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OIL AND GAS ENGINEERING FOR WELL COMPLETION

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ABSTRACT

Well Completion is an important work in the process of oil and gas well drilling, which is directly related to the development of oil and gas exploration effect and economic benefit. Petroleum Engineers in Foreign country attach great importance on the well completion technology, in recent years, well completion technology has development in the domestic too, especially the horizontal well completion technology had formed many mature technologies, particularly in the special reservoir sand control completion, unconventional reservoir fracturing completion, bottom water reservoir simulation completion, thermal recovery well completion, and smart completion, however, although these completion technology has made some progress, there is still a big gap that compare to completion technology in the foreign countries, that affected the yield and economic benefit of oil and gas wells to a certain extent. In this paper we will discuss Oil and Gas Engineering for Well Completion.

Keywords: *Oil, Gas, Engineering, Well Completion, Well Drilling, Economic, Technologies, Petroleum, Production, Planning, Interventions, Abandonments.*

INTRODUCTION:

Petroleum engineering consists of three major components: drilling, reservoir, and production. To develop oil and gas fields, we typically begin by developing a field development plan based on geological investigations conducted by seismic surveys during exploration. [1] The information obtained while drilling (Measurement While Drilling, MWD, and/or Logging While Drilling, LWD), open hole logging, and testing from exploration and appraisal wells prior to the construction of development wells for production. Reservoir engineers then investigate the properties of target formations and reservoir fluids. Reservoir Simulation is used to predict reservoir and individual well performance once well types and spacing are selected from the reservoir study based on the characteristics of the target formations. [2]

Completions engineering is the process of finishing drilled and cased wells and bringing them online.

Completions Engineers may also be in charge of a variety of other related processes that occur over a well's life cycle, such as workovers, re-completions, remedial interventions, and abandonments.

During well planning, completion engineers will collaborate closely with the drilling team to ensure that their planned operations can be supported by the well design.

Although completions will vary greatly depending on the field and reservoir, once the well has been drilled and cased, engineers will plan, cost, and execute a programme to perforate, test, stimulate, and put the well on production to begin producing the oil and gas reserves.

Following the removal of the drilling rig, a first completion occurs. Casing, cement, and/or a packing mechanism isolate the wellbore, preventing any oil or gas from entering and flowing to the surface.

Completions procedures vary greatly depending on location and reservoir type. In general, an area of interest is selected from open-hole logs that reveal indicators of oil or gas.

A perforating gun is run into the wellbore, a controlled set of explosives (charges) are set off perforating the casing, cement and reservoir. This allows the oil and gas to flow into the wellbore and to surface.

Stimulation is frequently required for wells to flow economically. This can include pouring acid into the reservoir or hydraulically fracturing it. If the reservoir is under-pressure, artificial lift equipment may be required to help raise the hydrocarbons to the surface. [3]

This booklet was created to detail the steps involved in finishing wells for oil or gas production or injection. Several of the topics covered are included in, or are closely related to, the Schlumberger organization's or alliance partners' spectrum of services and products. These topics are covered in greater depth to provide a better knowledge of the technology and to aid in the identification of prospective Schlumberger applications.

There are three essential needs for any completion (which are shared by nearly every oilfield product or service). A completion system must include a method of producing (or injecting) oil or gas, which is;

- Safe
- Efficient
- Economic

The current state of the business may lead operators to place an inordinate focus on the economic requirement of completions. However, as will be shown later, a suboptimal finishing method may jeopardise long-term company objectives. For example, if the company's goal is to maximize a reservoir's or field's recoverable reserves, a poor or inadequate completion design might substantially jeopardise achievement of the goal as the reservoir depletes. In brief, the completion configuration and equipment employed are ultimately determined by the technical effectiveness of the complete completion system, as well as the unique firm objectives. [4]

After drilling a well to its total depth, oil and gas exploration and production (E&P) companies must complete one critical phase. They must prepare the well for oil or gas production, or go through the well completion stage of hydrocarbon extraction.

Oil and gas well completions should have the following outcomes in order to be deemed successful:

Well completions should join the reservoir to the production tubing, allowing oil and gas to flow to the surface or fluids to be injected into the reservoir.

To avoid interference with the producing reservoir, well completions should isolate the oil and gas reservoirs to protect the generating zones from non-producing zones.

Well completions must safeguard the reservoir's integrity and minimise formation damage.

