



Original Research

## Investigation of Well Equipment in Oil Industry

Alireza Bozorgian

Department of Chemical Engineering, Mahshahr Branch, Islamic Azad University, Mahshahr, Iran

### GRAPHICAL ABSTRACT



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### ABSTRACT

Production rates from oil fields will be reduced over time due to various factors. So it is necessary to use some methods to compensate the reduction in the oil and gas production rates. Gas overflow is one of the artificial overflow methods that is used with the aim of rehabilitating and increasing the optimal flow of oil wells. In this method, high pressure gas is injected at a certain point inside the fluid column in the well, thereby reducing the average density and subsequent pressure on the bottom of the well, and thus reactivating the well. In optimizing the operation, increasing the production and benefiting from the maximum operation of the well and its facilities are considered. In this project, two-phase current was model using a mechanistic model and parameters such as pressure profile, temperature, phase fractions and phase velocities are calculated. Then, with the help of node analysis, the natural production of the well is simulated and the need to use the method is investigated. When the reservoir energy (reservoir pressure) is not high enough for continuous production from the well, the artificial overflow method is used in oil production. Gas overflow method is one of the artificial overflow methods that is used to increase the oil production from wells. In this method, high pressure gas is injected into the well to make the fluid column lighter, increasing the reservoir pressure to produce oil.

### Introduction

\* Corresponding author: *Alireza Bozorgian*  
E-mail: [a.bozorgian@mhriau.ac.ir](mailto:a.bozorgian@mhriau.ac.ir)  
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Well filling methods are very different and tasteful. In each well, different people have different ideas and ways of working to complete the well. The completion program of each well starts prior to the drilling operation and continues until it is completed and even thereafter when the well is in service. A complementary program must be implemented in such a way as to enable maximum production for a long time at the lowest cost. Regardless of the method of filling the well, it may be open or wall-mounted. The choice of required flow paths and the sizes of these paths are also very important. The gain layer with different pressures requires several paths.

Of course, this operation is not applicable in wells with limited diameter as it may reduce the production fluid flow. In many cases, the repair and completion operations, the well to open the window from inside the walls and create a new hole in case of production problems from the first hole due to retention or lack of sealing of the upper layers.

Also adjacent to the gas cap, new hole is caused by a problem. In some cases, the only way to combat corrosion caused by corrosive fluids in wall / liner pipes is to use a well repair operation to remove the pipes from the complementary strand, which involves heavy costs.

When a well is equipped with a brain tube, this tube prevents corrosive fluids from contacting the wall tubes and consequently their corrosion, and only the brain tube itself is corroded.

In this case, by sending a light repair rig and spending a little time and money, the brain tube can be taken out of the well and being replaced with a new brain tube. However, by continuously or intermittently injecting anti-corrosion materials and pumping gasoline into the brain tube, the inner surface of the tube can be covered with a very thin layer of this material from the beginning to end and direct contact of the tube with corrosive fluids can be prevented.

### **Completion Systems**

Once the route or flow paths have been decided, a complementary system is designed for operation. Completion system is a set of different tools, each of which is designed according to the specific needs of the well. Conventional completion systems are driven using conventional methods and toolkits. Cost is always the most important and fundamental factor in planning the completion of any well.

Due to corrosion and erosion, well repair and harmful effects on the environment are included. Completion costs also include projected costs of well service and maintenance repairs. In a successful completion program, costs are balanced by the strength of the well and the production of profitable amounts of oil.

The cost of an ideal and suitable completion should not exceed the amount needed to provide a chance to produce from the well with the highest income, the degree of safety and in

the longest time and with the least repairs. The key to success is the overall efficiency of a well, not the size of the budget. Not every high cost is always associated with a high profit, and a low cost does not always mean low potential.

The cost-effectiveness of completing a well depends on the well itself and its future, not its price. For example, the fluids produced from a well are corrosive. If the oil produced from the well can cover the cost of completing the well against corrosion, these devices must definitely be used in that well. If investing heavily in a well helps to use all of its proven productivity, the costs must be paid. If the right balance between costs and talents and exploitation power is found, the well can have a successful result.

