

Oil industry water reuse protects the environment and improves water supplies

A number of regulatory drivers across the country are creating wastewater treatment challenges for industry.

In western Canada, water scarcity is a topic of almost daily discussion in the editorial pages of newspapers and magazines. It is widely recognized that fresh water has become a finite and limited resource that is critical to sustaining the health of both aquatic ecosystems and the economy. The situation has become so serious, in fact, that the University of Alberta's David Schindler wrote recently that the area will soon face "a crisis in water quantity and quality with far-reaching implications."

Wastewater reuse

The rapidly growing demands of municipalities and industry, which are competing for water with traditional agricultural users, have focused attention on the need for more efficient use of fresh water to meet forecasted future re-

quirements. In locations such as the semi-arid regions of southern Alberta, the province has imposed a moratorium on further withdrawals of water from the Bow, Oldman and South Saskatchewan rivers. Alberta Environment has stopped accepting applications for new water licenses from these rivers.

This has forced industry to explore improved methods to increase recycling and reuse of wastewater as a means of conserving and reducing its reliance on the limited availability of fresh water.

Newalta pioneered and has refined the use of centrifuge technology for oil-field applications. Closed-loop drilling systems using portable machines enable 100 per cent of water-based drilling fluid to be re-circulated at the wellhead, thereby reducing both fresh water consumption for oil and gas well drilling and dramatically reducing the volume of drilling fluid requiring disposal. This technology is now deployed throughout

western Canada, Wyoming and Texas.

This technology is also finding application in Alberta's oilsands. It takes two to four barrels of water to produce one barrel of bitumen. To reduce the demand on surface and fresh groundwater, great emphasis is placed on recycling and reusing the brackish produced water recovered from *in situ*, thermal production of bitumen.

While most operators use sophisticated produced-water recycling systems, all require effective oil/water separation as the first step in their treatment process. Many struggle with the accumulation of stable oil/water emulsions in the front end of their recycling systems. The emulsions are frequently resistant to traditional chemical treatment methods of separation. Some who rely on flash treatment of these emulsions to evaporate the water fraction now find that this impairs their oil quality by leaving behind residual salts, particularly chloride. Centrifuges are able to effectively separate these emulsions into a clean on-spec bitumen product and a water stream of a quality that can be recycled and reused for steam generation.

In the semi-arid regions of southeast Alberta and southwest Saskatchewan, 5,000 to 7,000 shallow natural gas wells are drilled each year. It is estimated that approximately 1 million cubic metres of fresh water, usually municipal drinking water, is used annually to prepare the hydraulic fracturing fluids that are used to stimulate and improve the productivity of these wells. Approximately 50 per cent of this water is consumed during the fracturing process and the remainder is usually disposed of by deep-well injection.

Recognizing that such consumptive use of communities' limited supplies of drinking water in these water-short areas is not sustainable, Newalta embarked on a multi-year program to develop a method for recycling the waste flow-back water from gas well fracturing. This resulted in the successful development of a two-step membrane filtration process that produces an effluent which can be reused for prepar-

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ing new fracturing fluids with a comparable cost to using and disposing of fresh water, while offering obvious conservation benefits.

Since this still requires 50 per cent make-up to replace the fraction of water consumed in the fracturing process, Newalta is now working with a community in southeast Alberta to recycle its municipal wastewater effluent into a suitable water supply for industrial use. This innovative solution will replace oilfield use of potable water, ensuring priority access to drinking water for residents, while providing a secure long-term source of water for industrial users in the region. This approach also holds great potential for broader application across the country.

Wastewater treatment for discharge

While a shortage of water is the primary issue in the Prairie provinces, manufacturing and other industrial sectors, more strongly represented in southern Ontario, Québec and British Columbia, face other challenges. In these urban locations, the concerns and interests of industry and regulators are more focused on water quality issues, specifically with regards to the contaminants being discharged to municipal wastewater treatment systems and ultimately to the ecosystem.

Many industrial facilities, which by virtue of their size or the nature of their operation find it difficult to treat their wastewater on-site, rely on third-party waste treatment services to process their effluent at off-site centralized waste-



Pilot testing membrane filtration technology for recycling of oilfield wastewater. Author is pictured in foreground.

water treatment facilities. Newalta has treatment facilities across Canada to service such customers.