Well completions must be designed to resist corrosion and creep and not collapse into the reservoir or the wellbore.

Well completions should also include a method for detecting and evaluating changes in reservoir conditions and hydrocarbon flow rate through well testing.

Well completions must prepare the wells for the next stages of oil or gas extraction.

Finally, how engineers decide to construct a well will affect the pace of oil and gas production as well as the time it takes to pump oil and gas from the well. [5]

REVIEW OF LITERATURE:

Systems for Petroleum Production (Economides et al., 2012). Production engineering is the most closely related subject to well completion among the other disciplines. The purpose of completions design is to constantly give the greatest means of producing oil and gas. Many of the theories and equations used in this study are described in greater detail in Petroleum Production Systems. Inflow equations for various reservoirs under various boundary conditions, thorough hydraulic fracture designs, detailed theory of matrix acidizing in both sandstone and carbonate formations, and sand production management are some examples. [6]

Recent Advances in Hydraulic Fracturing (Gidley et al., 1989) covers fracturing completion. In Recent Advances in Production Enhancement with Acid Stimulation, almost all fracture-related hypotheses for conventional reservoirs are thoroughly discussed. [7]

(2008) (Kalfayan) Stimulation by acid. Acidizing is another well stimulation procedure that is often utilised to increase well performance. Acidizing is a complicated statistical technique, especially in carbonate deposits, and completion for acid stimulation allows the stimulation to succeed. provide acidizing theories and field operation in all aspects in depth, laying the groundwork for understanding how to create an acid stimulation completion. Hydraulic Fracturing.

Understanding fracture theory is required to design completions for efficient fracture stimulation. [8]

Objectives:

- Designing the Completion Process: Perforation Design, Pump Schedule and Completion Procedure;
- Well completions should help reduce the resistance to oil and gas flow.
- A completion is an operation on an oil and gas well to open up the reservoir to production.

RESEARCH METHODOLOGY:

The impact of well completion parameter optimisation and completion technique optimisation on the overall drilling and completion process should be considered. Furthermore, we should increase our investment in manpower and material resources, as well as strive to overcome technical challenges in order to develop a series of staged fracturing and advanced intelligent water control completion tools with independent intellectual property rights, as well as a comprehensive set of supporting application technologies. This study introduces the current horizontal well completion technology at home and abroad, analysing the differences in well completion technology between the domestic and foreign, and discussing the future research direction of well completion technology. [9]

RESULT AND DISCUSSION:

The formation characteristics determine the alternatives available to completion engineers. If the permeability of the formation is low, engineers may choose to induce a hydraulic fracture by pouring a slurry of water, sand, or other materials through the perforations and into the formation at high pressure. Pump pressure is applied to the stubborn formation until it yields and splits open. After that, the slurry is injected into the freshly formed formation fractures. When the pumps are switched off and the well is uncovered, the water drains, leaving the sand behind. This prop-pant keeps the freshly formed fractures open. As a result, the hydrocarbons have a high-permeability pathway from the deposit to the wellbore.

While oil and gas flow easily through permeable rocks, such formations can be unconsolidated and prone to breaking up into minute sand particles, which can then flow into the wellbore with produced fluids. These particles have the potential to clog perforation tunnels and prevent fluids from accessing the well. To prevent these particles from migrating through the formation, engineers may inject chemicals into it to bind the sand grains together. Engineers may also choose a sand control technique--or a mix of techniques--that includes various types of sand screens and gravel packing devices to keep sand from entering the wellbore. These systems, which are intended to prevent sand migration, allow fluids to freely flow through them.

