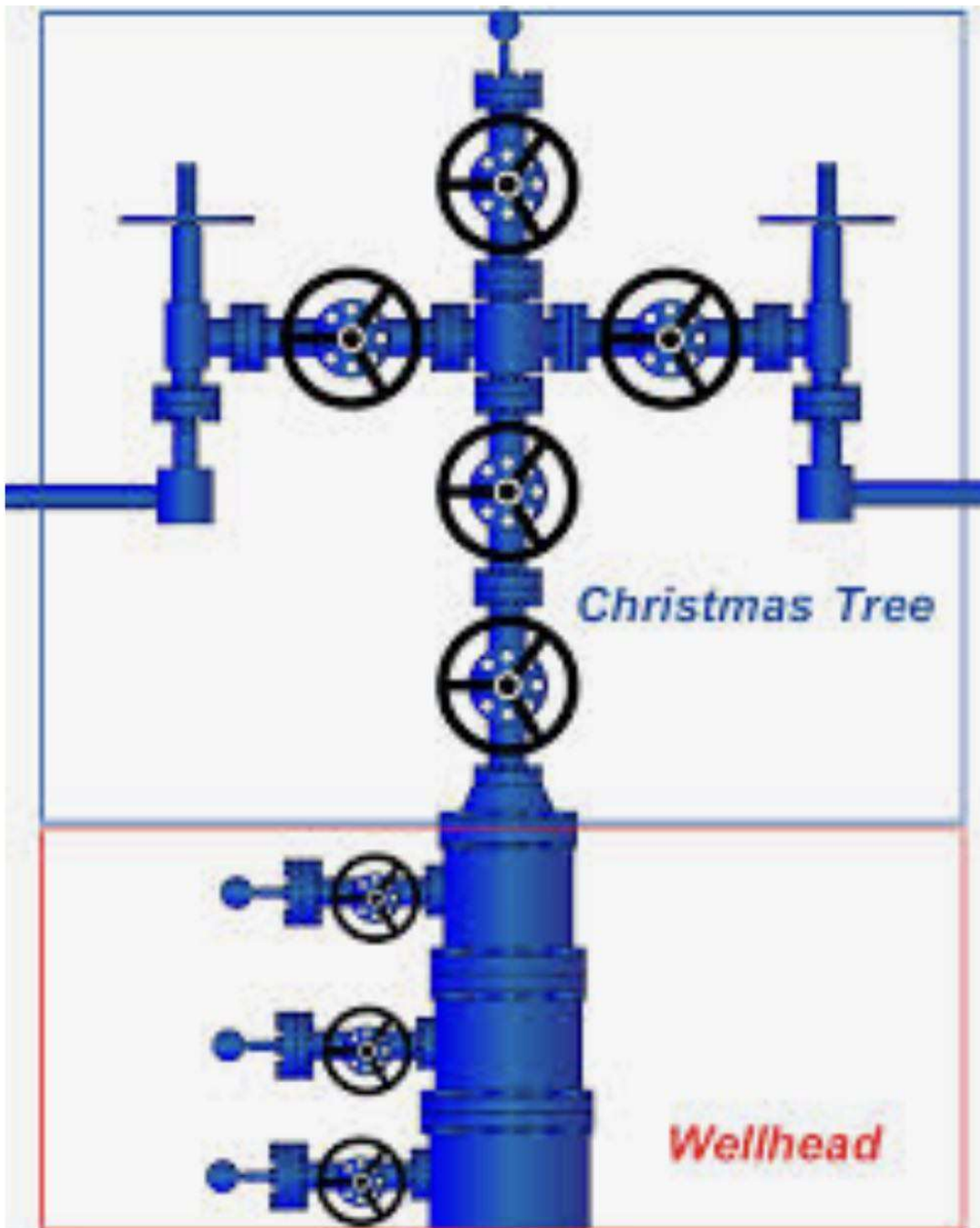
- Protection of casing from well pressure and corrosion.
- As subsurface well control.
- As an anchor for the tubing.

3- **Subsurface safety valve (sssv):** Subsurface valve installed in the tubing string near the surface, the valve remains open as long as fluid flow is normal and closed when surface equipment of the well have something amiss.

4- **Well head:** includes all equipment on the surface that supports the various pipe string , seals off the well and controls the paths and flow rates of reservoir fluid . All well heads have at least one casing head and casing hanger , tubing head and tubing hanger and Christmas tree.

5- **Christmas Tree:** a group of valves and fittings installed above the tubing head to regulate measure and direct the flow of fluids from the well.





15-1-5 Types of completions:

1- Open hole completion: It is the drilling of a well into the productive reservoir layer containing oil without dropping the casing. Shows figure (7).

Advantages :

- No extra cost for cementing, casing and perforating.
- Providing a large production diameter.
- The possibility of deepening the well more than other methods.
- The possibility of change this type of completion to another type.

Disadvantages:

- The well needs to be cleaned regularly.
- It is not possible to produce from two layers at the same time if the pressures of the layers are different.

2- Liner completion:

a- Screen and liner completion.

Liner : It is a casing, but it does not reach the surface, but rather is fixed to the last casing, and then it descends the screen

In order to prevent entry of sand and cuttings into the well. Shows figure (6).

Advantages :

- No extra cost for cementing, casing and perforating.

- The layer damage is small because the cement used in this method is less than the closed completion.
- No need to clean the hole because of the screen.

Disadvantages:

- The difficulty of performing the stimulation process for the productive layers due to the presence of screen.
- Difficulty deepening the well due to the presence of screen.

b- Perforated liner completion.

The liner is installed over the producing layer and perforated.

Shows figure (5).

Advantages :

- The production of water and gas can be controlled by choosing the perforation region far from the gas and water region.
- The produced layer can be easily stimulation.
- The possibility of deepening the well.

Disadvantages :

- Additional cost due to cementing and perforating.
- Cementing of liner is difficult.
- Extra drilling operation time for cementing and perforating.

3- Perforated casing completion : the production casing will be run through the pay zone , cemented and perforated. Shows figures (3) , (4) and (9).

Advantages :

- Easy control of water and gas production.
- Can be selected for stimulation (fracturing or acidizing)
- Full diameter apposite pay zones.
- Easily deepened.
- Easy to use with multiple completion technique.

Disadvantages:

- Cost of perforating long zone may be great .
- Damage of pay zone.
- Less productivity of pay zone.
- Difficult log interpretation.

