THE ULTIMATE FILTRATION TOOL

THE UTILIZATION OF TUBING SCREENS AND PUMP SCREENS IN DOWN HOLE PUMP OPERATIONS

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ABSTRACT

Sand problems can cost a company valuable time, money, and resources. Various methods have been used to reduce sand problems experienced in rod pump operations. This presentation will propose an alternative solution utilizing pump screens and tubing screens to handle the sand problem and increase production and profit capability. Illustrations will be examined, which explain how pump and tubing screens function, and case studies will be reviewed that discuss the benefits and limitations of the screens.

SAND PROBLEMS IN THE WELL

In the production of oil, sand particles and/or other abrasives are pumped with the fluid to the surface. As the particles travel up the tubing, separation occurs. The smaller particles stay suspended and are lifted to the surface; however, the larger, heavier particles fall down and settle on top of the rod pump. This repeated process can lead to two major problems:

Sand Cutting

As fluids are pumped from the well bore, sand and/or large abrasives are pulled into the pump, slowly moving between the barrel and the plunger and causing Asand cutting.@ The sand cuts restrict the flow of production, which greatly affects the performance of the well. In time, sand cuts can also result in pump failure. When this occurs, production must cease, the rods must be pulled, and the pump must be replaced (**Figure 1**).

Rod Buckling

Another problem caused by sand is Arod buckling.@ As sand packs in around the pump, it restricts the ability of the plunger, which can result in buckling of the rods. The buckled rods rub against the tubing, which causes wear on the rods, tubing, and pump. In time a hole can be worn into the tubing, which stops pressure and the flow of oil. Production must be stopped so that the rods and tubing can be replaced (**Figure 2**).

The continued pumping and separation of sand can cause sand cutting and rod buckling to occur over and over again during the life of a well. In order to combat the sand problem, some production companies have chosen to utilize the help of pump and tubing screens, which have proven in many cases to save the company time, money, and resources.

HOW DOES A PUMP OR TUBING SCREEN WORK?

Pump and tubing screens are manufactured out of vee-wire screen and are used to filter out large sand particles and other abrasives before the fluid enters the pump, which helps to maximize the life of the equipment. The object of a down-hole screen is to prevent an influx of sand from flowing into the production tubing and/or pump screen while maintaining desired production levels. The key to the success of the screen is the vee-wire construction. The vee-wire slot opening (which is the gap or opening between the vee-wires) provides only two point contact with sand grains and cannot become plugged as easily as other methods, such as the slotted pipe or the wire mesh, which can become plugged easily due to their design. The size of the slot determines the filtration size, with each slot measuring 1/1000th of an inch per slot (Ex. an 18 slot screen has a opening of 18/1000ths of an inch). The design inwardly enlarges to prevent particles from becoming jammed in the slot. The particles that are near in size to the slot opening simply pass through freely (**Figure 3**). The vee-wire slots come in varying sizes in order to successfully filter the specific kind of sand that is causing the problem in a well. There are two main kinds of sand: formation sand and frac sand. Formation sand is smaller than other kinds of sand and is usually irregular in size. Frac sand is larger than formation sand and is very uniform. Frac sand is usually the most abrasive kind of sand. It is important for a producer to know exactly what kind of sand is causing the problem in the well in order to choose the slot size that will most effectively filter the sand, yet still allow an acceptable flow of fluids. The screens also come in a variety of lengths. Length is a critical factor in sand screen use. Most plugging occurs when the fluid velocity is too fast, causing sand to become wedged in the opening. The longer the length of screen placed in a well, the slower the velocity. A lower fluid velocity is less likely to pull the solids into the slotted opening of the screen. Generally, when a producer is contemplating the use of a pump or tubing screen in a well application, the producer is asked to provide a soil example so that the filtration company personnel is able to choose the most effective screen for the unique requirements of the job. The screen is only a small part of the tremendous cost of an oil well, but it is critical to its success.

Although the pump screen and the tubing screen are similar in construction and general use, they differ in size and specific function.