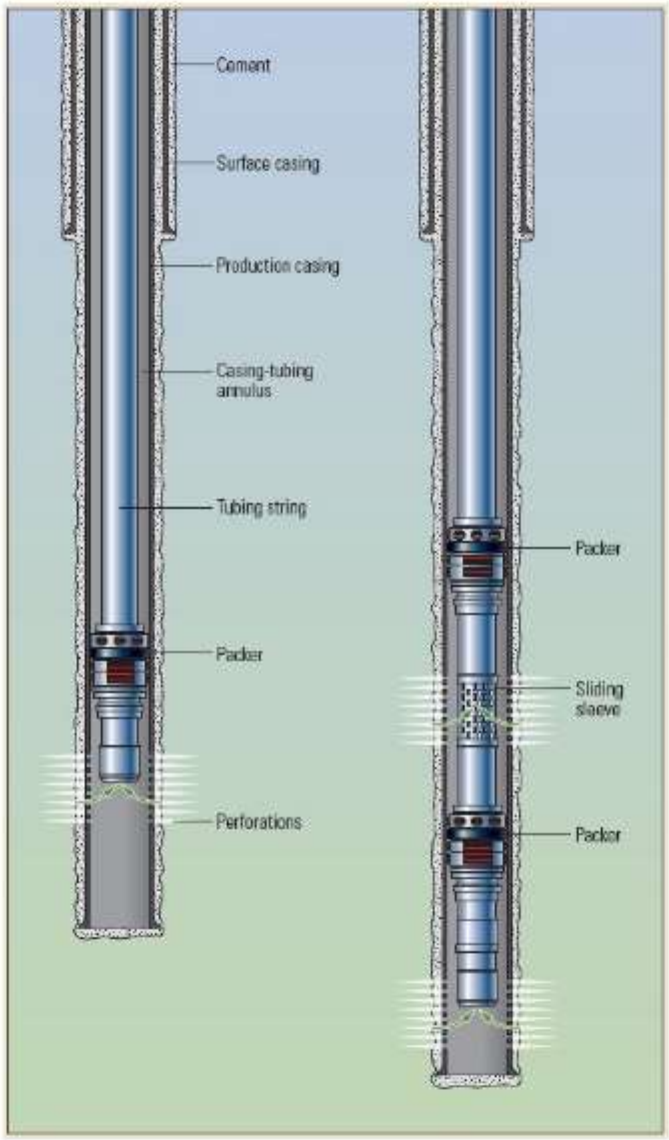

Figure 1: Single-Zone and Multizone Well Completions

Well completions in single zones and multizones. A packer, which forms a seal inside the production casing, hydraulically isolates the tubing string from the region above the packer, known as the backside, in the single-zone completion (left). To avoid casing corrosion, the backside includes completion fluid containing corrosion inhibitors.

At least two packers divide the producing zones in the multizone completion (right). Fluids from all zones can be mixed during production, or production from the higher zone can be stopped by shutting a sliding sleeve until operators determine the fluids can be mixed. Alternatively, operators can allow the lower zone to deplete before inserting a plug (not pictured) above it and opening the sliding sleeve to generate just from the upper zone. [10]

Driven by Dissolved Gas The oil in a dissolved gas drive reservoir contains dissolved gas. When the pressure declines, or draws down, the gas escapes from the oil, propelling fluid through the reservoir towards the wellbore. Furthermore, the gas aids in the movement of fluids to the surface (Figure 2). Dissolved gas drive, widely regarded as the least effective reservoir drive mechanism, typically delivers just 15% to 25% of the oil originally present in the reservoir. [11]