15-1-6 Types of completion for the productive zones:

- 1- **Single zone completion:** the most common method of completing single pay zone is to use single tubing string and packer.
- 2- **Multiple zone completion:** Multiple zone completion could be completed by one of the following methods:
 - a- Single string dual completion: the lower payzone will produce through the tubing while the upper pay zone will produce through casing. shows figure (11).

- b- Twin string dual completion: in such completion , separate flow from two zones can be maintained through two tubing strings and two packers. shows figure (12).
- c- Twin string dual completion: the two lower pay zones will produce through the tubing while the upper pay zone will produce through casing. shows figure (13).

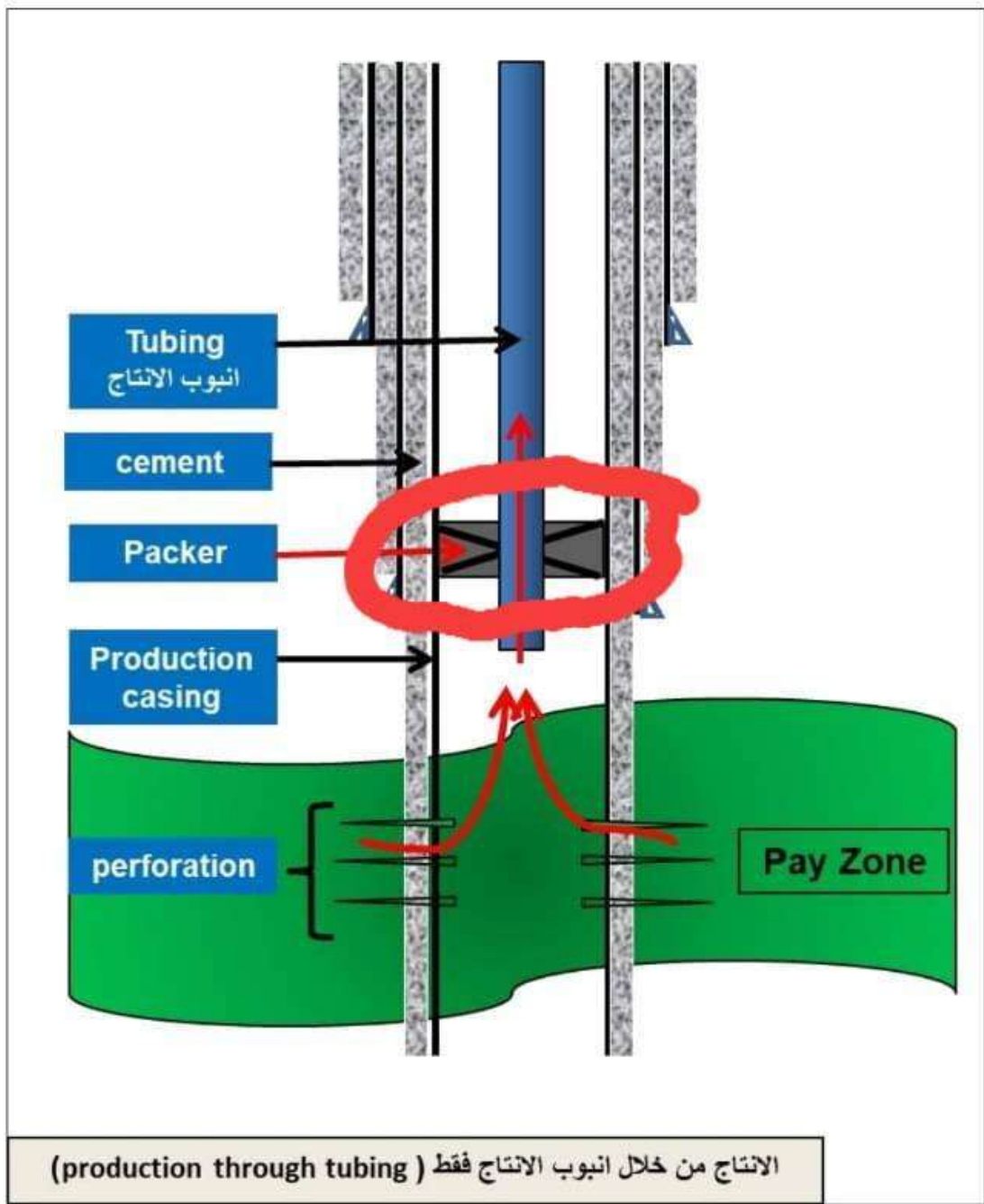


Figure (3)

