Annual environmental report

BC Operations

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About this report

Chapter 1

In 1999, Rio Tinto Alcan's BC 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.

BC Operations is comprised of operations and assets in Kitimat, Kemano and the watershed region. In addition to the permit reporting for Kitimat operations, a summary report for compliance of the Kemano Operations environmental permits is provided.

2014 was a transition year for the Kitimat smelter with unique challenges associated to the idling of three Vertical Stud Söderberg (VSS) potrooms along with preparation activities for modernized smelter operations.

In 2014, Kitimat Operations reported twelve non-compliances. A discussion of the non-compliances, impacts and responses are highlighted in Chapter 11 of this report.

The 2014 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. ❖

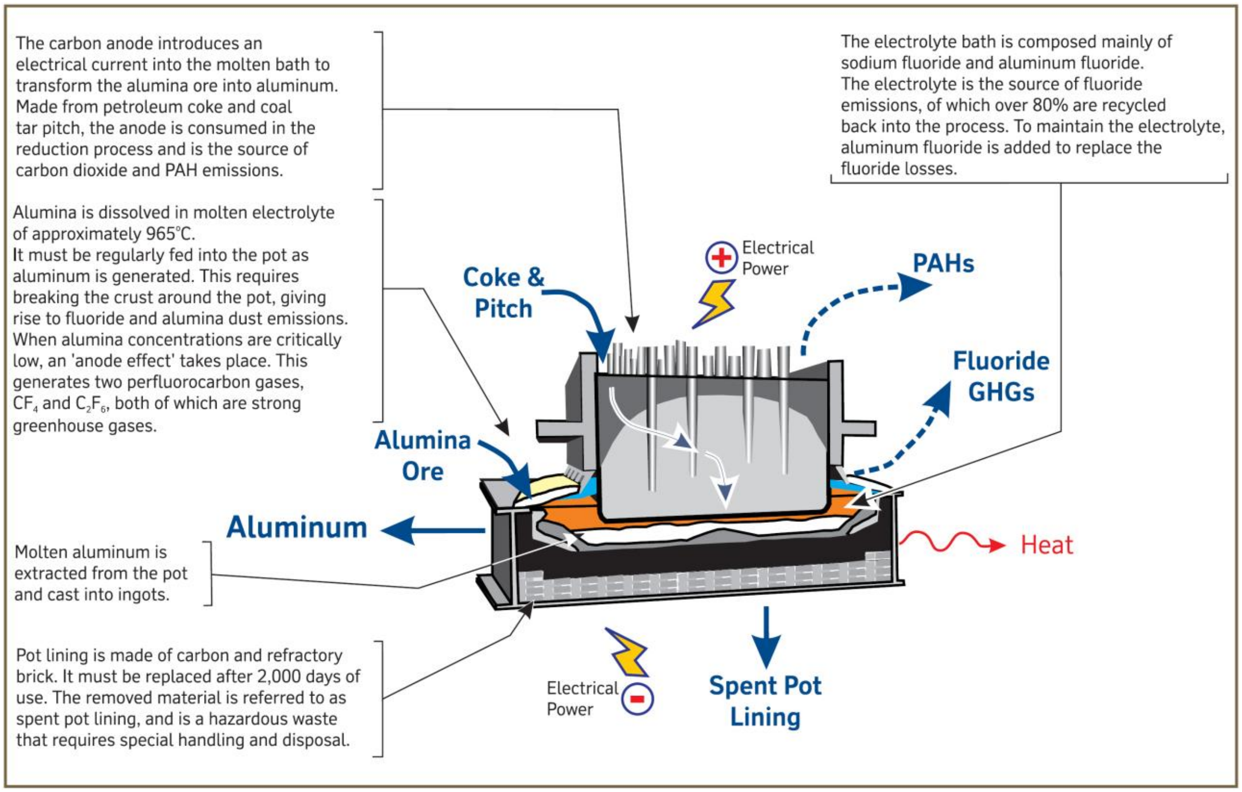

Figure 1.1 Aluminium manufacturing process

Aluminium Metal is extracted from raw alumina using an electro-chemical "reduction process" that takes place within a steel-encased pot or cell.

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 aluminium smelter located on the Northwest coast, at the head of Douglas Channel.

