Annual environmental report
BC Operations
2013

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About this Report

Chapter 1

In 1999, Rio Tinto Alcan's Kitimat Operations became the first industrial facility in British Columbia to obtain a multi-media environmental permit from the provincial government. This permit comprehensively addresses multiple emissions, effluents and solid waste, sets limits and establishes monitoring and reporting requirements. The multi-media permit replaced a number of previous permits and is a key regulatory compliance benchmark for smelter operations.

The permit provides guidelines for a results-oriented environmental management approach. Kitimat Operations combines the permit guidelines with other proactive strategies to facilitate vigilant compliance monitoring and regular communications with public and private stakeholders.

The multi-media permit mandates annual reporting to measure performance against established permit standards. This Annual Environmental Report is provided to meet the reporting requirements under the permit. It is submitted to the provincial government and made available to the public.

In addition to the permit reporting for Kitimat Operations, a summary report for compliance of the Kemano Operations environmental permits is provided.

2013 presented the Kitimat Smelter operation with unique challenges associated to organization changes and infrastructure upgrades in preparation of the Kitimat Modernization Project (KMP).

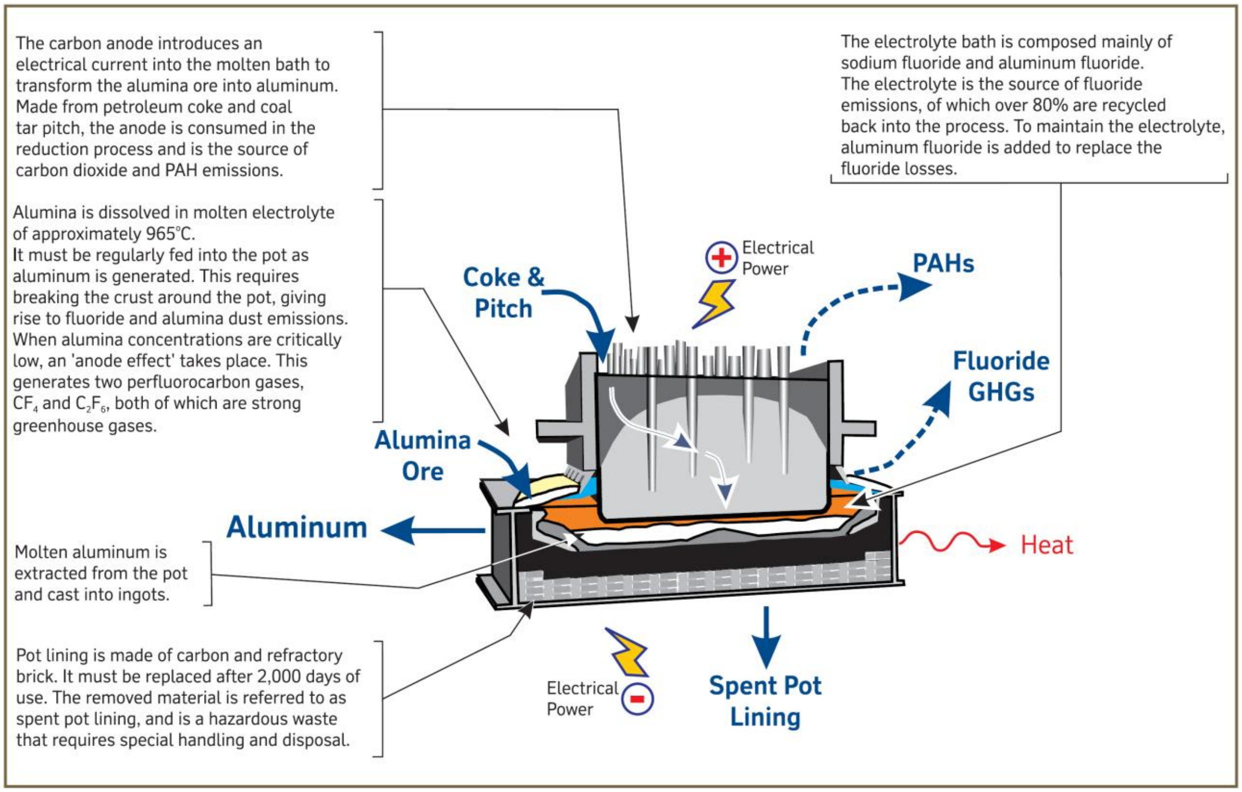
In 2013 Kitimat Operations reported three non-compliances associated to equipment failure and five non-compliances associated to non-compliant roof emissions. Two Non-compliances were reported for Kemano operations. A discussion of the non-compliances, impacts and responses are highlighted in Chapter 11 of this report.

The 2013 Annual Environmental Report is available online at www.riotintoalcaninbc.com. Locate the report by selecting Media then Environmental Reports from the drop-down menu. The website also provides information on key environmental performance indicators.

Questions or comments are welcome and may be made through the contact page on the website. ❖

Figure 1.1 Aluminum Manufacturing Process

Aluminum Metal is extracted from raw alumina using an electro-chemical “reduction process” that takes place within a steel-encased pot.



Operational Overview

Chapter 2

Rio Tinto Alcan operates a multi-faceted industrial complex in northern British Columbia, which is one of the largest in the province. Its focal point is the Kitimat aluminum smelter located on the northwest coast, at the head of Douglas Channel.

On December 1, 2011 Rio Tinto authorized the investment of US$2.7 billion for the modernization of the Kitimat Operations (www.kitimatworksmodernization.com). The quality of the water discharge has improved since the Kitimat Modernization Project (KMP) ongoing site improvements initiated back in 2011 and sustained operational practices during 2013. Details are presented in Chapter 4, effluents.

Before KMP, Kitimat Operations had an annual rated production capacity of 282,000 tonnes of aluminum. The main raw material used at the smelter is alumina ore, large volumes of which are imported from international suppliers and delivered by ship. Alumina is composed of bonded atoms of aluminum and oxygen. An electrolytic reduction process is used to break the bond and produce aluminum.

The electrolytic reduction takes place in the potroom buildings. These buildings house specially designed steel structures called pots. The pots function as electrolytic cells. They contain a molten bath or electrolyte made up mainly of highly conductive cryolite in which alumina ore is dissolved. Electricity flows through the electrolyte from an anode to a cathode. The electricity breaks the aluminum-oxygen bond. The heavier aluminum molecules sink to the bottom of the pot in the form of molten aluminum. Molten aluminum is then extracted and transported to the casting centres located within the smelter, where it is temporarily stored in holding furnaces. Various alloying materials (such as magnesium, copper, silicon and iron) are added to produce specific characteristics such as strength or corrosion resistance.

The aluminum is then poured into moulds and chilled with water, forming solid ingots of specified shapes and sizes. Kitimat Operations produces three types of ingots: value added sheet, extrusion ingot (in rectangular forms), and trilok ingots, which are sold to customers in North America and Asia for remelting resulting in a variety of end-use applications.

The smelter site also includes facilities that produce raw materials required for aluminum production including the on-site anode paste plant and a calcined coke plant which produce materials used in the manufacturing of anodes.

The electrolyte reduction process requires the use of large amounts of electricity. Electricity for Kitimat Operations is generated at the Kemano Operations' powerhouse, a 1,000 megawatt hydroelectric generating station located 75 kilometers southeast of Kitimat. This generating station uses water impounded in the 91,000 hectare Nechako Reservoir in north-central British Columbia. ❖

Figure 2.1 Kitimat Operations Map

Effluent Collection and Treatment

- 1 D-Lagoon and Emergency Outfall
- 2 D to B-Lagoon Diversion (2001)
- 3a 3b 3c Direct Stormwater Discharges
- 4 J-Stream Discharge
- 5 Potline 1 Discharge
- 6 Middle B Discharge
- 7 North B Discharge
- 8 B-Lagoon
- 9 B-Lagoon Discharge
- 10 Salt Water Addition
- 11 A-Lagoon
- 12 F-Lagoon Former Weir Location
- 13 F-Lagoon Emergency Outfall
- 14 F-Lagoon
- 15 Discharge from Water Treatment Clarifier

Waste Storage, Disposal & Managed Sites

- A1 Yacht Basin
- A2 Scow Grid
- A3 Concrete Slab Storage
- A4 SPL Landfill
- A5 Wood Burn Area
- A6 South Landfill
- A7 North Landfill
- A8 Waste Oil Storage (Building 104)
- A9 Spent Potlining Overburden Soil Cell
- A10 Wharf Dredgeate Cells
- A11 Scrap and Salvage Recycling
- A12 Hazardous Waste Storage (Buildng 504)

Plant Components

- B1 Wharf
- B2 Green Coke Storage
- B3 Coke Calciner
- B4 Anode Paste Plant
- B5 Potlines 1-2
- B6 Potlines 3-5
- B7 Water Treatment Primary Clarifier

Environmental Management and Certification

Chapter 3

Introduction

The foundation for environmental management throughout Rio Tinto Alcan's global operations is the Health, Safety and Environment (HSE) Policy. HSE directives establish corporate-wide standards on major environmental, health and safety topics.

The HSE Policy and the more specific requirements of the Rio Tinto Health, Safety, Environment and Quality (HSEQ) Standards are put into practice at B.C. Operations through a comprehensive, operation specific Risk Management System. A dedicated coordinator who champions risk management and its auditing process oversees the Risk Management System. The system is maintained through adherence to the HSEQ Management System's 17 Elements encompassing the continuous improvement cycle of Plan, Do, Check and Review (PDCR).

Independent certification

In Since 2001, B.C. Operations' Risk Management System has been successfully certified under the demanding requirements of ISO 14001, an environmental program of the International Organization for Standardization. ISO 14001 provides independent verification that BC Operations assesses its environmental implications, has procedures in place to address issues, and works continually to lighten its environmental footprint. In keeping with a corporate-wide commitment to a sustainable management approach, B.C. Operations attains certification combining ISO 14001 standards (Environment), the OHSAS 18001 standards (Occupational Health and Safety Advisory Services) and the ISO 9001 standards (Product Quality).

Since 2010, our HSEQ Risk Management System has encompassed the ISO 14001, OHSAS 18001 and ISO 9001 certification standards in one system, as prescribed by Rio Tinto Corporation. This system builds on the requirements of the various management system standards to improve and sustain the process structure and add a level of rigor and consistency of rigor.

Audit program

Independent ISO compliance and conformance audits are conducted as a condition of certification. The internal and external Safety, Environment and Quality Management System surveillance audits took place in 2013 as planned. The Kitimat Operations' integrated certification was successfully maintained.

Compliance with all environmental laws and regulations is the foundation for our environmental performance Standards. In 2013, external audits were carried out to assess the ongoing regulatory compliance as well as the verification of the Environmental Performance Agreement between Rio Tinto Alcan Kitimat and Environment Canada relating to the performance objective of the PAH Emissions, Program details described in Chapter 5.❖

Excellence in managing HSE responsibilities is essential to our long-term success and is the hallmark of Rio Tinto Alcan's activities.

Health, Safety and Environment Policy

Rio Tinto Alcan is committed to protecting the environment, preventing pollution and safeguarding the health, safety and welfare of those who work at or visit our sites in a manner that is respectful of local laws, customs and cultures.

Our vision is supported by our core values of fairness and honesty, integrity, respect, teamwork, trust and transparency, passion for excellence and tenacity in achieving results. As a business, we care about people and the world in which we live.

Health, Safety and Environment (HSE) guiding principles

- We collaborate to identify and eliminate, or otherwise control, HSE risks to our people, our communities and the environment in which we operate.
- We use the HSE risk framework and the application of the hierarchy of controls to develop and deliver measurable HSE objectives and targets.
- We deliver our HSE responsibilities and ensure our employees are equipped and trained to achieve our Goal of Zero incidents, injuries and illnesses.
- We encourage our employees to adopt a healthy, safe and environmentally conscious lifestyle both at work and home.
- We improve and support our suppliers' and customers' contribution to sustainable development by promoting the responsible use and multiple benefits of our products.
- We continuously seek to reduce the environmental footprint of our operations and related activities by:
  - Improving the energy efficiency and our natural resource consumption,
  - Reducing, reusing and recycling materials to minimise waste and pollution,
  - Endeavouring to protect and restore natural biodiversity,
  - Identifying and undertaking specific programmes to reduce the greenhouse gas emissions of our business.
- We generate sustainable HSE performance through long term, mutually beneficial relationships with our communities, governments, our business partners and other stakeholders.

To support the implementation of this policy, Rio Tinto Alcan commits to:

- Holding leaders accountable for the delivery of HSE improvements and for providing the necessary resources to do so.
- Requiring all in the business to understand their responsibilities and accountabilities in respect of HSE and to visibly demonstrate their commitment, through their actions, towards achieving our Goal of Zero incidents.
- Complying with all applicable laws, Rio Tinto HSE standards and other voluntary requirements.
- Developing, implementing and maintaining recognised management systems and programmes that ensure appropriate and consistent implementation of this HSE Policy, globally.
- Obtaining assurance of our HSE policy and management systems through regular audits and reviews of our performance.
- Promoting effective employee, contractor and stakeholder participation in and awareness of HSE issues and programmes related to our operations through training, communication and regular public reporting of performance.

As individuals, we personally commit to applying the principles of this policy to continuously improve *The way we work* every single day.

Jacynthe Côté, chief executive, Rio Tinto Alcan

February 2009

Effluents

Chapter 4

Introduction

Sources and infrastructure

Surface runoff from the smelter site, originating as snowmelt and rain, accounts for most of the water discharge. Seasonal precipitation varies significantly, and total discharges can be over 100,000 m^3 per day during fall and winter storms.

Whether water is in use at the smelter or accumulating through surface runoff, it collects contaminants from various sources. It is directed through underground drains and surface channels to one of the six inflows, then into B-Lagoon that discharges into the Douglas Channel.

All effluents, with the exception of several storm drains, are directed to B-Lagoon through one of six inflows, referenced as: F-Lagoon, D to B-Lagoon Diversion, North B Discharge, Middle B Discharge, Potline 1 Discharge, and J-Stream Discharge (refer to Effluent system and waste management map on **Figure 2.1**). With the implementation of the Kitimat Modernization Project Water Management Plan during the summer of 2011, completion of the soil excavations and remediation, the storm runoff has been returned to F-Lagoon, two new outfalls have been added to improve the management of KMP surface water runoff.

B-Lagoon consists of a primary and a secondary pond: Upper and Lower B-Lagoons. Designed to remove contaminants by sedimentation or settling and to smooth fluctuations of inflows and contaminant levels, B-Lagoon discharges effluent continuously into the Douglas Channel. In 2013, the average discharge rate was 36,645 m^3 per day.

The retention time for water in the lagoon is usually more than ten hours (confirmed by measurements conducted in 2005), but is reduced to about five hours during runoff events and heavy rainfall. Lagoon vegetation acts as an additional filter to reduce the impact of certain contaminants and is particularly effective during the summer months.

In addition to the B-Lagoon outfall, an emergency outfall accommodates significant inflow surges. F-Lagoon and D-Lagoon are also designed with emergency overflows in case of significant surge. In 2013, there were two overflow events at F-Lagoon that were within the permitted limits.

Discharge measurements related to permit requirements and additional monitoring are described below in the following 2013 Performance section.

2013 Performance

Effluent water quality monitoring

Effluent water quality is monitored annually for the following parameters: flow variability, dissolved fluoride, dissolved aluminum, total suspended solids, cyanide, temperature, conductivity, hardness, toxicity, acidity and PAH. Of these parameters, dissolved fluoride, dissolved aluminum, and total suspended solids are monitored for long term trends.