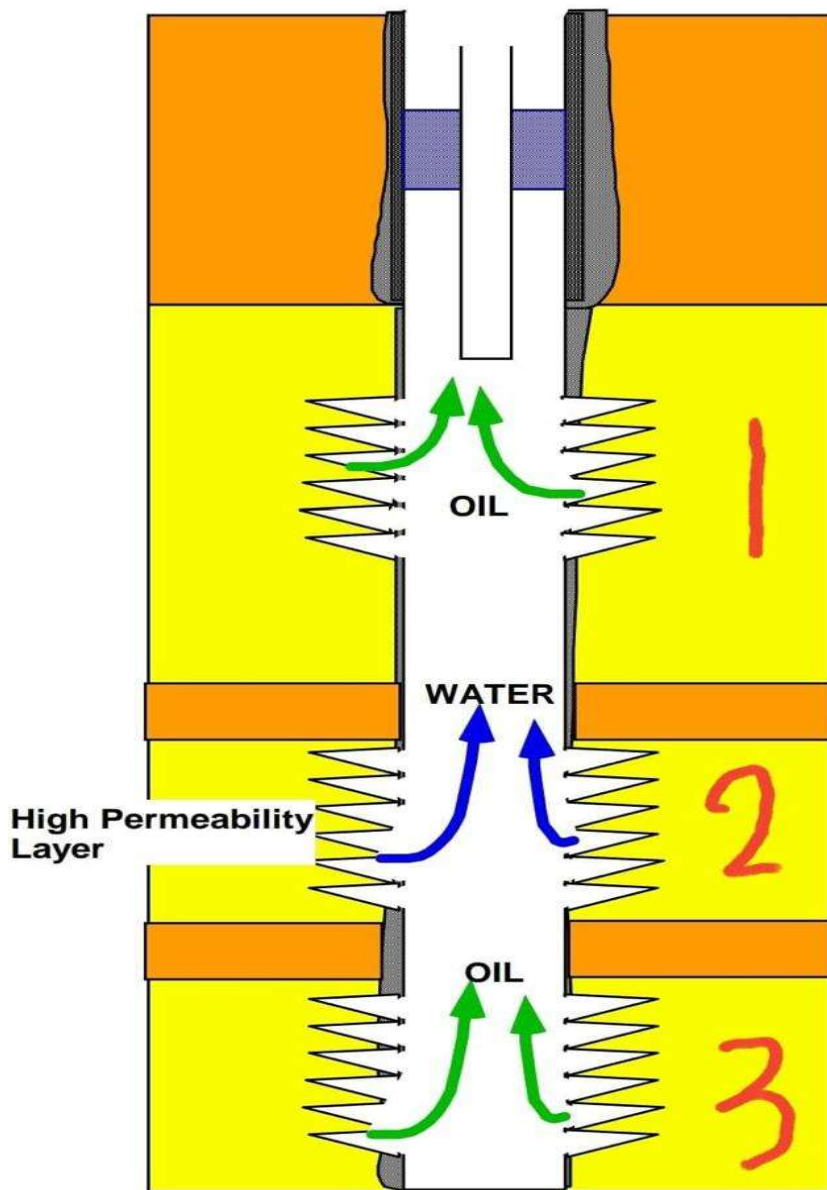


Figure (4)

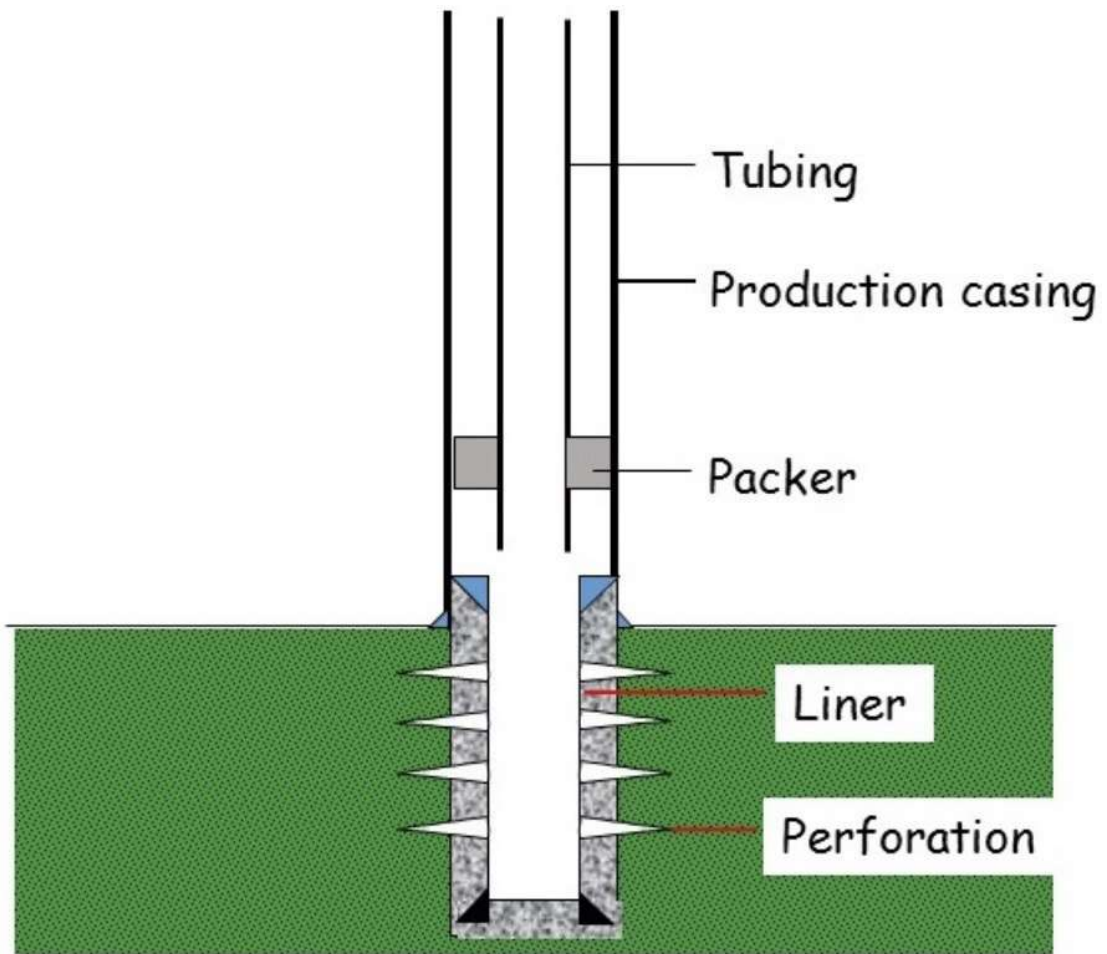


Figure (5)