### **Completion with Components Inside Well**

In this method, the installed facilities give a new and unique capability to the well. These devices can also be installed and operated in open-hole and cased-hole wells, for example, SUB surface safety valve as a lifeguard in case of emergency operation.

### **Cerebral Tube Pendant**

It is a piece that is placed in the brain tube (TBG HD Spool). This piece has special seals on the outer surface, performs the sealing work on the head of the completed string and cuts the connection between the brain tubes and the space behind the brain tubes (daliz). The main functions of this device are:

- Hanging all kinds of complementary strings in the well.
- Blocking the space below and concentrating the well in the middle duct of the brainstem.
- Possibility of installing one-way, two-way and back Press Valve valves in its middle duct and blocking the well to discharge the shut-off valves and mount the well crown or vice versa.
- A suitable place to pull out the brain tubes in repair operations and...

Another feature of this brain tube pendant in the field of urban completion is that it has the ability to move the brain tube slightly, which arises from the expansion and contraction of the brain tube due to the heat and cold and other factors (up to about half a foot or about 10 cm). In other words, it does the job of short sliding pipe in the field of completing the urban. L.D can be used in wells that do not have a brain tube, because its percussion is blind. Of course, this system is not used today, but it has been used in some old wells that are being repaired. Its percussions are closed by Hand Wheel.

And if the well needs to be repaired, the presence of well service personnel is required. After the repair operation, it is better to replace this part as soon as possible. An evolved version of the L.D. system uses pipe rams. In this example, the brain tube can also be used. The rams block the space around the pipes and the oil pressure behind it must be released to remove the complementary string. Its general system is the same as that of a blower, except

that the blowers are operated by oil pressure, but the L.D.O. is closed by a hand wheel and fastened by bolts. (L.D.O) is one of the alternatives to the brain tube pendant and the tube of the brain tube that only blocks the space above the casing head and is used instead of the Completion Head in the crown of the well.

This device is made by the Cameron company and if this device is used in a well, the brain tube cannot be used in it. The gearbox system is used to open and close the faster. The force required to close or open it is provided by a manual gear.



**Figure 1.** A sample of a brain tube pendant Unborn Pacifier

A pipe-like piece is installed in certain places of the complementary string. This piece has a place for plugs to sit and block the wells. It is also possible to install other devices such as in-well reducers and temperature and pressure measuring devices, provided there is a special lock in it. Landing nipple consists of two parts: leak stopper and locker.

### Selective Landing Nipple

This pacifier can be used in any number in the supplementary field and plugs in all or any of them selectively.

Of course, the use of this sample is obsolete today, but there are wells in the system whose complementary string has such pacifiers it is able to pass through all pacifiers by performing a special blocking operation on the last pacifier that has been placed and locked. The models are polished at the bottom and in some others at the top. Several numbers can be used.

### Landing Nipple SSSV

This sample can be considered as a part of the nipple, but the existence of a place to install a deep safety valve and inch efficiency with the ability to install a lock switch  $\frac{1}{4}$ . This valve distinguishes this pacifier from other types. There is usually a SWAGE LOCK on the body. The pacifier is replaced by a normal safety nipple by inserting a dummy (replacement of the safety valve).

### Line Control ( $\frac{1}{4}$ " Control Line and ACC)

The control line from the construction point of view includes two types: Seamless and welded. Seamless construction is such that inside the steel plant, a solid bar is drilled from the middle part under special conditions and with special methods of this work by passing the mandrel in molten conditions, and a one-handed pipe is prepared. In this method, the length of the prepared pipe is limited. In making Welded steel strip, it is rolled under and rolled, then the seam is welded and produced with the desired length. In this method, the length of the pipe up to 3222 feet can be provided.

If there is a need for completions that require the control line to be driven to greater depths,

there are the tools needed for a completely secure connection. In the following, we will fully explain the vital role of each of these devices. Swage Lock is used to connect the control line at the beginning and end. For example, in completing the suburbs, one end of the control line is used for Tubing Hanger and the other end is used for 3SV LANDING NIPPLE. Control line control restraint 4 to 0 BAND STRAPs are placed on each branch of the pipe. This device, like a control belt, restrains the line on the pipe body.