In 2013 the grab sample was missed on October 6th as result of the alarm communication failure following equipment upgrades (more details provided in Chapter 11). Additional measures have been implemented and procedures have been reviewed with all staff to prevent a reoccurrence.

Flow variability

Variability in the flow from B-Lagoon into Douglas Channel is mainly a function of precipitation. As shown in **Figure 4.1**, peak rain events and flows occurred in from January to March and from September through December. The total amount of rainfall in 2013 (2,440 mm) was comparable to 2012 levels (2,465 mm).

Long-term trends

Dissolved fluoride, dissolved aluminum, and total suspended solids are the most meaningful performance indicators of the plant effluent water quality. Average annual performance for these have been consistently maintained below permit levels (10 mg/L, 3 mg/L and 50 mg/L respectively) in recent years. **Figure 4.2** illustrates the long-term trend performance.

The impact of a major precipitation event (Dec 26th) was observed as an increase of dissolved fluoride and dissolved aluminum in B-Lagoon outfall and the second F-Lagoon overflow in 2013.

In 2013 dissolved fluoride, dissolved aluminum and total suspended solids decreased in comparison to 2012 and 2011 levels. Decreases in dissolved fluoride, dissolved aluminum and total suspended solid loads can be attributed to the lower than average rainfall experienced in 2013 and the success of Rio Tinto Alcan's Ecological Target Initiative. This initiative was established in 2010 with a target of reducing dissolved aluminum loading to below 5,800 kg per year.

The 2013 activities continued focusing on preventing alumina entering the courtyards and maintaining housekeeping. As a result 2013 was for the second consecutive year where the target was met (1,571 kg).

Dissolved fluoride

Dissolved fluoride originates mainly from the leaching of a landfill formerly used to dispose of spent potlining. Information on the spent potlining landfill is reported in Chapter 9, Groundwater monitoring. Other sources of fluoride are raw material losses and air emissions captured in runoff. The amount of precipitation and surface runoff can significantly influence the levels of dissolved fluoride.

Dissolved fluoride is monitored using continuous monitoring; daily composite sampling and monthly grab sampling. Daily composite and grab samples are sent to an outside laboratory for analysis (refer to Chapter 12, Glossary for sample method definitions).

The permit specifies a maximum concentration of 10 mg/L of dissolved fluoride in effluent; this level was not exceeded in 2013. Average dissolved fluoride concentration for the year derived from composite sampling was 2.46 mg/L. This value is lower than 2012. The long-term trend is illustrated in **Figure 4.2**. The 2013 composite and grab sampling results (**Figure 4.3**) profile the higher concentrations that occurred during the higher precipitation and surface run-off during the year.

Figure 4.1— Flow Variability, B-Lagoon

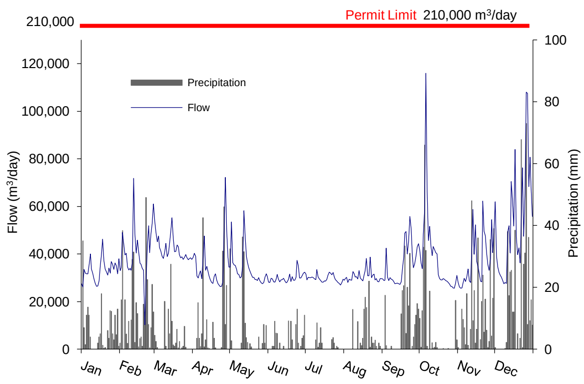
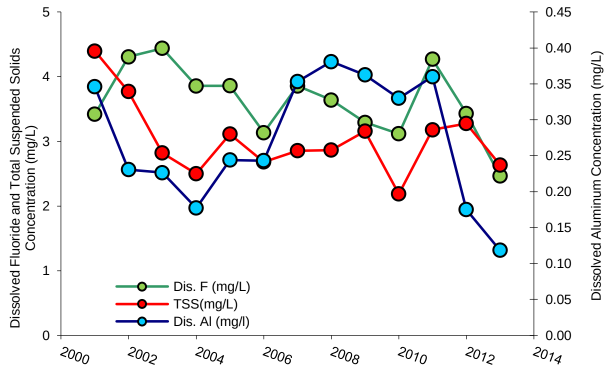


Figure 4.2— Dissolved Fluoride, Dissolved Aluminum & Total Suspended Solids, B-lagoon 2013.



Dissolved aluminum

Aluminum metal at Kitimat Operations, such as finished products stored outside at the wharf, have a very low solubility and contribute little to the discharge of dissolved aluminum.

In addition to its use as a raw material, alumina is also used in the scrubbing process to remove fluoride from smelter emissions. Some scrubbed alumina is released through the potroom basements and roofs. In this form, scrubbed alumina has a higher solubility and is a contributor to both dissolved aluminum and dissolved fluoride.

In 2013, concentrations of dissolved aluminum did not exceed the maximum permit limit of 3.0 mg/L. The annual average of dissolved aluminum concentration was 0.12 mg/L (**Figure 4.4**).

Figure 4.3— Dissolved fluoride, B-Lagoon 2013

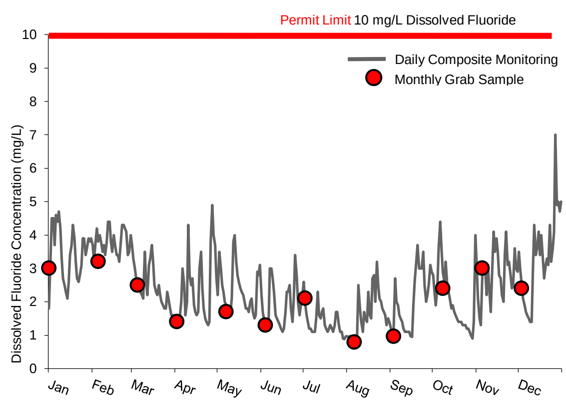
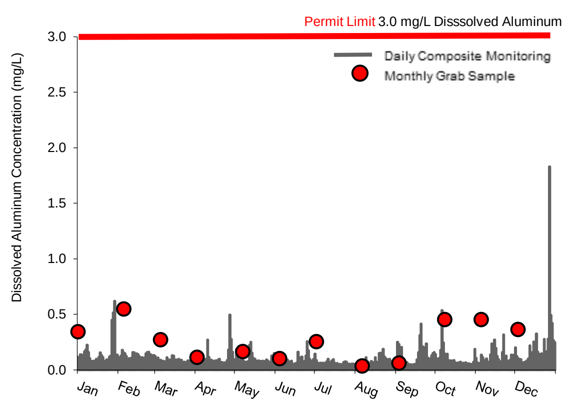


Figure 4.4— Dissolved Aluminum, B-lagoon 2013.



Total suspended solids (TSS)

Solids that remain suspended in discharge from B-Lagoon include small amounts of materials used in industrial processes at the smelter and other naturally occurring substances like dust, pollen and silt. There is a proportional relationship between TSS levels and concentrations of both dissolved aluminum and polycyclic aromatic hydrocarbons (PAH), because these contaminants are usually bound to suspended solids in water when entering the B-Lagoon system.

B-Lagoon is a large and well-vegetated area that is highly efficient in absorbing and processing effluent compounds. The permit specifies a concentration maximum of 50 mg per litre of TSS in effluent. Concentrations in 2013 were much lower than the permit level. The annual average concentration for the composite samples was 3.4 mg/L. The highest concentrations occurred during February and April (**Figure 4.5**).

Cyanide

Cyanide is formed during the electrolytic reduction process and retained in the cathode lining material known as spent potlining (SPL). In the past, material in the cathode was deposited in the on-site SPL landfill. Today, 100 per cent of newly generated SPL is shipped off-site to a secure landfill. Groundwater and the bottom of the SPL landfill lining interact, generating a leachate containing cyanide. The J-Stream in-flow captures this groundwater leachate, depositing it into B-Lagoon.

The permit specifies a maximum concentration of 0.5 mg per litre of strong acid dissociable cyanide (the more abundant, although less toxic form) in B-Lagoon. Concentrations are determined from the monthly grab samples. The average concentrate on was 0.002 mg/L. The permit level was not exceeded in 2013. Weak acid dissociable cyanide is also monitored, although there is no permit requirement. The level of this form of cyanide was also low with an average concentration of 0.00070 mg/L (**Figure 4.6**).

Figure 4.5— Total suspended solids, B-Lagoon 2013

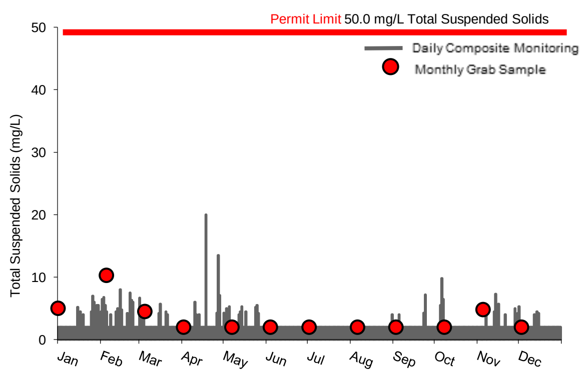
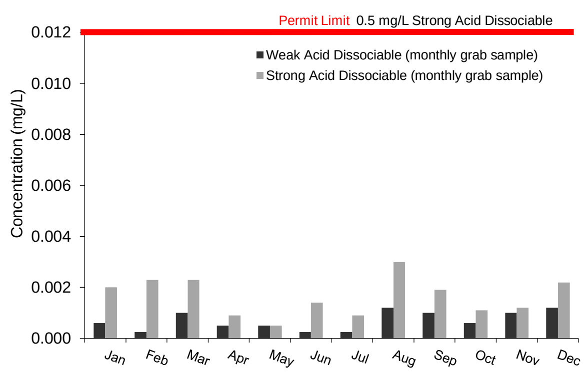


Figure 4.6— Cyanide, B-lagoon 2013.



Temperature

Water used for cooling is the major source of effluent at Kitimat Operations. B-Lagoon is designed to retain effluent long enough to ensure water temperatures are not elevated when discharged. The permit requires that the temperature of the lagoon discharge does not exceed 30°C. Temperatures were within permit requirements during 2013 (**Figure 4.7**).

Conductivity, hardness, salt water addition and toxicity

Studies conducted in B-Lagoon demonstrate that the addition of salt water to the effluent reduces toxicity by increasing conductivity and hardness levels. Since 1997, salt water has been pumped into B-Lagoon at the connection between the primary and secondary ponds. As per permit requirements, the addition of salt water is monitored and managed to maintain non-toxic discharges.

In 2008, an independent consulting firm conducted a review to examine the correlation between seawater addition rates, conductivity, hardness, and toxicity. The review was in fulfillment of section 8.2.5 of the multi-media permit requirement. Results confirmed that the addition of sea water was successful at reducing the toxicity of the B-Lagoon effluent.

The data also confirmed the best way to predict toxicity is via aluminum concentration, conductivity and pH. Conductivity and hardness are monitored on a continuous and daily composite basis respectively, even though there are no permit limits for either parameter (**Figure 4.8**). These measures provide information that ensures the salt water addition system is contributing to the elimination of toxicity at the B-Lagoon outfall.

Water toxicity is determined through the application of a bioassay test. The toxicity of water discharged from B-Lagoon is tested by exposing juvenile rainbow trout to the effluent in a certified laboratory under controlled conditions (96LC_{50} bioassay test). The permit requires monthly monitoring with a survival rate of at least 50 per cent for trout tested. All effluent discharge bioassay tests at B-Lagoon passed during 2013.

Figure 4.7— Temperature, B-Lagoon 2013

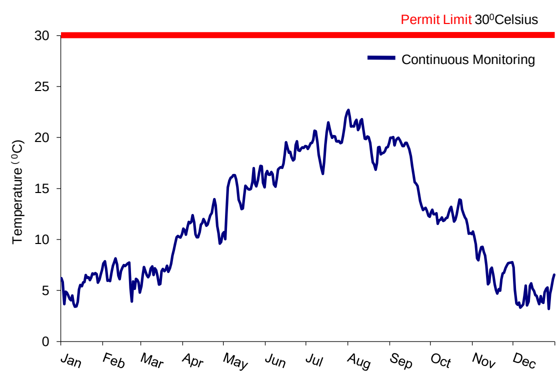
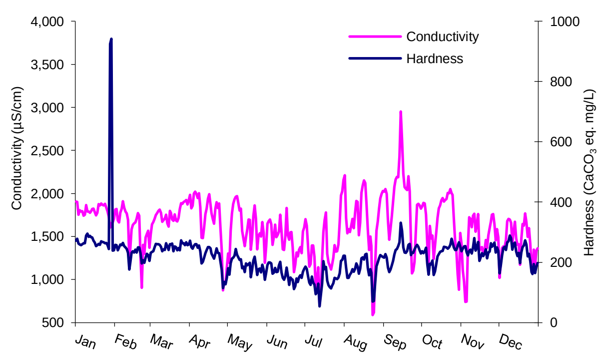


Figure 4.8— Conductivity & Hardness, B-lagoon 2013.



Acidity

A variety of contaminants can influence the acidity of effluent, by either increasing or decreasing the pH. A pH level of 7.0 is neutral, and water sources found adjacent to Kitimat Operations (Anderson Creek and the Kitimat River) usually have a pH level slightly below neutral (i.e. acidic, rather than basic).

Acidity is monitored using a variety of methods (continuous, daily composite and monthly grab samples). Daily composite samples are provided to an external laboratory for analysis.

The permit requires that the pH of the effluent is maintained between 6.0 and 8.5. The 2013 annual pH composite sample average was 7.3. All sample measurements were within the permit limits during 2013 (**Figure 4.9**).

Polycyclic Aromatic Hydrocarbons (PAH)

Polycyclic Aromatic Hydrocarbons (PAH) are a large family of chemical compounds (more than 4,000 have been identified), generated by the incomplete combustion of organic material.

Various operations at the smelter generate PAH (in both particulate and gaseous forms). They originate in discharges primarily from potroom roof dust captured in precipitation and surface runoff. Other sources include raw material (green coke and pitch) handling.