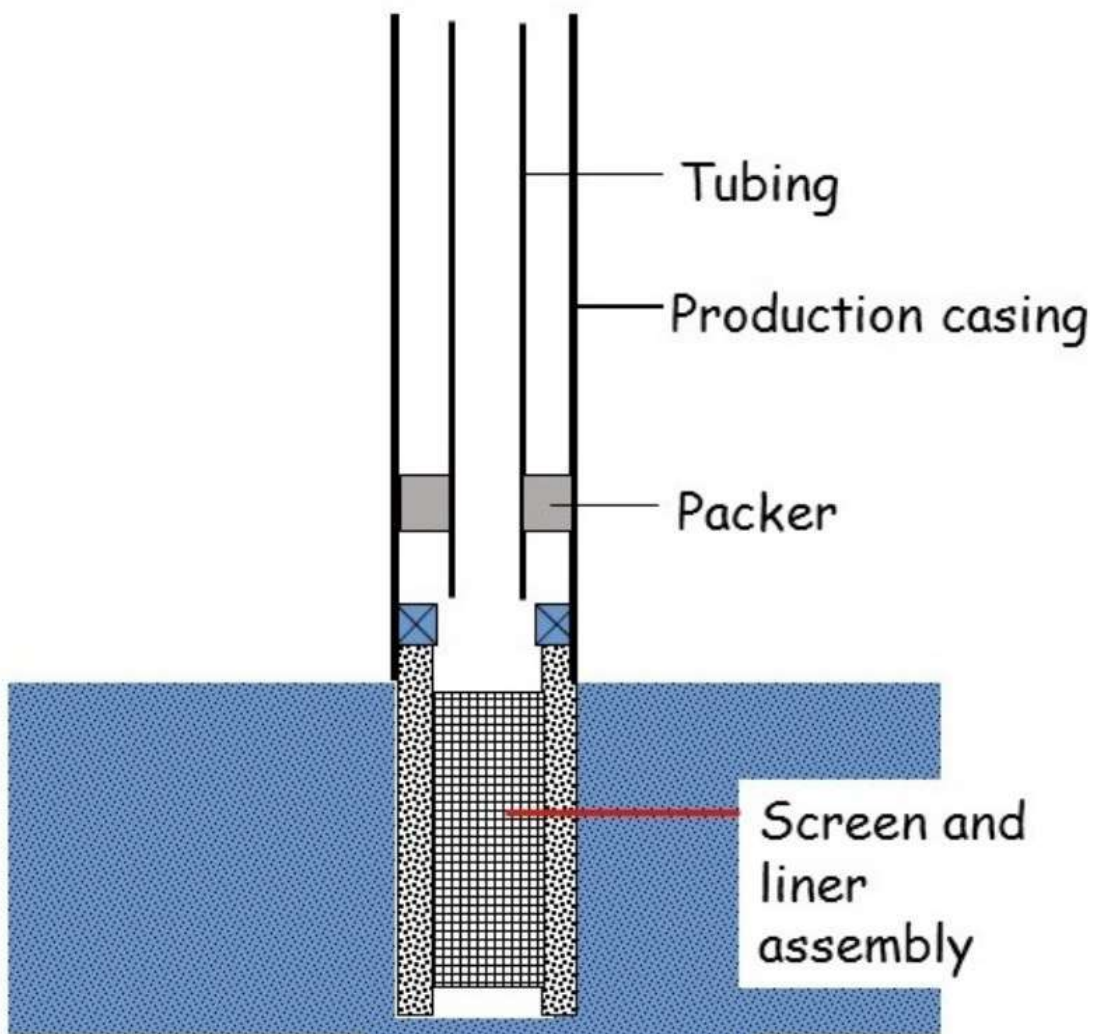


Figure (6-a)

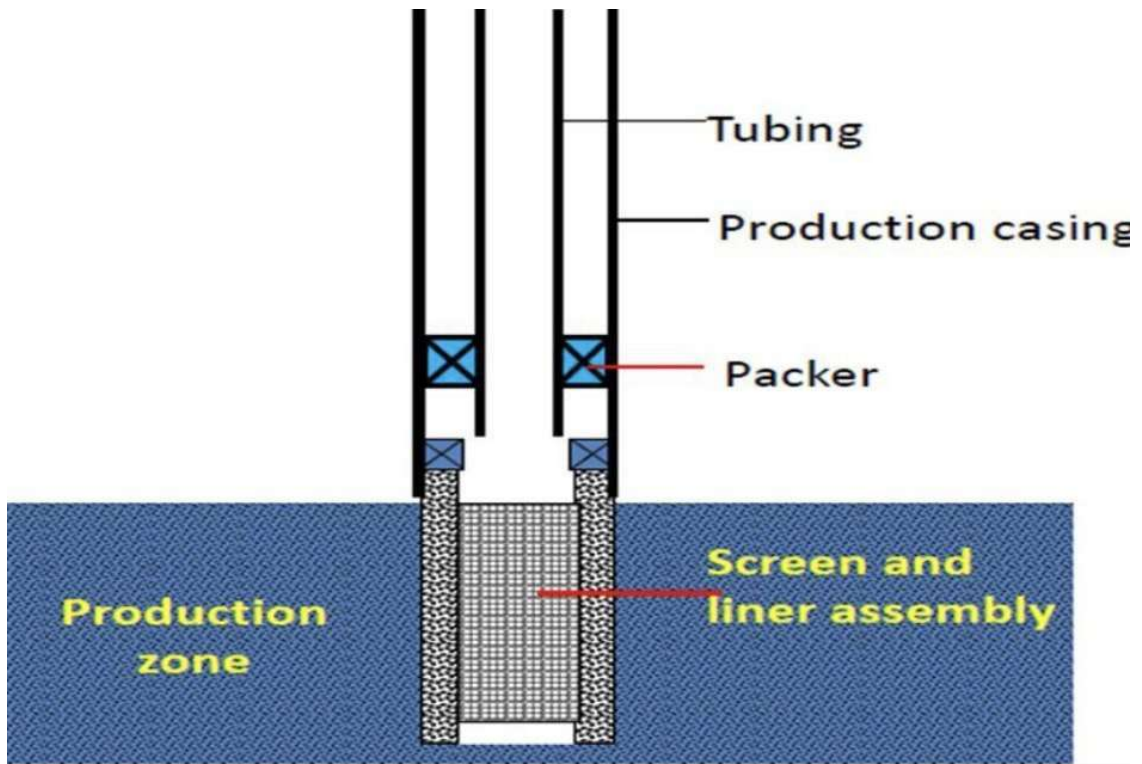


Figure (6-b)

- Open Hole Completions.

- Production casing to be set above the zone of interests.

