Published on *CD-adapco* (http://www.cd-adapco.com)

? > Forever Blowing Bubbles

Forever Blowing Bubbles

SECTOR OIL&GAS

Forever Blowing Bubbles

Revolutionary MBF™ Separator Design with CFD

Stephen Ferguson in conversation with GLR Solutions Ltd. CEO Douglas Lee

Faced with increased water-cuts from maturing wells and a combination of environmental legislation and operational demands, Oil and Gas operators are being forced to review their separation processes. Not only must separation trains now handle a larger throughput of well fluids (due to the increased water content), but the water that they deliver for disposal or re-injection must also be cleaner than ever before.

In this article, we explore how Canadian company GLR Solutions has applied advanced Computational Fluid Dynamic simulation in the design and implementation of their Micro Bubble Flotation technology which has become recognized in the industry as one of the highest performance methods for treatment of produced water.

At the heart of most Oil and Gas separation processes is the API Skim Tank. Slow and reliable, the skim tank depends on the difference in specific gravity between oil and water, lighter oil eventually floating to the top of the denser water content, where it can easily be skimmed off. Although ubiquitous, the standard skim tank suffers from the long retention times required to perform effective separation, which can be useful when buffering out the effects of upstream spikes in production, but ultimately is inefficient when separating small amounts of oil from large amounts of produced water. API gravity tanks are also relatively inefficient when dealing with heavy oils or emulsions.

To counter these shortcomings, many modifications to the traditional API vessel have been attempted, aimed at increasing the separation efficiency of the API vessels (wherever possible using existing separation equipment), often resulting in the introduction of internal structures or distribution nozzles, which are intended to encourage the coalescence of oil droplets within the tank. A more novel, and generally more effective approach, involves flooding the separation vessel with bubbles of gas, which adhere to similarly sized oil particles and float them to the surface of the tank. This approach, known as Induced Gas Flotation, or IGF, usually requires the partitioning of the vessel into various chambers so that the bubbles can act on successfully cleaner batches of produced water. The downside of IGF is the requirement for additional process vessels, limited efficiency due to bubble size limitations of conventional equipment, and that the relatively low retention times do not provide an adequate buffer against upstream disturbance (process upset).

GLR Solutions have devised, with the aid of extensive CFD simulation, an improved gas flotation technology that uses micro bubbles of gas (~10-50 microns in diameter) to assist separation. Douglas Lee, President and CEO of GLR Solutions, explains: *"A bubble of gas of a given size will attach itself to a similar sized oil droplet and encourage it to float to the surface where the oil coalesces, collects and is skimmed off."*

According to Lee, GLR Solution's Micro Bubble Flotation technology (MBF™) substantially enhances the separation process over conventional skim tanks and IGF and gives much improved separation results: *"The benefits of this are increased revenue from recovered oil, fewer problems in reinjection of the water, elimination or fewer chemicals where chemicals are used and the ability to separate oil even in an emulsified state with considerable savings in the reduction of chemicals."*

Fewer problems in reinjection include less plugging of the formation due to oil and solids contamination and a reduced need for expensive well workovers to remedy plugging. A reduced level of oil and solids in the outlet from the skim tank also offers much reduced loading on final, oil removing filters when in use. One of the most unique applications of MBF™ is directly within API tanks which typically incorporate multiple stages to enhance removal of the oil, while eliminating of oil short-circuiting. The application of gas flotation within API tanks provides increased retention time, relative to an IGF separator, which would buffer any upsets in oil concentration or flow rates produced in upstream operations.

Case Study – MBF™ Separation for ENI Dacion

GLR Solutions have invested heavily in CFD simulation, both in the initial development of the MBF™ system, and while planning large-scale commercial installations, including the recent installation of an API tank based flotation system in Eastern Venezuela.