PAH are monitored using two methods: weekly analysis of composite and monthly grab samples. PAH are also analyzed from grab samples taken during special events. B-Lagoon discharges are monitored and analyzed for 18 of the most common PAH compounds, although there are no permit levels for PAH in effluent (**Figure 4.10**). ❖

Figure 4.9— Acidity, B-Lagoon 2013

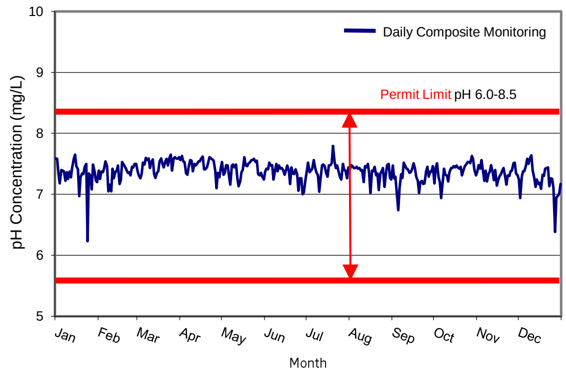


Figure 4.10— Polycyclic Aromatic Hydrocarbons, B-lagoon

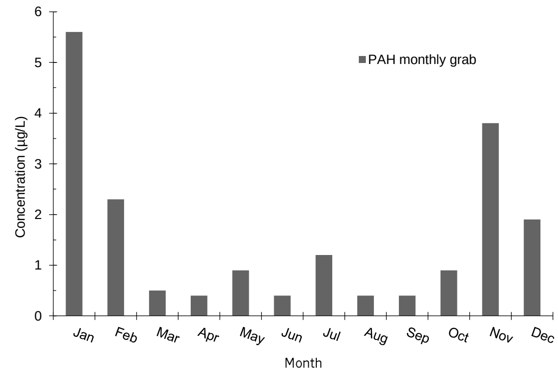
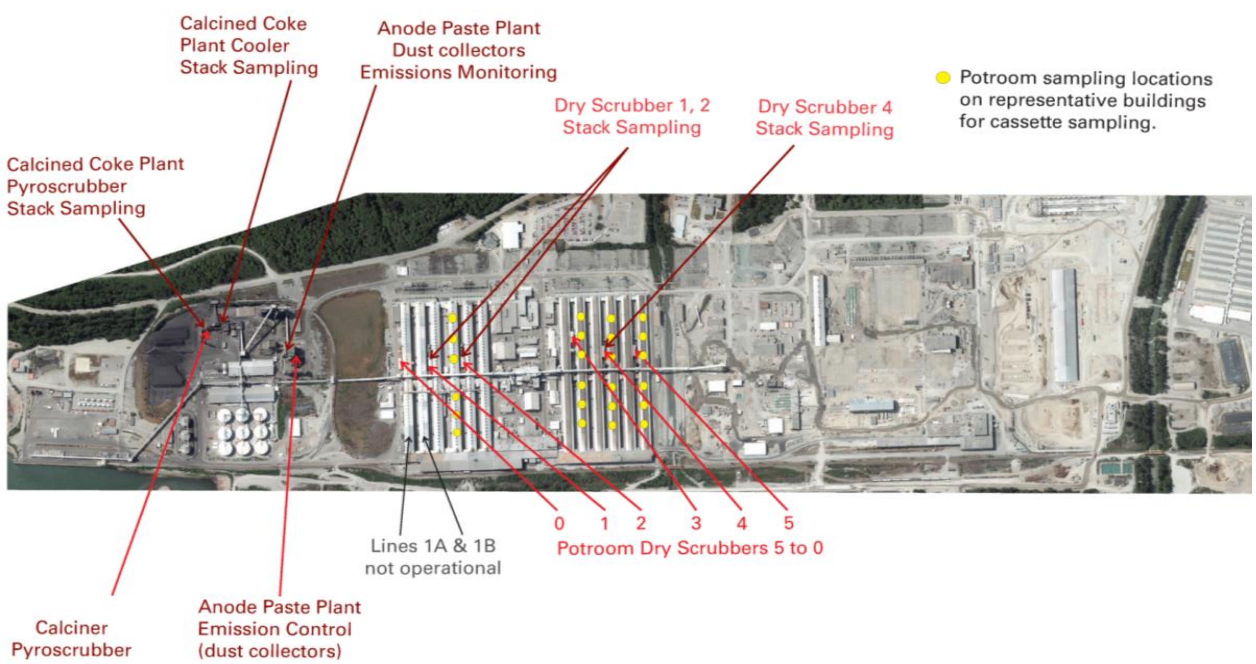


Figure 5.1 Potroom roof sampling locations



Emissions

Chapter 5

Introduction

This chapter describes the results of on-going monitoring of various gaseous and particulate-matter in air emissions from Kitimat Operations. Performance results relate to type and source of emissions.

Emission types

The primary types of emissions monitored are gaseous fluoride (Fg), sulphur dioxide (SO_2), polycyclic aromatic hydrocarbons (PAH), nitrogen oxides (NOx) and greenhouse gases (GHG).

Sources

Major sources of air emissions at Kitimat Operations include the potrooms roofs and scrubbers, the Calcined Coke Plant, the Anode Paste Plant, and exhaust stacks. Wind-blown or nuisance dust (picked up from raw material storage piles, process ventilation systems and during raw material transportation) is another contributor to air emissions.

Pollution control equipment, situated at various locations in and around Kitimat Operations, includes the potroom dry scrubbers, the coke calciner pyroscrubber and the Anode Paste Plant dust collectors. Air emissions are collected and processed via these pieces of equipment to remove most airborne pollutants.

Air quality monitoring

In addition to monitoring emissions, regular and extensive air quality and vegetation monitoring is conducted in the Kitimat valley. Information on these monitoring programs is detailed in Chapters 6 and 7.

2013 Performance

Gaseous fluoride (Fg)

Three major sources contribute to fluoride emissions: the molten bath reduction process; coke and pitch density and quality; and alumina ore density, size and quality. Fluoride emissions are monitored at roof top locations on potroom lines 2A, 3B, 4B and 5B (refer to the yellow dots on the potroom roof sampling locations on **Figure 5.1**).

The molten bath dissolves the alumina ore by an electrolytic reduction process through which aluminum is produced. The bath is composed primarily of sodium fluoride and aluminum fluoride and is the main source of fluoride emissions at Kitimat Operations. More than 80 per cent of fluoride emissions are collected and recycled back into the process, but some escapes do occur due to process upsets.

Over the past three decades, there has been a substantial reduction in gaseous fluoride emissions. Between 1974 and 1981 significant decreases resulted from improvements in collection systems, dry scrubbing, pot design and operating procedures. Smart-Feed Logic was introduced as a way of improving the process of feeding alumina ore into the pots. The Smart-Feed system alerts potroom staff to the occurrence of anode effects so that corrections can be made.

The alumina ore quality has a significant impact on the reduction process. Impurities in the alumina ore promote chemical reactions known as anode effects, Anode effects contribute to both fluoride and greenhouse gas emissions.

The carbon anode – made from coke and pitch – is consumed in the molten bath reduction process. Problems with anode integrity (such as cracking) are major contributors to fluoride gas escapes. When anode integrity is compromised, carbon enters the electrolyte. This results in overheating of the pots, thus breaking the gas seal and reducing gas collection efficiency. Changing global markets for coke indicate that the quality of the coke continues to be unpredictable. Lower quality coke contributes to anode quality problems. Consultation with anode integrity experts are on-going to provide an improved understanding on how to operate with market ready materials.

When the pots do not operate normally, such as during overheating; they are referred to as "exception pots". Because exception pots are associated with fluoride gas escape, they are recorded. The average number of exception pots in 2013 was higher than in previous years associated to anode related problems.

In preparation of the potlines shutdown, in 2008 the gaseous fluoride permit limit (including both potroom and dry scrubber emissions) was set by the Ministry at 50 tonne of gaseous fluoride loading per month and replaced the rate measurement of gaseous fluoride per tonne of aluminum. The gaseous fluoride emissions rate is still tracked internally and showed an increase in 2013 compared to 2012 (**Figure 5.2**). The annual average fluoride emissions loading during 2013 was 37.8 tonne gaseous fluoride per month compared to 34.5 tonne gaseous fluoride per month in 2012. During 2013, there were no loading monthly exceedances of the gaseous fluoride emissions limit (**Figure 5.3**).

Figure 5.2— Gaseous fluoride emissions, rate measurement potroom roofs1998-2013

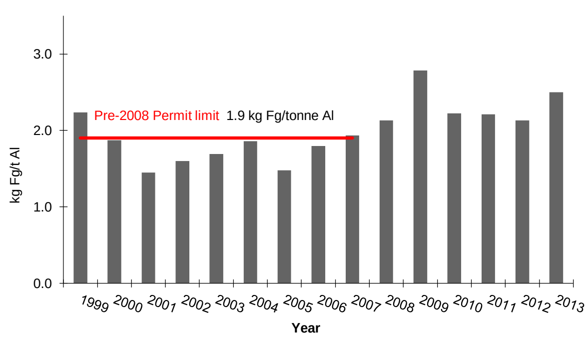
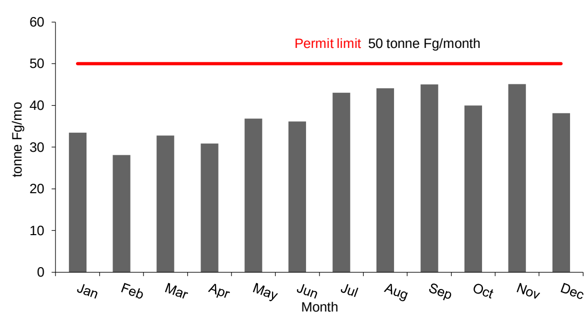


Figure 5.3— Gaseous fluoride emissions, loading measurement Potroom roofs 2013.



There is a relationship between the number of exception pots and fluoride emissions: the higher the exceptions, the higher the emissions. Exception pots are pots that are not operating normally. In 2013 exception pots were unusually higher during Q3 and Q4 leading to higher emissions than in 2012. Sick pots are pots that cannot be sealed properly due to elevated temperatures in the bath from anode problems. Repairs require the pots to remain open. While the sick pots are open, they release emissions. It can take time to get these pots back to normal operating conditions.

Gaseous fluoride is known to have negative impacts on the health of vegetation. Due to elevated gaseous fluoride emissions during the growing season, the routine annual vegetation survey found elevated levels of fluoride in vegetation adjacent to the plant site (refer to Chapter 7).

Sulphur dioxide (SO_2)

Sources of sulphur dioxide at Kitimat Operations include green coke and coal tar pitch. Both are raw materials used to manufacture anodes. Coke calcination is a process used to change green coke into a useable form. Sulphur dioxide emissions occur during calcination and the electrolytic reduction process through which aluminum is produced.

From 1993 to 1999, the sulphur dioxide emission permitted was 20.7 tonne per day on an annual average basis. This level was achieved until 1998 through the increased use of low-sulphur coke. However, low-sulphur coke has created problems with anode integrity, which contributed to exceedances of the limits for both sulphur dioxide and fluoride emissions. Raw material adjustments were required to bring fluoride emissions down, but made the old sulphur dioxide permit limit unfeasible.

In April 2013 in preparation to KMP, a new sulphur emissions limit was set at 42.0 tonne per day. SO_2 emissions decreased from 16.1tonne per day in 2012 to 13.9 tonne per day in 2013 associated to a reduced metal production. The emission levels remained well below the permit limit (**Figure 5.4**). Monthly average performance was also consistently below the permit limit (**Figure 5.5**).

Figure 5.4— SO_2 emissions, Kitimat Operations 1999-2013

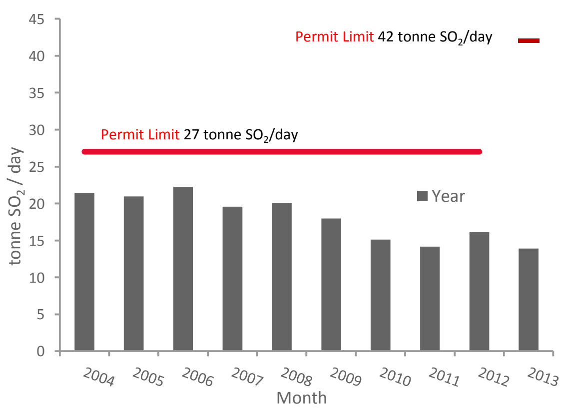
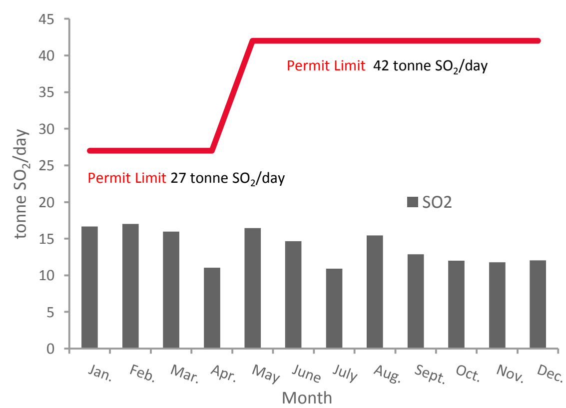


Figure 5.5— SO_2 emissions, Kitimat Operations 2013



Polycyclic Aromatic Hydrocarbons (PAH)

PAH are a large family of chemical compounds (more than 4,000 have been identified), which are produced by both industrial processes and various forms of combustion such as wood-burning stoves and forest fires. They occur in emissions from Kitimat Operations primarily as a by-product of anode paste manufacturing, anode baking and anode consumption.

The multi-media environmental permit requires the monitoring of air emissions from representative potroom buildings for 18 of the most common PAH. PAH content in the emissions from Kitimat Operations was higher in 2013 at 161.3 tonne per year compared to 136.4 tonne per year in 2012 (**Figure 5.6**). Following the observed rate increase during Q2, monthly monitoring was implemented during Q3 and Q4.

In April 2008, an agreement regarding PAH was signed between Rio Tinto Alcan and Environment Canada. The purpose of this agreement was to set environmental performance objectives with respect to atmospheric emissions of PAH from Rio Tinto Alcan's Söderberg plants in B.C. (Kitimat) and Quebec (Shawinigan and Beauharnois). From 2008 to 2011, the environmental performance objective determined for Kitimat Operations was 0.8 kg per tonne

Al. In 2012 the objective was lowered to 0.75 kg per tonne aluminum. The average PAH emissions were higher in 2013 at 0.91kg per tonne aluminum compared to 0.72 kg per tonne aluminum in 2012 (**Figure 5.7**). The average PAH emissions in 2013 were above the set environmental performance objective. The investigation has determined that the stud management in the potrooms had an impact on the increase in PAH emissions. Improvements have been made to the stud quality and stud pulling practices. As well, the most problematic pots were shut down.

Figure 5.6— PAH emissions, loading measurement roofs Potroom roofs 1999-2013

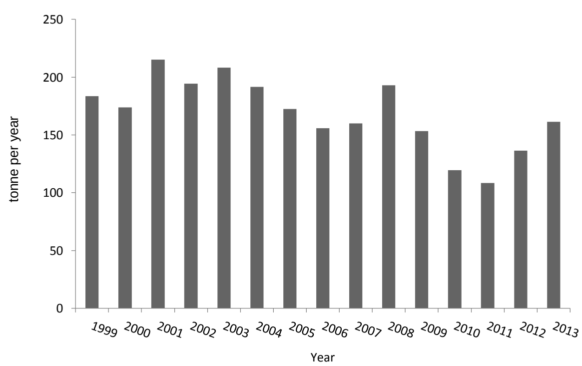
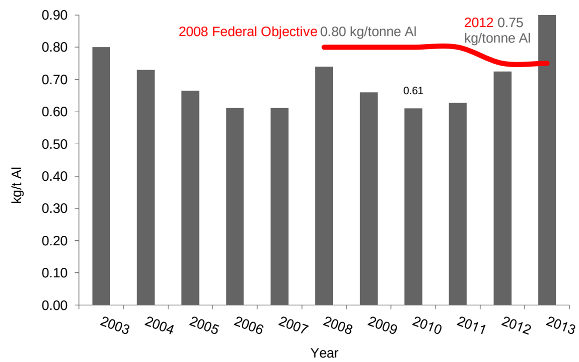


Figure 5.7— PAH emissions, rate measurement, potroom 2003-2013

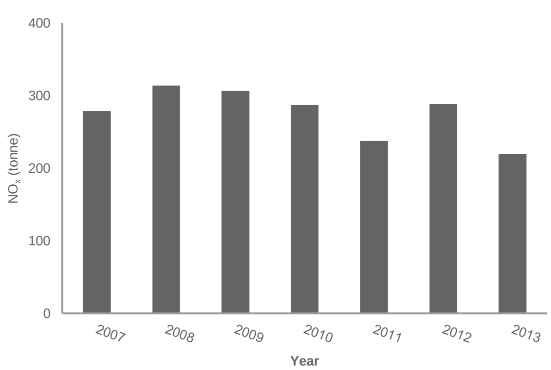
* 2010 value corrected following validation



Nitrogen oxides (NO_x)

Nitrogen oxides are produced through the operation of the smelter and the coke calciner. Nitrogen oxides are relevant to smog and other potential air quality concerns (which have not been a significant problem in the Kitimat valley).

