HWSB® Start-up Instructions

Innovation has been slow in the oil and gas industry. A key reason is the paradigm "Because we've always done it that way." Together, we can change that!

A Technical Paper

Prepared for

Facility Engineers and Designers

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EXECUTIVE SUMMARY

The Oil-Water Interface Is Key

This document is intended to provide tips and guidance for starting up any new HWSB® Skim Tank (aka Gunbarrel). Each HWSB® Skim Tank is designed to first clarify water, separating most of the oil to produce injection/disposal quality water. In so doing, the typical HWSB® captures more oil that other systems like the "standard Gunbarrel." The HWSB® is designed to have a specific oil layer, or pad, so the oil has enough time to dehydrate. The break point between the oil layer and the water below is called the "oil-water interface." The elevation of this interface is the key to the performance of the HWSB®. Please check your KBK drawing for the pre-designed oil-water interface level.

While the HWSB® is designed to be far more forgiving than other oil-water separation systems, upsets can and will occur. In an upset condition the oil-water interface level is likely to change. While the HWSB® is mildly tolerant of an improper oil-water interface level, the interface level should be maintained within 18" of the designed location shown on all KBK HWSB® design drawings for the system to function properly. If it is too high the oil will leave the HWSB® "wet" with higher-than-normal BS&W contents, and the owner will be penalized for high BS&W content.

If it is too low the normally clean, clear effluent water will begin to carry over unusually high concentrations of oil and grease. Additionally, as the oil-water interface level drops the HWSB® will carry a larger oil pad than necessary, permanently retaining more oil than it was designed to store. At today's oil price, just one extra foot of oil pad adds several thousand dollars to the operating cost! And the lower-than-normal oil-water interface level can result in unnecessary oil carryover.

In order to control the oil water interface most HWSB®s are shipped with adjustable water legs. However, at the client's request, some HWSB®s

are designed with fixed spillover water legs, and others with interface probes.

Interface probes like the dual channel "Guided Wave Radar" are used to detect the oil water interface and electronically actuate automatic valves to throttle water out of the HWSB®. Such probes should be calibrated on the bench test apparatus prior to start-up, and once the operator has them installed, fine-tuned to detect the difference between their oil and their water.

The purpose of this document is to guide you through the initial set-up to get it "right."

THE COST OF OIL CARRYOVER

Oil carryover is a financial killer. Oil contaminates the injection/disposal well, prematurely plugging it. The costs of stimulation jobs and/or re-drilling can run from $150,000 to over one million dollars. Additionally, any oil carried over is not sold causes the facility return on investment (ROI) to decline dramatically. Just 300 parts per million (PPM) of oil carryover in 15,000 barrels of water represents five barrels of lost oil every day. At an oil price of $68/barrel this plant loses 1825 barrels of oil worth over $125,000 each year. Worse, the 300 PPM represents 1580 pounds of oily "goo" being injected down the disposal or injection well every day. That translates to 288 tons of plugging material every year!! That oily goo will plug the well bore, it's not acid soluble, and it is almost impossible to back-scuddle, acidize, or stimulate out of the well bore.

It is no wonder that oil carryover is a genuine problem, often causing the facility owner to have to re-drill the injection or disposal well; an exercise that can cost millions of dollars!

So, establishing the proper separation in the HWSB® is a key to the financial success of any facility. And to do this, we need to focus on the water-oil interface as our target during start-up. Here are KBK's suggestions to help accomplish this:

RECOMMENDED SETUP PROCEDURE

1. Set the tank one a properly compacted, prepared, and level pad.

   A. KBK recommends the use of grade bands (aka "tank rings") set level and filled with pea gravel.
   B. Set the HWSB® tank on the pad making sure to adjust it as necessary so it is true and level 360°.
      a. Check the top of the oil bucket with a laser level to make sure it is level. Trim as necessary (a saws-all works well).
   C. With the manway cover(s) removed, slowly pump water into the normal inlet and look for leaks in the inlet piping and the center column.
      a. Repair, as necessary.
   D. Repeat "C" above for the oil bucket. This can be done using a hose to fill the oil bucket with the oil outlet valves closed.

2. Next, shut the inlet and outlet valves.

   A. Close the oil outlet valve.
   B. Leave the valve between the HWSB® and the water leg open, but close water leg outlet valve.

