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Water Production Performance and Control of Oil Field

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Abstract

Water production is one of the major technical, environmental, and economical problems associated with oil and gas production. Water production can limit the productive life of the oil and gas wells and can cause several problems including corrosion of tubular, fines Migration, and hydrostatic loading. Produced water represents the largest waste stream associated with oil and gas production. Therefore, it is of importance to alleviate the effects of water production.

Conventionally, water production can be avoided by adopting new drilling practices such as drilling horizontal, deviated or infill wells. Different well completion designs also offers a mean to manage water production through selectively perforate dry zones, placing a liner or installing down whole flow separation equipment. Moreover, chemical treatment arises as one of the promising water-shut-off techniques through polymer flooding.

Keywords: Environmental; Economical problems; Oil and gas production; Hydrostatic

Introduction

The major constituents of concern in produced water are salt content (expressed as salinity, total dissolved solids, or electrical conductivity). Technologies and strategies applied to produce water comprise a three tiered water hierarchy:

- Minimization
- Recycle/Re-used
- Disposal

Most onshore produced water is re-injected to underground formations, either to Provide additional oil and gas recovery or for disposal Techniques to minimize and control produced water volumes should be establish by their major steps:

- Sources of produced water
- 2 - Methods to identify
- Remedial actions

Literature Review

Water production performance of oil field

Water production is one of the major technical, environmental, and economical problems associated with oil and gas production. Water production can limit the productive life of the oil and gas wells and can cause several problems including corrosion of tubular, fines migration, and hydrostatic loading. Main Causes of Water Production are:

- Mechanical problems
- Corrosion or wear holes
- Excessive pressure
- Formation deformation
- Fluid invasion in wellbore
- Completion related problems
- Reservoir depletion

Mechanical problems

Many water entry problems are caused by poor mechanical integrity of the casing. Holes caused by corrosion or wear and splits caused by flaws, excessive pressure, or formation deformation can allow unwanted reservoir fluids to enter the casing. An unexpected increase in water production could be the result of a casing leak (**Figure 1**) [1].

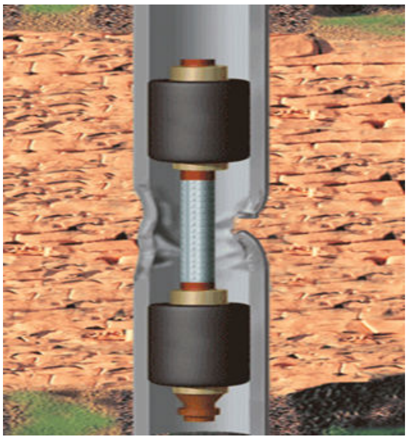

Figure 1: Mechanical problems.

Most casing leaks occur in the casing above the top of the cement. Therefore, when the leak breaks into the wellbore, drilling mud that was left in the annulus between the casing and open hole during primary cementing operations enters the wellbore [2].

Communication problems

Communication problems are classified as either near wellbore or reservoir related. Near wellbore problems are channels behind casing, barrier break downs, and completions into or near water. Reservoir Channelling through higher permeability zones or fractures, and fracturing out of zone. Near well bore or reservoir related:

- Channels behind casing
- Barrier breakdowns
- Completion into or near water
- Coning and cresting
- Channelling through high perm zones or Fractures

Channel flow: Channel flow behind casing failed primary cementing can contact water bearing zones to the pay zone these channel allow the water to flow behind casing in the annulus Water produced From channels behind the casing can be identified by temperature log and using the WFL Water Flow Log (A record of the velocity and direction of water flowing in and around a borehole based on oxygen activation).

Barrier breakdowns: Even if natural barriers, such as dense shale layers, separate the different fluid zones and a good cement job exists, shale's can heave and fracture near the well bore. As a result of Production, the pressure differential across this shale's allows fluid to migrate through the well bore. More often, this type of failure is associated with stimulation attempts. Fractures break through the shale layer, or acids dissolve channels through it.