Figure 5.8— Nitrogen oxide emissions, Kitimat Operations



NOx emissions are estimated using a combination of actual measurements and USEPA emission factors. For 2013 the method of calculation of NOx emissions for the annual environmental report changed to reflect the same calculation used for the National Pollutant Release Inventory (NPRI). Smelter-wide NOx emissions for 2013 were estimated at 219 tonne per year compared to 288 tonne per year in 2012 (**Figure 5.8**).

The coke calciner operated 260.3 days in 2013 down from 295.8 days in 2012. The NOx emission rate from the calciner decreased to 14.7 kg per hour in 2013 from 15.9 kg per hour in 2012.

Potroom dry scrubbers

The potrooms are a major source of emissions at Kitimat Operations, and the potroom dry scrubbers are therefore very important components of the plant's pollution control system. Continuous monitoring for gaseous fluoride is conducted on each potroom dry scrubber to ensure elevated emissions levels are promptly addressed.

The permit requires multi-faceted dry scrubber compliance tests on a regular basis on three of the six operating scrubbers. In 2013, no non-compliances occurred (**Table 5.1**).

When a dry scrubber stops functioning for any reason (downtime), gases are re-routed from the non-operating scrubber to two adjacent scrubbers. Occasionally, electrical or mechanical problems can result in dry scrubber downtime without interconnection to an adjacent unit. Such incidents are tracked as a percentage of total possible operating hours (**Table 5.2**). There were no occurrences of dry scrubber downtime in 2013.

Table 5.1 — Potroom dry scrubbers, annual stack tests

Performance Measure	Dry Scrubber #		
	1	2	4
Date	21 Jun	25 Jun	26 Jun
Flow (m^3/min) Permit limit: 1,560 m^3/min	1306.3	1206.5	849.2
Total Particulates (mg/m^3) Permit Limit: 70 mg/m^3	53.1	44.1	60.4
Particulate Fluoride (mg/m^3) Permit Limit : None	0.4	0.5	0.8
Gaseous Fluoride (mg/m^3) Permit Limit: None	10.1	2.3	1.2
Sulphur Dioxide (mg/m^3) Permit Limit: None	261.3	320.9	795.6
Date	21 Jun	23 Jun	27 Jun
Polycyclic Aromatic Hydrocarbons (mg/m^3) Permit Limit: None	0.4748	1.0696	0.1067

Table 5.2 — Potroom dry scrubbers, downtime 2013

Percentage Downtime			
January	No Occurrence	July	No Occurrence
February	No Occurrence	August	No Occurrence
March	No Occurrence	September	No Occurrence
April	No Occurrence	October	No Occurrence
May	No Occurrence	November	No Occurrence
June	No Occurrence	December	No Occurrence

Total particulate emissions

The total particulate emission for 2013 was 1,447.6 Mg. This total includes all sources including the potroom roofs.

Potroom particulate emissions

Potroom roofs are the largest contributor of total particulate emissions. Particulate emission samples are taken at each of the representative potroom buildings using six sample positions on each building during two consecutive sample periods, once every quarter.

Long-term performance of potroom particulate emissions has been consistently below the permit limit except for 2009 (**Figure 5.9**). The permit limit of 7.5 kg particulate per tonne Al is applied to average emissions calculated quarterly. Anode management challenges led to an increase of particulate emissions in the latter part of 2013 above the permit limit at 7.6 and 8.0 kg particulate per tonne Al in Q3 and Q4 respectively (**Figure 5.10**).

Figure 5.9— Particulate emissions, potroom roofs 1999-2013

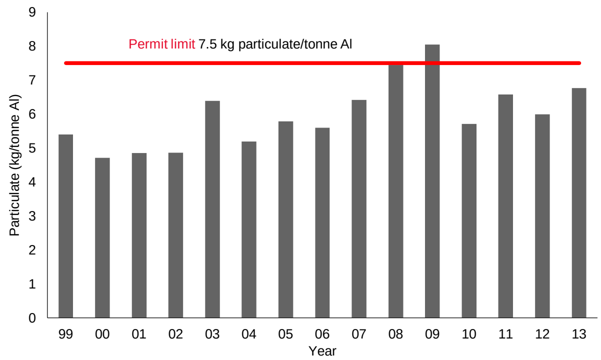


Figure 5.10— Particulate emissions, potroom roofs, 2013

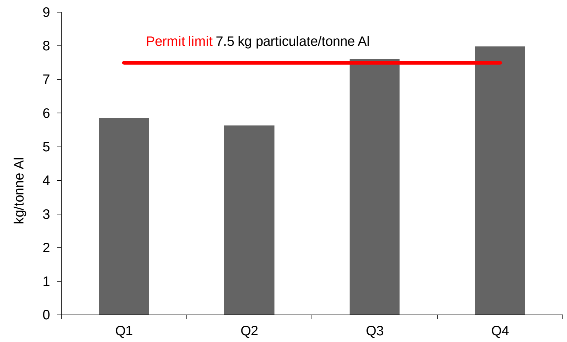
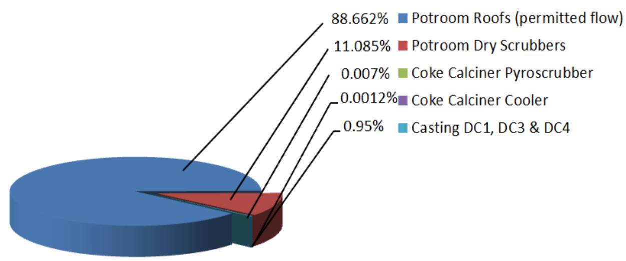


Figure 5.11— Particulate emissions, Kitimat Operations



Following the increased monthly monitoring during Q3 and Q4 implemented as part of the investigation, five non-compliances were reported exceeding the permitted particulate rate; details are described in Chapter 11. The annual average was 6.8 kg particulate per tonne Al which is an increase from 2012 at 6.0 kg particulate per tonne Al. Particulate emissions from the potroom roofs accounted for 88.8 per cent of total particulate emissions for Kitimat Operations in 2013 (**Figure 5.11**).

Calcined Coke Plant

Two different emission sources at the calcined coke plant (the pyroscrubber and the cooler) are monitored relative to permit limits for particulate content. In January 2013, equipment failure at the cooler resulted into a particulate emission that exceeded the permitted process emission, details of the non-compliance is presented in Chapter 11. Emissions from the coke calciner's pyroscrubber are also monitored for sulphur dioxide and nitrogen oxide concentrations (**Table 5.3**).

Table 5.3 — Calcined Coke Plant, annual stack test, 2013

Emissions Performance Measure	Calcined Coke Plant Pyroscrubber	Calcined Coke Plant Cooler
Particulates kg/hour Permit Limit	16.8 (Jun) 14.3 (Nov) 21.1	2.28 (Jun) 2.67 (Nov) 3.9
SO_2 kg/hour Permit Limit	200.2 (Jun) 242.3 (Nov) n/a	1.13 (Jun) 1.66 (Nov) n/a
NOx kg/hour Permit Limit	14.2 (Jun) 15.1 (Nov) n/a	n/a n/a n/a

Table 5.4 — Anode Paste Plant, annual stack test, 2013

Source	Particulate Permit Limit (mg/m^3)	Particulate Emissions (mg/m^3)
Dust Collector DC10	120	20.7
Dust Collector DC11	120	19.1
Dust Collector DC12	120	6.9
Dust Collector DC13	120	65.4
Dust Collector DC14	120	5.3
Dust Collector FC 3	120	42.2
Dust Collector DC111	50	29.1

Anode Paste Plant

Various emission sources at the anode paste plant are controlled using dust collectors. The dust collector discharge stacks are monitored relative to permit levels for total particulate content (**Table 5.4**). All these sources were in compliance with the permit in 2013.

Chlorine consumption

Chlorine is used during the process of casting aluminum ingots. Gaseous chlorine is mixed with nitrogen and argon and used to flux (remove) impurities from the molten metal. The permit limit for chlorine consumption is 300 kg per day. This limit has not been exceeded since 1999 (**Figure 5.12**, **Figure 5.13**).

Figure 5.12— Chlorine consumption, casting 2005-2013

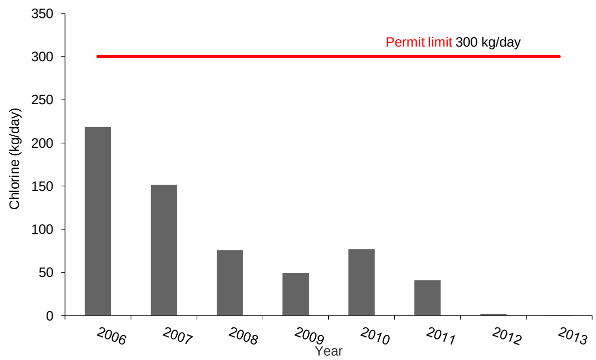
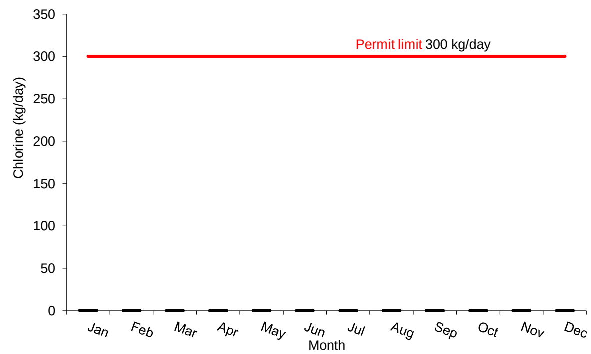


Figure 5.13— Chlorine consumption, casting, 2013



SF_6 consumption

SF_6 is used during the process of casting aluminum ingots. In 2013 the casting centers that used this gas were shut down so there was no SF_6 reported from casting. A small quantity (0.32 kg) was used in 2013 during the 3rd party PFC emission validation campaign in the potrooms.

Natural gas consumption

Natural gas is widely used at Kitimat Operations in various applications where heat is required. Variables affecting usage levels include production levels and the availability of energy generated by the hydroelectric facility at Kemano Operations.

Kitimat Operations consumption rates and associated emissions are calculated using standards developed by the U.S. Environmental Protection Agency. During the past year, natural gas consumption decreased in the casting area by 1.0 per cent and was reduced in the smelting area by 1.5 per cent. There was an increase in the anode paste plant area by 0.5 per cent. Plant-wide in 2013, consumption decreased by 1.0 per cent (**Table 5.5**).

Greenhouse gas emissions

There are a number of sources of greenhouse gas (GHG) emissions at Kitimat Operations (**Figure 5.14**). Most emissions occur during the smelting process, and most smelting-related emissions are attributable to anode effects (**Figure 5.15**). Anode effects produce perfluorocarbons (PFC), a form of GHG with a particularly high carbon dioxide equivalency.

Kitimat Operations GHG emissions decreased in 2013 to 4.34 from 4.70 tonne of CO_2 equivalent, per tonne of aluminum production. This was due primarily to continued control of the anode effect minutes and the update of the PFC calculation coefficients (**Figure 5.16 & 5.17**). The total amount of CO_2 emitted in 2013 excluding anode effects was 392,632 tonnes of CO_2^e. ❖

Table 5.5 — Natural gas consumption and associated emissions

Year	Natural Gas Consumption m^3/yr	Associated Emissions for Natural Gas Use (tonnes/year)			
		Nitrogen Oxides	Total Particulates	Sulphur Dioxide	Carbon Monoxide
2001	24,719,317	39.55	3.01	0.24	33.22
2002	26,718,911	42.75	3.25	0.26	35.91
2003	26,412,184	42.26	3.21	0.25	35.50
2004	27,610,071	44.18	3.36	0.27	37.11
2005	24,423,744	39.08	2.97	0.23	32.83
2006	25,403,363	40.65	3.09	0.24	34.14
2007	25,837,200	41.34	3.14	0.25	34.73
2008	25,931,400	41.49	3.15	0.25	34.85
2009	24,013,100	38.42	2.92	0.23	32.27
2010	23,564,629	35.89	2.73	0.22	30.14
2011	20,864,400	33.38	2.54	0.20	28.04
2012	19,695,700	31.51	2.39	0.19	26.47
2013	19,492,700	31.19	2.37	0.19	26.20

Table 5.6 - DC 4 Casting bi-annual stack test

Emissions Performance Measure	May 31, 2013	October 4, 2013
NO_X mg/m^3	32.8	6.5
Chloride mg/m^3	46.4	4.9
Chlorine mg/m^3	0.3	4.3
Total Particulate mg/m^3	157.4	140.5

Table 5.7 - Liquid pitch incinerator stack test, 2013

Emissions Performance Measure	June 16, 2013
Polycyclic Aromatic Hydrocarbons (mg/m^3)	0.051
Total Particulate mg/m^3	81.7

Figure 5.14— Total GHG emissions by source, 2013

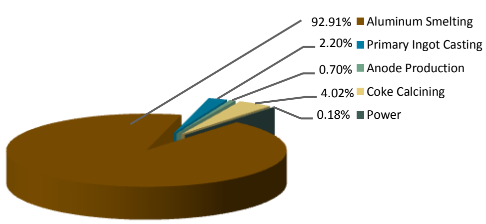


Figure 5.15— Breakdown of aluminum smelting GHG by source

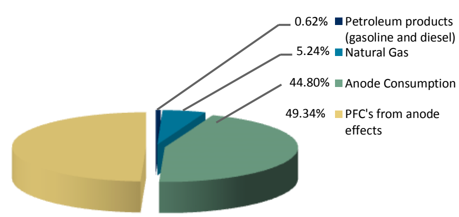


Figure 5.16— GHG emissions, Kitimat operations 2003-2013

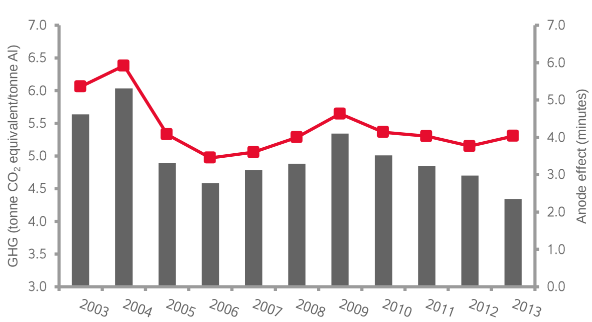
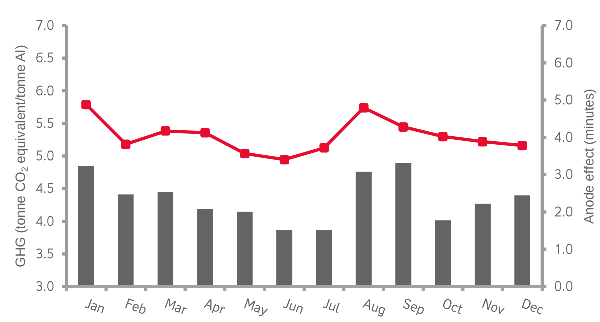


Figure 5.17— GHG emissions, Kitimat Operations, 2013



Air Quality Monitoring

Chapter 6

Network overview

B.C. Operations conducts continuous ambient air quality monitoring at five stations in the lower Kitimat valley. The monitoring regime tests for and measures the concentrations of a variety of pollutants in the air. The five monitoring stations (Riverlodge, Whitesail, Haul Road, Kitimat Smeltersite Road and Kitamaat Village) and their monitoring parameters are illustrated in **Table 6.1**.

