Casing Type Pumping With Hydraulic Pumps

By K. D. SNEDEKER
Kobe, Inc., Brownfield, Texas

The subject heading of this article eliminates the necessity, it would appear, for any discussion on what constitutes the fundamentals of a Kobe Hydraulic Pumping System. Consequently this will not be discussed in this article. We shall assume that the reader is familiar with the basic fundamentals of the system sufficiently to consider the following presentation.

The writer would like to state briefly some facts concerning the Kobe Production Unit (Bottom Hole Pump) that should be considered when reading this article.

1. The Kobe Pump is a piston displacement pump. It has the closest maintained piston to intake valve clearance that the writer has observed in any oil well pump.

2. The pump piston is pressure lubricated by the power oil. The power oil being clean, the Kobe Pump is not damaged, scored or abrasive cut by produced fluids. This factor explains the reason why a Kobe Pump will successfully pump abrasive fluids including 100 percent water successfully without the usual damage experienced by oil well production pumps.

Pressure lubrication by the power oil is applied to practically all moving parts in the Kobe Pump. Hence damage to Kobe Pumps from abrasives is generally in direct ratio of the quality of the power oil.

This appears, in the opinion of the writer, a feature that contributes considerably to the potentiality of the pump to give long service, and is a feature that is unique in its completeness in oil well pumps.

3. The length of the piston travel is constant, allowing a more efficient calculation of displacement volumes.

4. A Kobe Pump will not "gas lock." The writer has formed this opinion in observing the operation and performance of Kobe Pumps displacing gas at 12,400' pump setting, recorded intake pressure of 150 P.S.I. against a discharge head of 12,400' of heavy water laden fluid.

This feature could constitute a separate lengthy discussion and I will not detail further in this article.

5. There is nothing about the construction of a Kobe Pump that prohibits natural flow of production thru the pump, provided the well has the capability to do so. The only factors of consequence that provides any difference in this respect to a rod type pump is that the discharge production fluid column is always composed of power oil and produced fluid, it is not agitated by rod movement, it is relatively heavy, so that the tendency for natural flow is reduced.

6. The operation of a Kobe Pump creates no discernible oscillation of producing tubing. I believe therefore that any hazard to well casing, that could be anticipated by oscillating loads against a casing packer, that are to be considered with single action oil well pumps, hydraulic or rod type, can be minimized when considered with single action oil well pumps, hydraulic or rod type, can be minimized when considering the use of a Kobe Pump.

7. By simple calculation from the operating pressure of a Kobe Pump, a very accurate estimation of the pump intake pressure and indicated Bottom Hole Pressure can be accomplished.

At this time this type calculation is accepted by governmental regulatory agencies in many states, including Texas, for Bottom Hole Pressure recordings.

Kobe Hydraulic Casing Type pumps are confined to two basic types at the present time. There is the Conventional Insert and Free Type.

Both have common features in that they use the casing for the production tubing and require only one string of tubing for power oil transmission.

Both require a casing packer. Selection of types and makes of packers also have a common requirement to both types. In the case of each type, the production pump is usually, not always set directly above the packer. Hence in the case of deep wells and we have many set in the 12,000' depth range pumping water, it is not unusual to reach an operating situation wherein below the packer there is 150 P. S. I. pressure, above the packer there is 5,000 P. S. I. pressure. Under this condition the writer cannot recommend the use of a hookwall type packer because many fail to hold under such situations. In all fairness, it must be said, not all have failed but most hookwall packers have fail-

ed in one installation or another.

The only packer that has held consistantly under this extreme condition is the Baker Model D Production Packer, in the writer's personal experience. Obviously, perhaps there are other packers capable of holding constantly. The writer has not observed performance of same for comparison.

However, the cost of above suggested packer makes comparison under other conditions, average conditions I might remark, not particularly favorable if not justified. A large percentage of our casing type pumps use hookwall packers successfully. I refer to settings not deeper than 8,000'.

Neither the Conventional Insert nor the Free Type Casing Pumps requires special grade well tubing. In each instance, the well tubing is supported partially on the production packer and partially by suspension from the tubing hanger.

The operation of the Kobe Pump does not set up any extra tensile requirements, even in deep wells, so that tubing of a grade ordinarily selected by the operator for natural flow is sufficient for the purpose. It should have sufficient tensile strength to unseat a packer at the depth set.

The internal pressures applied to the I. D. of the well tubing, required to operate the Kobe Pump, is usually always within the specifications of the tubing. It must be realized of course that the static head of fluid within the well tubing is offset by the static head of the produced fluid on the O. D. of the tubing.

The Conventional Insert and the Free Type Casing systems have another common feature.

In each instance the power fluid travels down the well tubing and returns mixed with the produced fluid through the casing annulus. This provides a simple manner to circulate corrosion inhibitors as same can be easily and simply injected into the power fluid at the surface pump for circulation as above noted. Hence protective chemicals can be spotted directly above the casing packer, protecting all wall surfaces of all the well tubing including the inside of the well casing.