Completion into or near water: Completions into or near water. Completion into the unwanted fluid allows the fluid to be produced immediately. Even if perforations are above the original water-oil contact, proximity allows production of the unwanted fluid, through coning or cresting, to occur more easily and quickly [3].

Reservoir related problems

Early water breakthrough may be due to fractures, high-permeability streaks or channels within the reservoir. When this happens, sweep efficiency in low-permeability zones will be extremely low and large quantities of oil will be left in the reservoir coning and cresting. Fluid coning in vertical wells and fluid cresting in horizontal wells both result from reduced pressure near the well completion. This reduced pressure draws water from an adjacent connected zone toward the completion. Eventually, the water can break through into the perforated or open hole section, replacing all or part of the hydrocarbon production. Once breakthrough occurs, the problem tends to get worse, as higher cuts of the unwanted fluid are produced. Although reduced Production rates can curtail the problem, they cannot cure.

Reservoir depletion

Water production is an expected consequence of oil or gas production. There is very little that can be done to reduce water production in a depleted reservoir. Generally at the later stages of production the focus of water control will shift from preventing water production to reducing cost of produced water [4].

A fracture is any local separation or discontinuity plane in a geologic formation Fractures are commonly caused by stress exceeding the rock strength, Fractures can provide Permeability for fluid movement, such as water or hydrocarbons. Fracturing out of zone an improperly designed or poorly performed stimulation treatment can allow a hydraulic fracture to enter a water zone. If the stimulation is performed on a producing well, an out of-Zone fracture can allow early breakthrough of water. If the fracturing treatment is performed on an Injection well, a fracture that connects the flooded interval to an aquifer or other permeable zone can divert the injected fluid, providing very little benefit in sweeping the oil zone. As mentioned in Section 2, many operators tag the tail end of their prop pant with radioactive tracer, so if the well does not respond as Anticipated, they can log the well to determine where the fracture went.

Methods to identify sources

Production-water sampling and analysis should be conducted on a regular basis on each producing well. Establishing a baseline water analysis provides valuable information if production or well conditions change suddenly. Changes in chloride or total dissolved solids (TDS) provide insight to problems and remedial action [5].

Chloride concentration

Can be used to determine if produced water is connate water (production water) or water introduced to the well during stimulation or from other sources. Changes in chloride concentration can indicate invasion of water into the well due to poor mechanical integrity. Lower than normal chloride Concentrations can indicate a shallow casing leak. Iron concentrations can predict the probability of Formation damage from iron oxide precipitation. pH can also indicate the probability of metal oxide Precipitation. Knowing the specific gravity of your produced water is useful in determining bottom hole Hydrostatic pressure:

- Production logging
- Finding tubing-casing leaks
- Detecting lost circulation zones
- Determining if packers or bridge plugs are leaking
- Detecting fluid channels behind casing
- Developing production profiles
- Locating gas-oil-water contacts

Spinner (flow meter) surveys are used to meter fluid flow rates within cased or uncased wells. They are useful in determining production rates, detecting thief zones, locating lost circulation zones, finding holes in casing or tubing, and assisting in injection and production profiles. Differential Temperature

Survey Measures temperature of the wellbore fluid under Static (shut-in) or dynamic (flowing) conditions, Can detect behind pipe communication problems

Cased Hole Formation Resistivity (CHFR) The ability to measure formation resistivity directly through casing in monitoring wells allows the measurement of water saturation further away from the wellbore. Advances in digital electronics have made it possible to produce the sufficiently accurate and stable down whole sensors required to measure formation resistivity through steel casing. The main purpose of CHFR is reservoir monitoring. During the production life of a reservoir, through casing formation resistivity data may help understand fluid flow and recovery processes in several ways:

Evaluation of reservoir fluid saturation changes with time, including the identification of swept zones, Potential flow barriers and bypassed oil.

- Monitoring of movement in oil/water contacts.
- Identification of take-off rate-induced water coning, by repeat logging at different take-off rates.
- Allowing time to re-establish stable conditions.
- Estimating residual oil saturation to a waterflood or a combined water-alternating-gas (WAG) flood.
- Measuring formation resistivity through casing allows the evaluation of residual oil saturation further away from the wellbore than open hole logs or sponge cores.