Table 6.1 Ambient air monitoring network

Ambien Air Network	Kitimat Smeltersite Road	Haul Road	Riverlodge	Whitesail	Kitamaat Village	Yacht Club
Sulphur Dioxide (SO_2)	✓	✓	✓		✓	
Particulates ($PM_{2.5}$)	✓	✓	✓	✓	✓	
Polycyclic Aromatic Hydrocarbons (PAH)	✓	✓		✓	✓	
Hydrogen Fluoride (HF)	✓		✓		✓	
Rain Chemistry		✓				
Meteorological monitoring	✓	✓	✓	✓	✓	✓

The collected air quality data are used to compare regional air quality results with federal and provincial guidelines. These data are then analyzed to:

- Track variations and trends in regional air quality.
- Assess the impact of specific emission sources.
- Assess and refine air quality management strategies.
- Support research on the impacts of air quality on property, vegetation and health.

Five air quality parameters are monitored: hydrogen fluoride (HF), sulphur dioxide (SO_2), polycyclic aromatic hydrocarbons (PAH), and two levels of fine particulate matter. Particulate matter is referred to as PM_{10} and $PM_{2.5}$ and is measured against size thresholds of 10 and 2.5 microns, respectively.

Meteorological (weather) monitoring data are collected at all five monitoring stations plus the Yacht Club station. Precipitation monitoring and analysis is undertaken using samples collected at the Haul Road station. The Precipitation sampler was upgraded during late summer. The weather and the precipitation data provide additional insight into air quality data interpretation.

Weather monitoring

Two new meteorological stations became operational in 2011, one at the Kitamaat Village station and the other at the Yacht Club located at the south end of the Plant site. Each station measures temperature, wind direction and wind speed. Additionally, the Campsite Station measures relative humidity.

The 2013 upgraded meteorological and weather monitoring data control program operated by B.C. Operations is carried out to approve Ministry standards. In the event that air quality monitoring data indicate a problem on a particular date, weather data can provide insight into pollutant sources and other contributing factors.

Quality assurance and control

The validation of air quality data is conducted using a quality control/quality assurance process. The quality control component is to ensure that all instrument maintenance and operational guidelines for the instrument are being followed correctly and documented.

Air quality monitoring stations in the Kitimat valley are operated by an independent consultant. A technician performs weekly inspections and routine maintenance on the equipment. Air quality data are reviewed monthly, validated and submitted to the Ministry. In the event where remedial actions are required to ensure the validity of the data, this information is reported to the Ministry.

The quality assurance procedure is conducted by Ministry staff. This involves visits twice per year to the sites. A review of station and instrument documentation, condition and a reference audit calibration check on each instrument being operated under permit is completed.

The results of the quality control/quality assurance process are then used to validate the data collected by the Provincial Air Quality Monitoring network (www.env.gov.bc.ca/epd/bcairquality).

In 2012, Rio Tinto Alcan initiated a 2-year plan to replace and upgrade the ambient air monitoring equipment to optimize the network operation and meet the new 2013 ministry data reporting requirements for $PM_{2.5}$ and to improve the data processing and reporting process. In 2013, all $PM_{2.5}$ and PM_{10} monitors and SO_2 analyzers were replaced by brand-new modern equipment. This replacement and upgrade plan will be completed in 2014.

2013 Monitoring results

Hydrogen fluoride (HF)

There are currently three Picarro analyzers (cavity ring down spectroscopy) operating in the network: Riverlodge, Kitamaat Village and Kitimat Smeltersite Road. The annual average measurement at Riverlodge was 0.2 parts per billion (ppb). The annual average measurement at Kitamaat Village was 0.1 parts per billion (ppb). The Kitimat Smeltersite road station is considered a fence line station and is located north of the operating smelter. The purpose of this station is to provide understanding on levels of emissions at the source. An annual average of 1.3 ppb was measured there **(Table 6.2)**.

Sulphur dioxide (SO_2)

Ministry air quality objectives define 10 ppb as the maximum desirable level of sulphur dioxide in the air on an annual average and 62 ppb as the maximum desirable concentration on a 24 hour average. No exceedances of either of the provincial of federal maximum desirable levels occurred in 2013 **(Table 6.3)**.

Table 6.2 — Hydrogen fluoride monitoring, 2013

Station	Annual Average of 24 hour concentrations (ppb)
Riverlodge	0.2
Kitamaat Village	0.1
Kitimat Smeltersite Road*	1.3

* Classified as a fence line station: North of the operating smelter

Table 6.3 — SO_2 monitoring, 2013

Station	Annual Average of 24-hour concentrations (ppb)	Days Above the Maximum Desirable Concentration Level (BC Level A)
Riverlodge	0.7	0
Haul Road	1.9	0
Kitamaat Village	0.2	0
Kitimat Smeltersite Road*	4.4	0

Particulate (PM_{10} and $PM_{2.5}$)

Fine particulates have a wide variety of sources, both natural and human-caused. In northern B.C., forest fires (prescribed and wild), beehive burners, emissions from fireplaces and wood burning stoves are among the major contributors to fine particulate emissions.

In addition to these primary particulate emissions, further contribution occurs due to gas emissions undergoing physical and chemical reactions. Emissions from Kitimat Operations, including sulphur dioxide and nitrogen oxides, are among the precursors to these secondary particulates.

Ambient air quality objectives established in 1995 defined the 24 hour limit for PM_{10} as 50 micrograms per cubic meter (µg/m^3). The Canada-wide standards established in 2009 defined the 24 hour limit for $PM_{2.5}$ as 25 µg/m^3 and the annual arithmetic mean as 8 µg/m^3. The Kitimat Smeltersite Road station, which is considered a fence line station, had one exceedance of the $PM_{2.5}$ objective during 2013. No other stations had exceedances of the maximum desirable levels **(Table 6.4)**.

Table 6.4 — PM_{10} and $PM_{2.5}$, PHA monitoring, 2013

Station	PM_{10}		$PM_{2.5}$	
	Annual Average (of 24-hour concentration) µg/m^3	Days Above Reference Level 50µg/m^3	Annual Average (of 24-hour concentrations) µg/m^3	Days Above Reference Level 25µg/m^3
Whitesail	-	-	2.6	0
Riverlodge	9.3	0	3.2	0
Haul Road	-	-	4.0	0
Kitamaat Village	-	-	3.4	0
Kitimat Smeltersite Rd*	-	-	8.6	1

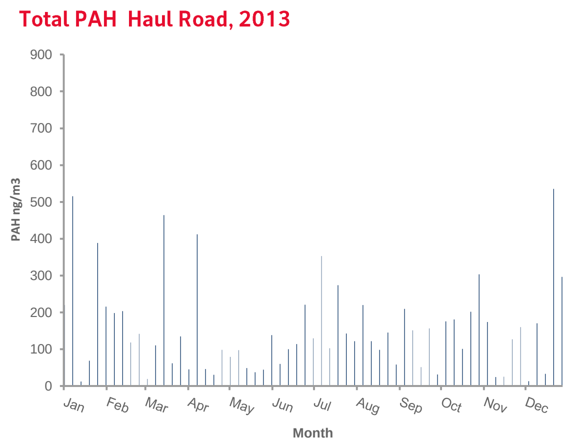
* Classified as a fence line station: north of the operating smelter

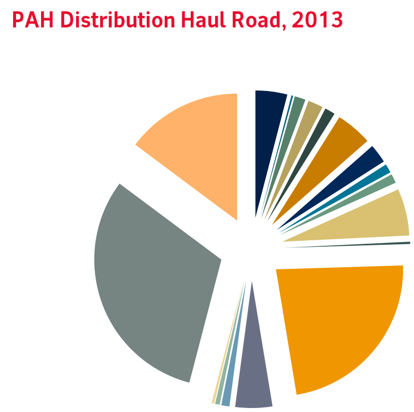
Polycyclic Aromatic Hydrocarbons (PAH)

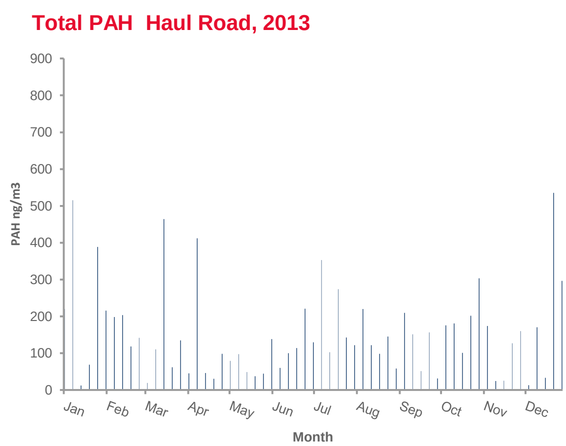
PAH are generated by the incomplete combustion of organic material. Various procedures at Kitimat Operations generate PAH, in both dissolved and gaseous forms. They occur in emissions primarily as a by-product of the anode manufacturing process; other sources include vehicle exhaust and smoke from forest fires and wood-burning stoves.

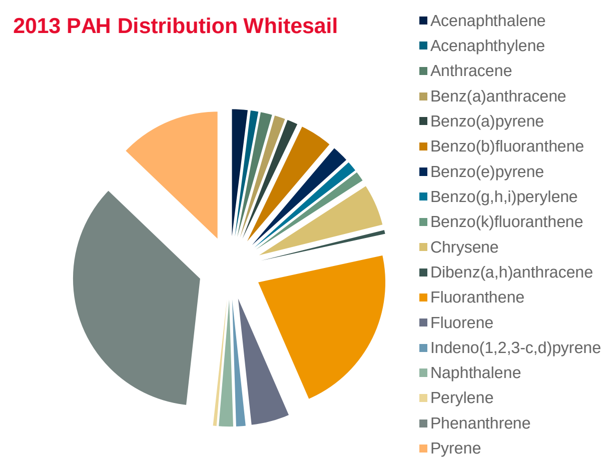
Figure 6.1— Total PAH, 2013

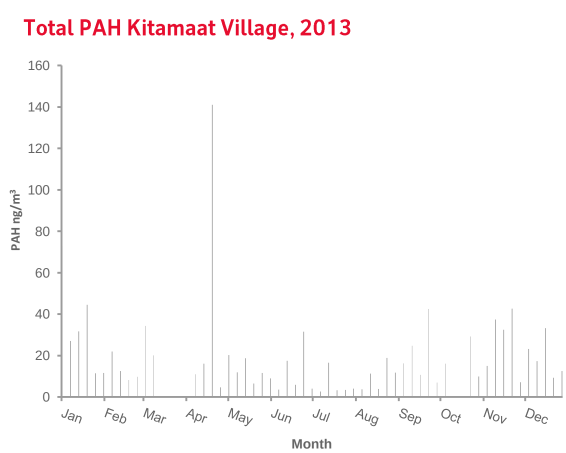
Figure 6.2— PAH distributions, 2013

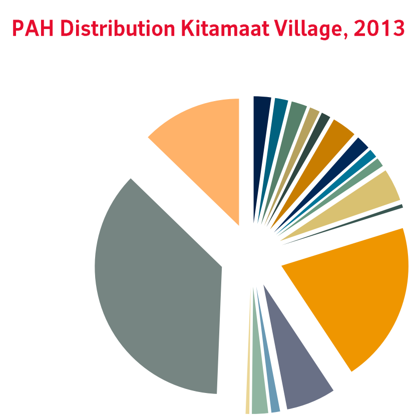












Ambient air monitoring is conducted to test for the presence of some of the most common PAH, although no permit limits exist. Sampling is done on a schedule that is coordinated with the National Air Pollution Surveillance (NAPS) to enable comparison of findings from different monitoring sites.

In 2013, total PAH showed a high degree of variability **(Figure 6.1)**. This is typical when compared to previous years. The distribution of PAH is largely consistent from one station to another, once the distance from the source is accounted for **(Figure 6.2)**.

The geometric mean PAH concentration for Haul Road station was higher in 2013 (110 ng/m^3) than in 2012 (100 ng/m^3). At the Whitesail station, the PAH concentration was slightly lower in 2013 (17 ng/m^3) compared to 2012 (18 ng/m^3). At the Kitamaat Village station PAH concentrations were lower this year (14 ng/m^3) compared to 2012 (19 ng/m^3). PAH at the Smeltersite Road station was 134 ng/m^3 **(Table 6.5)**.

Table 6.5 —Geometric mean PHA concentrations, 2013 & 2012

Station	PAH Concentrations (ng/m^3) 2013	PAH Concentrations (ng/m^3) 2012
Whitesail	17	18
Haul Road	14	100
Kitamaat Village	14	19
Kitimat Smeltersite Rd	134	-

Rain chemistry

Precipitation samples are collected on a weekly basis from the Haul Road station. Rain chemistry monitoring has been conducted since 2000. Rainfall quantity is recorded. Samples are assessed for criteria for rain acidity and concentrations of 11 specific substances. Annual averages of weekly samples and the geometric mean measures are presented in **Table 6.6**. There are no permit levels or objectives for this procedure.

High levels of acidity (i.e. a low pH) and concentrations of certain substances are characteristic of the condition referred to as ‘acid rain’. Long-term vegetation monitoring (refer to Chapter 7 – Vegetation monitoring) in the Kitimat valley has confirmed an absence of this type of damage. ❖

Table 6.6 —Rain Chemistry monitoring – Haul Road Station 2006- 2013

	Parameter		2007	2008	2009	2010	2011	2012	2013
Precipita-tion	Precipitation Depth (mm)	average	52.1	44.1	30.0	33.2	43.6	18.1	47.8
		geomean	27.2	25.3	11.1	10.6	24.7	13.4	29.5
Acidity	Rain (pH)	average	4.9	4.9	5.4	5.3	5.1	5.1	4.4
		geomean	4.9	4.9	5.3	5.3	5.0	5.1	4.3
	Acidity (to pH 8.3) $CaCO_3$ (mg/L)	average	7.1	7.3	6.0	6.8	5.2	5.5	4.4
		geomean	6.3	6.3	5.0	4.8	3.5	4.0	3.2
	Acidity - Free (µeq/L)	average	30.6	27.9	12.5	12.1	17.6	18.5	24.5
		geomean	13.4	12.2	4.4	4.9	8.5	7.7	16.7
	Alkalinity - Total $CaCO_3$ (mg/L)	average	1.1	1.8	2.2	1.5	0.5	0.6	0.3
		geomean	0.6	1.2	1.7	1.2	0.4	0.4	0.3
Concentration of Specific Substances (mg/L)	Chloride (Cl)	average	0.3	1.0	1.0	1.1	0.6	1.2	0.3
		geomean	0.3	0.9	0.9	1.0	0.5	0.8	0.2
	Fluoride (F)	average	1.6	2.3	2.4	1.6	1.6	1.7	1.9
		geomean	1.4	2.0	1.7	0.9	1.1	1.3	1.4
	Sulphate (SO_4)	average	2.9	3.8	5.2	3.0	1.4	1.9	1.4
		geomean	2.2	2.9	3.2	1.8	1.0	1.5	1.1
	Ammonia Nitrogen (N)	average	0.087	0.098	0.135	0.122	0.082	0.078	0.049
		geomean	0.072	0.084	0.075	0.074	0.044	0.067	0.039
	Nitrate Nitrogen (N)	average	0.062	0.048	0.066	0.057	0.033	0.054	0.156
		geomean	0.039	0.042	0.049	0.047	0.024	0.044	0.127
	Total Dissolved Phosphate (P)	average	0.020	0.031	0.035	0.006	0.006	0.018	0.007
		geomean	0.012	0.017	0.012	0.005	0.003	0.010	0.006
	Aluminium (D-Al)	average	0.386	0.574	0.621	0.412	0.488	0.458	0.462
		geomean	0.313	0.452	0.372	0.218	0.305	0.338	0.241
	Calcium (D-Ca)	average	0.431	0.668	0.686	0.301	0.147	0.257	0.224
		geomean	0.272	0.463	0.449	0.195	0.099	0.196	0.108
	Magnesium (D-Mg)	average	0.046	0.083	0.079	0.098	0.037	0.054	0.059
		geomean	0.043	0.078	0.074	0.086	0.032	0.043	0.039
	Potassium (D-K)	average	0.200	0.2	0.4	0.320	0.163	0.343	0.155
		geomean	0.105	0.202	0.216	0.185	0.062	0.154	0.058
	Sodium (D-Na)	average	1.121	1.293	2.101	1.172	0.743	1.330	0.536
		geomean	0.847	1.114	1.513	0.752	0.551	1.026	0.364

Vegetation Monitoring

Chapter 7

Introduction

The vegetation monitoring and assessment program consists of two parts: an annual collection of current year foliage of western hemlock, followed by an analysis of the concentration of fluoride and sulphur content in needle tissue; and, on a biennial basis, a survey of vegetation in the vicinity of Kitimat Operations to document the health and condition of vegetation. The annual collection has been conducted since 1970, giving B.C. Operations one of the largest historical databases of this type in British Columbia. The data provides long-term and comparable measures of fluoride and sulphur absorption in vegetation, both of which are found in emissions from Kitimat Operations.