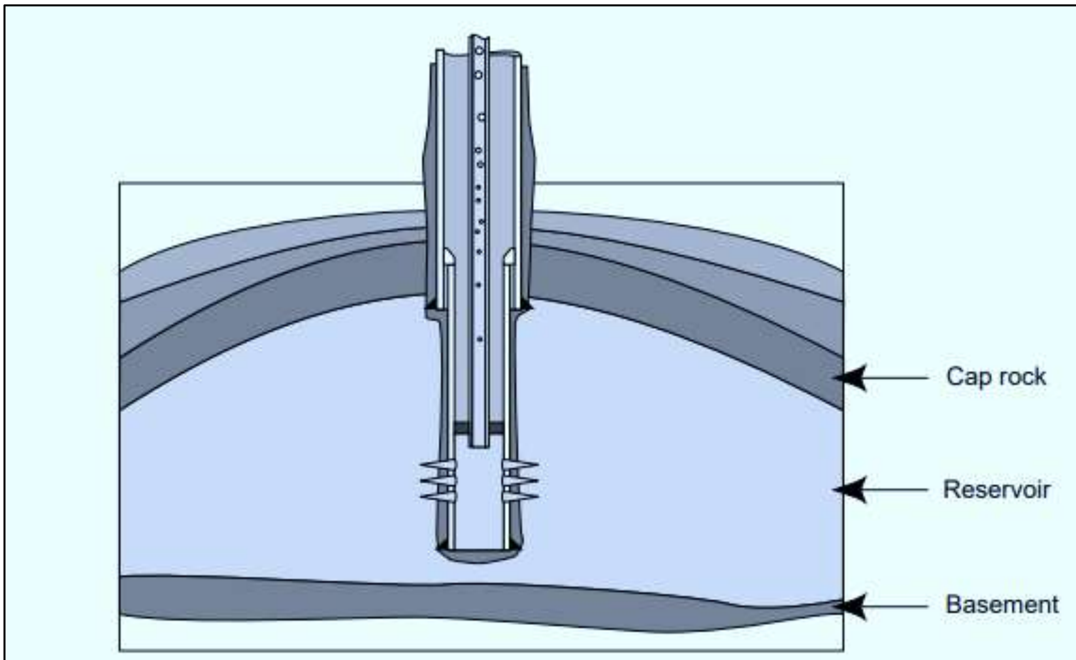

Figure 2: Dissolved Gas Drive Reservoir.

Oil Well:

An oil well is a term for any drilling or boring through the Earth's surface designed to find and release both petroleum oil and gas hydrocarbons.

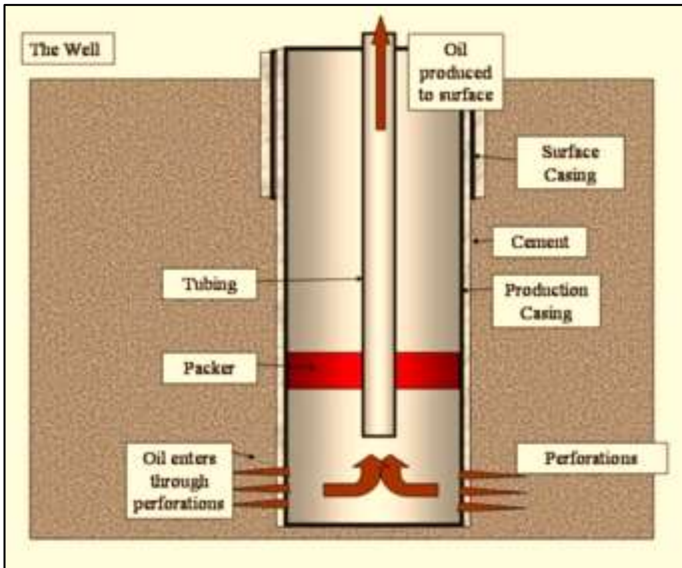

Figure 3: Oil Well

The well is created by drilling a hole of about (100 to 800 mm dia) into the earth with an oil rig turning a drill bit. After the hole is drilled, a metal pipe called a 'casing' is cemented into the hole. In order to gain access to the "hydrocarbon producing interval", the casing and cement are either perforated ('cased hole completion') or an additional section of earth is drilled below the casing ('open hole completion'). In most cases, several casings are set into the well, starting with a large shallow casing, and then deeper casings are set into smaller holes drilled through the upper casings. [12]

Well Test (Oil and Gas):

A well test is the execution of a set of planned data collecting actions in the petroleum business. The collected data is analysed to gain a better understanding of the hydrocarbon properties and the features of the underground reservoir where the hydrocarbons are confined.

The test will also provide information on the condition of the specific well used to collect data. The overarching goal is to determine the reservoir's ability to generate hydrocarbons such as oil, natural gas, and condensate. [13]

Volumetric flow rate and pressure measured in the selected well are among the data collected throughout the test time. The results of a well test, including as flow rate and gas oil ratio data, may aid in the well allocation process for an ongoing production phase, whereas other data about reservoir capabilities will aid in reservoir management.

There are numerous flavours of well testing and various ways to categorise test types according on their purposes; nonetheless, there are two basic groups based only on objectives: productivity tests and descriptive tests. According to the Oklahoma Commission on Marginally Producing Oil and Gas Wells' Lease Pumper's Handbook, there are four main well test types: prospective tests, daily tests, productivity tests, and gas oil ratio tests, with the latter three falling within the larger productivity test category. [14]

The objectives of tests will change throughout the different phases of a reservoir or oil field, beginning with the exploration phase of wildcat and appraisal wells, progressing to the field development phase, and finally to the production phase, which may also vary from the initial period of production to improved recovery by the end of the field lifecycle time.

Figure 4: Example Well Testing Package. Shown: Choke Manifold, Well Testing Separator, flare stack, surge tank and Wellhead. [15]

Flow Test:

This test has also been referred to as the daily test and may go by other names. numerous wells may produce to a shared separator, and flows from numerous separators or facilities may be sent into a commingled flow in a pipeline that conveys oil or gas for sale (export).