The focus, first and foremost, is to recover materials of value from waste – the most common of which in industrial wastewaters is oil. A variety of chemical, thermal, and mechanical processes are used for recovery and purification of oil to convert this common wastewater contaminant into a reusable and/or marketable by-product.

Heavy metals, another common contaminant in industrial wastewaters, are precipitated, separated from the wastewater and immobilized in a dewatered

filter cake that can be safely disposed of in non-hazardous landfills.

Dissolved organic compounds, which contribute excessive oxygen demand, and volatile organic compounds (VOCs), which contribute toxicity, often must also be addressed.

Newalta has invested in the development, demonstration and deployment of wastewater treatment technologies to accomplish these treatment objectives. In Brantford, Ontario, a new state-of-the-art facility was commissioned in 2007 with the ability to treat oily and metal-contaminated wastewaters. It incorporates both horizontal-bowl and disk-stack cen-

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trifuges to process emulsions and produce high quality by-product oil. New filter presses produce a landfill-ready filter cake with low water content which passes the TCLP leaching test. The facility also incorporates some of the most advanced environmental controls of their kind, including tertiary containment in new waste storage and processing areas and thermal oxidation of process emissions, for reliable control of odours and VOC emissions.

At the Newalta Chateauguay Facility on the south shore of Montreal, an aging lamella clarifier was replaced in 2007 with a dissolved air flotation (DAF) unit to clarify treated wastewater and separate precipitated metal sludge. Experience with the technology elsewhere coupled with bench-scale testing indicated that DAF would improve throughput capacity, produce a higher quality effluent containing lower suspended solids concentrations, and generate a thicker sludge for dewatering in the facility's filter press. The unit was commissioned in early 2008 and performance has thus far met or exceeded expectations.

Québec is also home to the innova-

tive development of biological treatment technology used to co-treat industrial wastewater and landfill leachate at the Newalta Laterrière Facility near Chicoutimi. Industrial wastewater is pre-treated for removal of oil and metals and blended with anaerobically-digested leachate prior to treatment in an aerobic bioreactor. Residual organics are oxidized with ozone and hydrogen peroxide

At its Surrey, BC facility, Newalta recently installed electrocoagulation in combination with rotary drum vacuum filtration to provide simultaneous removal of emulsified hydrocarbons and heavy metals. The technology uses electric current and sacrificial depletion of iron electrodes in place of chemical coagulation to destabilize emulsions and precipitate metals. More than a year of operating experience has indicated that the technology is capable of providing effluent quality that consistently meets discharge criteria at a lower operating cost than the facility's earlier chemically-based treatment system. An additional benefit has been the simplicity of operation.

Opportunities to deploy electrocoagulation technology at other facilities are

currently being evaluated, including Toronto, where air stripping was recently added to improve the removal of VOCs from treated effluent.

Emerging issues and evolving standards

While the ability to provide consistent removal of conventional contaminants such as hydrocarbons, heavy metals and dissolved organics remains important, regulatory standards are continually evolving. The Canadian Council of Ministers of the Environment is currently finalizing its strategy for the management of municipal wastewater effluent. When released, this initiative is expected to prompt municipalities across the country to review their sewer-use bylaws and, in some cases, adopt stricter standards for the discharge of industrial contaminants to sewers.

In parallel, public interest and regulatory attention is increasingly turning towards emerging contaminants such as endocrine disrupting compounds, pharmaceutically active compounds and personal care products. Conventional industrial wastewater treatment technologies commonly used today are not necessarily adequate to deal with these challenges.

Recognizing that technology will be the key to addressing these issues, Newalta continues to invest in the development and demonstration of innovative and new wastewater treatment technologies to ensure it stays ahead of emerging issues and is ready to respond to the needs of its customers as new treatment standards arise.

Summary

Industry is increasingly recognizing water as a valued resource to be conserved and used wisely. Effluent standards of yesterday often do not meet the requirements of stakeholders today or the expectations of tomorrow. The evolution of technology will continue to provide opportunities to reduce water use, improve reuse opportunities and improve effluent quality. Those who embrace these technologies will be prepared for the challenges that lie ahead.

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