The purpose of the monitoring and assessment program is to:

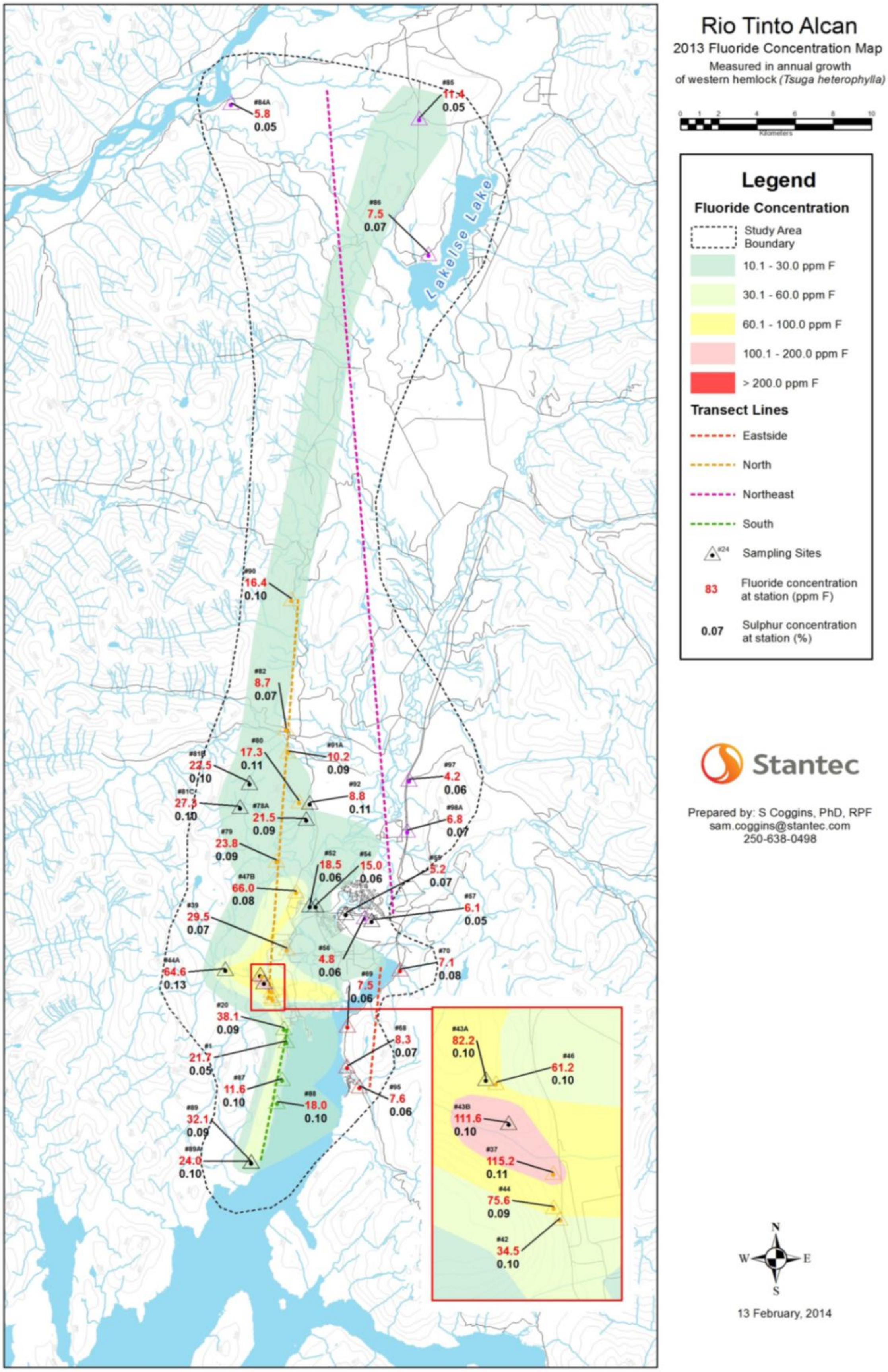
- Document the general growing conditions in the Kitimat area during the year of the inspection.
- Provide an assessment of the overall health of vegetation in the area, including documenting significant occurrences of insects and diseases.
- Document the concentration of fluoride and sulphur content in vegetation.
- Document the extent and severity of injury to vegetation associated with emissions (gaseous fluoride) from the Kitimat Operations.
- Provide early warning of changes in conditions.

In 2010 changes were made to the vegetation monitoring and assessment program based on Dr. John Laurence's (Plant Pathologist consultant) recommendations. The results of that investigation centered on the effectiveness of the monitoring program. Changes to the program were made in three areas:

- Changes to sample site locations.
- Standardization of sampling protocols.
- Increased quantitative assessment and documentation of the vegetation condition during biennial visual inspections.

Collection of western hemlock for foliar analysis is now conducted along directional transects away from the center of Kitimat Operations. The directional transects allows an estimation of the maximum concentrations of fluoride and sulphur in foliage as well as the reduction in deposition with distance from the Smelter. Sample harvesting is usually conducted at 37 sites at the end of the growing season by gathering the current year's growth. This is done because vegetation is more sensitive to fluoride and sulphur emissions in the spring, when new tissue is tender and growing rapidly. The sampling program focuses on hemlock because it is evenly distributed throughout the valley and is a reliable indicator for vegetative absorption of emissions. This year's samples were collected by an independent consultant and analyzed at Rio Tinto Alcan's Vaudreuil Analytical Laboratory in Quebec.

Figure 7.1— Fluoride and sulphur concentration map, Kitimat-Terrace Area, 2013



One of the significant improvements made to the sampling methodology is to conduct the sample collection in a short time frame. In 2011, one more site was added to the usual 37 sites bringing the total number of sampling sites to 38. In 2013 all 38 samples were collected in a two week period. They were then refrigerated in their collection bags until processing. Field sampling occurred between August 13 and 21.

The data reflects results from sites which have been consistently monitored since the inception of this program, while the fluoride concentration map (**Figure 7.2**) was developed using only sites sampled in 2013.

In addition to annual vegetation sampling, the multi-media permit also requires that a qualitative assessment of vegetation condition in the Kitimat valley be conducted by an external expert every second year.

2013 Monitoring results

Fluoride content

There is a strong correlation between fluoride concentrations in hemlock and fluoride emissions from the potroom roofs at Kitimat Operations. In 2013, fluoride concentration in hemlock samples averaged 28 ppm, which is the same as 2012 (**Figure 7.2**).

On a monthly basis, gaseous fluoride emissions from Kitimat Operations did not exceed the permit limit of 50 tonne per month. (**Figure 7.3**) There were no non-compliances relative to the gaseous fluoride emissions in 2013.

Figure 7.2— Western hemlock fluoride content and gaseous fluoride emissions, potroom roofs 2003- 2013

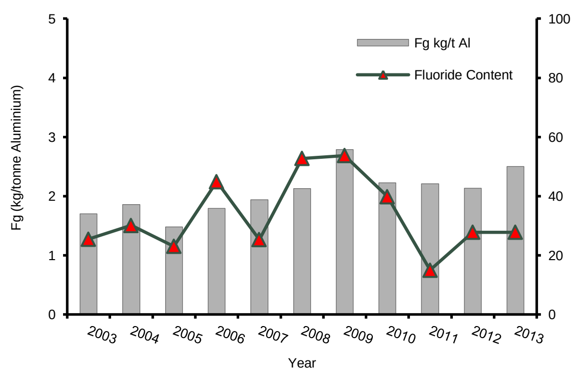
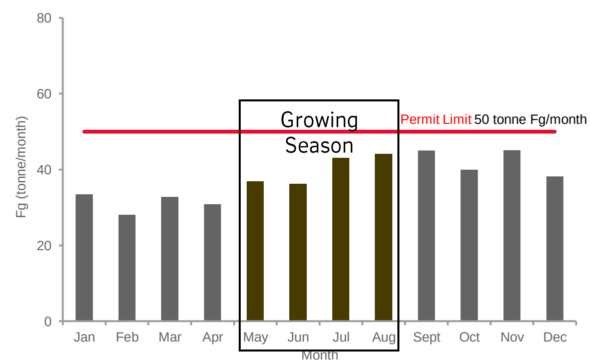


Figure 7.3— Gaseous fluoride loading, potroom roofs, 2013



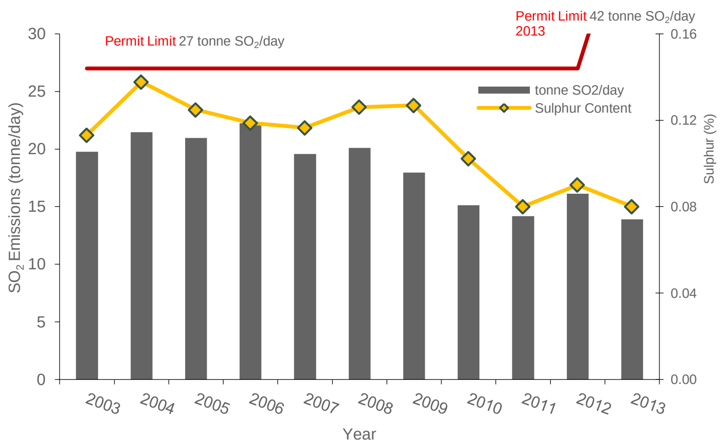
The fluoride and sulphur concentration map (**Figure 7.1**) shows the geographic distribution of accumulated fluoride in hemlock throughout the study area. This map shows the expected range of accumulated fluoride levels at and between sample plots with color-coded concentration ranges.

2013 results show that higher concentrations of fluoride in hemlock foliage continue to be measured in collections from areas located immediately downwind of the smelter site, and generally decrease in concentration with increasing distance from the smelter. Foliar fluoride concentrations continue to be near-background or background levels at sites in Kitimat town site, Kitamaat Village and Lakelse Lake.

Sulphur content

Vegetation can absorb higher concentrations of sulphur than fluoride before visual damage can be detected. Annual averages of sulphur concentrations in vegetation in the Kitimat-Terrace area have remained relatively uniform, with little variance across the sample area and have rarely been found above background levels.

Figure 7.4— Western hemlock sulphur content and sulphur dioxide emissions, Kitimat operations, 2003-2013



The average sulphur concentration in hemlock for 2013 was 0.08 per cent which was a slight decrease from the 2012 value of 0.09 per cent (**Figure 7.4**). The fluoride and sulphur concentration map (**Figure 7.1**) shows the geographic distribution of accumulated sulphur in western hemlock throughout the study area.

Qualitative assessment

The biennial qualitative inspection was last conducted during the 2012 sampling season and reported in 2012. ❖

Waste Management

Chapter 8

Introduction

The operation of the smelter results in the generation of various solid and liquid wastes. In August 2010, the multimedia permit was amended to allow for the disposal of KMP non-hazardous related wastes into the south landfill. The amendment is inclusive of the design, operation and closure phases. The appropriate procedures for handling, storage and disposal of these wastes are in place and are reviewed as changes in operations occur.

Waste management procedures ensure full compliance with requirements related to regulated hazardous wastes and additional materials deemed to be hazardous by B.C. Operations.

Opportunities for waste reduction and for improvements in waste handling are assessed and implemented on a continuous basis. In particular, opportunities to recover, reuse, and recycle waste materials are pursued whenever feasible. On-going practices include reducing raw material usage, thus reducing demand on the landfill and contributing to reducing the overall impact on the environment.

Waste management activities are tracked and reported. All waste types including those disposed at the South Landfill (i.e. inert industrial waste, asbestos materials, contaminated soil, and putrescibles), monthly wood waste and hazardous waste externally disposed or sent for recycling are reported in compliance with the permit requirements.

2013 Performance

Spent potlining

Spent potlining (SPL) is one of the most significant hazardous waste materials produced at Kitimat Operations, and its disposal presents a challenge throughout the aluminum industry.

Alternative treatment and disposal options continue to be investigated, while efforts to increase potlining lifespan (and thereby reduce SPL generation) continue. During 2013, a total of 5,318.7 tonne of SPL were shipped off-site for treatment and permanent disposal in a secure landfill compared to the 6,960 tonne in 2012.

Asbestos and refractory ceramic fibres (RCF)

Asbestos and refractory ceramic fibres (a less hazardous substitute to asbestos) are used for insulation. These materials are considered by Kitimat Operations to be sufficiently hazardous to require special disposal methods.

In 2013, 5 m3 of asbestos and ceramic fibers materials were collected and disposed of that were associated with regular smelter maintenance activities. As part of the KMP site remediation, approximately 564 m3 of soils and concrete materials containing >1% of asbestos fibers were safely disposed at the North Landfill (**Figure 8.1**) (refer to Kitimat Operations map Fig. 2.1 for waste storage, disposal and managed sites).

Waste sludge

Grease and paint sludge are collected and sent off-site for environmentally safe disposal. Grease sludge is generated from the use of grease in various mechanical applications, while paint sludge may consist of leftover paint or wastes such as solvents used to clean paint brushes. Volumes of both wastes fluctuate depending on the levels of particular activities at the smelter site in any given year. In 2013, the grease sludge volume was 1,230 litres and the paint sludge volume was 1,640 litres (**Figure 8.2**).

Figure 8.1— Asbestos and RCF disposal, 2004-2013

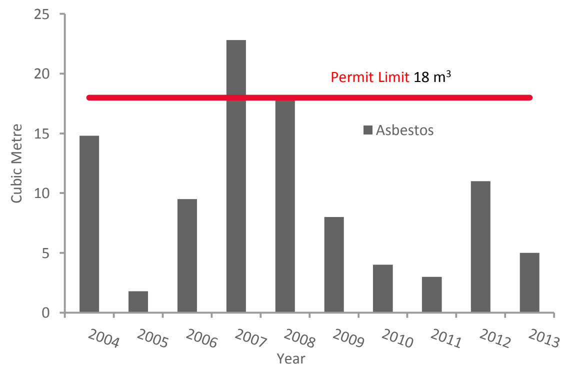
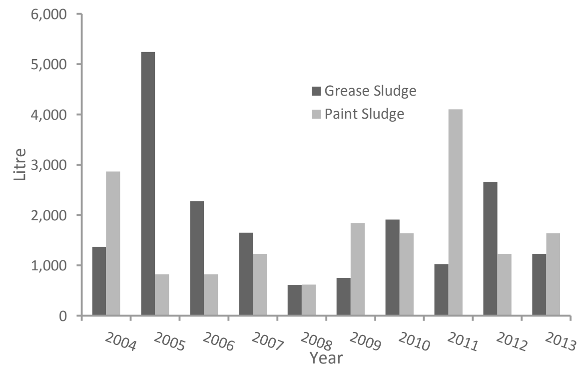


Figure 8.2— Waste sludge, 2004- 2013



Wood waste

Wood waste is collected from around the smelter site on a regular basis and sent to a wood containment area adjacent to Kitimat Operations South landfill. Wood is burned once sufficient volumes have accumulated at the containment area. Ten burns were conducted in 2013. As of August 2011, a permit amendment allows for the burning of up to 960 m3 per month, and there were no exceedances of this limit in 2013. A total of 6,327 m3 (3,163.5 tonne) of wood waste was burned during the year (**Figure 8.3**).