Mechanical integrity tests

Mechanical integrity can be determined by pressure testing or by casing inspection logs. In some instances an acoustic fluid level shot can assist in locating a leak in the casing. Pressure testing to isolate casing leaks is typically conducted using a Retrievable Bridge Plug (RBP) and Packer. The goal is to isolate the leaking interval as quickly as possible. The majority of casing leaks Occur where there is no cement behind the casing. One common technique is to run the packer and RBP into the well and set the RBP just into the top of the cement interval behind casing. Pressure test the RBP and move the packer up and down the hole, pressure testing both through the tubing and on the annulus at different packer settings until the leak is isolated. Once a long section of casing passes the pressure [6].

Casing inspection logs

Casing inspection methods include multi-fingered caliper logs, electrical potential Logs, electromagnetic inspection devices, and borehole televiewers. Of these, the majority measures the extent to which corrosion has taken place. Only the electrical potential log indicates where corrosion is currently occurring. With the exception of caliper logs, all the devices require that tubing be pulled before running the survey, since most are designed to inspect casing rather than tubing and all are large diameter tools.

Remedial actions

Water Shutoff Technology is defined as an operation that hinders water from entering the production wells each problem type has solution options:

- Mechanical solution
- Chemical solution

Mechanical solution

In the main near the well bore problems such as casing Leak or flow behind casing and water out layer, without cross flow, Mechanical or inflatable plugs with and without cement are used to control the water production

Chemical solution

Polymer flooding is a very important method for improving the water flooding sweep efficiency to increase oil recovery and reduce water production. It can yield a significant increase in oil percentage recovery by reducing the water production and improving the recovery when compared to the using conventional methods to prevent water flooding in certain reservoirs.

Cement squeeze techniques

Too often, the injection of cement slurries into the casing/wellbore annular space, through casing perforations or splits in damaged sections.

Cementing placement techniques

Within these two classes, there are two basic techniques (the Braden head squeeze and the squeeze tool technique) and two pumping methods (the running squeeze and the hesitation squeeze). Each of these classifications and techniques is explained in this section.

Discussion

Braden head placement technique

This technique, illustrated in, is normally used when low-pressure squeezing is practiced, and when there are no doubts concerning the casing's capacity to withstand the squeeze pressure. No special tools are involved, although a bridge plug may be required to isolate other open perforations further down hole (**Figure 2**) [7].

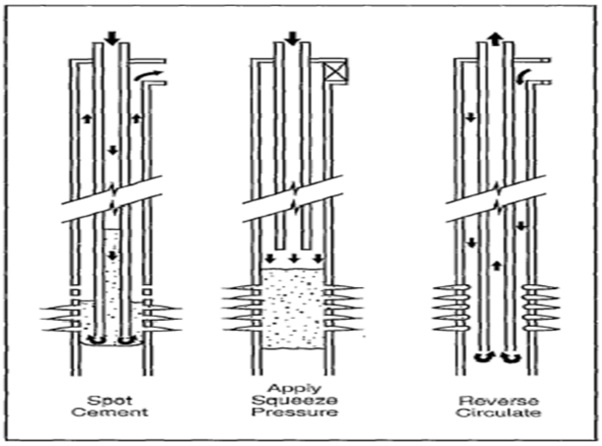

Figure 2: Braden head placement technique.

Open-ended tubing is run to the bottom of the zone to be cemented. Blow Out Preventer (BOP) rams are closed over the tubing, and the injection test is performed. The cement slurry is subsequently spotted in front of the per-formations. Once the cement is in place, the tubing is pulled out to a point above the cement top, the BOPs are closed, and pressure is applied through the tubing. The Braden head squeeze is very popular because of its simplicity.

Squeeze tool placement technique

This technique can be subdivided into two parts-the retrievable squeeze packer method, and the drillable cement retainer method. The main objective of using squeeze tools is to isolate the casing and wellhead while high pressure is applied down hole [7].

