Petroleum and Mining Engineering College

Department of Petroleum Reservoir Engineering

Third stage

Petroleum Product Engineering

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Mechanical considerations

The mechanical configuration or "well hookup" is often the key to being able to deplete the reservoir effectively, monitor downhole performance, and modify the well situation when necessary. The mechanical configuration of the well is the key to being able to do what ought to be done in the well from the standpoint of controlling the flow of reservoir fluids, oil, gas, and water.

- Functional requirements
- Operating conditions
- Component design
- Component reliability
- Safety

KEY SUBJECT AREAS IN PRODUCTION ENGINEERING

Production technology is both a diverse and complex area. With the on-going development of the Petroleum Industry the scope of the technological activities continues to expand and as always increases in depth and complexity. It is however, possible to identify several key subject areas within Production Technology namely:-

- Well Productivity
- Well Completion
- Well Stimulation
- Associated Production Problems
- Remedial and Workover Techniques
- Artificial Lift / Productivity Enhancement
- Surface Processing

Methods of completion:

In the development of a hydrocarbon reservoir, a large number of wells are drilled and require to be completed, to allow the structure to be depleted. However, the drilling and completion operations are crucial to the long term viability of the wells in meeting the specified objectives. The design and completion of both production and injection wells are required to satisfy a number of objectives including:

- Provision of optimum production/injection performance.
- Ensure safety.
- Maximize the integrity and reliability of the completion over the envisaged life of the completed well
- Minimize the total costs per unit volume of fluid produced or injected, i.e. minimize the costs of initial completion, maintaining production and remedial measures.

The fundamental design of a completion consists of four principal decision areas, namely:

- 1. Specification of the bottomhole completion technique.
- 2. Selection of the production conduit.
- 3. Assessment of completion string facilities.
- 4. Evaluation of well performance / productivity-injectivity

These four decision areas, as shown in Figure - 16, should provide a conceptual design for the completion of the wells. However, this design process normally is initiated on the basis of data from exploration wells and considerable uncertainty may exist as to the validity and accuracy of that data. Thus a number of alternative designs for well completions will normally be selected and retained as a contingency.

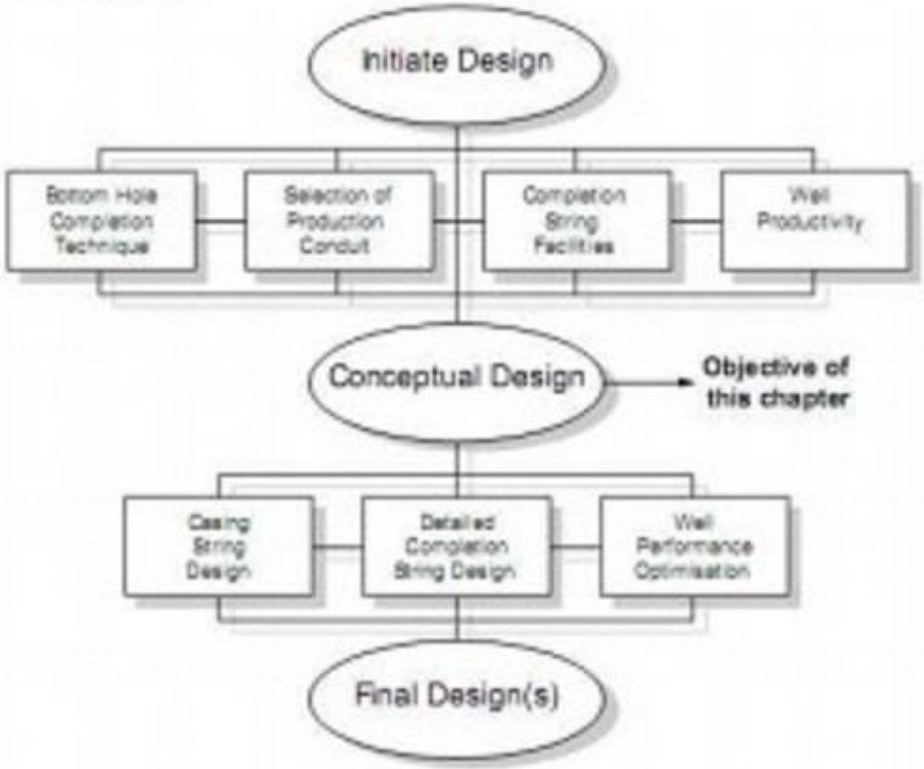

Figure - 16: Completion Design Strategy

Basically there are three main methods of completing a well which are:

1- Open-hole completion
2- Cased-hole completion
3- Liner completion; this completion can be include two types:
   a- Screen and liner completion.
   b- Perforated liner completion.