Tires

Two main types of tires are used at Kitimat Operations: solid rubber tires in areas where there may be contact with molten metal, and pneumatic tires elsewhere. Although tests have been conducted, no recycling option has been identified for solid tires and they are disposed of at the Kitimat south landfill. All used pneumatic tires are sent to a local company which recycles 90 per cent (materials chipped for other uses) and 10 per cent are re-treaded for reuse as tires. A total of 532 tires (330 solid and 202 pneumatic) were disposed of or sent for recycling in 2013 (**Figure 8.4**).

Figure 8.3— Wood waste burns, 2013

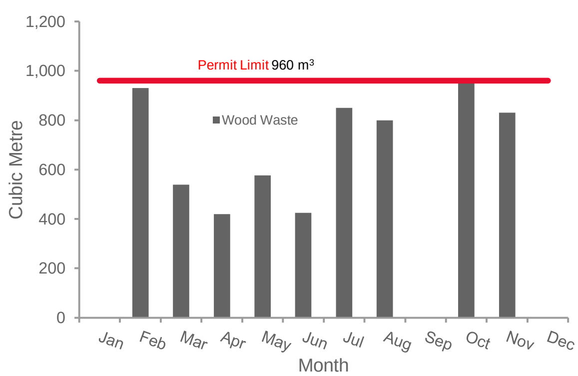
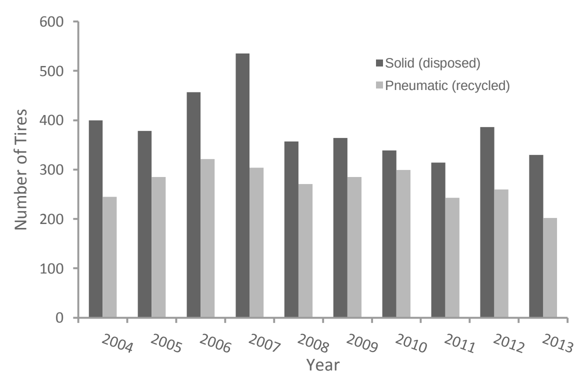


Figure 8.4— Disposed or recycled tires, 2004- 2013



Oily water

During the normal course of operations, oil-based materials can become contaminated with water (primarily rain water). These materials are collected and sent to a waste handler in Prince George that recovers the oil. Volumes collected for recovery decreased last year, with a total of 17,242 litres sent for recovery in 2013 (**Figure 8.5**).

Waste liquids

A variety of categories of waste liquids (used or contaminated) are routinely collected and sent to facilities in Prince George for either recovery or recycling into other products. Volumes of these materials fluctuate depending on the levels of particular activities at Kitimat Operations in any given year (**Figure 8.6**).

Figure 8.5— Oily water recovery,2004-2013

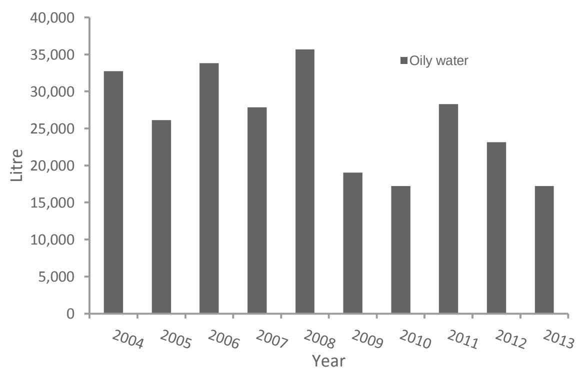
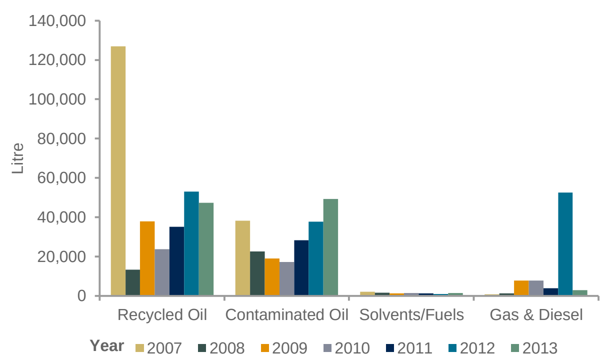


Figure 8.6— Disposed or recycled tires, 2004- 2013



Lead acid batteries

Used lead acid batteries are sent to a facility in Ontario where they are broken down into their constituent parts for recycling. The number sent for recycling varies depending on the number of batteries that reach the end of their lifespan in any given year. A total of 24.2 tonne of lead batteries were sent for recycling in 2013 (**Figure 8.7**).

Lamps

Used fluorescent and high-intensity lamps are sent to facilities, mainly located in Ontario, where they are broken down into their constituent parts for recycling. This ensures appropriate disposal of mercury and other heavy metals found in these types of lamps. A total of 10,454 lamps were sent for recycling in 2013 (**Figure 8.8**).

Figure 8.7— Recycled lead batteries,2004-2013

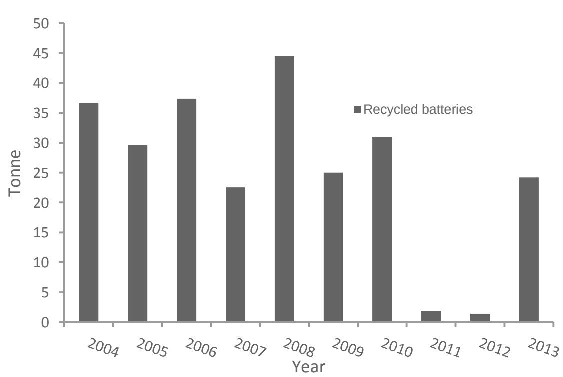
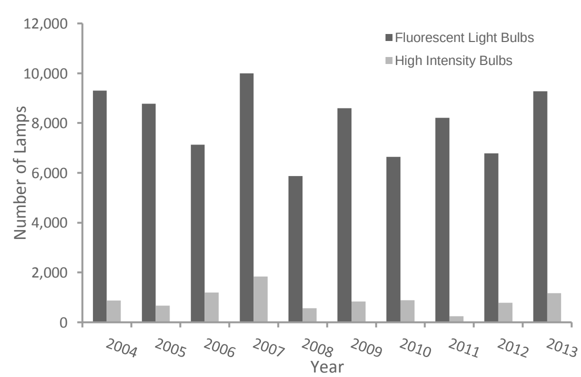


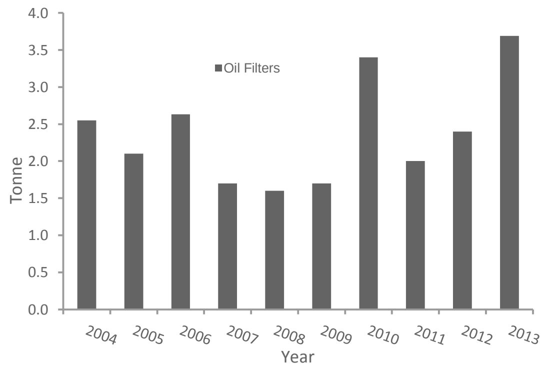
Figure 8.8— Recycled lamps, 2004- 2013



Oil filters

Used oil filters are sent to facilities in Alberta where they are broken down into their constituent parts for recycling. Prior to shipping, filters are first drained and crushed on-site. A total of 3.7 tonne of filters were sent for recycling in 2013 (**Figure 8.9**).

Figure 8.9— Recycled oil filters, 2004-2013



Landfill management

The South Landfill is the main landfill for smelter operations. It has been operational since the plant opened and is expected to be open for six years after the KMP is complete.

Incoming waste streams included: industrial waste, putrescible waste, contaminated soils, asphalt and asbestos contaminated materials which include soil and concrete. Surveys are carried out twice a year for reconciliation of the forecasted disposed volumes.

The total volume of materials disposed in 2013 for KMP related wastes and operations were 43,832 m^3.

Miscellaneous process waste

In addition to the special disposal and recycling initiatives described above, various types of miscellaneous process wastes are shipped off-site. A variety of processing and disposal methods are employed to deal with the miscellaneous process waste (**Table 8.1**).

❖

Table 8.1 — Miscellaneous process waste, 2013

** All values are in tonnes unless otherwise noted.*

Process Waste	Tonnes Shipped [1]	Destination
Steel Scrap	1,030.6	Sold as scrap metal
Aluminum Pot Pads	1,161.4	U.S. recycling company
Anode Carbon	456.5	Canadian disposal company
Duct Scraping (Stabilized)	NA	Canadian disposal company
Duct Scraping	415.2	U.S. disposal company
Aluminum Saw Chips	88.4	U.S. recycling company
Studblast Fines	205.6	Canadian disposal company
Carbon Dust (Side Millings)	Integrated	Canadian disposal company
Electrical Wire (Insulated)	4.1	Sold as scrap metal
Crucible Lining	43.1	Canadian disposal company
Aluminum (Miscellaneous)	11.9	Sold as scrap metal
Pitch Cones/Fines	3.5	Canadian disposal company
Steam Cleaning Sludge	26,093 L	Canadian disposal company
Air Filters	23.4	U.S. disposal company
Stainless Steel	4.3	Sold as scrap metal
Sodium Hydroxide Solution	1,845 L	Canadian disposal company
Brass/Copper	0.3	Sold as scrap metal
Aluminum Smelting Residue, Inert	2,542	U.S. recycling company

Groundwater Monitoring

Chapter 9

Introduction

A variety of monitoring programs are conducted relating to groundwater quality and flow in the vicinity of Kitimat Operations' landfill sites that are, or have the potential to be, a source of contamination. In 2013, these efforts focused on the spent potlining landfill and the dredgeate short-term storage cells. Long-term initiatives are underway with objectives to further reduce groundwater contamination and identify disposal and treatment options for stored materials.

2013 Monitoring results

Spent potlining landfill

The spent potlining landfill is comprised of three separate subsections formerly used to dispose of spent potlining (SPL). The landfill is located south of Potroom 1A and north of the Anode Paste Plant (refer to Kitimat Operations map **Figure 2.1**).

Prior to 1989, approximately 460,000 m3 of SPL was disposed of at the landfill site as per permit limits. The landfill was decommissioned in the fall of 1989 and initially capped with a low permeability cover. Over the next decade the three subsections were capped with polyvinyl chloride (PVC) liners. The capping significantly reduced surface water infiltration, thus reducing contaminant loading into the environment.

Between 1989 and 2004, SPL was stored in Buildings 504 and 550 prior to disposal in a secure landfill. Since 2005, all of the SPL material generated on-site has been transferred to specially designed containers and shipped off-site for disposal.

Groundwater monitoring has been carried out in accordance with the requirements of the multi-media permit and the Technical Assessment Report submitted to and accepted by the Ministry early in 2004. The Technical Assessment Report presented an improved monitoring method and loading calculation procedure based on an extensive and calibrated groundwater flow model.

Groundwater levels were continuously measured using 20 pressure transducers installed in selected groundwater wells. Pressure transducers were utilized to increase the precision of the water level measurements used for the volumetric flux calculations. These calculations play an important role in estimating contaminant loading from the SPL Landfill.

The annual groundwater sampling program was completed in November 2013. Sampling was conducted along three main transects: the Near-Shore Fence, the Near-Landfill Fence and the Main Transect east of the Anode Paste Plant. Groundwater samples were analyzed for the following parameters: dissolved fluoride, cyanide (SAD – strong acid dissociable), dissolved metals, dissolved oxygen, electrical conductivity, temperature, redox potential and acidity. An extensive report that documents and interprets the results of the annual groundwater sampling program is sent to the Ministry each year.

Dissolved fluoride is a contaminant of key concern. Since 1998, concentrations of dissolved fluoride have gradually declined (**Figure 9.1**). The Main Transect best demonstrates the long term monitoring results for all three transects.

Figure 9.1— Dissolved fluoride concentration, SPL landfill

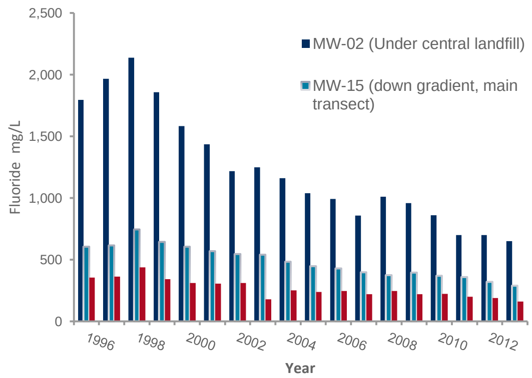
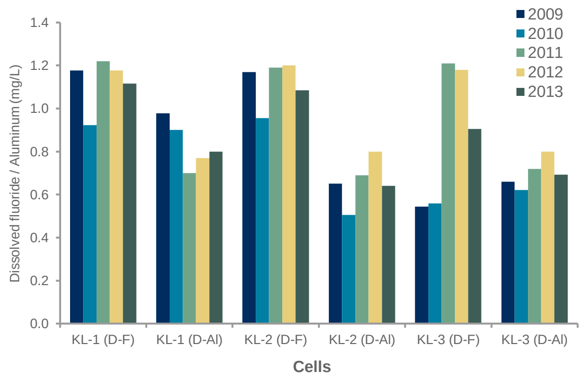


Figure 9.2— Dissolved fluoride & aluminum, wharf dredgeate monitoring cells



Reported estimates of contaminant loading in the Douglas Channel marine environment from the SPL Landfill in 2013 were comparable to previous years reported. In 2013, fluoride, cyanide and aluminum loadings were estimated to be 20159 kg, 335 kg, and 739 kg respectively.

Dredgeate cells and SPL overburden cell

The wharf dredgeate cells consist of two lined cells located north of Anderson Creek. They contain approximately 2,000 m^3 of ocean sediment dredged from the wharf berthing area in 1995. This sediment was removed during a normal dredging operation and required special disposal because of the presence of PAH in the form of solid pitch (pencil pitch). Kitimat Operations no longer receives pitch in this form. Maintenance of these cells has included liner replacement in one cell (2003) and liner upgrading in the other (2004).

Three wells were used to monitor groundwater in the area surrounding the wharf dredgeate cells. They are referred to as KL-1, KL-2 and KL-3 and are located to the west, south and east of the cells respectively. Groundwater sampling was conducted on a quarterly basis in 2013. The samples were analyzed for dissolved fluoride and dissolved aluminum. The 2013 contaminant monitoring results are consistent with historical trends and are within the expected seasonal variation (**Figure 9.2**).

The SPL overburden cell is located west of the wharf dredgeate cells. The SPL material is composed of approximately 10,500 m^3 of overburden material that came from the eastern lobe of the SPL landfill in 1996. The overburden cell was originally lined with a Claymax liner that has since been replaced several times, with a synthetic liner most recently in 2010.

