The SAGR beds were constructed to address water quality issues resulting from cold water temperatures.

Meeting Effluent Limits

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British Columbia town ensures adequate supply of potable water

ARTICLE SUMMARY

Challenge: The potable water supply in Dawson Creek, British Columbia, Canada, was extremely limited and affected by the cold temperatures.

Solution: The city built a reclamation water treatment plant with SAGR technology.

Conclusion: The availability of potable water is increasing and water quality is improving.

Lagoon systems for wastewater treatment are commonly used in small- to medium- sized communities in Canada and Northern United States. The systems are designed to be either aerated or facultative (naturally aerated) to meet effluent discharge regulations. Recent trends have led to the introduction of more stringent effluent standards in many regions across North America.

Lagoon-based treatment systems provide some nitrification (ammonia removal) capability during the summer months, but are incapable of meeting current standards during long exposure periods of low water temperatures (less than 1°C). It has long been debated that meeting municipal standard regulations (MSR) was not possible when temperatures reached a low of 4°C. To address this issue without abandoning current lagoon treatment infrastructure, submerged attached growth reactor (SAGR) technology was developed.

The requirement of an adequate supply of quality potable water is an ongoing issue due to increasing populations in urban and rural municipalities, as well as demands from economic activities. In Canada, provinces are becoming more aware of the importance of maintaining quality water through proper management of the water supply and wastewater. British Columbia and Alberta stand out from the rest of Canada as the only provinces with water reuse regulations according to proceedings from a Canadian Council of Ministers of the Environment (CCME)-sponsored workshop. British Columbia's MSRs are rooted in and comparable to California's Title 22 code of regulations for recycled water. California was the first state to create regulation standards in 1918 and has since revised them; it remains one of the leading regions in North America for maintenance of adequate water supply.

British Columbia regulations have influenced and created incentives in many municipalities throughout the province. As a result, 3% of wastewater generated within the province is reclaimed, thus reducing the demand on potable water supply, according to proceedings from the CCME workshop. A prime example of the benefits of reclaimed water projects in this province is the recent partnership between Shell and the city of Dawson Creek, which is slated to reduce the city's potable water use by 25%, earn an estimated $1 million annual revenue and provide a clean and reliable water supply for one of Shell's hydrocarbon recovery projects in N\northeastern British Columbia.

Dawson Creek

The city of Dawson Creek is located in northeastern British Columbia 736 miles from Vancouver and 367 miles from Edmonton, Alberta. The city's water source is the Kiskatinaw River (Peace River tributary). This source often is plagued by high turbidity during the spring freshet and low summer water levels due to lack of mountain snow melts or glaciers to replenish water volume. Recent growth in the oil and gas sector has lead to an increased pressure on the available potable water. The industry normally procures potable water from the city at filling stations for use in deep well injection, road dust control and mud preparation. Tapping potable water from Pine or Peace River to supplement that obtained from Kiskatinaw River also was considered. Due to the large distance between the river and city's reservoir, this option was deemed too costly to be practical.

Meeting Potable Water Demand

To address the demand for potable water, Dawson Creek decided to build a reclamation water treatment plant (RWTP) to produce a minimum of 4,000 cu meters per day by treating available wastewater to meet British Columbia's MSR "Unrestricted Public Access" reclaimed water standards. This approach would provide the required nonpotable water to the oil and gas sector with the added benefit of reducing demand from the water supply. Other initiatives—such as water conservation bylaws or adopting British Columbia's "Living Water Smart" approach to water management—would ensure adequate water supply for the city of Dawson Creek and satellite communities that utilize the city's potable water.

The city issued a request for a proposal from the private sector to raise capital to upgrade its existing wastewater treatment facility to meet unrestricted public access reclaimed water standards. In return, the successful proponent was offered a 10-year right to 85% (3,400 cu meters per day) of the reclaimed effluent from the treatment plant. Possible uses for the reclaimed water include oil and gas production, dust control and/or sports field watering. Shell provided the winning proposal and contributed a significant portion of required total capital.

The city reserved the right to the remaining 15% (600 cu meters per day) of reclaimed water for possible use in watering parks and sports fields. Alternatively, the city could offer this portion of reclaimed water for use in industry for a nominal fee. The estimated 25% reduction in potable water demand ensured that the city will have an ample supply of water to meet future demands.