In the case of the Free Type Kobe Pump the well tubing can be usually cleansed sufficiently by circulating down the tubing and out of the annulus.

In the case of the Conventional Insert Pump, the well tubing or power oil transmission line can also be circulated to cleanse out abrasives. This is accomplished by use of a wire line set circulating joint, set immediately above the pump.

The features noted previously in this article that are common to both types Kobe Casing Type Pumping Systems allow the operator to make a wide range application of pumping equipment, in consideration of fluid lift and fluid volume with very little cost outlay for special materials.

When contemplating a Kobe Casing Pump the features of the Free Type Pump are always more attractive and preferable to the Conventional Insert, to the operator. So, selection of the one type against the other is usually governed by the following operational requirements.

1. Volumes to be produced.
2. Required fluid lift.
3. Size of well casing.

Kobe, Inc., offers the Kobe Casing Type Free Pump in only two basic sizes at this time.

First, we offer the 2" Casing Type Free Pump. This installation requires a minimum of 2" well tubing. In the 2" size we offer the following 100 percent displacement specifications.

1. Maximum produced fluid — 270 B/D from 6,300' 2" x 1 - 3/16" Pump.
2. The maximum effective fluid lift is from 15,000'—95 B/D—2" x 13/16" Pump.
3. 2" x 1" Pump rated at 174 B/D from 10,000'.

Secondly, we offer the 2 1/2" Casing Type Free Pump. This installation requires a minimum of 2 1/2" well tubing. In the 2 1/2" size we offer the following 100 percent displacement specifications.

1. Maximum produced fluid, 500 B/D, from 7,000'. 2 1/2" x 1 - 7/16" Pump.
2. The maximum fluid lift is from 15,000'. 182 B/D 2 1/2" x 1" Pump.
3. 2 1/2" x 1 - 1/8" Pump rated at 262 B/D from 13,400'.
4. 2 1/2" x 1 1/4" Pump rated at 349 B/D from 10,000'.

Hence, I would summarize the Kobe Free Type Casing Pump as—by use of same, an operator is able to produce at 100 percent ratings 182 B/D from 7,000' if 2 1/2" well tubing is used. I should like to advise at this point that we regularly adapt our 2" Kobe Pump to use in 2 1/2" tubing as well as use in 2" tubing.

I am sure you realize the immediately above are maximum ratings both on depth and fluid volumes, at our recommended maximum rated pump speeds. In many instances, particularly in speed ratings, the operator has elected to exceed our ratings with the result that displacements have resulted well above that noted above.

I should like to further point out that in many instances we are pumping volumes as low as 25 B/D from 12,400' at intake pressures ranging at 200 P. S. I. This is accomplished by the use of our 2" x 13/16" and 2 1/2" x 1" pumps operating at reduced speeds.

While noting that in many instances operators have exceeded recommended maximum speeds on Kobe Pumps with satisfactory results, to my knowledge they have never exceeded the recommended setting depths of the Kobe Pumps with any degree of success. This again requires some qualification. When we say setting depths we actually mean effective fluid lift.

In other words, a Kobe 2" x 1 - 3/16" Pump has a recommended maximum setting depth of 6,300'. Many times this size pump is set at greater depths and the displacement obtained with good operation. In this instance however the fluid lift required has not exceeded 6,300'. We suggest to operators, that in making a Casing Type Free Pump installation, or any Kobe Free Pump installation involving 2" Power tubing that a Kobe 2" pump will produce at 100 percent efficiency 270 B/D from 6,300', 174 B/D from 10,000' and 95 B/D from 15,000'.

The immediately above can be applied to the ratings of 2 1/2" pumps summarized previously on this article.

For example—The operator has a 12,000' well. He has installed a string of 2" EU J55 tubing set on a packer, in 5 1/2" O. D. casing. Artificial Lift is required for further production.

He requires 50 B/D from bottom. He can install a 2" Kobe Free Casing Pump with very little extra equipment other than the Kobe pump. He uses his packer, well tubing, tubing hanger.

He requires 1200 B/D from 10,000'. He can install a 4" Conventional Kobe Casing Pump again using all his well equipment with very little extra cost other than the price of the Kobe Pump.

In each instance, the operator has very little special handling of tubing involved. Installation of each consists simply of running a string of tubing in the usual manner with a packer and setting same.

The only basic difference in manner of installation of the two types is that with the Conventional Insert Casing Pump, the pump is lowered into the well on the well tubing. To change pumps, the well tubing must be removed.

The proceeding should justify the attraction that the Kobe Casing Type Free Pump has for some operators. Many operators have successfully applied this type of pumping equipment to wells in West Texas. There is every indication that some wells can be successfully depleted in this manner of pumping.