Always close two BAND STRAPs on both sides of the pipe connection and the rest of the pipe length 2 Or the other 3 BAND STRAPs. Obviously, due to the placement of the CONTROL LINE in a fixed slot, the SLIPS usually rise in a straight line to the last connection point, which is usually the TUBING HANGER. It should be mentioned that the end of the control line is 1 to 2 meters They are twisted under the TUBING HANGER so that in case of an accident during the SWAGE LOCK connection, if the pipe is damaged for any reason, the damaged part can be separated and another connection can be made from the extra part.

This valve is installed on land at a depth of approximately 02 meters. But in the sea, depending on the taste of the service company and the employer, it is installed at a depth of 122 to 222 m. According to what you have learned, 3SV LANDING NIPPLE is installed under the TUBING HANGER to control the safety valve, which puts the deep valve in the open state under a special mechanism.

Almost all safety valves have a replacement and the replacement of all these valves is a piece. The shaped tubes on which a lock is usually closed, and has the ability to put a plug in it after installation and a lock on the outer surface of DUMMY and a series the seal is of the V. PACKING type, which is located inside the breast pacifier and protects it. The purpose of placing the alternative in the pacifier is to prevent damage and bruising and to prevent drilling mud and waste from entering the control line duct. The presence of a deep safety valve is a gift that COMPLETION STRING gives to the well. AVAILABLE SHUT DOWN and completely blocks the flow path.

### **Flow Calming Crown**

In parts of COMPLETION STRING that have a diameter reduction path on both sides of this diameter reduction from the inlet part will be accompanied by pressure drop and flow traffic and reduced fluid velocity, and in the output part will increase the output fluid velocity and create CAVITATION phenomenon, so necessary In the design of the supplementary field, these two places must have more strength than the other parts.

As a result, FLOW COUPLING, which has a greater thickness and more suitable metallurgy, and HARD FACING and polishing operations are performed on its inner diameter, so that changes can be made. Solve the flow regime in itself usually has two short and long branches that determine the flow path of their location.

A phenomenon that occurs due to a sudden decrease in diameter at the outlet due to turbulence of the flow creates more destructive effects in this part. We have to close the 32-foot or longer branch and put the short branch, which is usually 12 feet, at the other end of the production well. When passing through the safety valve or replacing the safety valve A short soothing crown (usually about 12 feet (below the pacifier and a long soothing crown) usually about 32 feet (usually placed on top of a safety valve pacifier). But in the injection well, it will definitely be the opposite of the above situation.

### **Blast Joint**

In the parts where the COMLETION STRING is placed in front of the grids, the outer surface of the COMLETION STRING is severely attacked by the outlet fluid, so it is necessary that this part is also equipped and has the necessary resistance, which can be said to be almost the opposite of FLOW COUPLING. This means that the operation performed on the ID FLOW COUPLING is included on the OD BLAST JOINT. In completing the DUAL COMPLETION, this device should be used, and if it is not available, thicker pipes with more pounds per foot can be a solution to delay well repair.

Blast Joint is a branch of hard steel with the best alloy and pipe thickness more than other core pipes that have a special resistance to corrosion and is usually available in sizes of 12 and 22 feet.

In the dual complementary string, in front of the lattice distance in the upper tank, depending on the length of the lattice distance, one or more branches of a special pipe called a sand trap crown are used. In the absence of this part, branches with more lbs. / ft can be used. This piece is used in dual completion of Timur water tank. In completing the standard dual in DUAL PAKER and the space between two packers, if we have grids, its use is a requirement, which is opened and closed at the required time by well drilling methods by Shifting Tool. Usually, this device causes it to close on one end and open it on the other.

### **Sliding Valve**

This piece is designed to establish an optional connection between the cerebral cortex in the space above the packer and the name "The other is CIRCULATING DEVICE", which is opened and closed at the required time by well drilling methods by Shifting Tool. Usually, this device causes it to close on one end and open it on the other.

