Kamloops Centre for Water Quality:
Membrane Technology Ensures Water Safety

History of Water Treatment in Kamloops


An Outside View of the Kamloops Centre for Water Quality

The waters of the North and South Thompson Rivers that meet in Kamloops, British Columbia, have long influenced settlement in this growing city. Surrounded by sprawling arid grasslands and rolling mountains, the confluence of the rivers has drawn people to its banks ever since the native, seminomadic Secwepemc people gathered there to trade goods and enjoy the pristine waters. The native fur trade attracted the first European settlers to this area and the gold rush of the 1850s brought the railway, which facilitated the rapid expansion of the city.

For generations, the river has always provided aboriginals and the early settlers with an abundance of pure, safe drinking water. As the trading post became a settlement, and the settlement grew to be a city, the river began to show signs of decline, and many residents became concerned about the river's water quality.

In the early 1940s the City of Kamloops began chlorinating the municipal water supply to reduce the risk of illness from water-borne pathogens. Until recently, pre-screening and chlorination were the only treatments that the City provided for the drinking water supply. However, as the population of the City and the surrounding area continues to grow, the increasing activities along the watershed are adversely affecting the river water quality. Forestry, agriculture, mining, recreation, construction, and transportation are all producing an increase in the sediment and pollutants from point and non-point sources that are entering the river.

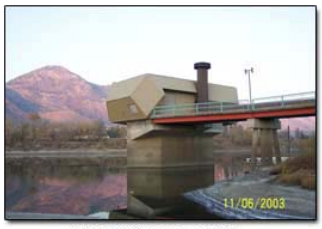
South Thompson River Turbidity Spikes

Typically every spring, this city of 82,000 people observes silted debris washing down the South Thompson River, causing turbidity spikes in the range of 30 to 50 NTU, and in the past have peaked to over 500 NTU. Although the problem is usually short lived, the prior chlorination system used could not remove the suspended solids from the water.

In the past the City advised residents to boil water for additional protection whenever turbidity rises above 5 NTU and also compensated by increasing the chlorination levels in the distribution system to combat rising turbidity events. But troubling outbreaks of water-borne illnesses in nearby communities left many Kamloops residents wondering if they were at risk of a similar occurrence.

Committee Looks for Solutions

In 1997, the City formed the Committee on Drinking Water Quality to specifically address the water quality issue. During the Committee's review process the Thompson Health Region applied new conditions to the City's operating permit for potable water production. The changes required the City to reduce potable water turbidity to below 1 NTU 95 percent of the time, eliminate at least 99.9 percent of Giardia and Cryptosporidium, and maintain trihalomethane concentrations below 100 µg/l.



Intake on Thompson River

The Committee continued with developing strategies to ensure compliance with the new operating conditions and issued a final report in January 2000. Several options were examined by the Committee that included improvements to the watershed to reduce pollutants andsediment in the river, development of alternative water sources from the Clearwater River or a new groundwater source, purchasing water from a neighboring aboriginal band, and the construction of a new water treatment plant.

The Community Advisory Committee recommended that anew water treatment plant would be the best solution for Kamloops to ensure a stable, long-term, high quality water supply. The Committee also recommended that membrane filtration should be further investigated as an option to a conventional, sand filtration plant.


Zeon Membrane Pilot Plant

Pilot studies of four leading membrane systems were conducted during 2000, and the results were presented to city council in May 2001. The results showed that membrane filtration could provide higher quality water to the City, and was easier to operate than a conventional sand filtration plant. The study also showed that the capital cost of constructing a new membrane filtration water treatment plant would be about the same as that of a conventional plant.

Membranes Selected

In September 2001 the Kamloops city council selected membrane technology as the best solution for the new plant, and a year later, in September 2002, awarded ZENON Environmental Inc. with the contract to supply immersed, low-pressure ultra filtration membranes for the project. ZENON was selected over three other membrane suppliers after a detailed review process which, in addition to the pilot testing, also included company experience and qualifications, product quality, and project lifecycle costs.


Membrane Cassette

Construction of the new $48.5 million Kamloops Centre for Water Quality Treatment Plant (KCWQ) began in April 2003 and construction was complete by the end of December 2004. The plant is now Canada's largest low-pressure, enhanced coagulation membrane water treatment plant and will be capable of supplying up to 160 MLD (42.3 MGD) of clean drinking water to the community, regardless of the turbidity in the raw river water.

Leadership in Sustainable Design

In addition to providing a safe drinking water supply, the new water treatment plant demonstrates the City's leadership in water conservation and environmental stewardship. The facility is designed and constructed according to Leadership in Energy and Environmental Design (LEED) criteria to reduce the environmental impact of the construction and operation of the plant.

Water conservation measures are in place throughout the facility. The development of a green roof will reduce run off and absorb heat while overflow from the roof and the porous pavement in the west parking lot will be redirected to a constructed wetlands. Grey water from the plant processes will eventually provide irrigation to city parks and an adjacent sports field. Even the building itself incorporates recycled materials in the concrete, aluminum, insulation, and drywall, just to name a few.

