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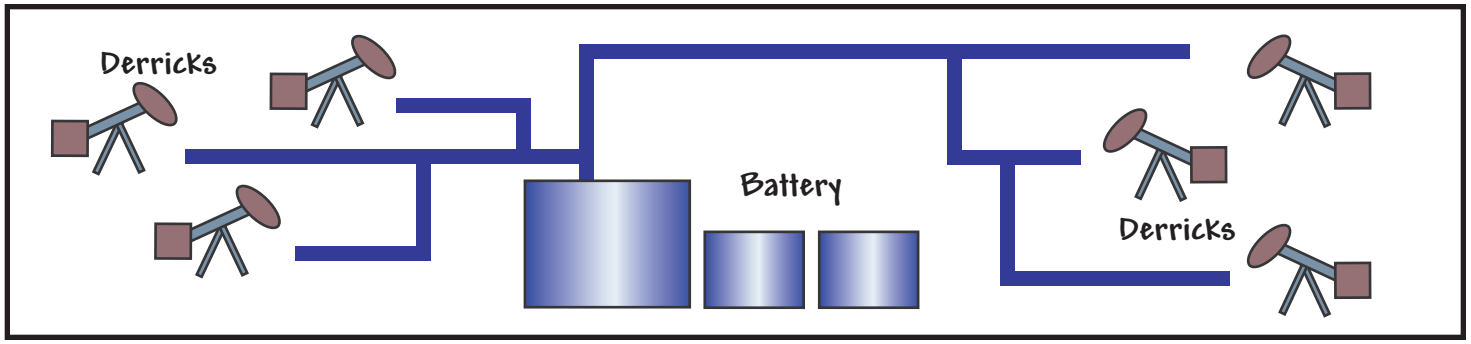
Date: September 2005
Project: COP-System prototype - (2 month) produced water field trial
Author: Separatech Canada Inc.

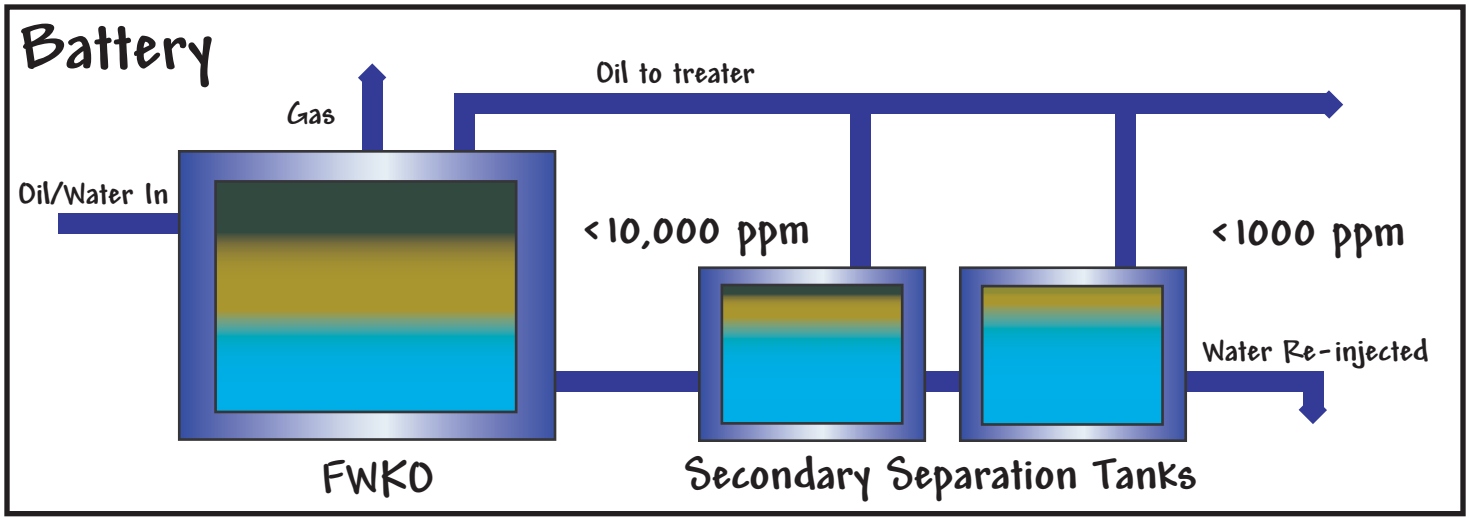
13 API - HEAVY OIL BATTERY TRIAL # 2 (Alberta, Canada)