Although the total flow rate of all wells is measured, the contributions of individual wells are unclear. It is critical to understand individual contributions in order to account for hydrocarbon material balance, as well as for well monitoring and reservoir management.

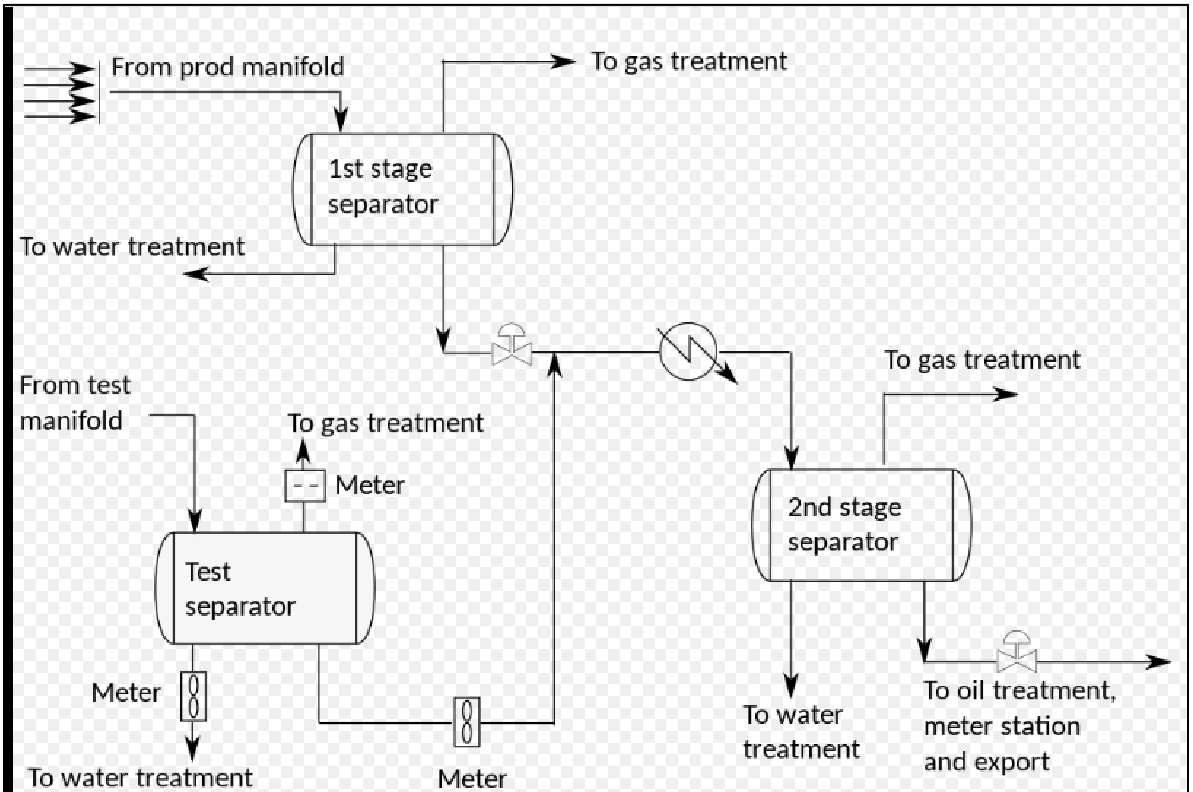

Figure 5: Simplified Process Flow Diagram.

Process flow diagram that has been simplified. A manifold delivers a multi-phased flow of oil and gas from multiple wells to a facility. Flow from only one well may be routed to the test separator (shown). The test separator has the capability of separating gas and water from oil and measuring each component under different conditions. [16]

CONCLUSION:

As major oil and gas fields have steadily entered the deep development stage and large-scale development of unconventional reservoirs represented by shale gas has begun, new requirements for horizontal well completion technologies have been recommended. However, horizontal well completion technologies in China are now unable to meet the needs of oilfield development. As a result, new horizontal well completion and supplementary technologies must be developed. First and foremost, sufficient attention should be devoted to well completion, and tight collaboration between geology, reservoir, and engineering should be actively encouraged, so that the single completion may be evolved into a systemized system of drilling, well completion, and oil recovery.

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