Thompson Rivers University Water Education and Research Centre

Thompson Rivers University (TRU) has partnered with the City of Kamloops, and Zenon Environmental to form the TRU Water Education and Research Centre located inside the Kamloops Centre for Water Quality. This facility consists of a double classroom and two laboratories designed for instrumentation and science/research activities. The TRU Water Education and Research Centre will accomplish a variety of research goals and will provide much needed training opportunities throughout the entire water industry in addition to facilitating national and international collaborations.

Thompson Rivers University is in the final stages of developing a two year associated diploma program in Water Treatment Technology that will provide operations staff the option of pursing up to 180 Continuing Education Units (CEU's) exclusively in the water treatment field. This unique program will utilize numerous delivery formats, including distance, and in some cases enhance courses with an onsite practical component, that will be offered at the Kamloops Centre for Water Quality.


Blower Room

The program is designed to be flexible and meet the provincial requirements of those already practicing in the water treatment industry, as well as those interested in entering the profession of water treatment. Some operators currently in the field may only want to meet the continuing education unit requirements (CEU's) defined by various regulatory agencies. To accommodate these operators, each major course will consist of a series of smaller modules. An operator has the flexibility to choose which module they wish, to achieve specific CEU targets. These credits can be applied later towards the Water Treatment Technology Program.

Research

The ability to conduct research in the new TRU facility will allow the on-going collaborations with the City of Kamloops to be expanded, and provide new opportunities to work on issues important to our community and others. It will also serve as a centre for research collaboration with other Canadian and International organizations.


Primary Permeate Room

This facility will provide a focus area for future research projects and opportunities involving collaborations between TRU faculty and students. In addition, will provide benefits to the local region, and could well extend nationally and internationally.

Plant Operation

The City's new membrane ultrafiltration WTP pumps water from the South Thompson River to a low lift pumping station for screening and coagulant addition to aid in the removal of total organic carbon (TOC). The removal of TOC minimizes the formation of any chlorination byproducts such as trihalomethanes which are suspected carcinogens. Six flocculation tanks will mix the incoming water for several minutes to facilitate floc formation and then release it to the membrane process tanks.


Hypochlorite System

The flocculated water flows by gravity into membrane process trains. The plant is equipped with 12 process trains; however, water production is handled by 11 trains to enable one train to be removed from production for maintenance cleaning. ZeeWeed® membrane cassettes are immersed directly into the process tanks. Thousands of membrane fibers hang loosely in each membrane cassette and a slight vacuum is applied to the end of each membrane fiber to draw water through microscopic pores and into the hollow fibers. With a nominal pore size of 0.04 µm, the 7 membranes form a physical barrier to suspended solids and provide greater than 4-log removal of pathogens such as Giardia and Cryptosporidium. Rejected particles remain in the process tank.


Treated Water Heater

The Kamloops Centre for Water Quality incorporates a two-stage filtration process that enhances the recovery of potable water from the river. This second stage has six trains of ZeeWeed UF membranes and can treat up to 12.5 MLD (3.3 MGD) of reject water from the first stage. Any reject water from the secondary stage is currently being returned to the headworks of the plant and mixed with the incoming raw water for further processing. This configuration enables the plant to recover 99 percent of potable water from the river and also substantially reduces the cost of raw water pumping and waste streams to the sewer system. In the final step, chlorine is added as a disinfectant, prior to releasing the water to the municipal distribution system.

Plant Operations Update – 1 year Later

The Kamloops Centre for Water Quality "officially" opened and started producing water full time February 18th, 2005. The following day, an open house was set up to allow the general public a tour of

the new facility. While official counts were not made, it was estimated that over 3000 people showed up for a tour of the new facility. Attendance numbers were so large, that a second open house was held on April 23, 2005 to accommodate the overwhelming interest from the general public in this new facility.

To date (January 2006), over 23 billion litres of water have been produced by over 10 million individual membrane fibers immersed in 18 tanks at the Kamloops Centre for Water Quality. Turbidity has been undetectable and the online laser turbidity instruments remain fixated at their lowest measuring limit. A unique feature of this facility is the ability at any time to check the integrity of the entire membrane system. Sensitivity is so accurate, that a single fiber breach can be detected and repaired within hours. To date, none of the fibers producing potable water have experience any breaches.

The facility is operated and staffed 24 hours a day, 365 days a year, consisting of 5 operations staff and one supervising Crewleader. The Kamloops Centre for Water Quality is a Class IV facility; is one of the most technologically advanced water treatment facilities in Canada and has high academic recruitment standards for all staff. All operations staff must also obtain mandatory EOCP Water Treatment Level III certification as a condition of employment.

September 2005 Water Quality Parameters:

	Apparent Colour (PtCo units)	pH	Hardness (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	Temp (°C)	Total Suspended Solids (mg/L)
Raw	17	7.85	38.0	53.14	1.50	16.7	3,2
Finished	< 1	7.93	37.8	61.04	0.01	17.5	0

Future Expansion

The Kamloops Centre for Water Quality has been constructed with community growth in mind and, when required, additional membrane cassettes can be added individually to the process tanks to increase output capacity to a total of 200 MLD (52.8 MGD). Each process train currently holds six membrane cassettes, but space is provided for eight cassettes, enabling water production capacity to be increased incrementally as necessary.

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