The process would have to establish a reliable, simple, and low operation and management cost

Three SAGR beds were constructed to operate in parallel.

process that maximized the existing infrastructure. More importantly, it would have to meet British Columbia MSRs for reclaimed water under the "Unrestricted Public Access" category and, as a result, also meet and exceed the CCME requirements on a year-round basis.

After discussions with the city's designated consultant, the decision was reached to add an NEI SAGR process to provide post-lagoon BOD5 and ammonia removal, and significantly reduce demand on process equipment downstream. Added benefits would include a significant reduction in lagoon effluent total suspended solids (TSS) and pathogens. For final turbidity and TSS polishing following the SAGR, cloth disc filters would be implemented followed by a chlorination unit for disinfection.

The SAGR Process

Many small communities in Canada and Northern U.S. currently are using lagoon systems for wastewater treatment, which often experience process water temperatures below 1°C for extended periods in winter. As a result, continuously discharging systems cannot meet low ammonia limits during the winter months. An alternative is to store lagoon effluent for intermittent discharge when water temperatures improve. This approach is impossible for many communities due to large capital and land requirements associated.

The SAGR process was developed to address these issues. The performance parameters and sizing of the SAGR process are based on extensive testing performed on post-lagoon demonstration systems located in Lloydminster, Saskatchewan, and Steinbach, Manitoba. Lloydminster was commissioned in 2008 and is currently in operation, while the Steinbach pilot was in operation from 2007 to 2010.

Depending on effluent requirements, the system design can be adjusted to meet effluent ammonia levels of less than 1 mg/L in summer months and less than 2 mg/L in winter months, with influent water temperatures as low as 0.5°C. For the Dawson Creek RWTP, three SAGR beds (modules) were constructed to operate parallel to one another, following the existing aerated lagoon system.

The SAGR process can be utilized for nitrification following any secondary treatment process, including aerated or facultative lagoons. It is a clean gravel bed with a horizontal flow distribution chamber at the front end to distribute the influent wastewater across the width of the entire bed. The gravel provides the necessary surface area for growth and attachment of a nitrifying biomass within the bed and is sized to optimize bacterial growth and hydraulic flow. A horizontal effluent collection chamber at the back end collects all the treated effluent and channels it to the discharge structure. Sizing of the bed is based on influent loading rates and temperature, as well as the required rate of nitrification.

NEI Linear aeration is laid along the SAGR floor and provides the continuous, year-round aerobic conditions necessary for nitrification to take place within the bed. The aeration grid and bed layout are designed to optimize biomass growth by balancing predation/decay with growth throughout the bed. This in turn minimizes long-term flow obstruction due to biomass overgrowth.

Dawson Creek SAGR Performance

Nelson Environmental staff provided operational training and commission on Sept. 13, 2011, following successful completion of system construction.

All MSR effluent objectives were met prior to implementing the disc filters, with the exception of turbidity (no bacterial indicator data was provided). This trend is expected to continue and improve as the SAGR process matures to establish an optimal biomass film within the beds.

Preliminary results indicated that the upgraded facility is well on its way to meeting effluent quality objectives and solve the potable water availability concerns. There is potential for capital cost recovery for the city of Dawson Creek, considering that demand for the reclaimed water by the oil and gas industry (within this geographic location) is most likely to remain high for the foreseeable future. The RWTP effluent quality far exceeds the recently published CCME effluent quality requirements and as a result, the city is ahead of the curve in meeting the 30-year grace period allocated by the federal government for wastewater treatment plant upgrades.

Shell, on the other hand, gained an alternative source for process/fracturing water that is cost-effective and high quality. Shell has access to 3,400 cu meters per day of water over a 10-year period for its initial investment, amounting to significant long-term savings and capital recovery. The company built a piped system to convey the reclaimed water from the RWTP to the site, resulting in approximately 85 daily trucks taken off the road that previously conveyed water from Dawson Creek's bulk filling station to the site. This also translates into long-term cost savings, along with good environmental stewardship.

All of this is possible due to the SAGR's ability to provide high levels of wastewater treatment in cold climates while preserving the low operational and maintenance required for lagoon based wastewater treatment systems. Other SAGR installations at various locations in Canada and the U.S. are helping to meet strict effluent requirements and solve numerous process lagoon-based operational and water quality problems without abandoning existing infrastructure. WWD

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