SAGD Water Treatment

2014

New technology to reduce OTSG fouling and improve efficiency

ORGANOCAT™

4800 Strawberry Lane
Louisville, KY 40209
Phone: 502-992-0661
Fax: 502-368-9971
info@organocat.com

www.organocat.com

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Executive *Summary*

In 2011, OrganoCat was contracted by one of the world's largest oil companies to work on a project to remove dissolved silica from SAGD process and blowdown water. After successfully completing Phase 1 work on dissolved silica removal, the client agreed to continue Phase 2 work with OrganoCat. The scope of work included further research into the best methods to (1) treat blowdown water with the goal of reducing silica and organics; (2) develop improvements and/or alternatives for warm lime softening based on findings in Phase 1; and (3) characterize the best methods for (1) and (2) in terms of specific process parameters like temperature, settling versus centrifuge, sediment characterization; and process characterization in terms of cost estimates, operability, reagent lead-times and shelf life, required spares and extraordinary factors. Other specific factors were also explored and tested.

OrganoCat tested a matrix of electro-physical-mechanical devices and reagents in order to understand the underlying mechanisms of silica, organics and other dissolved minerals, to determine the best methods for their removal, and to characterize the byproducts and processes.

In the course of the project, the mechanisms of dissolved silica removal, organic and mineral carbon removal, and calcium and magnesium removal were understood and documented. It was determined that blowdown water could be treated with one or a combination of two electro-physical-mechanical devices and one inexpensive reagent, resulting in an 88.7% reduction in dissolved silica, a 64% reduction in total carbon, a 64.5% reduction in organic carbon and a 53.5% reduction in inorganic carbon. With this blowdown water treatment process, the entire process water stream will be improved, reducing OTSG fouling, improving current WLS efficiency (and reducing the total chemical demand), improving boiler efficiency (even increasing the percentage of water available for boiling), reducing the unusable water that is currently deep-welled, and increasing the total usability of the water stream.

The devices are believed to be relatively inexpensive (on the order of a pump of equivalent size), easy to maintain and service, and robust for the operating conditions found in Canada. The reagent is relatively inexpensive with standard lead-times and shelf-life compared to general chemicals. There are no known extraordinary factors at this stage of development.

Although the new technology has great potential for simplifying and improving the current total process and blowdown water treatment processes, OrganoCat recognizes that the current capital investment within typical 20-100K bbl/day SAGD operations is large, and the necessity to leverage the existing infrastructure is preferred. Therefore, it is recommended that the new technology be introduced first into the blowdown water stream as a new and secondary process, thus improving the overall water stream. The full technology could then be designed into future SAGD operations at the beginning stage.

The project is ready for the next phase of testing – pilot scale design and field test.

Data, Results & Conclusions

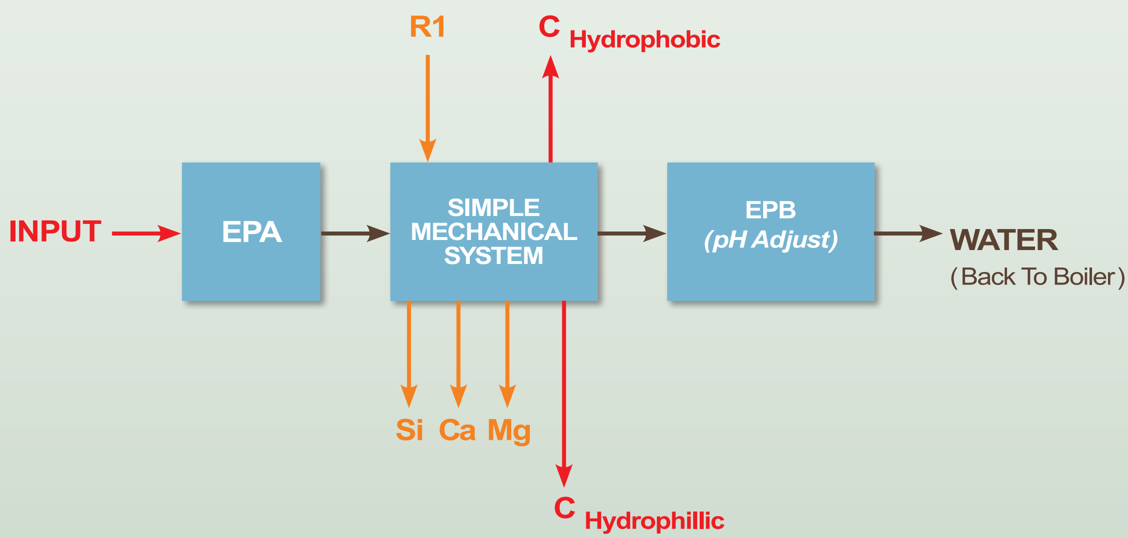
Table 1, below, shows the best results for the recommended method for BW treatment.

