Oil-Water Separation Economics

Executive Summary

With the oil prices hovering between $80 and $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, often used to try to separate that oil, were designed to remove small quantities of water from large quantities of oil, not small amounts of oil from large quantities of water. Today's high water cuts suggest that these old industry workhorses may therefore be obsolete when large volumes of water are involved. One effective substitute has been developed and proven. It is the patented HWSB™ Skim Tank-Gunbarrel. Its design is quite sophisticated compared to a conventional gunbarrel, so its cost is higher. However, at today's oil prices, the cost difference *pays out in days, not years, making it one of the best possible investments today!* 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. Even 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, the 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 25 barrels of oil per month on average, which is hauled back to the oil storage tanks and sold.

Now let's calculate the <u>direct</u> 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 $80/barrel, this represents a direct net loss of $11,033 in oil revenue each month, or $132,396 per year in direct lost revenue.

Let's also calculate the <u>indirect</u> 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. This oily residue has a tendency to plate out on the tubulars, the well liner, the well bore, and the formation rock. As this is a water insoluble material, as it coats the formation face it begins to restrict the flow of water from the well to the formation. In a year the oily residue represents 395,660 pounds of plugging material. Most suspended solids in the water accumulate in this material, increasing the volume of the deposit, and causing 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 impervious flow paths that eventually cause 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 common 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 is also common that injection rates fall off and injection pressure increases more rapid than before, and even more rapidly after each subsequent stimulation effort until a point of diminishing returns is reached. Eventually, when stimulation efforts fail and the well bore is obviously damaged beyond reclamation it is time to 1) re-drill, 2) sidetrack and recomplete, or 3) drill a new disposal well. The costs for these more drastic measures range from $500,000 to $3,000,000. 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 capture and sell as much of the entrained oil as possible, and to take steps to prevent well plugging from any/all other sources of contaminants (solids, bacteria, etc.).

One such step is to select separation equipment that actually separates all physically separable oil from the produced water. Such a piece of equipment is the HWSB™ Skim Tank (Gunbarrel) developed and patented by HTC, Inc.

The HWSB™ is a high-efficiency oil-form-water atmospheric vessel. While its appearance is not unlike that of a plain gunbarrel from the outside, looking inside reveals that it is quite complex; nearly two tanks in one. Its patented design provides for a 20-30 fold increase in separation efficiency, reducing the oil-in-water concentration to below 50 ppm and often even lower.

Since the HWSB™ is made up of enough labor and nearly enough 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 60-72% hydraulically efficient separating nearly all physically separable oil, the cost may secondary.

And, when we compare the conventional API gunbarrel oil carryover rates with the HWSB™, and recall that the difference is worth over $130,000 per year in additionally recovered oil alone, not counting the savings concerning well stimulations and re-drilling costs, the added capital cost of the HWSB™ pales in comparison!

The Real Numbers

A 12' X 24' API FRP gunbarrel costs about $22,000 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 $38,500 plus an additional $7500 for an engineered pre-fabricated FRP water leg matched to the operating conditions of the HWSB™.

The cost difference is $22,000. Using the numbers in the above example, that difference pays out in two (2) months from the recovered oil alone! Add in the well work that is eliminated or prolonged, and 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 with its patents for the HWSB™ Skim Tank (Gunbarrel) as its foundation. Today HTC has grown. Its staff now also generates specialty oil, gas, and solids separation process equipment and complete facilities designs.

HTC's dozens of complete production facilities and SWD plant facilities scattered throughout the US and the world. Each one successfully processes the industry's ever-more complex produced fluids, and every one exceeds the expectations of its owner. HTC specializes in flowback water treatment systems, frac sand removal, and ESP produced oil wells. HTC's takes care with every detail to make sure every system works as it should.

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