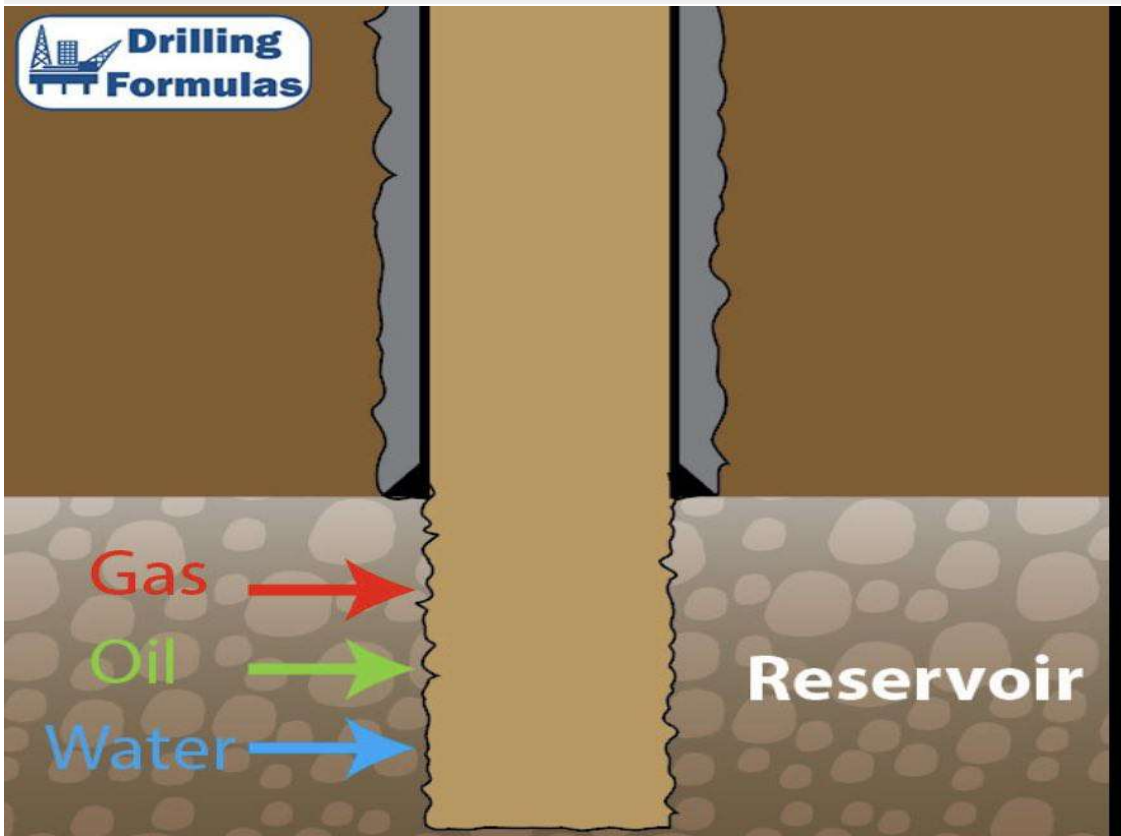
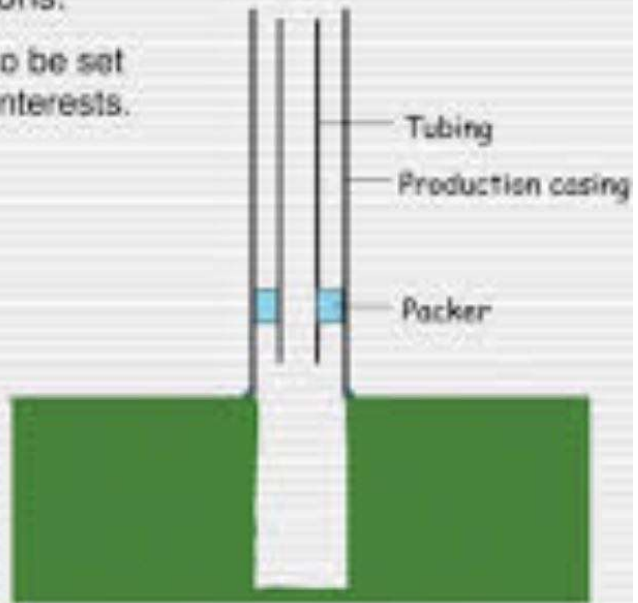


Figure (7)

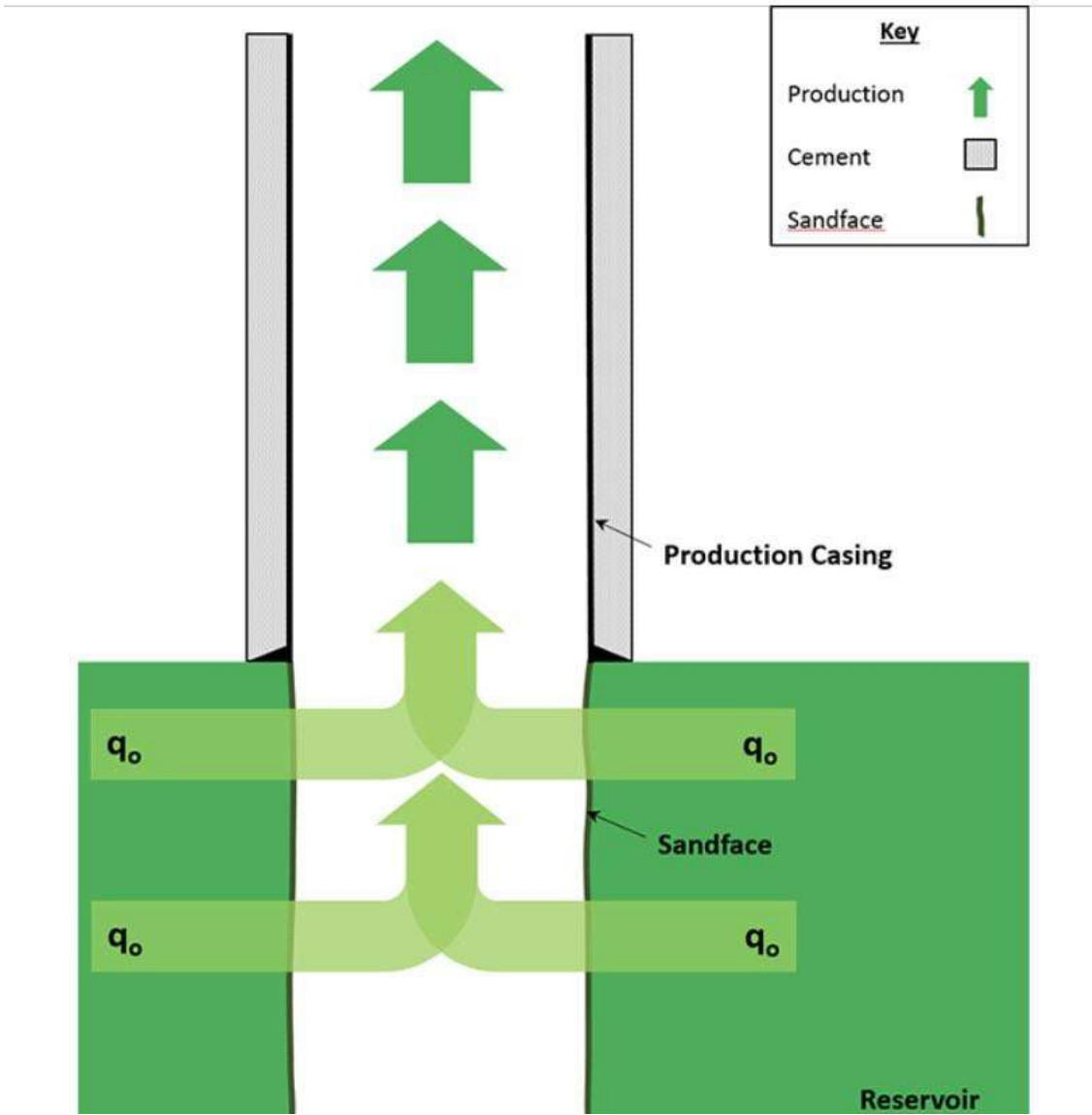


Figure (8)