### **Sliding Tube**

Basically, the design and construction of a sliding tube in the completion string is made in order to neutralize the phenomenon of expansion and contraction in the string of the cerebral tube, which is fixed in place by the brain pendant at the top and by the ball at the bottom. Usually, in the short completions, a sliding pipe with a length of 1 stroke is used, and in the long finishing line, a sliding pipe with

a length of 3 to 0 m is used, in Baker Type M by clutching and switching, or in the normal type. The presence of a universal groove or any other locking system locks the two parts of the cylinder and the piston of the sliding tube together and allows the transmission of rotation or torque to the lower parts. Have to become.

This sample has the ability to rotate at 302 degrees and while being sealed, it is locked in fully open position. When placed between the cerebral tubes, they fully open it and place the pins in place. After installing the ball, the pins are broken with the weight they put on it and the sliding pipe is made semi-open. Of course, a special type of sliding pipe is driven closed in the well. It is called PBR (Polished Bore Receipted) and is made by Otis Company.

### **Acne Tube Rupture**

This piece is closed directly on top of the ball in the form of reservoirs and is connected in the form of a latch in the ball and has pickings for leaking in two directions, connecting it to the ball. A piece of reaction pipe is a Persian translation of this piece, and it is better to pronounce it in Latin. It has two important applications: Sometimes it is not necessary to remove the entire complementary string and the supplementary string is separated from the connection of the reaction pipe to the ball and removed for repair, which reduces the cost of repairing the well to a considerable amount.

It is possible to drive the supplementary string in two stages using a piece of reaction pipe.

Separation of the string from the packer is a blessing, especially in WORK OVER operations.

### **Topak**

The ball is a piece that sits almost at the bottom of the brain tubes of a well-filling string. It is connected to the upper core pipes. After being installed inside the wall pipe or lining of the well, due to having a special sealing rubber (ELEMENT), the pressure and fluid connection of the well with the back of the core pipes are completed from the lowest point of the string. It breaks and its slips (SLIPS) sink into the metal body of the installation site and prevent the ball from moving up and down. Packer is the most important part in the complex completions and it is almost impossible to remove it. Most balls are installed in the well with this method.

It is common today to place an unbroken pacifier with a blocker under the ball. In similar cases, after reaching the desired depth, the ball is installed at its own pressure by applying pressure.

In the Ball Set type, the ball is sent to the desired depth with a special installation tool, and then the ball is released. After reaching the installation tool, the ball is placed in the seat and by blocking the path, it increases the pressure and as a result, the ball is installed.

### **Mill out Extension**

This connection of two pin ends is usually present in permanent packers. Usually in the

PACKER TAIL section, when the PACKER is of permanent type, it is the first device. Permanent packers are recognizable at a glance. That is, in the repair operation, it must be milled. Grind some packers with PACKER PICKER and the rest with JUNK MILL OR ECONO MILL and then take it out of the well.



**Figure 2.** An example of mill out extension perforated joint

It is an ordinary and short pipe branch with holes of a certain number and diameter throughout its body and the bottom of the BOX and PIN head is produced or can be produced in different sizes with different diameters. On either side of it there are two NO GOs, and at the end is a MULE SHOE OR RE-ENTRY GUIDE SHOE. Usually one or two TUBING branches are placed under the mill out extension. The standard length of a PERFORATED JOINT is usually 12 feet. This tube provides a specific path and location for pressure and temperature measuring instruments and operations in the trail below the ball.

### **Re-Entry Guide Shoe**

The new generation is a shoe that usually has a NO GO number on it and is a UNIFORM piece that has both SHOE and NO GO. Its cut edge is completely horizontal and has an arched recess that GUIDE the well tool inside. In the size of 2.875 inches, it usually has to be made while driving.

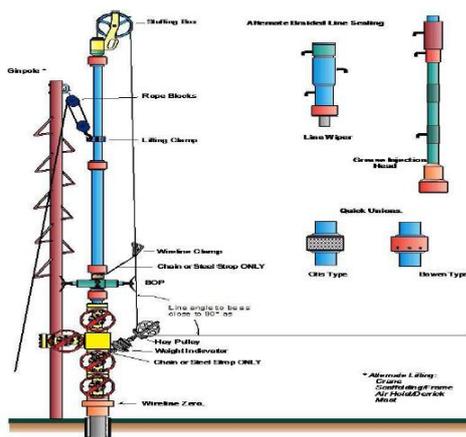
### **In-well Operations and Repairs**

In the wire line operation, we do different things for the COMPLETION STRING components using the wire / cable of the drilling rig of special equipment that we tie at the end of the string. Wireline operations can also be performed on live wells. This section includes devices and equipment for measuring pressure, temperature and sampling of fluid inside the well and other special operations that we will say in the following.