BACKGROUND:

Mixtures of produced water and oil from conventional oil wells in Alberta are typically sent to large "batteries"or central collection/processing facilities where oil and gases (H2S) are separated and water is re-injected into the formation for disposal.



In one of the first stages of treatment at these batteries the produced water from the various oil wells is removed from the produced oil stream by the Free Water Knock-Out (FWKO). The oil is sent to a "treater" where chemical processes remove unwanted contaminants such as water and suspended solids before being piped or trucked to a refinery. The water exiting the FWKO will still contain significant amounts of free-floating and emulsified oils. (Upwards of 10,000 ppm or 1%) In most cases, this water and oil mixture is sent to additional tanks for further oil separation and recovery by gravity. Oil being drawn off of the secondary separation tanks is sent to the "treater" as well with the water typically being injected into a disposal well. Even after the secondary separation tanks, the treated water being disposed of can still contain significant amounts of oil. (Upwards of 1000 ppm or .01%)



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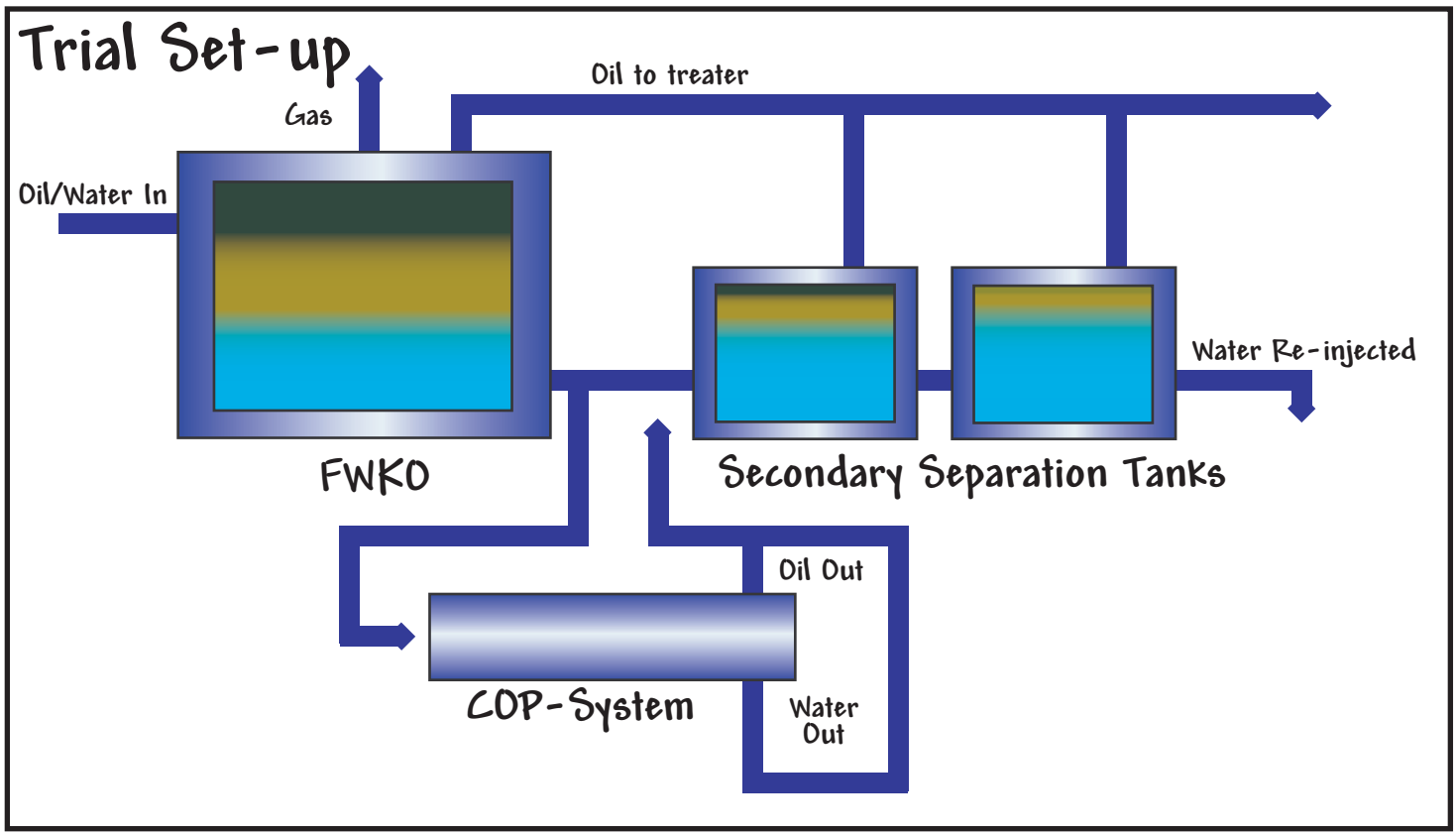
BACKGROUND CONT'D:

These production methods are not only wasteful, but can also lead to slowed production and increased production costs. The higher the concentration of oil being re-injected, the more quickly the disposal wells will clog causing a potential slowdown in production while costly chemical (acid) treatments are performed to re-open them.

Separatech identified the COP-System as a potentially low-cost polishing technology for this largely uncontrolled and costly practice of re-injecting oily water. It was determined that if proven successful, the COP-system would not only recover more oil and reduce the frequency of re-injection well treatments but could also eliminate the need for secondary separation tanks entirely and all costs associated with them, including initial capital outlay and annual opex costs.

In the fall of 2004, a single vessel system was configured for high flow rate and moderate clean-up. (less than 100ppm OIW residual) A trial was performed that demonstrated the COP-System and ROD Media could successfully separate actual heavy oil emulsions being drawn off of a battery's FWKO in Northern Alberta. The prototype was fed a source water containing oil concentrations well above 3500 ppm. All outlet samples contained less than 100 ppm. However, due to the lack of an automated backwash feature, the trial was cut short as the system became clogged with suspended solids towards the end of every 24 hour cycle.

By late summer 2005, Separatech was prepared to attempt the same test again with a fully automated and explosion proof COP-System prototype which now featured an automatic backwash and new ROD Media which was designed specifically for the oilfield emulsions noted in the first trial. The following report will explain the 2nd trial set-up and the results achieved.



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DESCRIPTION OF SETUP:

The trial took place between Mid-September and Mid-November, 2005 at the same battery facility the first trial was run at 9 months earlier in Northern Alberta.

> COP-System pilot unit consisted of 1 Coalescing Unit (12” in diameter by 6 feet long)
> Equipped with 3 pneumatic three-way valves for Automatic Backwash
> Backwash and Operation cycles controlled by 1 timer in an explosion-proof control panel
> COP-System was installed across a water outlet control valve on a Free Water Knock Out
> Oil and Water outlet streams from the COP-System prototype were fed back into the FWKO water outlet line downstream of the initial control valve.
> Water rate off the bottom of the FWKO averaged 8500 m3/day.
> Flow rate through the COP-System averaged 180 m3/day
> Oil was 13 API with density of 979 kg/m3
> Process temperature averaged 27 Celsius

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RESULTS:

A total of nine (9) set samples were taken over the first two days of the trial. Both inlet and outlet samples were taken in 160 ml glass oval sample bottles. The first two sets of samples were cut with xylene in a 50/50 mixture. After shaking and settling, the oil content (ppm) was determined colormetrically with standards recently prepared for this battery by a chemical company. The accuracy of this method is at worse +/- 100ppm, but usually +/- 50ppm. The oil content of the other 7 set of samples were analyzed by an infrared spectrometer with a solvent extraction.