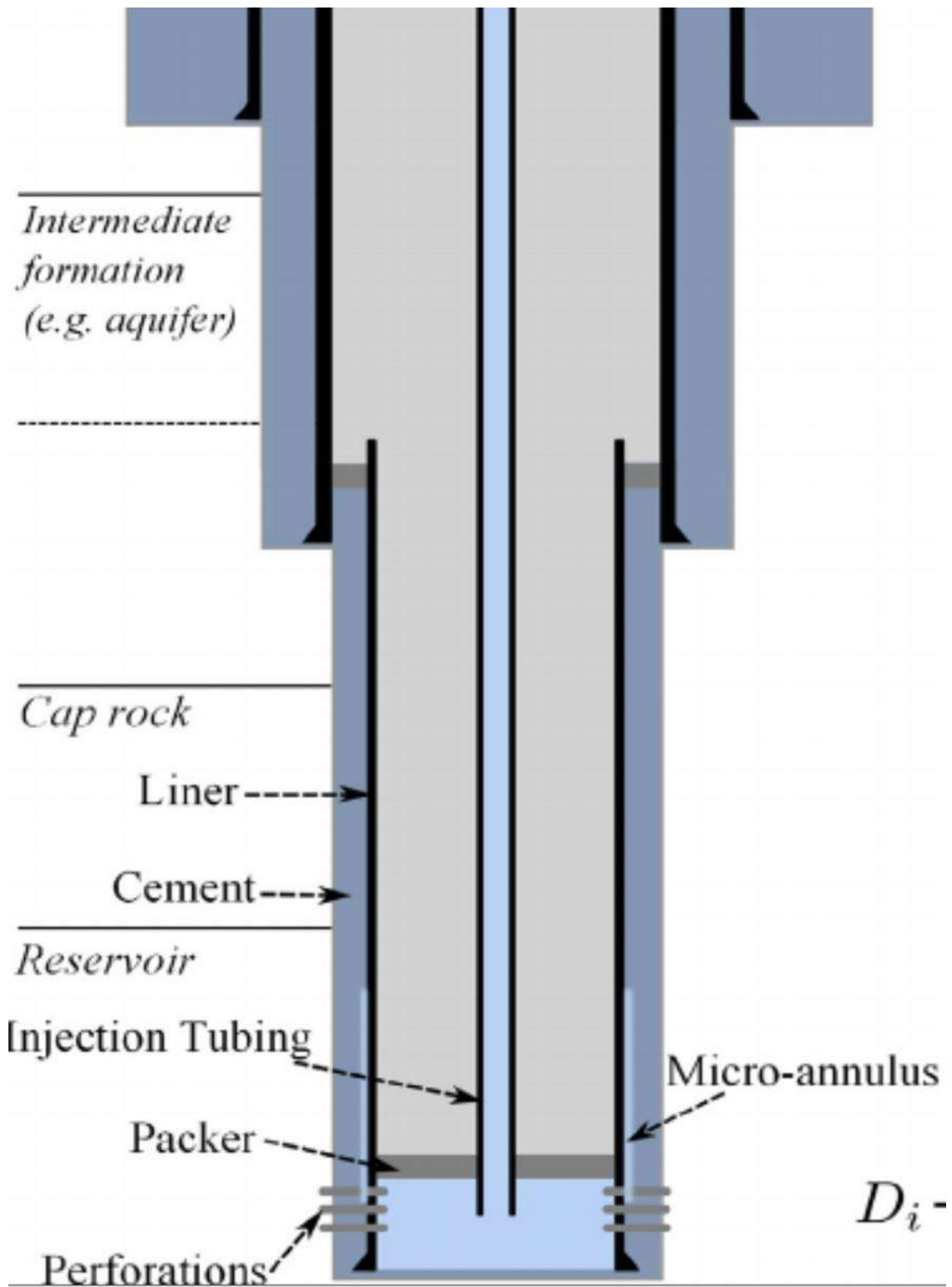


Figure (9)