TABLE 1: BLOWDOWN WATER TREATMENT DATA

ANALYTE	UNITS	ORGANOCAT SAMPLES - BEST RESULTS					
		OC2122711C	OC21227118	OC21227119	OC2012712C	OC20127129	OC201271210
		CONTROL	PEB-Ca + R1 + R2	R1 + R2	CONTROL	EPA + EPB	EPA + R1 + EPB
Mg	wt ppm	2.60	0.658	0.636	2.25	0.757	0.185
Si	wt ppm	69.5	**0.255**	**< 0.215**	77.7	**8.77**	**16.5**
TOC (Total Organic Carbon)	PPM C				3520	**1250**	1940
TC (Total Carbon)	PPM C	4970	**1540**	**2310**	3760	**1350**	2260
TIC (Total Inorganic Carbon)	PPM C	<223	**< 122**	**< 179**	230	**107**	319

This method includes EPA, EPB and Reagent 1 (R1) as depicted in Diagram 1.

DIAGRAM 1: PREFERRED BW TREATMENT METHOD. C HYDROPHILIC AND HYDROPHOBIC ARE DIFFERENT ORGANIC CARBON FORMS.



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Data, Results & Conclusions

For the preferred BW (blowdown water) treatment method, there will be capital expenditures for EPA, EPB and the mechanical system and a variable operational expense from the Reagent (R1) use, energy use and maintenance.

The capital cost for EPA is equivalent to a pump of similar size. The capital cost for EPB is difficult to approximate given several different design point options, but it is assumed that EPB cost would be 2-4 times the EPA cost.

The energy use for EPA is about 10-20% of the energy consumed by an equivalent sized pump. The energy used by EPB is estimated to be less than 0.02 kWt hour/ liter or 0.075 kWt hour/gallon or 20 kWt hour/ m3. The Reagent 1 cost is estimated to be approx. $0.59/bbl. EPA is a newly designed unit that was tested in lab scale only. EPB, in its pilot scale version, has been used for years in some chemical processes.

Although the devices have not been tested in SAGD plant conditions, the method is considered very robust for the climate, throughput and general conditions experienced in SAGD processing in Canada. Spares would be needed as a course of normal operations and uptime reliability, but no different than any other type of equipment like pumps and motors. There are no known extraordinary factors, but it is early in the development process, and they will be more clearly determined in the pilot stage. The mechanical system should be considered equivalent to standard processing equipment, e.g., a mixing tank.

The lead-time for R1 is standard for general chemicals. The shelf-life of R1 is also considered standard for chemicals and would not be an issue.

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Contact *Information*

OrganoCat LLC

4800 Strawberry Lane
Louisville, Kentucky 40209

Primary Contact:

Jeff Sangalli
Vice President/General Manager
Phone: (502) 992-0661
Fax: (502) 635-5598
Cell: (502) 216-6511
Email: Jeff.Sangalli@OrganoCat.com
Website: www.OrgcanoCat.com