Separation Economics

The Value of Efficient Separation in 2015

EXECUTIVE SUMMARY

More than ever before, with the oil prices hovering below $60/barrel, 2015 operating economics favor separating and selling of very single drop of crude oil to enhance cash flow. HTC's technologies do just that!

We all know that produced water volumes far exceed oil production in today's oilfield operations. We also know that some oil often remains entrained in our produced water. In 2015, "some" is too much!

Since the beginning of oilfield operations Gunbarrels have been used to separate water from oil. Conventional API Gunbarrels are known to separate small quantities of water from large volumes of oil, but fail to efficiently separate small volumes of 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 at separating small amounts of oil from large quantities of water by virtue of their very design. Therefore, the Gunbarrel may be considered obsolete for use in high water cut operations

An effective substitute was developed in the 1990s, proven, and is now essentially perfected. It is the HWSB™ Skim Tank, and the Cold Weather HWSB™, both invented by HTC.

The HWSB™ design is quite sophisticated compared to the Gunbarrel of old. And unlike any conventional Gunbarrel it is significantly more efficient in high water cut applications. The cost difference pays out quite rapidly, usually <u>in a matter of days</u>, making it an excellent investment!

This paper provides a look at the payout economics in a typical and easy to follow example.

Example Economics

Since the advent of water flooding in the late 1940s water cuts have been on the increase in oilfield operations. And, in today's mega-fields (the Baaken and Eagle Ford shale oil reservoirs) water dominates production as wells age. Higher and higher water cuts often mean more and more water-entrained oil is lost. That oil usually goes to SWD facilities and some of it remains entrained in the disposal water. As oil concentrations in waste water build, disposal wells plug, increasing the cost of poor oil-water separation!

Let's look at an example:

In this example, a typical oilfield operation produces and disposes of 6,000 barrels of water per day from oil wells produced with ESPs and rod pumps. The produced fluids flows through a free water knockout, into a water storage tank, and are pumped to a disposal plant. The oil concentration in the produced water arriving at the disposal plant varies 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 sold at a discount as waste oil. 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 $60/barrel, this represents a direct net loss of $8,275 in oil revenue each month, or $99,297 per year in direct lost revenue. In just 10.07 years the loss totals $1 million!

Let's also calculate the indirect losses in this example, as they can exceed the direct losses:

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 in the well bore on the face of the formation. This deposition is a water insoluble material, and it coats the sand grains at the formation face. This "coating" penetrates into the pose spaces of the formation near the well bore, gradually restricting flow as it plugs the pore spaces, restricting the flow of water into the formation. As time goes by, this gets worse and worse, until pressures rise and injectivity ceases to be viable.

In a year this oily residue represents 395,660 pounds of plugging material trying to enter the formation. The suspended solids in the water accumulate in this material, increasing the volume of this well plugging deposit, and accelerate the plugging. As the oily residue to build up on the formation face water flow diminishes. Eventually injection pressures to climb and injection rates to decline.

As injectivity falls off it is common practice to stimulate the well, often using a dilute solution of hydrochloric acid or other stimulation solvents, 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, usually more rapid than before, and even more rapidly after each subsequent stimulation effort. Finally, the point of diminishing returns is reached. Subsequent stimulation efforts prove to be futile.

At this point the well bore is obviously damaged beyond reclamation and it is time to 1) work over the well, 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 about $300,000 to $3,000,000 or more. Furthermore, the actions precipitating these costs can be necessary every few years.

These then are the indirect net costs 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 do so in a fashion that allows us 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 $99,297 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 $10,000 for an engineered pre-fabricated FRP adjustable water leg matched to the operating conditions of the HWSB™. The cost difference is $25,000.

Using the numbers in the above example, that difference ***<u>pays out in about two (2) months</u>*** *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. Bill's goal was to develop 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 replacement). Today HTC has grown and the technologies have expanded. The HWSB™ has become a standard of the industry, dominating oil-water separation in most new SWD plants.

HTC's complete production and SWD plant facility designs can be found throughout the US and around the world. Each one successfully processes the industry's ever-more complex produced fluids, and facility outperforms 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.