1- **Open-hole Completion**:
The simplest approach to bottomhole completion would be to leave the entire drilled reservoir section open after drilling, the production casing is set on top of producing zone before drill the production formation that contain the hydrocarbon fluids, then after casing was cemented, producing formation drilled, see figure - 17. Generally open-hole has greater application in carbonate zones.

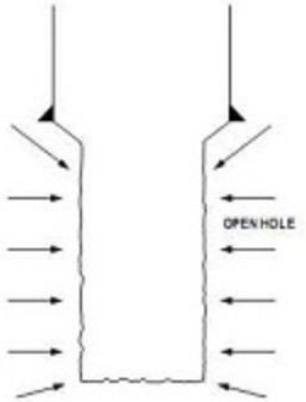

Figure - 17: Open-hole Completion

Advantages;

1- Adaptable to special drilling techniques to minimize formation damage or to prevent lost circulation into the producing zone.

2- No perforating expense.

3- Log interpretation is not critical since entire interval is open

4- Full diameter opposite pay.

5- Can be easily deepened.

6- Easily converted to liner or perforated completion

Limitation;

1- Excessive gas or water production difficult to control.
2- Selective critical section in production zone to fracturing or acidizing more difficult.
3- May require frequent well-bore cleanout.
4- Requires more rig time on completion

2- **Cased-hole completion:**

The production casing is cemented through producing zone and perforated, see figure - 18.

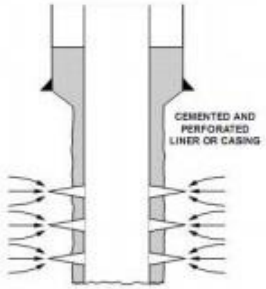

Figure - 18: Cased-hole Completion

Advantages;

1- Excessive gas or water production can be controlled more easily.
2- Can be selectively stimulated.
3- Log and formation samples available to assist in decision to set casing or abandon.
4- Full diameter opposite pay.
5- Can be easily deepened.
6- Will control most sand, and is adaptable to special sand control techniques.
7- Adaptable to multiple completion techniques.
8- Minimum rig time on completion.

Limitation;

1- Cost of casing cement and perforating for long zones may be significant.
2- No adaptable to special drilling techniques to minimize formation damage.
3- Log interpretation is critical for most of logs except production logging.

Liner completion:

I. **Screen and Liner completion.**

The production casing is set on top of producing zone, than the screen and the liner is set through producing zone, see figure - 19.

Advantages;

1- Adaptable to special drilling techniques to minimize formation damage or to prevent lost circulation into the producing zone.

2- No perforating expense.
3- Log interpretation is not critical since entire interval is open
4- Do not require frequent well-bore cleanout.
5- Will control most sand, and is adaptable to special sand control techniques.

Limitation;

1- Excessive gas or water production difficult to control.
2- Selective critical section in production zone to fracturing or acidizing more difficult.
3- Wellbore deepened is not easy.
4- Requires more rig time on completion.

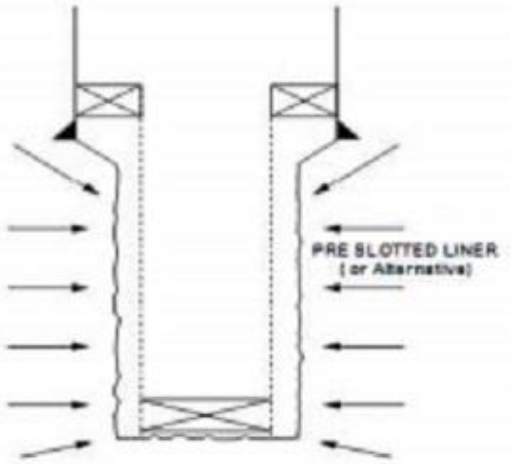

Figure - 19: Liner Completion