Sand-Pro® Sucker Rod Pump for Fluid with Sand Production Conditions In Down-Hole Sucker Rod Pumps

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ABSTRACT AND SCOPE

The patent-pending Harbison-Fischer Sand-Pro® sucker rod pump has been field tested since August 2006 in wells located primarily in California. Results have been favorable in these sand-producing wells by increasing the time between pump repairs.

This paper will review the test data and the characteristics of these wells. It will also describe the fundamentals of this method of artificial lift, and present what was learned about pump component selection and downhole applications.

INTRODUCTION AND BACKGROUND

Fluid with Sand Production: Sand is among the hardest materials located in a sucker rod pumped well. Its hardness is about 7 on the Mohs scale, the same as quartz rock and about the same as hardened stainless steel sucker rod pump components (stainless steel balls and seats), and only slightly less hard than carbonitrided sucker rod pump barrels or sprayed metal plungers. Some sucker rod pump components are harder; such as nickel carbide plated barrels, carbide/sprayed metal plungers, and carbide balls and seats.

In California there are many wells that produce large percentages of sand and high water cuts. In these wells pump life is shortened due to wear of the plunger and/or barrel. Generally the shorter of the two receives the most wear during its pumping life. With Pampa Pumps the barrel is shorter than the plunger, and is used in wells with plunger sticking problems and plunger wear problems. Standard API style sucker rod pumps use plungers that are shorter than their barrels.

Many methods have been tried over the years to lengthen sucker rod pump runs in sand production conditions wherein the pump is worn prematurely by sandy abrasives. Plunger and barrel treatments as well as various sucker rod pump configurations have been tried. Although the Harbison-Fischer Sand-Pro® sucker rod pump is relatively new and has only been tested in a dozen wells it is hoped that its unique approach to the wear problem will provide a long-term solution.

THEORY

The Harbison-Fischer Sand-Pro® Sucker Rod Pump: All pump companies and many inventors and operators have come up with ways to address the abrasive sand production problem, mostly through harder coatings or ways to keep the sand away from the plunger-barrel interface. Many of these ideas were tested and some are still undergoing field tests.

The biggest problem affecting plunger/barrel life is the leading edge of the plunger barrel interface, where high pressure tends to force sand between the plunger and barrel. With a short plunger and long barrel sucker rod pump design the plunger is running over the sand particles on the upstroke while the high pressure is forcing them into the plunger/barrel interface. This is the standard sucker rod pump configuration in use today and is also the American Petroleum Institute standard design for interchangeability.

The Pampa Pump design overcomes some of the problems of standard sucker rod pumps through the use of a long plunger and short barrel, where the plunger is always stroked out of the barrel. On the upstroke of the Pampa Pump the plunger is moving out of the top of the barrel pulling sand particles away from the plunger/barrel pressure

interface while pressure is trying to push the sand and fluid into the interface. This approach has helped significantly by lengthening run times.

The theory for the Sand-Pro® utilizes a principle of two plungers to separate the pressure handling plunger from the gas handling plunger, thus allowing the pump to load with almost zero intake pressure, a major breakthrough in sucker rod pump design.

The Sand-Pro® sucker rod pump uses this concept to separate the pressure sealing function from the sand handling function. The upper, sand handling plunger keeps the sand away from the lower, pressure sealing plunger enabling it to function with less wear since it does not have to contend with the majority of the sand particles.

The upper sand handling plunger is characterized by having balanced pressure above and below the plunger. This gives the relatively soft sealing cups a longer life since they do not seal against the high pressure of the pump installation depth.

The lower, pressure sealing plunger is sprayed metal coated with a hard, HRC 58-62 sprayed metal coating to resist wear due to the high pressure and sand particles that may come into contact with the leading edge of the plunger.

The two plungers are connected with a standard pull tube with holes in its lower end. A sand shield is installed between the outside diameter of the pull tube and the inside diameter of the pump barrel. The sand shield prevents or minimizes sand infiltration into the area above the lower plunger. Sand can accumulate in the annular area between the pull tube and sand shield and flow back into the interior of the pull tube to be produced up the tubing.

FIELD TESTS

The prototype was successfully tested in August of 2006. Field tests started shortly thereafter and to date all field tests have been successful. To date fourteen (14) field tests are running and most have passed previous run times.

Upper Plunger: Valve cups have been tested with good results but any type of sand handling, positive sealing elements can be used on the upper plunger. The number of valve cups is based on the rule-of-thumb of four (4) cups per thousand feet of fluid lift, although it is postulated that fewer cups would be necessary than in standard pressure-type applications.

Lower Plunger: For the field tests we used a relatively close fit to the barrel to minimize slippage and possible movement of sand past the sand shield. Several fits were tried with the closer fits being the best choice. Some have been run with valve cups or composition rings as lower plunger extensions. Since the field tests are ongoing at this time there is not a conclusion as to which configuration will be best.

SUMMARY

Field testing is continuing with good results as previous run times are being surpassed. Additional data will help with minor option choices, such as the best type of upper plunger sand handling rings for certain conditions.

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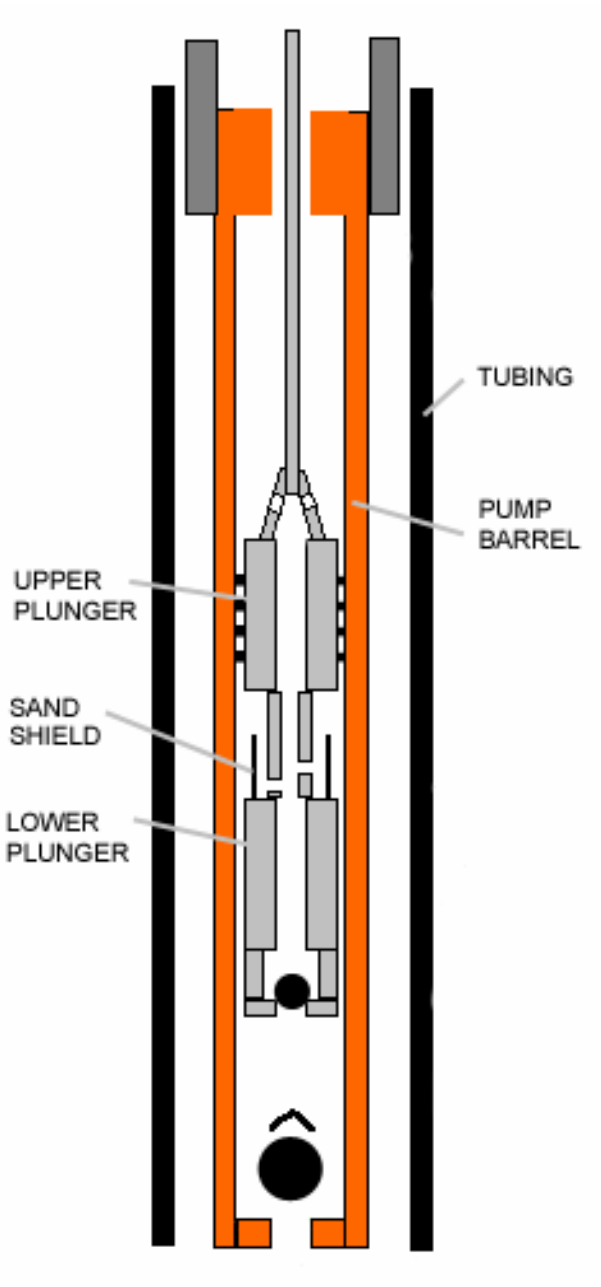
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