ENI Dacion BV, is a Venezuela based joint venture of ENI S.p.A. a worldwide oil producer and oilfield operator, owns and operates numerous facilities for the treatment of oil and water. GLR Solutions were engaged to provide the most appropriate separation technology for the GED-10 Station in the Dacion field. The GED-10 Station is one of ENI's smaller facilities; when it was originally designed and built, water cuts in the produced oil were typically very low, with anticipated flow rates of 5,000 – 10,000 bwpd. However, as is typical for reservoirs with active aquifers, water cuts have significantly increased in recent years (the station currently operates at 6,000 bopd, 15,000 bwpd), and it is expected that the facility will eventually need to handle flows of up to 25,000 bwpd. This has meant the majority of the equipment now has insufficient capacity to be used in the way it was originally designed.

During previous development in the Dacion field, expensive water treatment systems had been installed, based on desanding and de-oiling hydrocyclones and nutshell filter technology. Despite the high capital and operational costs of these (relatively complex) solutions, the level of treatment efficiency delivered by these systems was insufficient. ENI decided to evaluate other technologies for the selection of the most appropriate system for GED-10 in order to meet the treatment capacity and water quality specifications. ENI established a set of selection criterion in order to determine which separation technology was most appropriate, based on: ease of operation and maintenance; cost of operation and maintenance; capital cost; peformance; and flexibility (the ability to handle a large range of inlet flow fluctuations, both in total flow, and oil and solid content).

After internal evaluations within ENI, the multi-chamber API tank configuration of MBF™ was selected, allowing GLR Solutions to set about designing the optimal configuration for the GED-10 field. Aware that there would be little opportunity for post-installation modification (without disrupting oil revenue from the station), GLR Solutions decided to undertake detailed design analysis using CD-adapco's STAR-CD CFD package: *"A major factor which aided in the determination of an optimal tank design was Computational Fluid Dynamics (CFD) modeling,"* says *Doug Lee. "CFD simulation allows us to simulate fluids in a variety of compositions as they flow through the complex three-dimensional structure of the separator."*

An optimal design, as determined by GLR Solutions, had to include a number of attributes. As the design was to be incorporated into an existing tank at GED-10 Station, and it was known that flow rates would be increasing, it was important to make use of the available volume of the tank: *"For heavy oil applications, such as GED-10, it is essential to ensure that there is sufficient contact between oil droplets and microbubbles throughout the tank,"* said Lee. *"Using CFD modeling we could not only visualize the flow patterns within the separator, but we could also track the progress of individual microbubbles. This allowed us to conclusively demonstrate that sufficient mixing occurred between the microbubble and produced water streams and that adhesion would readily occur in the designated region of the tank."*

As well as ensuring sufficient contact between bubbles and oil in the produced water, it was also necessary to ensure that, after contact with the oil, the bubbles were transported directly to the liquid surface, and not through the outflow of the separator where they might cause problems for downstream processes: *"CFD modeling allows us to track bubble particles through the tank. We can therefore predict whether bubbles travel to the lower portions of the tank and, if so, how we can*

04

[1]

Description:

Faced with increased water-cuts from maturing wells and a combination of environmental legislation and operational demands, Oil and Gas operators are being forced to review their separation process. Not only must separation trains now handle larger throughput of well fluids (due to increased water content), but the water that they deliver for disposal or reinjection must also be cleaner than ever before.

Energy Special Report - Read More... [2]

Industries:
?? ? ?? [3] ? Oil and Gas - Application
?? ? ?? [3] ? Oil and Gas - Sub-Industry
?? ? ?? [3] ? Oil and Gas - Technology
Products:
STAR-CCM+ [4]

Source URL: http://www.cd-adapco.com/ko/node/5888

Links:
[1] http://www.cd-adapco.com/sites/default/files/article_teaser/thumbnail/blowing%20bubbles%20preview%20image.png
[2] http://www.cd-adapco.com/magazine/energy-special-report?page=4
[3] http://www.cd-adapco.com/ko/industries/%EC%98%A4%EC%9D%BC-%EB%B0%8F-%EA%B0%80%EC%8A%A4
[4] http://www.cd-adapco.com/ko/products/star-ccm