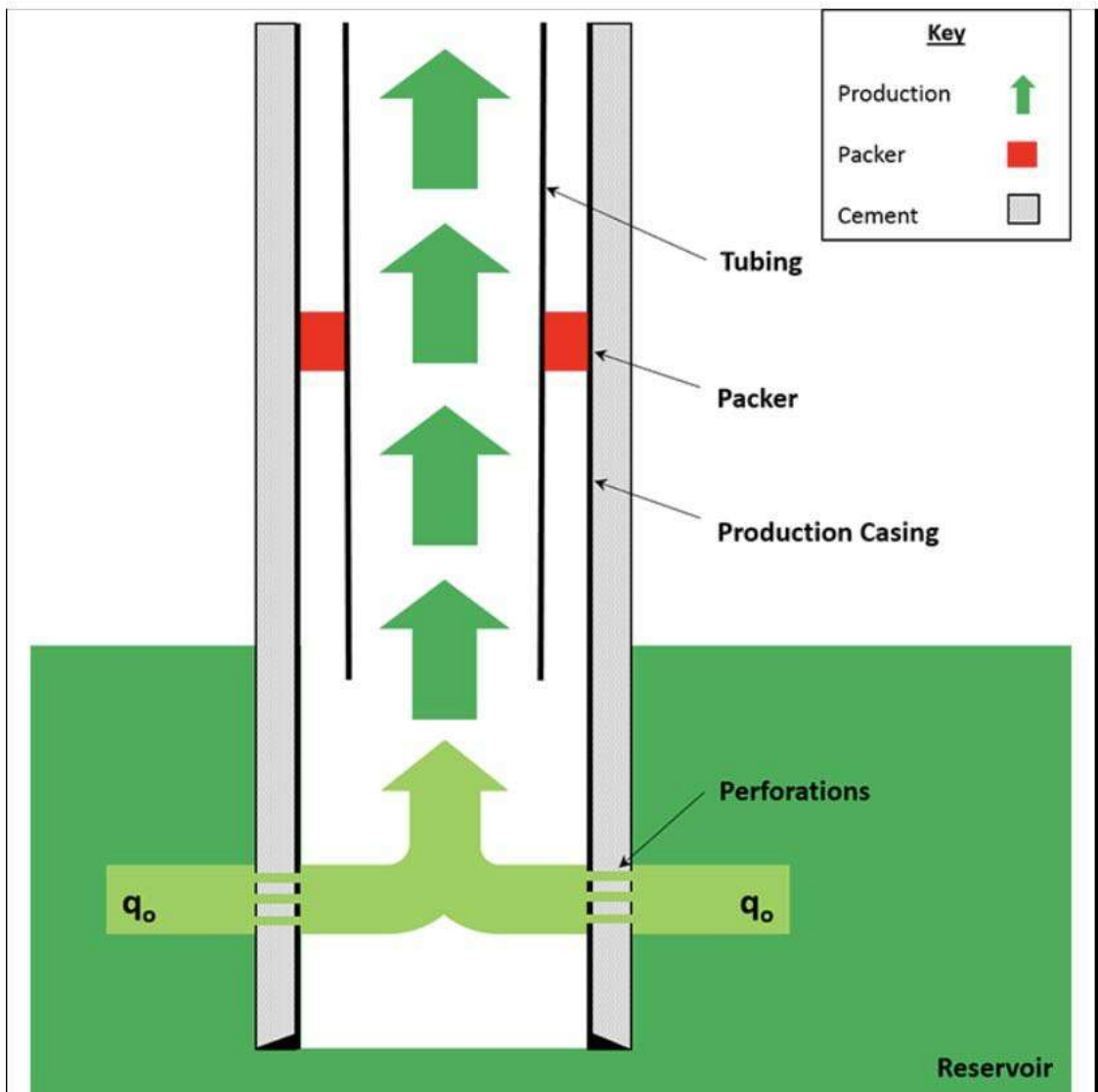


Figure (10)

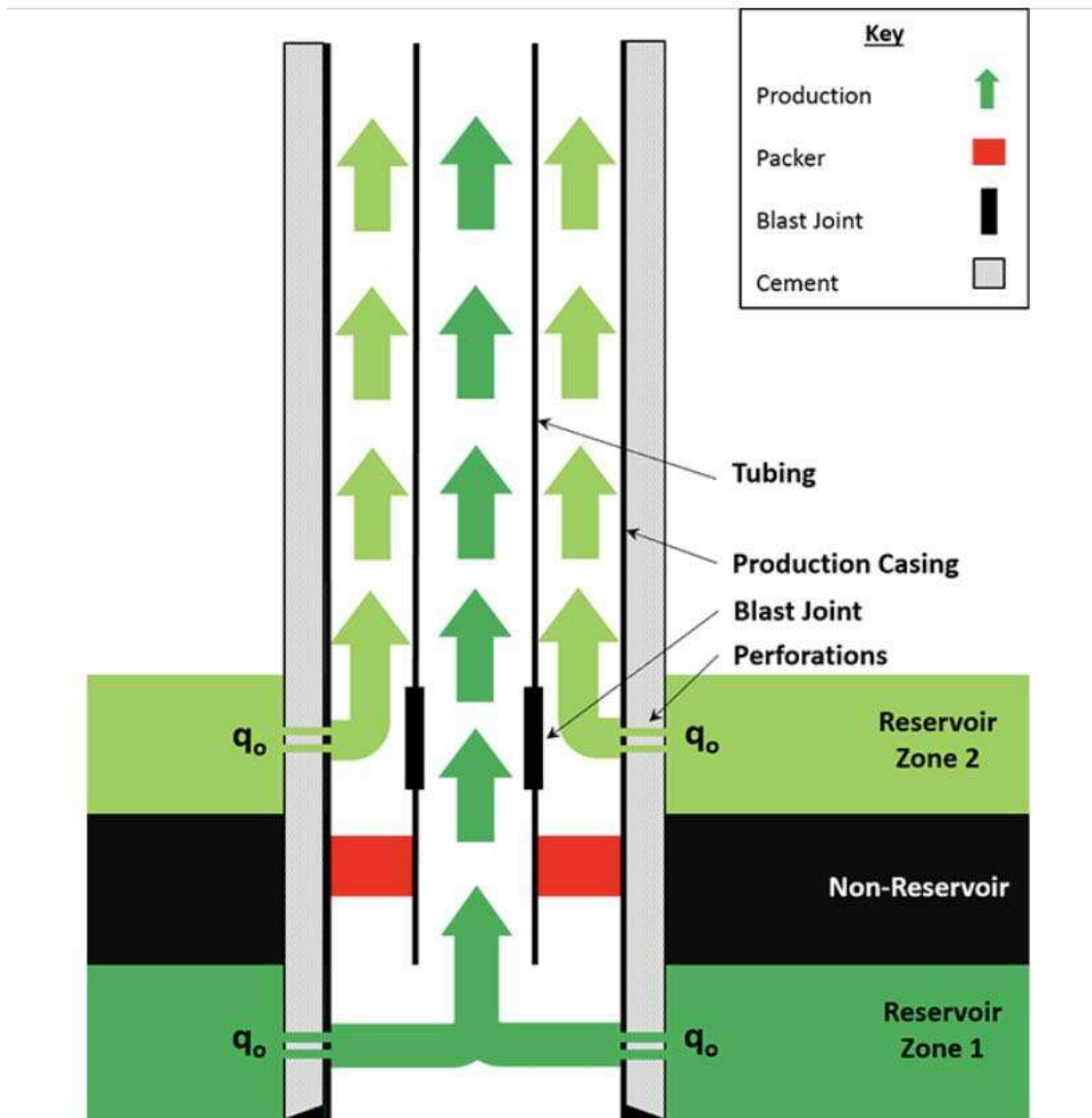


Figure (11)