The pilot unit used in this trial was set up for moderate clean-up of the oil. It was not our intention to remove oil contents to below 5ppm as we have done in other applications where regulations for discharge are more stringent. Because operators typically re-inject oil content in excess of 500 ppm in Alberta, the COP-System was designed to simply reduce that content to somewhere below 100 ppm. Instead of running through 4 ROD Media cartridges, the water was only directed through 2 cartridges during this trial. Trials on offshore oil platforms are slated to take place by the spring of 2006 and should give us a good idea about how well the COP-System technology performs in instances where the oil content must consistantly remain under 15 ppm.

Date	Operation hours	Inlet Flow m^3/d	Outlet Flow m^3/d	Sample In ppm	Sample Out ppm
2005-09-10	0.8	178	141	1000 ⟨	⟨ 25
2005-09-10	1.0	172	144	-	-
2005-09-10	1.3	170	137	-	-
2005-09-10	1.6	175	140	-	-
2005-09-10	1.9	174	141	-	-
2005-09-10	2.2	171	140	-	-
2005-09-10	2.4	174	140	-	-
2005-09-10	2.7	175	140	-	-
2005-09-10	3.0	175	141	1000 ⟨	⟨ 25
2005-09-10	3.3	175	143	-	-
2005-09-10	3.6	176	143	-	-
2005-09-10	3.9	176	143	-	-
2005-09-10	4.2	174	141	5800	9.2
2005-09-10	4.4	176	143	-	-
2005-09-10	4.7	176	144	-	-
2005-09-10	5.0	176	144	-	-
2005-09-10	5.3	176	145	-	-
2005-09-10	5.6	177	144	-	-
2005-09-10	5.9	176	144	-	-
2005-09-10	6.1	176	145	5400	8.5
2005-09-10	6.4	175	143	-	-
2005-09-11	23.7	172	141	5500	10.5
2005-09-11	24.0	171	140	-	-
2005-09-11	24.3	172	142	5600	11.5
2005-09-11	25.4	169	139	-	-
2005-09-11	25.7	170	140	5600	12.4
2005-09-11	26.2	168	138	-	-
2005-09-11	26.4	169	140	-	-
2005-09-11	26.7	169	139	5500	16.9
2005-09-11	27.4	169	139	-	-
2005-09-11	27.7	169	139	5400	17.2