Retrievable squeeze packer method

Retrievable packers with different design features are available. Compression- or tension-set packers are used in squeeze cementing. As shown in they have a bypass valve to allow the circulation of fluids while running in the hole, and once the packer is set. This feature allows the cleaning of the tools after the cement job, and the reversing out of excess slurry without excessive pressure; it also prevents a piston or swabbing effect while running in or out of the hole. The principal advantage of the retrievable packer over the drillable retainer is its ability to set and release many times, thus allowing more flexibility. Retrievable bridge plugs can be run in one trip with the packer, and retrieved after the slurry has been reversed or drilled out. Most operators drop one or two sacks of Frac sand on top of the retrievable bridge plug before the job, to prevent the settling of cement over the releasing mechanism (**Figure 3**) [9].

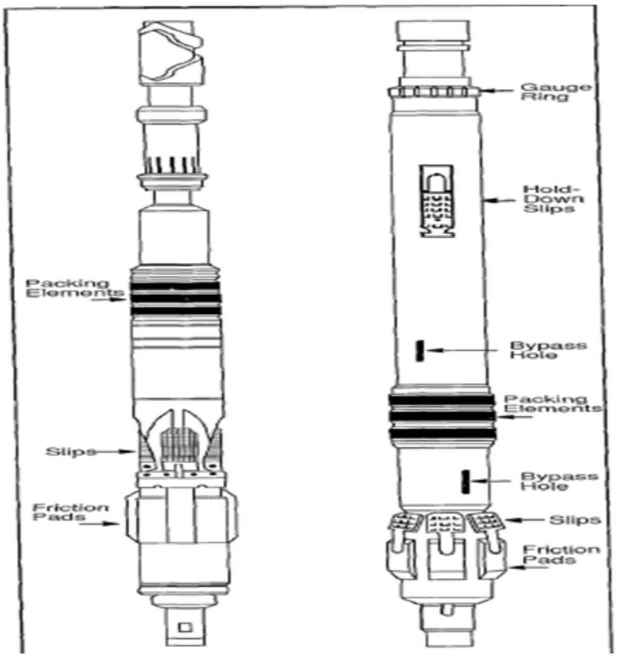

Figure 3: Retrievable Squeeze Packer Method.

Drillable cement retainer

Cement retainers are used instead of packers to prevent backflow when no cement dehydration is expected, or when a high negative differential pressure may disturb the cement cake. In certain situations, potential communication with upper perforations makes the use of a pack-er a risky operation. When cementing multiple zones, the cement retainer isolates the lower perforations, and subsequent zone squeezing can be performed without waiting for the slurry to set. Cement retainers are drillable packers pro-voided with a valve which is operated by a stinger at the end of the work string (**Figure 4**) [10].

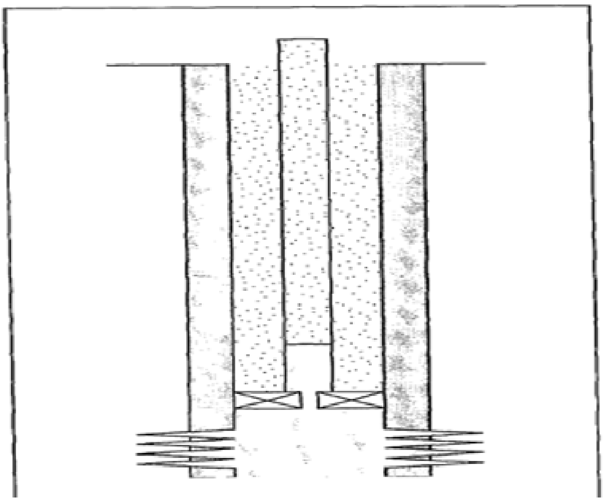

Figure 4: Drillable cement retainer.

Conclusion

Beneficial use of OGPW must take into consideration its field chemical make-up, the properties of the recipient soil, long-term land use objectives. They are normally used to isolate the casing below the zone to be treated. Their design is similar to that of cement. They can be run with a wire line or with the work string. Bridge plugs do not allow flow through the tool.

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