Pump Screen

The pump screen, also known as the pump guard screen, is run in place of the gas anchor on the bottom of the pump (**Figure 4**). It increases the life of the pump by decreasing the filtration size and reduces gas and scale breakout by decreasing pressure drop. The pump screen is constructed from 304 stainless steel, making it a long-lasting and reusable product. The openings are large enough to easily be cleaned with a wire brush and re-installed on the pump. The pump screen can be placed either below or above the casing perforations. When placed below the casing perforations, the liquid must u-tube, which causes much of the sand to fall to the bottom of the hole. When placed above the casing perforations, the sand screen is mounted on a joint of pipe. The other end of the pipe is attached to the rod pump. This pipe replaces the gas anchor. The additional length allows the sand screen to be placed down into the separator, which allows time for the gas to separate (**Figure 5**). The pump screen comes in various lengths and slot sizes, which makes it easier to choose the right pump screen for the job (**Figure 6**).

Tubing Screen

The tubing screen is run in place of the perforated sub below the seating nipple, which allows it to filter out the sand between the tubing and the casing. It is made up of a screen jacket that is slipped over a piece of perforated J55 tubing (**Figure 7**). The tubing screen is designed specifically for wells with a high lifting cost associated with sand failures. Part of the success of this type of filter is that it has a large circumference area. The tubing screen can be placed either below or above the casing perforations. When placed below the casing perforations, the tubing screen is screwed to the bottom of the seating nipple and a standard bull plug is installed on the other end. A 6 foot gas anchor is placed inside the tubing screen, which allows the pump to draw from the center of the screen. This design will maximize gas separation. When the tubing screen is placed above the casing perforations, it is screwed to the bottom of the seating nipple and a joint pipe with a bull plug installed is attached to the other end. A long gas anchor attached to the rod pump draws from the bottom joint below the tubing screen. This allows the screen to be the opening in a standard gas separator, which will replace the perforated sub. This design works well when filtering sand and gas (**Figure 8**). The tubing screen is available in a number of lengths and slot sizes (**Figure 9**).

LIMITATIONS

Although tubing and pump screens are the ideal solution to most sand problems, they do have limitations.

Fine Sand Particles

The smallest slot size for a screen is 6/1000ths of an inch. If a well is experiencing problems with fine sand particles that are smaller than this screen size, the screen would be ineffective in reducing the flow of sand.

Scale

Another limitation of the screen is experienced when scale is encountered in the well. Over time, scale can soften and build up on the surface of the screen, slowly coating the opening and restricting the flow of oil and gas. This is a problem that will clearly limit the ability of the screen to function properly. However, if a proper chemical program is introduced at the same time the screen is inserted into the well, the chemicals will break down the scale and allow the screen to function as it should.

Improper Screen Length

A third problem that can limit the ability of the screen is the selection of the wrong screen length for a particular well. A shorter screen will experience a faster or increased fluid velocity, whereas a longer screen will experience a slower or decreased fluid velocity. A faster fluid velocity is more likely to pull solids into the opening of the screen, which can result in a build-up that will reduce the flow of oil and gas or even cause plugging. The slower fluid velocity of a longer screen length is less likely to pull solids into the opening of the screen, therefore, the problems experienced by a shorter screen length simply do not occur. The key to success is the selection of a length that will inhibit the formation and build up of sand particles on the surface of the screen, yet still allow a desired fluid velocity.

Many of the problems experienced in connection with the screen are a result of either a lack of communication between the producer and filtration company personnel or improper use of the screen. Due to the potential limitations listed above, it is important for the producer and the filtration company personnel to discuss the well=s history and make a thorough examination of the well soil and conditions before selection of the screen is made.

CASE STUDIES

The following case studies have utilized tubing screens and/or pump screens to deal with sand and/or abrasive problems in the well:

Case Study #1

Apache Corporation, N.E. Drinkard Unit. The pumps in this field were seated below the perfs, with all wells having extensive rat hole depths. The field was experiencing both serious formation sand issues and gas interference. This combination was causing major maintenance and repair expense. The initial corrective action taken was the running of pump screens to help combat the influx of sand being pulled into the pump. The desired result was only partially achieved due to the existence of gas. A determination was made to run an OSI 24 foot tubing screen with a long dip tube. This configuration not only allowed for the correct filtration of sand, but also excellent gas separation. It also resulted in very long pump runs, which increased the company=s production numbers for the field, while substantially lowering the overall maintenance costs.

