

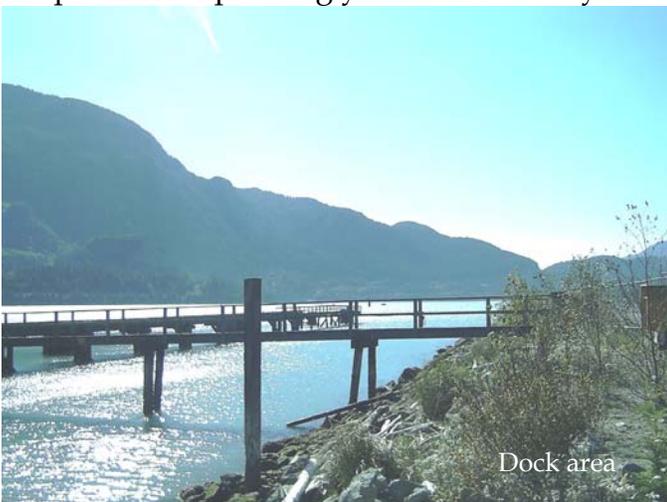
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Nexen: Former Chlor-Alkali Plant, Squamish, BC



Overview

The former Nexen chlor-alkali plant site is located south of the town of Squamish. It operated from the late 1960s to 1991 to produce caustic soda, hydrochloric acid, and chlorine. These products for the pulp and paper industry were manufactured using mercury-cell technology, resulting in losses of mercury to the environment via plant exhaust and effluent. Of the 18-hectare site, the southern six hectares became heavily contaminated with mercury at hazardous waste levels in an old lagoon and below the plant process area over the course of the plant's 26 operating years. After four years



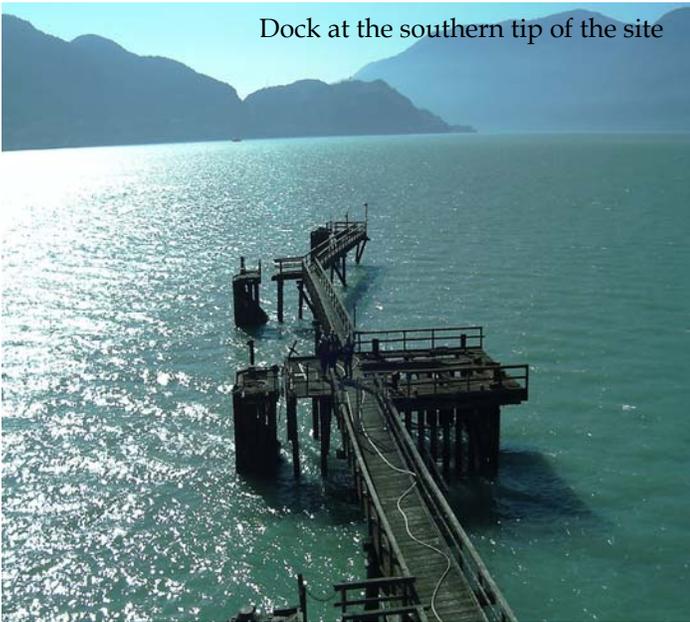
of hard work and \$40 million spent, this complex remediation project was successfully completed. The innovative technologies developed and the lessons learned have provided those involved with additional remedial tools and an expanded knowledge base – significant assets that can be shared with other practitioners and used in future remediation projects.



Innovations

The risk assessment undertaken at the former Nexen site was a groundbreaking element of the remediation process because of the remarkably large area of land covered. This area included upper Howe Sound and offsite lands and water bodies extending up to five kilometres from the plant boundary.

A key innovation developed during the remediation involved excavating contaminated soil within an area with strong tidal influences on groundwater elevations. Mercury-contaminated sludge from an early water treatment system at the site had been disposed



Dock at the southern tip of the site

of in an unlined lagoon, which was excavated as part of the remediation. The lagoon area was divided into more than 30 strips for the excavation process. Because of tidal fluctuation, resulting in a very limited daily work window, dedicated excavators and dump trucks were able to excavate and then backfill just one strip each day.

A total of 150,000 tonnes of mercury-contaminated soil and sludge was shipped to Alberta for disposal over the four years of remediation. Before the heavily contaminated soil could be shipped, soil stabilization technology was used to ensure the mercury was not leachable. This new stabilization process was later recognized and documented by the United States Environmental Protection Agency.