We are always faced with a gas displacement problem when pumping through a packer. As a Kobe Pump will not "gas lock" the matter of gas volumes the pump must handle is of primary consideration. It has been our experience that intake pressure draw down to solution pressure results immediately in very low pump end efficiency. In other words the Kobe Pump begins to compress foamy gassy fluid, so that the pump efficiency in relation to oil is very low. When the displaced gas is measured and gas compression equations applied, the total displacement of oil and gas always reflect efficient pump piston displacements.

This suggests that any well could be pumped to depletion, provided a Kobe Pump having sufficient displacement was installed. Usually in the past we found that when using a casing type installation and we had gas flashing under the packer the operator provided some means of gas relief, either installing a gas vent string or removing the packer type installation. Generally the result was immediate pump efficiency increase but no sustained increase in daily production.

There are exceptions of course to the above. Generally the immediately preceding experience is the case rather than the exception. Consequently after some years of trial on this mat-

ter the users of Kobe Equipment have conceded the preceding to be factual and accept the obvious reason for the low pump efficiency.

There are some instances where it is indicated that a casing type pump be removed and a parallel installation be made to increase the production pump efficiency, by withdrawing the production gas off the casing rather than displacing through the production pump.

This action would and could be justified by increasing the effectiveness of the installed surface horse power. Four times more horsepower is required to lift fluid at 25 percent pump efficiency than at 100 percent efficiency. Hence in multi-well lease operations particularly, the efficiency of the installed surface horse power always is to be considered.

The Kobe Free Type Casing Pump, as a result of the preceding discussion would appear to be a very effective means of producing fluid at a low installation cost and has special application to a particular type well.

Production requirements of many wells in West Texas, particularly Devonian Pay, are very much in excess of that obtainable with a Casing Type Free Pump. The operators are now requiring displacement volumes of up to 1,400 B/D, in some of these wells. Of the 1,400 B/D requirement we are operating in some instances producing 1,200 B/D of water.

At this time we can only accomplish this required displacement with a 4" Conventional Insert Casing Pump.

Submergence in these instances is of secondary importance, as those wells capable of producing volumes of 1,400 B/D show little or no effect of fluid draw down in the well bore. The operators choose a wide range of pump settings however. In West Texas, as we all know the Devonian Pay is found at the 12,000' range. Some operators elect to set the pump on bottom, apparently a hold over from recognized school of thought, "keep the water off the pay."

After some experience in pumping this pay, the operator generally sets his pump at a submergence of 4,500' to 7,000' from the top of the hole and starts producing. Some operators elect yet to run a tail pipe from the packer to the bottom of the hole, with the thought in mind yet of withdrawing fluid at the bottom of the hole, again to get as much water off the pay as possible.

It is the writers opinion that oil water ratio is not changed materially when either the high or low pump setting is made, in Devonian Production.

Hence it has been our experience that the operator in installing 4" Kobe Insert Type Casing Pumps can actually recover 50 percent of his well tubing in making a well installation.

You note in the preceding discussion the writer has confined discussion of large volume pumping to the 4" size Kobe Pump.

Kobe, Inc., makes a 3", 4" and 6" pump.

The 3" pump generally has not been used in West Texas primarily due to its limitation on volume. Well casing sizes, and lack of 3" tubing does not allow its application as a Free Pump.

The 4" Pump, in its size ranges, appear to meet the requirements of volume pumping in West Texas better than any other of our pumps.

The 4" x 1 - 3/4" Kobe Pump is rated at 822 B/D from 14,600'.

The 4" x 2" Kobe Pump is rated at 1,200 B/D from 10,000'.

The 4" x 2 - 3/8" Kobe Pump is rated at 1,850 B/D from 6,500'.

Installation of the 4" Kobe Pump is easily accomplished. An adapter is installed on the bottom of the pump replacing the pump seat. The adapter has a 2" E.U.A.P.I. male thread allowing connection to a packer on packer locater sub.

Should a hookwall packer be used, the pump is screwed into the packer coupling, lowered into the well to the desired depth and the packer set.

The power tubing is circulated, usually displacing same 2 times at as high a circulation rate as is provided by the surface pump. The Circulating joint is closed and the well is immediately on production.

When discusssing the Free Type Casing Pump, low pump efficiencies was pointed out and discussed, as same is a common and expected occurance on the type of wells these are usually installed in.

In the case of Devonian Pay however, generally the reverse is true when pumping with a 4" pump. The efficiencies of these pumps are consistently high. 95 percent efficiencies are common and 90 percent efficiency is to be expected.

The installation of a 4" pump offers one more advantage, especially attractive to the writer. Generally 4" Kobe Casing Type Installations are one well installations, or perhaps more to the point, each well requires the capacity of one surface pump. In such instances pump speed control is constant and requires little adjustment by the operating personnel as to flow of power fluid.

4" Pump installations are not contained solely to the Devonian Pay in West Texas. It so happens that this particular pay is currently more frequently equipped. We have 4" pumps set in many Ellenberger wells performing as in the Devonian. We even have 4" pumps set in the Clearfork.

In conclusion, it is the writers opinion all Kobe Casing Type installations are particularly economical and effective means of producing well fluids.