Separation Economics in 2014

Executive Summary

With the oil prices hovering around $100/barrel, current economics strongly favor separating and selling of very drop of crude oil possible. Water production now dominates many US oilfield operations, and too much oil remains entrained in it. Conventional API Gunbarrels fail to efficiently separate oil from large quantities of water. Gunbarrels were designed to remove small quantities of water from large quantities of oil, and do a poor job in the opposite condition of separating small amounts of oil from large quantities of water. Today's high water cut operations suggest that the Gunbarrel may be obsolete for use where large volumes of water are involved. An effective substitute has been developed, proven, and substantially improved. It is the HWSB™ Skim Tank-Gunbarrel, and the Cold Weather HWSB™, both patented by HTC. The HWSB™ design is quite sophisticated and unlike any conventional Gunbarrel, so it is quiet efficient. The cost is higher, but the payout occurs quite rapidly, usually *in a matter of days*. It is an excellent investment! This paper provides a look at these economics and backs them up with a typical, easy to follow example.

Example Economics

Water cuts have been on the increase for over 60 years in US oilfield operations since the advent of water flooding in the late 1040s. Even today's the Baaken and Eagleford shale oil production horizons have growing water cuts as new wells age. Higher and higher water cuts can mean more and more entrained oil is lost and goes unsold. As oil concentrations in waste water build, unrecovered oil economics are dramatic and startling!

Let's look at an example:

> In this example, an oilfield operation produces and disposes of 6,000 barrels of water per day from ESP and rod pump produced wells. The water flows through a free water knockout and on to a disposal plant. The produced water at the disposal plant contains from 300 ppm to 1500 ppm oil, and averages 650 ppm day-in-and-day-out. This represents 5.15 barrels per day or 154.8 barrel/month. Of this, the disposal plant accumulates only 25 barrels of oil per month on average, which is hauled back to the oil storage tanks and sold. The rest of the oil, 129.8 barrels per month is injected into the disposal well and is lost forever.

Now let's calculate the direct net loss of oil in this example:

> The portion of the 650 ppm oil of oil not captured and returned to oil storage/sales represents 4.3 barrels of oil per day. This is equivalent to 129.8 barrels a month. At a value of just $100/barrel, this represents a direct net loss of $13,791 in oil revenue each month, or $165,495 per year in direct lost revenue.

Let's also calculate the indirect net loss in this example:

> The 4.3 barrels of oil lost in the disposal process represents approximately 1084 pounds of organic material per day being injected into the disposal well. This oily residue has a tendency to plate out on the tubulars, the well liner, and more significantly on the well bore at the face of the formation rock. As this is a water insoluble material, as it coats the sand grains at the formation face it begins to restrict the pore spaces between the grains, thus restricting the flow of water from into the formation. As time goes by, this gets worse and worse.
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> In a year the oily residue represents 395,660 pounds of plugging material trying to enter the disposal zone. The suspended solids in the water accumulate in this material, increasing the volume of the well plugging deposit, and cause more even plugging. This oily residue tends to build up on the formation face, and in the formation within a few feet of the well bore, forming and oil-wet impervious flow path that eventually causes injection pressures to climb and injection rates to decline.

As injectivity falls off it is common to stimulate the well, often using a dilute solution of hydrochloric acid or another stimulation solvent, usually with added surface active chemical ingredients. After the first stimulation the results are often to return the well to near its original injection rate and pressure. However, it almost immediately the injection rates begin to fall off and the injection pressure increases. This usually happens more rapid than before, and even more rapidly after each subsequent stimulation effort until a point of diminishing returns is finally reached where stimulation efforts fail. Eventually, the well bore is obviously damaged beyond reclamation and it is time to 1) work over the well to back skuddle or nitrogen wash the crud out of the well bore, 2) re-drill the well, 3) sidetrack and recomplete, or 4) drill a new disposal well. The costs for these more drastic measures range from $500,000 to $3,000,000 or more. This then is the indirect net cost of poor water quality.

Solutions

With such staggering direct and indirect costs, it seems prudent to take positive steps to prevent well plugging from any/all other sources of contaminants (solids, bacteria, etc.) and to capture and sell as much of the entrained oil as possible.

One such step is to select a separation system that actually separates all physically separable oil from the produced water. Such a system is the HWSB™ Skim Tank developed and patented by HTC, Inc. to replace the far less efficient API Gunbarrel.

The HWSB™ is a high-efficiency oil-form-water atmospheric separation vessel. While its outward appearance is not unlike that of a API Gunbarrel, a look inside reveals that it is quite different, and obviously much more efficient. Its patented design provides for a separation efficiency that is 25-30 times more efficient than a Gunbarrel. While Gunbarrels often carry over 250-1500 PPM oil, the HWSB™ consistently reduces the oil-in-water concentration to below 50 ppm or even lower.

Since the HWSB™ is made fabricated with enough labor and materials to build two conventional API Gunbarrels, its cost is nearly twice that of a conventional Gunbarrel. However, since a conventional API Gunbarrel will be only about 3-5% hydraulically efficient at separating entrained oil from produced water, and the HWSB™ is up to 72% hydraulically efficient, the HWSB™ produces enough added oil recovery to pay out the cost difference in a matter of weeks, and the cost difference is secondary.

So, when we compare the conventional API Gunbarrel oil carryover rates and lost oil revenue with the higher oil recovery rates of the HWSB™, and recall that the difference is worth over $165,000 per year in additionally recovered oil alone in the example above, any the added capital cost for the HWSB™ pales in comparison! And, if we add in the savings in well stimulations and re-drilling costs, the savings far outweigh the costs.

The Real Numbers

A 12' X 24' API FRP Gunbarrel costs about $25,000 today without a water leg. The water legs for these are normally built in the field out of pipe at a cost below $2,000. A 12' X 25' HWSB™ costs about $40,000 plus an additional $9500 for an engineered pre-fabricated FRP water leg matched to the operating conditions of the HWSB™. The cost difference is $22,500. Using the numbers in the above example, that difference pays out in about two (2) months from the recovered oil alone! Add in the future well work and the payout accelerates to a matter of days!

Conclusions

HTC's HWSB™ is a proven technology that returns its capital cost to its owner several times each year. Over 250 of HTC's system and equipment designs are in service around the globe. HTC is proud of the fact that each and every one of them outperforms the expectations of its owner.

Because of the payout period is so short, the HWSB™ is a one of the best investments in oilfield surface facility separation technology today.

About HTC, Inc.

HTC was founded in 1993 by principal engineer Bill Ball. His goal was to provide innovative, high-tech process equipment designs that add value to the oil and gas industry. HTC was formed around and based on its patents for the HWSB™ Skim Tank (Gunbarrel). Today HTC has

grown and the technologies have expanded. Its staff and affiliates now also generate specialty oil, gas, and solids separation process equipment and specializes in complete production and SWD plant facilities designs.

HTC's complete production facilities and SWD plant facilities are scattered throughout the US and the world. Each one successfully processes the industry's ever-more complex produced fluids, and exceeds the expectations of its owner.

HTC also specializes in flowback water treatment systems that efficiently provide for frac and produced sand removal, and inversely emulsified production from ESP produced oil wells. HTC's takes care with every detail to make sure every system design is practical, easy to install, and works as it should.

HTC's track record of affordable design excellence is simply unmatched.