Case Study #2

BP America, Windham 128-9 Well. BP was forced to pull the well every six months due to damaged traveling valve or plunger cuts on the pump caused by sand cutting. The rods were also becoming stuck because of sand buildup. These issues were discovered as a result of reduction in the production output and indications on the surface and down-hole cards. The well was designated to pump a maximum of 50 bbls / day at a depth of 11,900 feet. Based on the maximum daily production outlay for the well, the previous configuration of down hole production tools for combating the issue was incorrect. The configuration was not separating the solids adequately and allowed the solids to flow into the pump barrel, which resulted in sand cuts to the plunger and inner barrel surface. It was determined that a new configuration was needed to correct the issue. An OSI 24 foot tubing screen was placed into the hole to filter out the larger abrasives, allowing the smaller, non-damaging particles to become suspended in the production stream and float to the surface. This allowed for better pumping efficiency and production output. Pursuant to the down hole dynamometer cards, the well is currently producing efficiently, with no indications of sand interference or damage.

Case Study #3

Chevron U.S.A., Dollarhide Field. The well experienced problems because the formation was not holding the sand structure. Chevron was forced to run the pump above the perfs and experienced large repair costs due to frequent replacement of barrels and plungers with sand cuts. The sand problems forced the lease operator to lower the rod string 2-3 times per week in order to recoup adequate production numbers. They also experienced some problems with iron sulfide. Chevron decided to run an OSI 15-slot tubing screen to filter out the frac sand, formation sand, and other abrasives, which increased the bypass tolerance on the pump barrel to .009 tolerance. It provided maximum filtration of solids and allowed the smaller particles to suspend to the surface with minimal to no damage to the pump. This resulted in longer pump runs (an average of 2-3 years) and significantly reduced repair costs. Chevron started out running 1 or 2 OSI 8 foot tubing screens but eventually changed to using OSI 24 foot tubing screens in all of their wells. This reduced the period of lowing rod strings to 6-8 week intervals. Chevron considers the tubing screen to be the first line of defense for handling the sand/abrasive issues it faces.

Case Study #4

Yates Petroleum, Southeast New Mexico. Yates experienced problems in this area with sand and abrasives damaging their pumps, resulting in excessive down time and high maintenance expense. They initially placed OSI 8 foot tubing screens in their wells for the filtration of formation sand. They later changed to the OSI 24 foot tubing screens when they became available. The tubing screens have given them longer pump runs, which has resulted in fewer incidents of down time and lower maintenance cost. In some of the wells, Yates has also experienced instances of gas interference and scale and frac sand problems. Different configurations and slot sizes have been utilized in the wells to correct these down hole issues, with positive results. Although Yates occasionally uses the OSI 8 foot tubing screen in their horizontal wells (running it above the perfs), the greatest corrective results have been experienced with the OSI 24 foot tubing screen, which they run on almost all of their wells in this area.

CASE STUDY REFERENCES

1. Burmea, John, Chevron U.S.A., Dollarhide Field, Andrews County, Texas and Southeast New Mexico.
2. Gonzales, George, BP America, Windham 128-9 Well, Crane County, Texas.
3. Lanier, Bruce, Yates Petroleum, Southeast New Mexico.
4. Warren, Mike, Apache Corporation, N.E. Drinkard Unit, Southeast New Mexico.