3. Next, fill the HWSB® with produced water to check for leaks. When the water begins to spill over the oil bucket into the oil tanks stop the filling process and check again for leaks in the oil outlet lines. Stop filling the tank with water and check the tank level to make sure it is staying full of water. If not, water is leaking out of the oil outlet line and into the oil tanks. Repair as necessary and repeat steps 1 and 2 until there are no leaks.

   A. If you have installed an electronic high-level alarm and/or shutdown control, continue to fill the tank slowly until the "High- High Shutdown Level" is reached. Set the "High-high Level Shutdown" (HHLSD) level control to trigger at this alarm

point. Drain the tank down 6" and check to see that the shutdown has cleared. Fill the tank slowly again and check to see that the HHLSD signal generates at the high-level shutdown point.

4. Next, drain the tank until the water level is exactly the distance below the oil spillover bucket indicated as the oil-water interface level on KBK's HWSB® drawing. Close all water leg valves.

5. Pump oil into the HWSB® until it begins to spill over into the oil bucket. Stop pumping oil into the HWSB®. Make sure the oil valves between the HWSB® and the oil storage tanks are open.

6. If the water leg is external adjustable, proceed to Step 7. Otherwise remove the blind flange from the top of the water leg. Measure down to the top of the water inside the water leg. The top of the spillover nipple (inside pipe) should be at this same elevation. If it is not, it must be adjusted so it is. Measure the difference (if any) between the water level and the top of the inside pipe. Raise or lower the inside pipe accordingly, until its top is at the same level as the water. Replace the blind flange.

7. If the water leg has an external adjustment assembly first raise the external adjustment until it is as high as it can be adjusted. Then open the inlet and outlet water leg valves. Observing the oil level in the tank slowly begin to lower the adjuster at little at a time until the oil level inside the HWSB® begins to lower. Raise the adjuster ¼" and stop.

   Color cut the tank to find the actual oil-water interface. Compare it with the level indicated on the HWSB® drawing. If the interface level is higher than shown on KBK's drawing, add more oil and raise the adjuster until the proper tank water-oil interface level is reached.

Repeat the above steps until the water –oil interface level is set with the water leg adjuster. Take your time and be aware that every 1" change in the adjuster results in a 4-6" (or more) in the oil-water interface.

A. Repeat the above as necessary until the levels are stable and at exactly the dimension shown on the KBK HWSB® drawing for your system. Note that this dimension may be different from system to system, location to location, so NEVER use one HWSB® drawing for another location!!

8. When you are sure the adjustment is correct, open the water outlet valve on the water leg. If there is any water in the outlet of the water leg, it will drain out into the next water tank, which should be empty to start this process. Double check the tank levels to make sure the top of the oil is still at the spillover ledge of the oil bucket. Then color cut the tank one last time to make sure the oil-water interface is at the correct elevation. Repeat the above until the levels are correct.

9. At this point you should be able to thief or color cut the tank and prove that the oil-water interface and the oil layer in the tank are consistent with the layer thicknesses shown on the KBK HWSB® drawing.

A. The oil should be just at the top of the oil bucket.

B. The water elevation inside the HWSB® should be as shown on the KBK HWSB® drawing.
   a. The water leg should now be adjusted correctly at the right spillover point, and the water leg valves should now be open. Water should not be spilling over into the next tank, and the tank levels should be steady, and unchanging.
   b. Make any "fine tuning" adjustments to the water leg spillover point as may be necessary.

10. Double check to see that the oil-gas interface is exactly even with the top of the oil bucket. You can see this through the thief hatch, or
use the gage tape to measure down to the oil level. Thief or color cut the tank one last time to confirm the oil layer thickness and the elevation of the oil-water interface.

11. The levels are now set for proper day-to-day operation.

START-UP

1. Next, open the inlet valve at the truck offloading pad and the inlet valves on the HWSB® to start the HWSB® operation.