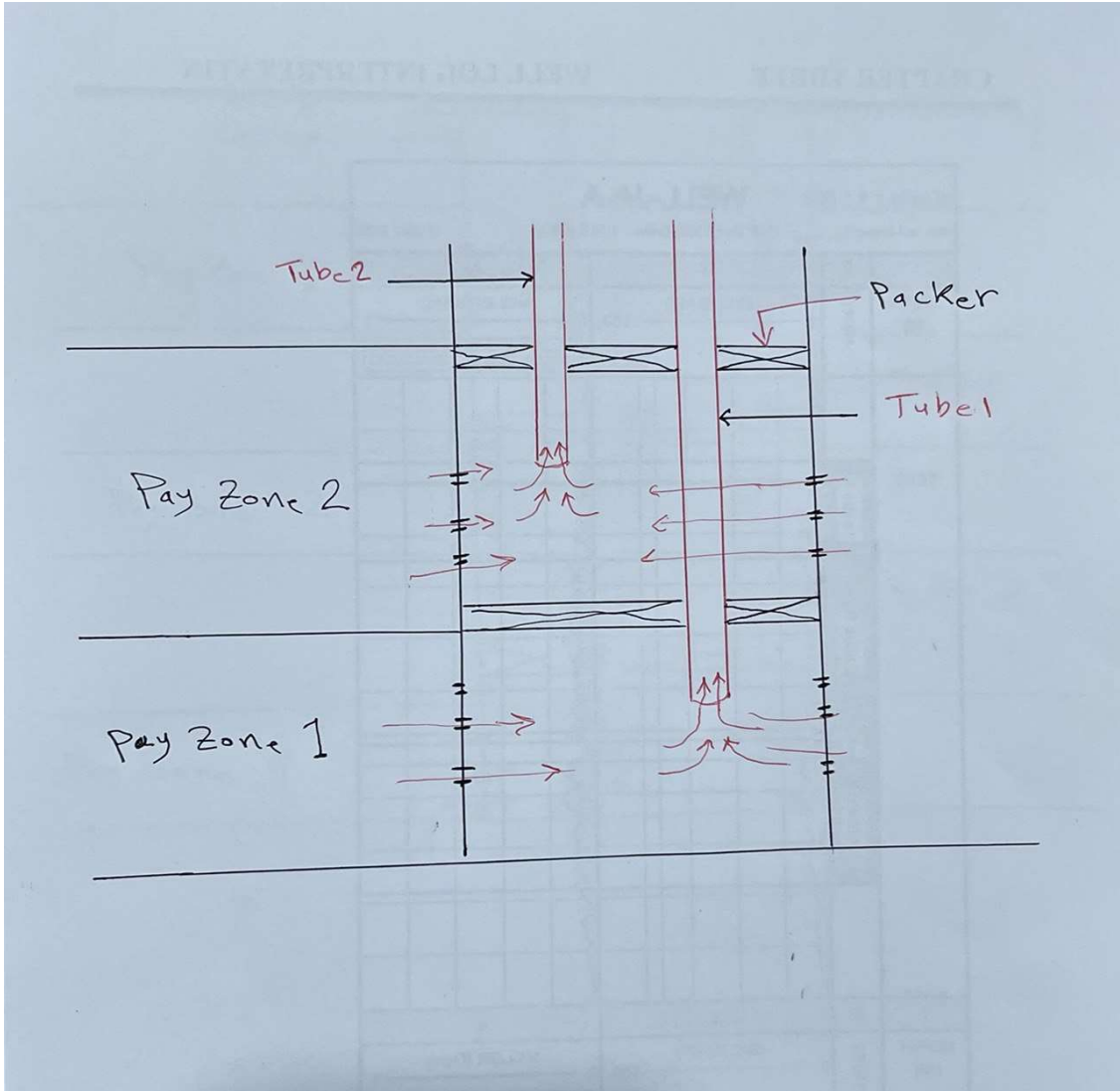


Figure (12)

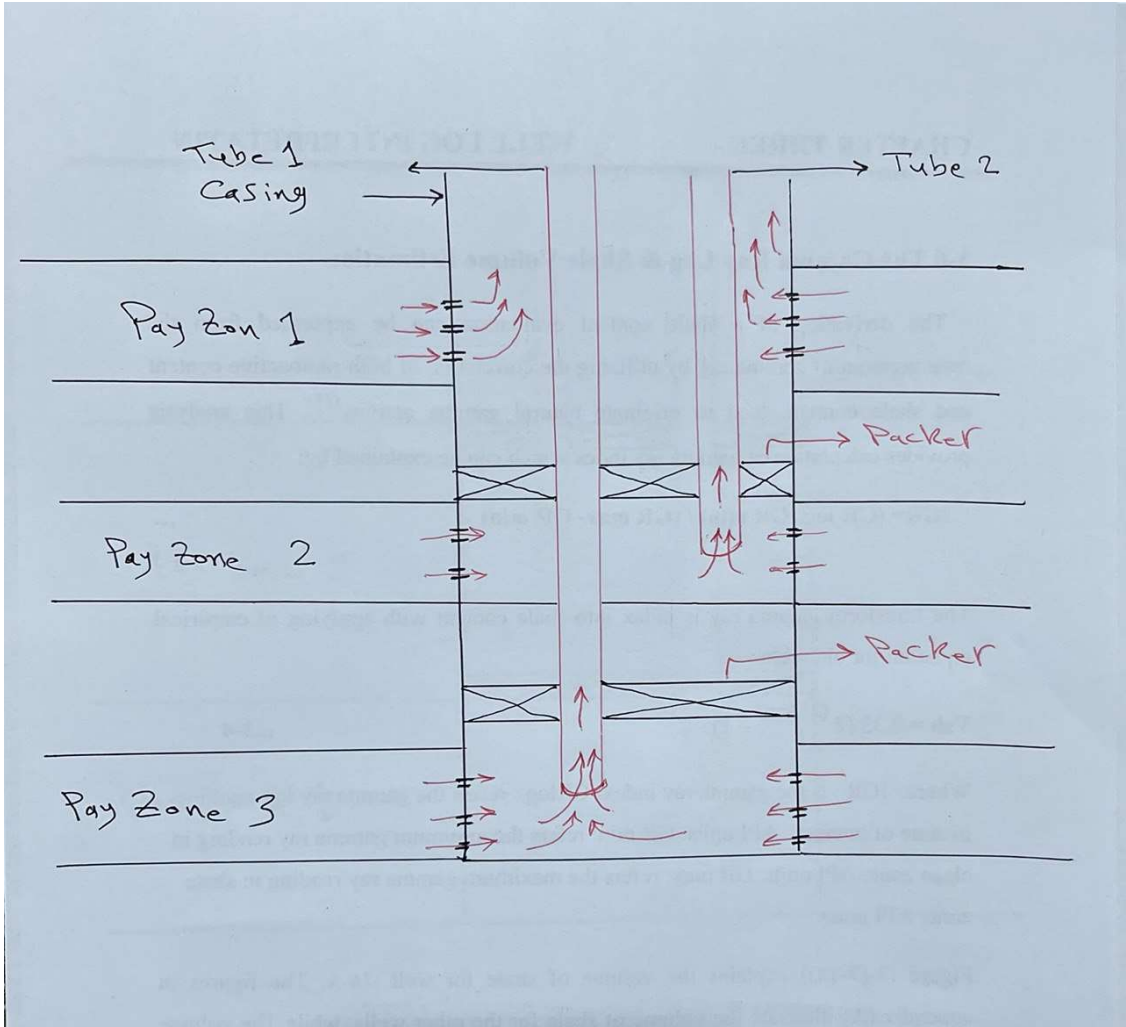


Figure (13)