As well, new soil-washing technology was developed for soil that had less severe mercury contamination. Mercury was recovered from the soil at an onsite soil treatment plant, and the cleaned product was reused as backfill. This technology is now a commercial process used worldwide. The water treatment plant itself was another notable example of new technology: innovative processes were developed to ensure the mercury levels in the treated water were safe for discharge to Howe Sound. However, it was

“Innovative technologies were developed by NORAM Engineering, a Vancouver based company. New technologies developed at the Squamish site used ‘waste to treat a waste’ technologies and adopted the Green Chemistry concept [to promote innovative chemical technologies that reduce or eliminate the use or generation of hazardous substances in the design, manufacture, and use of chemical products] for remedial solutions. These technologies are now commercially available for use in the remediation of sites with heavy metal contaminants in soil and water and provide a credible, proven, remedial solution in a sophisticated regulatory environment whilst minimizing contingent liability. The technologies have been granted US patents and are marketed as Lignet™ (solids treatment) and Lignor™ (water treatment).

The technologies are now being considered for treating contaminated leachable tailings in the mining industry prior to storage, in the treatment of Acid Mine Drainage waters, and the treatment of water and soil contaminated with arsenic. Since the completion of the Squamish project, private and government funded research on the development of environmental technologies linked to the findings at the Squamish site have resulted in seven peer reviewed environmental technology papers being published and three US patents granted with one US patent pending.

Favourable, independent studies on the suitability of the Lignet™ technology for treating leachable mining wastes, presently being stored under seawater, have been conducted in the world recognized research facility CSIRO, Australia, for Newmont mining corporation.”

*Tony Walsh,
NORAM Project Manager – Technology*

viewed as even more environmentally acceptable to re-inject the treated water into local groundwater and thus there was no surface water discharge during later stages of the remediation.

Finally, foreshore (intertidal) groundwater profiling techniques developed at the former Nexen site are still in use today. Discrete groundwater measurements are taken at varying depths to accurately delineate the dissolved mercury plume and track its attenuation prior to discharge to Howe Sound. It was this technology that led to the discovery that although the majority of contaminated surface soils had been removed, a deeper source of mercury continues to contribute to a persistent groundwater mercury plume. A new water treatment plant and a targeted groundwater capture system to control the plume is in place and monitoring at a reduced frequency are ongoing to ensure that levels of mercury at the point of discharge into Howe Sound remain acceptable for aquatic life.

Key lessons learned

Along with the accomplishments made in contaminated soil technology and groundwater profiling techniques as the Nexen project progressed, a number of key lessons were learned. The importance of having effective project management and a strategy with a clear vision for the future was apparent from the beginning. Part of the management strategy was to foster a strong sense of the importance of partnerships between Nexen, the ministry, and a wide range of other stakeholders.

Community engagement was key. Public meetings were held with environmental groups, representatives from the Squamish First Nation, and other community members to identify concerns, discuss toxicological objectives of the risk assessment, and share the risk assessment results at the end of the project.

Proceeding with the project in this fashion led to fairness, transparency, and a high level of public support. As a basis for that transparency, the regulatory procedure for the remediation was made available on the ministry web site. As well, the remediation order issued to Nexen underwent approximately 25 amendments, which included stakeholder input that served to clarify and strengthen it before completion. In total, more than 10 stakeholder groups were actively involved in the regulatory review process. The Squamish First Nation was involved from the beginning. Having their own legal counsel and technical consultant, they made a strong contribution to the remediation process by providing third-party review of the proceedings.

In 2004, the Provincial Crown transferred the former Nexen site to the District of Squamish. Having received prime waterfront property, complete with a sandy beach, the Squamish Oceanfront Development Corporation is currently working on development options for

Plant process area, soil-holding and treatment area, and strip excavations in the Old Lagoon



Cleanup of mercury contamination

the area. As part of this, Squamish is participating in the LEED (Leadership in Energy and Environmental Design) for Neighbourhood Development pilot program, designed by the U.S. Green Buildings Council to test its certification system for sustainable neighbourhood design. As well, Squamish is a Smart Growth on the Ground community, using “green” standards in buildings and infrastructure to reduce environmental impacts. The potential for growth at the waterfront represents significant economic benefits for Squamish. The town’s economy, formerly reliant on the forestry and rail sectors, has shifted dramatically in recent years towards the tourism and service sectors.



On January 22, 2004, Nexen was awarded a Special Environmental Award for its work in cleaning up the site of the former chlor-alkali plant. As expressed by the then Minister of Environment, Joyce Murray, “Nexen set a new standard of excellence in the cleanup of this site.”



Timeline

- 1965: Chlor-alkali plant built on the Squamish River estuary by FMC Canada
- 1970: Original wastewater treatment plant built
- 1989: Nexen buys plant from FMC Canada and assumes environmental liability
- 1991: Plant shuts down; Ministry of Environment becomes involved and recommends the company pursue independent remediation
- 1999: Remediation order issued by MOE
- 2003: Site remediation complete
- 2004: Provincial Crown transfers the site to the District of Squamish
- 2004: Special Environmental Award presented to Nexen by the Minister of Environment

Note: This summary is solely for the convenience of the reader. Site investigation/remediation reports and ministry file records should be consulted for complete information.

For more information, contact the Environmental Management Branch at site@gov.bc.ca.