Figure #1

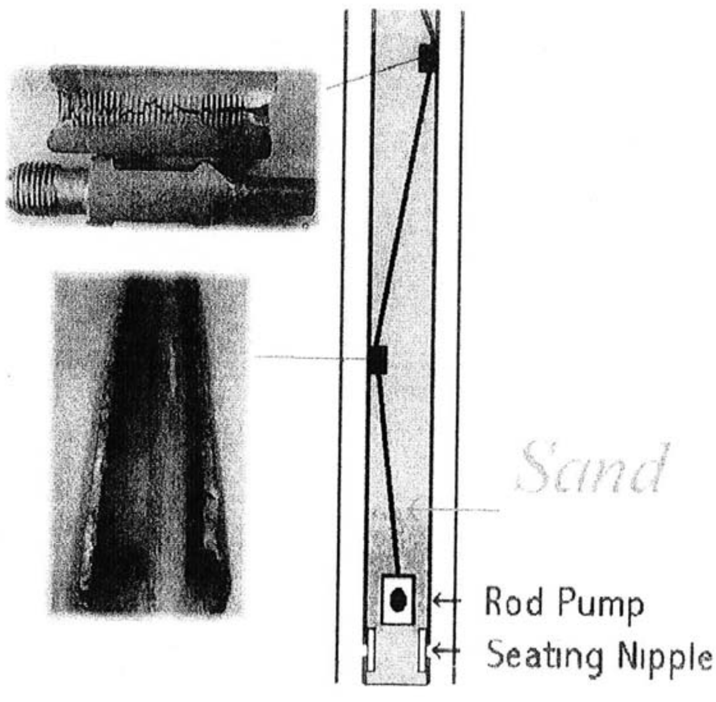


Figure #2

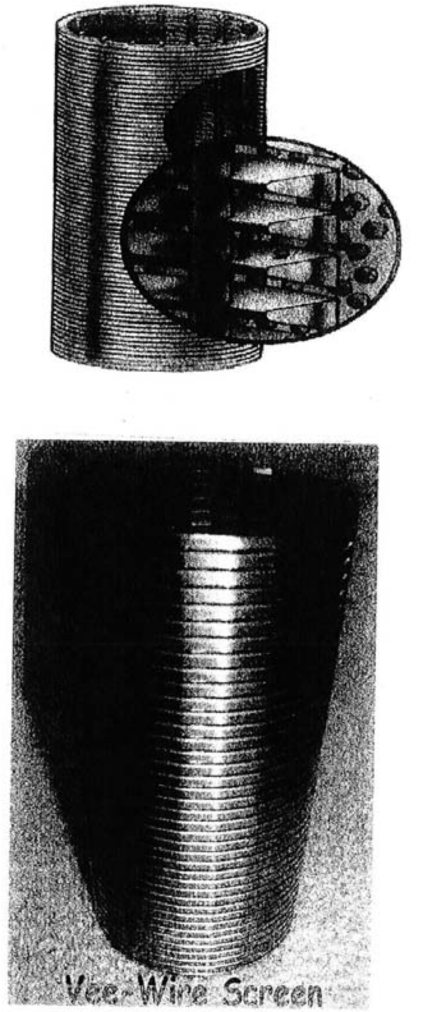


Figure #3

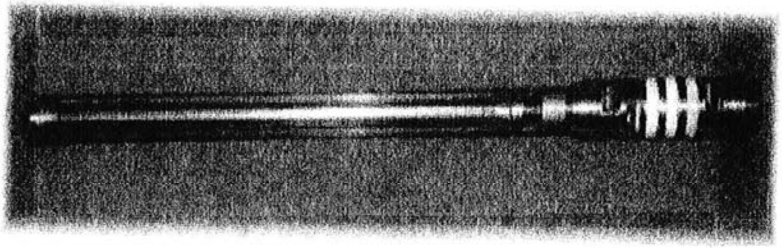
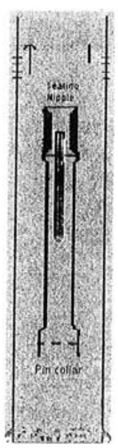


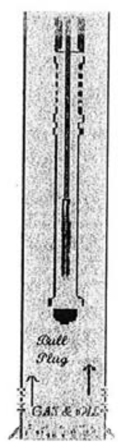
Figure #4



Configuration 1

←**Casing Perforations**

In this configuration, the pump guard screen is placed below the casing perforations.