Both the wharf dredgeate cells and SPL overburden cell have a double membrane lining system that collects water between the primary and the secondary liners. This water is tested and pumped out on a regular basis. In 2013 approximately 80 m^3 were pumped from the six sumps.

Kemano Permits

Chapter 10

Introduction

BC Operations Kemano facility is the hydroelectric power station that supplies electricity to Kitimat Operations. Up until 2000, Kemano Operations included a townsite with a resident population of 200 to 250 people. At that time the powerhouse was automated which reduced the operations and maintenance personnel to rotating crews of 20 to 30 people.

In 2013 project related activities continued to be conducted on-site. The number of individuals at the Kemano camp site was increased for the majority of the year, resulting in two permit exceedances in May 2013. The biological oxygen demand (BOD) level and the total suspended solids (TSS) concentration were non-compliant. Please see Chapter 11 for more details.

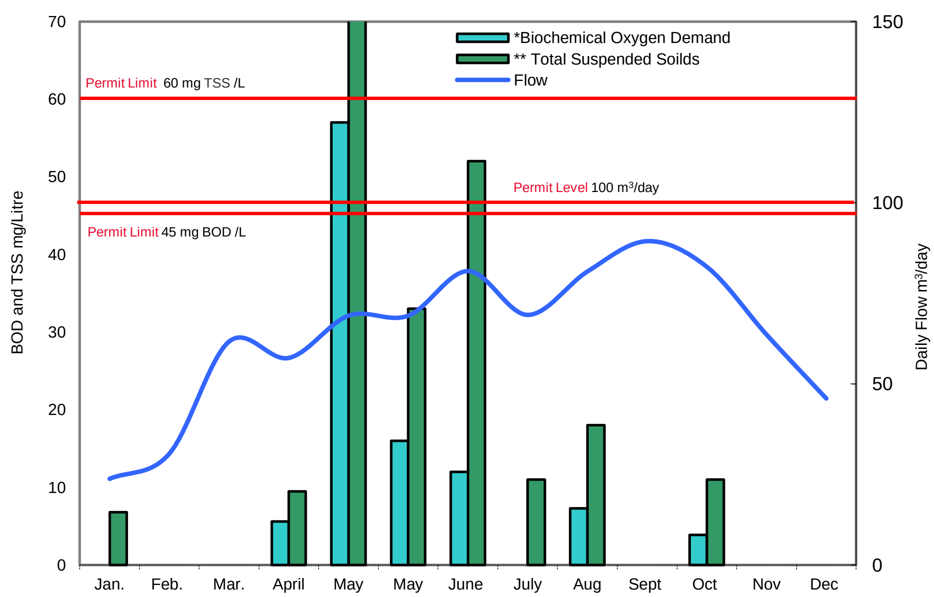
2013 Performance

Kemano effluent discharge

The Kemano sewage treatment plant and several septic tanks in the area surrounding Kemano have effluent discharge permits. The discharges consist of treated sewage and are subject to permit requirements with respect to BOD levels and concentrations of TSS. BOD is an indirect measure of the concentration of biodegradable matter, while TSS is a direct measure of suspended solids.

Prior to 2006, effluent results were analyzed monthly to establish a baseline. Since then, the permit requires only quarterly sampling. From May until August 2013 monthly sampling was initiated to confirm effluent measurements were back in compliance (**Figure 10.1**).

Figure 10.1— Effluent discharge Kemano 2013



Kemano emission discharge

An incinerator is used to burn municipal-type waste generated by rotating crews while residing at Kemano Operations. The incinerator is a double-chambered, fuel-fired, forced air unit. The permit requires that the exhaust temperature of the incinerator remain above 980°C and in 2013 permit requirements were maintained.

Kemano landfill

Non-combustible refuse and ash from the incinerator is buried in a landfill near Kemano. The landfill permit limits the amount of material to an annual maximum of 300 m^3. In 2013 45.28 m^3 of refuse were buried.

Treated sludge from the sewage treatment plant, septic tanks and biological containers are also deposited in the same landfill. Filtration ponds are used to de-water the sludge before disposal. The permit allows for disposal of up to 900 m^3 of treated sludge per year. In 2013 757.0 m^3 of sludge was disposed which is a large increase from 210.0 m^3 in 2012. This increase can be explained by the increase in population through 2013 which led to the two non-compliances.

Seekwyakin Camp effluent discharge

Seekwyakin Construction Camp, located three kilometres north of Kemano, was historically used by West Fraser Timber Co. Ltd. and B.C. Operations. Effluent sewage discharges from the camp require a permit when the camp has more than 25 residents. In 2013, Seekwyakin Camp saw very little activity and usage remained well below 25 residents. ❖

Summary of Non-Compliance and Spills

Chapter 11

2013 Performance

Non-compliance summary

In 2013, there were a total of 10 non-compliances (8 at Kitimat & 2 at Kemano). These non-compliances are summarized with a brief description of their causes and corrective actions that are either being assessed or implemented at the time this report was prepared (**Table 11.1**).

Three of the non-compliances were associated to emission releases and equipment failures, five of these non-compliances were related to particulate emissions associated to a series of upsets that impacted the reduction process and two water quality discharge exceedances at Kemano.

Spill summary

Spills at Kitimat Operations are first reported to the Plant Protection Department and subsequently to the Environmental Services Department. Regulatory requirements are in place to report certain types of spills to the Ministry of Environment (referred to as “reportable” spills), depending on the nature and volume of the substance spilled. In 2013, nine spills were reported to the Ministry (**Table 11.2**).

Spill-related awareness and prevention is a major focal point throughout Kitimat Operations. Immediate containment and minimization of potential environmental damage is the first priority. Specially equipped response teams are available when required. If appropriate, other agencies are informed and their cooperation enlisted.

Root cause analysis of reportable spills is conducted to prevent recurrence, and a system is maintained for recording and reviewing all spills and their frequency by type. This ensures that appropriate corrective actions are identified and tracked through to completion.

No known environmental damage was associated with any of the spills reported during 2013. ❖

Table 11.1 - Summary of Non-compliances, 2013

# of N/C	Non-Compliance	Occurrence date	Impact	Permit Requirement	Implemented Corrective Actions
			Kitimat		
1	Pollution control equipment failure – Coke Calciner cooler	Jan 30	Water pump failure caused a calcined coke particle emission to air	3.9 kg/h particulate	Short term: Pump belts for the main and back up pumps were replaced. *Completed* Drive belt inspection frequency increased. *Ongoing* Long term: Replacement of old pump design with new pumps (*Pending project upgrades*)
2	Data loss related to air monitoring network equipment failures	January	Remote access to Haul Road Data loss associated to logger complete failure	Network uptime > 75% to allow monthly and quarterly ambient air quality reports	Short term: - Haul road data loggers hard reset back in operation but experienced data loss - Emergency funds and purchase of equipment approved. *Authorized, replacement equipment was installed.* Long term: - New contractor responsible for maintenance, calibration & QA/QC In place as of Jan 2013. - Protocols and review procedures reviewed and approved *Completed Q1 2013* - Complete equipment network overhaul, include SO2, PM and data logger replacement along with setup of new communication protocols *Completed Summer 2013* - Audit of calibration and maintenance protocols *Completed Fall 2013*
3 - 4	Permit exceedance	Q3 August September	Q3 Average: 7.6 kg/Ton Al - Jul: 6.0 - Aug: 8.6 - Sep: 8.3	7.5 kg/Ton Al Particulate emission	Short term: Detailed investigation. *Completed* Interim: Additional sampling and supervision by Management via the Lean KPI – *ongoing*. ECP (Escalation Control Plan) focus on: Best operational practices Metal management Left over studs management Long term: KMP start up (under construction)
5	Missed Sample	October 6th	Control logic deprogramed – not alarmed. Late sample collection	F-stream extreme rain event overflow sample to be collected within the 1st hour of discharge.	Interim: Review of the requirements with stakeholders to ensure that weir elevation is monitored and samples timely collected during extreme rain events *Completed* Short term: Review and re-set the alarm notification system (audible, visual, e-mail) to primary responders. *Completed*
6-8	Permit exceedance	Q4 August September	Q4 Average: 8.0 kg/Ton Al - Oct: 7.6 - Nov: 7.8 - Dec: 8.5	7.5 kg/Ton Al Particulate emission	Short term: Shutdown of sick pots, replacement program for additional studs and clamps. *Completed* Interim: Additional sampling and supervision by Management via the Lean KPI – *ongoing*. ECP (Escalation Control Plan) f ocus on: Best operational practices Metal management Stud and clamp replacement Left over studs management Long term: KMP start up (under construction)
			Kemano		
1-2	Permit exceedance	May 28th	Exceeded the permitted Biological Oxygen Demand (57 mg/L) and Total Suspended Solids (88mg/L)	BOD: 45 mg/L TSS: 60 mg/L	Short term: Adjust the STP operation controls & procedures to compensate for the change of personnel. *Completed* Interim: Complete additional water quality samples to confirm that STP has returned to normal operation *Completed* Long term: Notification of onsite personnel quantity changes *Completed*

Table 11.2 - Summary of reportable spills, 2013

Occurrence	Substance	Amount	Environmental Media	Causes	Corrective Actions
8 January	Fraction 4 Coke fines	3 tonnes	Air	Communication error in commissioning of DC111.	A commissioning procedure was developed and implemented.
2 March	Diesel	<2 L	Drain Concrete Asphalt	Broken hose on bus parked by the main office building	Spill clean-up around drains and in Tour Building Creek. New version of the storm and effluent collection and discharge plan drawing to be completed by March 31, 2014.
11 March	Sewage	Unknown	Soil, fresh water	Failure of release valve at sewage lift station	Emergency response initiated. Inspections of release valves and sewage lines completed. Failure analysis for valve completed.
28 March	Sewage	2,000 L	Gravel	Raw sewage was noticed coming to the surface and accumulating in a ditch due to a break in the District of Kitimat sewage pipe.	Pumping from the camp was stopped. The pipe was repaired and the clean- up was complete.
6 April	Sewage	350 L	Gravel	Sewage tank overflowed during repair work.	Clean up was complete. Follow up discussion with the crew was completed.
9 August	Sewage	3,000 L	Soil, Gravel	Valve was partially closed.	The valve was opened. Tap root was performed with corrective actions assigned and completed.
26 September	Sewage	50 L	Soil, Gravel	Power loss	Action plan developed to be used during power outages.
26 November	Antifreeze	5 L	Marine	Mechanical failure in saltwater pump motor	Investigation resulted in the replacement of the bolts in the motor with corrosion proof ones.
1 December	Motor oil	20 L	Marine, asphalt	The extinguishment of a crane fire caused the spill.	Spill cleanup was completed.

Glossary

Chapter 12

Anode

One of two electrodes (the positive electrode) required to carry an electric current into the molten bath, a key component of the electrolytic reduction process that transforms alumina ore into aluminum.

Anode effects

A chemical reaction that occurs when the level of alumina in a pot falls below a critical level, resulting in reduced aluminum production and the generation of perfluorocarbons (PFC) – a variety of gases with a high carbon dioxide equivalency.

Anode paste

One of the materials used to manufacture anodes, composed of calcined coke and coal tar pitch.

Attrition index

An index used to express alumina strength: the higher the value, the weaker the alumina.

Carbon dioxide (CO_2) equivalency

This is a quantity that describes, for a given mixture and amount of greenhouse gas, the amount of $C0_2$ that would have the same global warming potential as the emission, when measured over a specified time period.

Carbon out

Removal of carbon fragments that have fallen off the anode or have formed points on part of the anode.

Cassette Sampling

A sampling procedure for air emissions where contaminants are collected using filters placed at regular intervals along the length of a potroom.

Cathode

One of two electrodes (the negative electrode) required to carry an electric current into the molten bath; a key component of the electrolytic reduction process that transforms alumina ore into aluminum.

Coke calcination/calcined coke

A process involving the use of high temperatures to drive off volatile matter found in green coke, thus producing calcined coke for use in anode manufacturing.

Composite sample

A composite sample is treated as a single sample, despite being made up of multiple temporally discrete samples. For example, all effluent composite samples are taken over 24 hours during which a 50 mL sample is collected every 10 minutes.

Dredgeate

Any material removed by dredging.

Dry scrubber

Pollution control equipment used to remove contaminants (in gaseous or particulate forms) from air emissions.

Effluent (B-Lagoon)

Water discharge flowing out of the B-Lagoon outfall after treatment in the B-Lagoon system.

Electrolyte

A chemical compound that provides an electrically conductive medium when dissolved or molten.

Electrolytic reduction

This process uses electricity to remove oxygen molecules from aluminum oxide to form aluminum metal.

Exception pot

A pot that is not operating within the normal range and could result in openings in the alumina sealing. Exception pots are associated with increased fluoride emissions.

Fugitive dust

Solid airborne particulate matter that is emitted from any source other than a stack or a chimney.

Geometric Mean

A geometric mean is a type of mean or average, which indicates the central tendency or typical value of a set of numbers by using the product of their values. The geometric mean is often used when comparing different items when each item has multiple properties that have different numeric ranges.

Green coke

The raw form of coke received at Kitimat Operations, which is calcined for use in the manufacture of anodes; a by-product of oil refining.

Grab sample

A grab sample is a discrete sample used to collect information for a specific or a short time. Variability of this data is much higher than a composite sample.

Leachate

A liquid which results from water collecting contaminants as it passes through waste material.

Leftover metal

Metal which accumulates in a pot when the schedule to remove the metal is not followed.

Loading

Loading is the emitted amount of a contaminate in a given time period.

Low magnitude pot

An exception pot which has had an anode effect with a magnitude of 25 volts or less.

Maximum allowable level

This level provides adequate protection against pollution effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being.

Maximum desirable level

This level is the long-term goal for air quality programs and provides a basis for the federal government's antidegradation policy for unpolluted parts of the country.

Maximum tolerable level

This level denotes time-based concentrations of air contaminants beyond which appropriate action is required to protect the health of the general population.

Ministry

The British Columbia Ministry of Environment; to which B.C. Operations reports on compliance with its permit requirements.

Off-light pot

Pots which have gone for a long period of time (generally 40 hours) without an anode effect.

Piezometer

A small diameter water well used to measure the hydraulic head of groundwater in aquifers.

Pitch

One of the materials from which anodes are made, and a by-product of metallurgical coke production.

Polycyclic Aromatic Hydrocarbons (PAH)

A group of aromatic hydrocarbons containing three or more closed hydrocarbon rings. Certain PAH are animal and/or human carcinogens.

Pots/potrooms

Pots are large, specially designed steel structures within which electrolytic reduction takes place. The 588 pots at Kitimat Operations are housed within 5 pot lines (1C, 2A, 2B, 2C, 3A, 3B, 4A, 4B, 5A and 5B)

Process correction

Accessing the condition of exception or sick pots and bringing them back to normal operating conditions.

Putrescible Waste

Waste that rots which can be easily broken down by bacteria, for example food and vegetable waste.

Pyroscrubber

A combustion-based system that controls dust emissions from the coke calciner.

Retention time

The average time a drop of water takes to move through a lagoon from inlet to outlet.

Scow grid

A dry dock for flat bottomed vessels (scows) formed from a series of piles and sills.

Sick pot

A pot that has an elevated bath temperature and cannot be sealed properly or is uncovered.

Spent potlining

Lining from the inside of pots, composed of refractory bricks and carbon that has deteriorated to the point where it needs to be replaced.

Stud

Studs constructed of steel are inserted vertically into the anode to conduct the flow of electricity through the anode and into the electrolyte.

Total Suspended Solids (TSS)

A water quality measurement that refers to the dry weight of particles trapped by a filter, typically of a specified pore size.

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