Depending on the type of well operation, wire or cable is used. So in this text, the meaning of cable or well wire is the same as the series of wells. Well cables are very diverse in terms of size and type and are available in sizes from "3.16 to" 16.5, which are usually of the sizes "1/4" and "1/16" are used. They are made of stainless steel, modified steel and galvanized. Cables are used in cases where more tension is required and the wires are not able to withstand this tension. Because the cables do not have a circular cross-section, they are leaked by a stuffing box with a special GREASE INJECTOR HEAD by applying hydraulic oil pressure.

Surface equipment for drilling wells with SLICK LINE

All tools used for in-well drilling operations must be resistant to hydrogen sulfide gas.



**Figure 3.** General schematic of well drilling equipment

### Rope Socket

It is a device that takes the wire from one end and provides us with standard reservoirs called UN 12 on the other. This device is used to connect the wellbore wire to the wellbore tool string. The tip of the device is round and conical in shape so that when lifting the wellbore tool, the tool does not get stuck to the edge of the brain tube and other parts. Or, if stuck on the edges, guide the conical rule of the whole set into the COMPLETION STRING.

### Blower

This device is used to knock and pull out control or cut-off devices such as safety valves. This device has different types, the two most famous of which are mechanical jar and hydraulic jar.

The mechanical jar is made up of two separate chain-like parts that can strike both up and down, which is uncontrollable. In the retrieval operation, the TUBULAR JAR is used instead of

the mechanical jar, which is another type of mechanical jar that is protected by its STROKE tube. This sample is used for the retrieval operation.

The area in which the actuator moves in a cylindrical manner and has several ducts for fluid exit. Of course, the impact of this type of jar is slower than that of the mechanical jar. This hinged connection gives the drilling rig flexibility.

### Pressure Control Devices and Surface Devices

As it is known, the pressure control components and surface devices are closed on the crown of the well. For this purpose, the safety valve is first taken out of the automatic mode so that it does not close when the well tool enters the well, in which case the well cable is cut off. Now remove the well cap and install the BOP pressure control device on the deep valve.

On the pressure control device, usually three branches of the pipe called lubricator are installed and the stuffing box is installed on it, so the airline operation is blocked in an environment and can be performed despite the pressure. The crane is used to lift the surface equipment to connect or open the wellhead, as well as to lift the lubricator and staff box to connect the tool to the wellbore cable. The length of the lubricator is a function of the length and diameter of the equipment to be inserted and exited from the well in a more accurate analysis. For example, to get 3 SV, you should definitely use lubricator. In the retrieval

operation, the basis for success must be established and the length and diameter of the FISH must be considered and added to the length of the lubricator.

Bleed off valve is the needle valve that connects to the lower branch of the lubricator. When the wellbore is taken out of the well and the wellbore valve is closed, the pressure and fluids in the system are discharged with this valve. If we have H<sub>2</sub>S in the system, it must be discharged in a safe place with the necessary connections.

Considering the method of filling the well, which may be an open hole or a walled pipe, the choice of flow paths and the size of these paths are also very important. It makes sense that each layer needs a unique path. Therefore, two or more operating layers with different pressures need several paths for production. It should always be kept in mind that layers with different pressures should never be interconnected by drilling, as this will lead to an eruption.

### Conclusion

Artificial descent methods are used when the reservoir pressure is not sufficient to deliver oil to the ground. Artificial overflow is a method to increase the life of well production and increase the harvest, reducing the minimum pressure required at the bottom of the well for production. It also increases the amount of harvest from the reservoir. Choosing the right artificial overflow method for long-term operation of most injection wells is important and improper selection can lead to the reduced

production and increased operating costs. The selection of the correct method of artificial overflow based on the effective parameters in production, according to the reservoir conditions, well constraints, production fluid properties

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