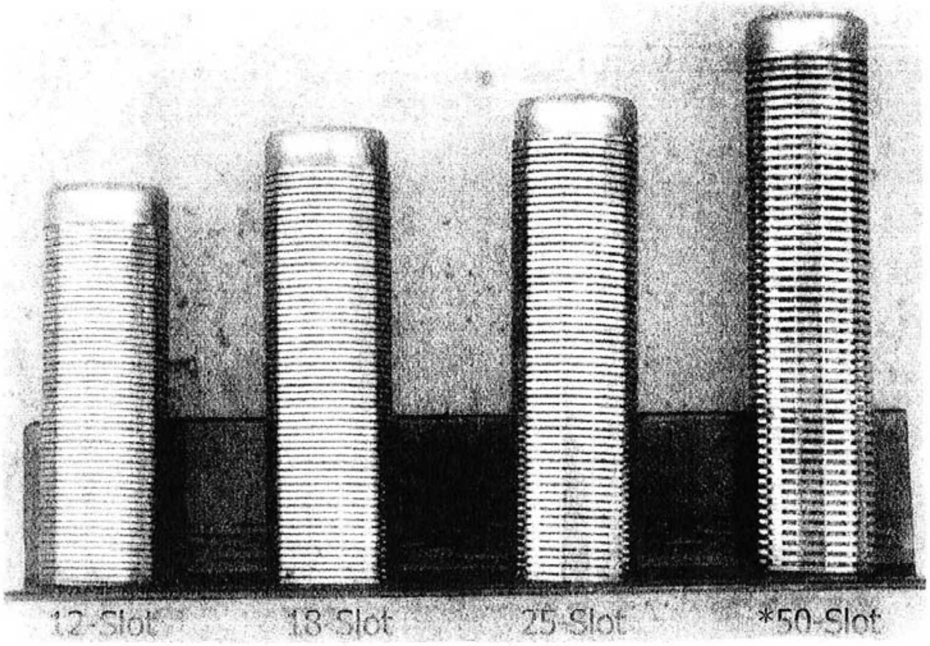


Configuration 2

In this configuration, the pump guard screen is placed above the casing perforations.

←**Casing Perforations**

Figure #5



Pump Guard Screens

3/4x8'	12, 18, 50 slot
1"x2'	12, 18, 50 slot
1"x3'	12, 18, 25, 35, 50 slot
1"x6'	12, 18, 25, 25, 35 50 slot
1"x8'	12, 18, 25, 35, 50 slot
1"x10'	12, 18 slot
1"x16'	12 slot (pipe based)

1-1/4"x2'	12, 18, 25, 35, 50 slot
1-1/4"x3'	12, 18, 25, 35, 50 slot
1-1/4"x6'	12, 18, 25, 35, 50 slot
1-1/4"x8'	12, 18, 25, 35, 50 slot
1-1/4"x10'	12, 18 slot

Figure #6

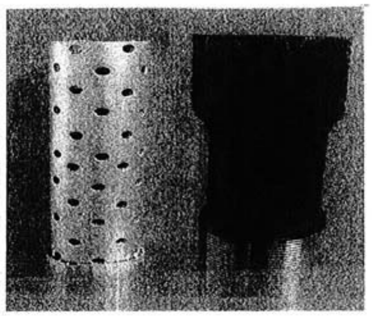
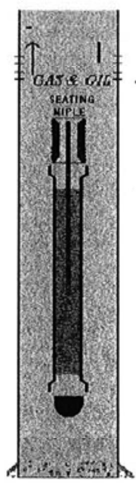


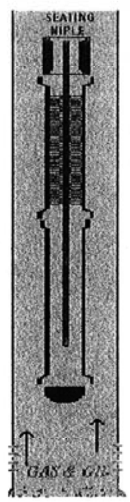
Figure #7



Configuration 3

← **Casing Perforations**

In this configuration a tubing screen is placed below the casing perforations.

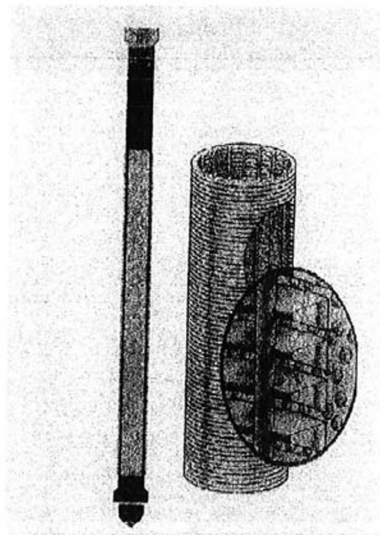


Configuration 4

In this configuration a tubing screen is placed above the casing perforations.

← **Casing Perforations**

Figure #8



SIZE	SLOT	Open Area	Pipe Base	Lift Sub Length	Weight Lbs.
2-3/8''x8'	12	66''	J55	11''	65
2-7/8''x8'	12	79''	J55	11''	80
2-3/8''x8'	20	102''	J55	11''	65
2-7/8''x8'	20	122''	J55	11''	80
2-3/8''x8'	50	199''	J55	11''	65
2-7/8''x8'	50	241''	J55	11''	80
2-3/8''x23.5'	12	197''	J55	3'	195
2-7/8''x23.5'	12	239''	J55	3'	240
2-3/8''x23.5'	15	239''	J55	3'	195
2-7/8''x23.5'	15	289''	J55	3'	240
2-3/8''x23.5'	20	304''	J55	3'	195
2-7/8''x23.5'	20	368''	J55	3'	240
2-3/8''x23.5'	50	596''	J55	3'	195
2-7/8''x23.5'	50	723''	J55	3'	240

Figure #9