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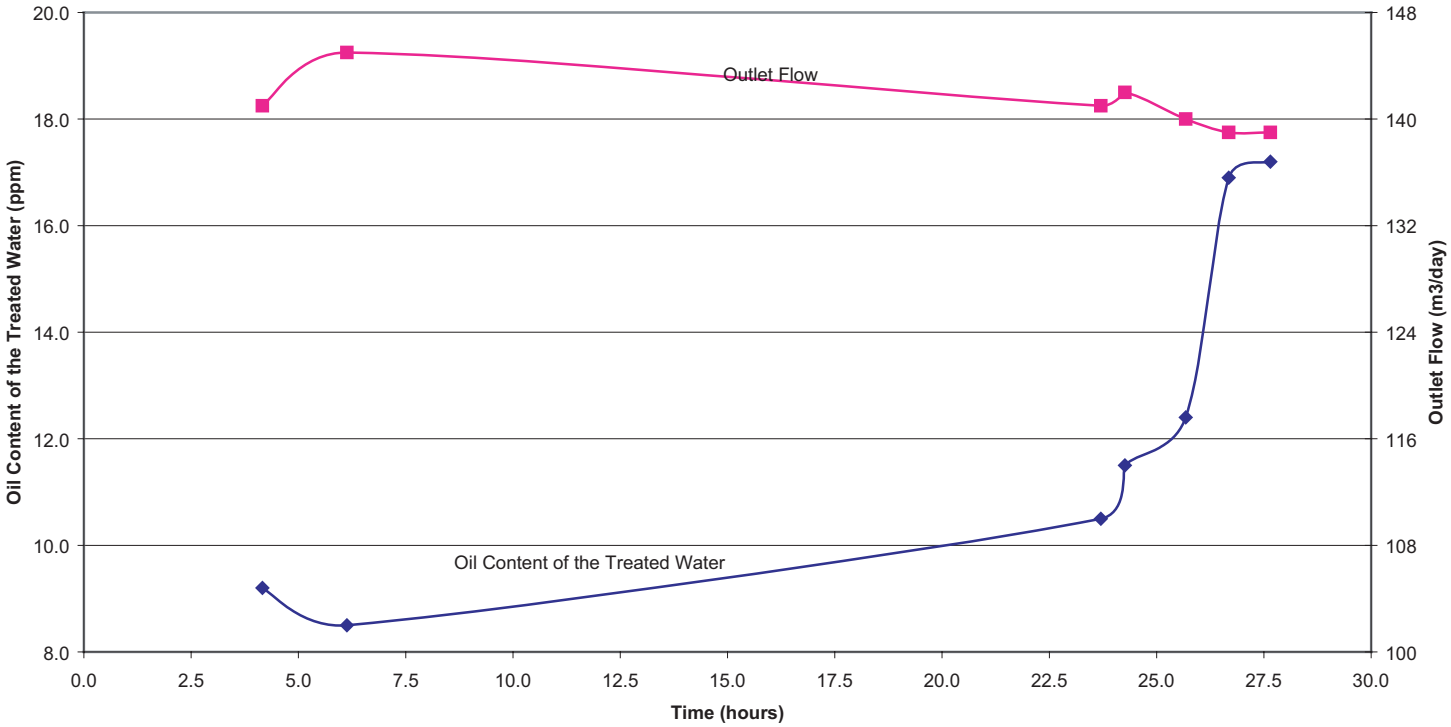
RESULTS CONT'D:

Figure 1 : Oil Content and Flow of the Treated Water Vs. time



Following the initial two days of this trial, some minor modifications were made and the the unit was put back online. The unit then ran continuously (24/7) for another eight weeks. Although no official samples were taken, operators did take samples at least once a week and reported that colormetrically the samples looked similarly clear to the results taken during the first two days. (Under 25 ppm) In the last week a spike in the oil content was noted. Samples contained oil contents nearing 200 ppm so the unit was taken offline. Upon opening the vessel it was determined that a broken media casing and susequent channelling resulted in the oil content increase.

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CONCLUSION:

Results were very encouraging. Oil content in the treated water was below 25 ppm in all samples while the water entering the COP-System had an average oil content of 5600 ppm. The ROD Media proved it could efficiently separate the heavy oil from produced water.

The outlet flow was also stable. It averaged 140 m3/d. This means the backwash was efficient enough to avoid exponential pressure drops and a subsequent exponential decrease in flow rate. Two things that had posed problems during the first trial in the fall of 2004.

The ROD Media continued to work effectively for 7 weeks without needing replacement. Had a media casing not ruptured, the media could have continued its effective separation of emulsions for an even longer time.

Based on these results, Separatech is in the process of scaling up the technology in order to process 1500 to 2000 m3/d. When completed in the spring of 2006 the unit will be run continuously for a period of at least three (3) months. It is our hope that once fully commercialized, the large units will eliminate the need for secondary storage/separation tanks and also reduce the amount of times re-injection wells must be cleaned throughout their lifetimes.