2. Have a truck loaded with at least 10 barrels offload normally, allowing the truck to run dry.

    A. If the truck offloads itself, expect a large outrush of air from the truck into the HWSB®. This is normal.

    B. If your facility uses offload pumps to offload water into the HWSB® instruct the drivers NOT to pressure up their tanker compartments to avoid the huge air inrush which can cause catastrophic damage to the offload pumps.

        a. Note that some systems are automated to avoid the huge rush of compressed truck compartment air that can occur as the compartment reaches the liquid-empty state.

            i. This automation often includes the load manifold at the truck connection point being fitted with a capacitance probe and automatic shut-off valve. The probe senses the difference between water and air and shuts the automatic load valve off when the truck begins to pump air into the load line.

ii. This probe MUST be field adjusted and proven to function. It must be maintained to avoid failures.

C. If the offload manifold is not automated as described above, be careful to keep the thief hatch closed while the truck blows down all air, as the huge inrush may blow oil out of the thief hatch.
   a. If the oil layer is observed to "bubble and burp" large quantities of air, decrease the vent valve setting or enlarge the vent valve until this stops.
   b. This sort of turbulence creates mixing, which is contrary to the intended purpose of the HWSB® and will result in water in the oil and oil and in the water effluent of the HWSB®.

3. For the first 72 hours color cut the fluid in the HWSB® to be certain the oil pad is remaining at the height shown on KBK's HWSB® drawing, give or take 2-3". Use the water leg adjuster to fine tune the oil-water interface in the HWSB® so the oil pad remains at 3'. As a reminder, every 1" of water leg adjustment is equal to about 4-6" of water-oil interface level change inside the HWSB® … so make **very small adjustments** and then recheck the oil pad after a few hours.

4. After 72 hours thief the top of the oil and check it for BS&W. It should be <1.0%. If it is higher, consider adding demulsifier to the inlet stream any time a truck is offloading. The HWSB® is designed to dehydrate the oil at least partially, so if it is not, the cause is not mechanical separation but chemically and heat (oil viscosity) related (i.e., methanol or high solids contents create chemical and solids induced emulsions. Either will be rather easy to resolve with the right demulsifier.)

A. If possible, isolate the BS&W layer using the HWSB® interface drains.
   a. Drain the BS&W layer into a dedicated oil tank. Time, the right chemical demulsifier, and heat will resolve most emulsions.

i. Fit the oil tank with a Model 401A tank mixer and immersion heaters.
ii. If the BS&W appears contaminated with frac gel, try adding chlorine dioxide, HCL, or bleach to break the gel.

b. If necessary, simply call your chemical man and have him check the BS&W against his demulsifier to make sure he is using the right compound in the right concentration for the emulsion that exists today and expect it to change.
i. If he's not adding any demulsifier now, add it right at the inlet line upstream of the degassing boot.
ii. The degassing boot is an excellent mixer. It should take no more than about 30 ppmv of the right demulsifier, if you need any at all.

5. Color cut the HWSB® every day for the first two weeks and adjust the water leg adjuster as necessary to maintain the desired oil pad, give or take a few inches.
   a. Use the interface draw offs to remove any accumulating BS&W layer.
   b. Use the center column solids drain to keep the HWSB® free of solids accumulations.

6. After the first few weeks of operation, color cut the oil pad every couple of weeks and adjust the water leg spillover, as necessary.

7. As time goes on conditions will change. Have the chemical man check his demulsifier at least every three months to make sure he's still using the most effective product.

RESTARTING AND EXISTING HWSB®

The procedures above apply to restarting an existing HWSB® too.

If the existing HWSB® has been out of service for some time, it is a good practice to drain and clean the tank and the water leg before restarting. While it is down, it is advisable to disassemble the water leg adjuster and to grease the O-ring seals on the internal slip sleeve to assure that the slip

sleeve won't leak after start-up, and to make certain future adjustments are possible.

It is always a good practice to drain, clean, and refill the tank and water leg with the same water that will be processed. If the HWSB® has been used to store fresh water for any reason, drain the entire tank and water leg, and refill both with the produced water the HWSB® will be processing.

A. The reason for his is that fresh water is much lighter than most produced water. It is so light that it typically flows rapidly through the heavier produced water layer, minimizing its retention time and therefore hindering the normal efficiency of the oil-water separation process.

CONCLUSION

That's it. In these systems, time is your friend. Make only small adjustments to the water leg adjuster, and then wait a day or so to experience the results. Trying to rush things will only create confusion, chaos, and frustration. Be patient and take your time.

Your start-up should now go smoothly.

ABOUT THE AUTHORS

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