On 1 December, 2011 Rio Tinto authorized the modernization of the Kitimat Operations with a total investment of US$4.8 billion (www.kitimatworksmodernization.com). In 2014, BC Operations proceeded to idle three VSS potrooms. Lines 5A and 5B were idled in June 2014, and in September 2014 BC Operations completed the idling of Line 1C. Idling of those potrooms was a significant milestone in 2014, underlining the transition to a modernized and greener smelter. This resulted in a significant reduction of the potroom emission loadings for 2014. The sequence of idling activities is a critical piece to the success of starting up the new smelter.

Before the Kitimat Modernization Project initiated, Kitimat Operations had a nameplate production capacity of 282,000 tonnes of aluminium per year. 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 aluminium and oxygen. An electrolytic reduction process is used to break the bond and produce aluminium.

The electrolytic reduction process 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 aluminium-oxygen bond. The heavier aluminium molecules sink to the bottom of the pot in the form of molten aluminium. Molten aluminium 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 improved strength or corrosion resistance.

The aluminium 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 tri-lock ingots, which are sold to customers in North America and Asia resulting in a variety of end-use applications.

The smelter site also includes facilities that produce raw materials required for aluminium 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 kilometre Southeast of Kitimat. This generating station uses water impounded in the 91,000ha Nechako Reservoir in North-central British Columbia. ❖

Effluent Collection and Treatment

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- 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
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- 9 B-Lagoon Discharge
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- 11 A-Lagoon
- 12 F-Lagoon Former Weir Location
- 13 F-Lagoon Emergency Outfall
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- 15 Discharge from Water Treatment Clarifier

Waste Storage, Disposal & Managed Sites

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- 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
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- 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
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Figure 2.1 Kitimat Operations map

Environmental management and certification

Chapter 3

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 BC 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

Since 2001, BC 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). ISO 14001 provides independent verification that BC Operations evaluates its environmental impacts, 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, BC 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 incorporated 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.

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 2014 as planned. Kitimat Operations' integrated certification was successfully maintained.

Compliance with all environmental laws and regulations is the foundation for our environmental performance standards. In 2014, 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 objectives of the poly aromatic hydrocarbons (PAH) emissions. Program details are described in Chapter 5. ❖

Health, Safety and Environment Policy

At Rio Tinto Alcan, we care about people and the world we live in. We understand that effectively managing our HSE responsibilities is key to our long term success. That's why we are committed to Zero Harm by Choice. This entails preventing fatalities, injuries and illnesses while working proactively to protect the environment.




Our Health, Safety and Environment Policy

We strive to protect the environment and safeguard the health, safety and wellbeing not only of the people who work at our sites but of the communities in which we operate. We achieve this by continuously improving our HSE performance across the organisation, while complying with Rio Tinto HSE requirements and local HSE legislation.

AWARENESS: All our employees, contractors and other key stakeholders are aware of and understand the health, safety and environmental hazards and risks that affect our business and neighbouring communities.

- We openly communicate with our key stakeholders and ensure that our employees are actively involved in matters affecting our HSE performance.
- For all positions and functions, HSE roles and responsibilities are clearly defined within job descriptions and procedures, and our leaders ensure that appropriate resources are provided to improve performance and hold people accountable.

COMPETENCE: All our employees and contractors have the competencies to undertake their work safely while taking care of their health and minimising environmental impacts.

- We ensure that employees and contractors are knowledgeable about the HSE risks that affect their work, the safe practices to be followed and the controls to be applied. We expect them to stop their work whenever a risk cannot be adequately controlled.
- We have an effective HSE Management System in place across Rio Tinto Alcan that takes Human Performance into account, and we ensure that people are empowered to raise HSE concerns with management.
- Our leaders make sure that HSE issues are identified, assessed and managed. This includes assessing the risks associated with HSE workplace hazards and taking action to implement the required controls to avoid incidents.

COMPLIANCE: Our work activities comply with all legal and other HSE related requirements, and our employees are empowered to take action to minimise HSE risks.

- We adhere to Rio Tinto standards including "The way we work", HSEQ Management Systems and HSE performance standards.
- We report and investigate incidents and take corrective action to prevent their recurrence.
- We actively review and openly report on our HSE performance against published objectives and targets.
- We develop and communicate strategic action plans in line with Rio Tinto's HSE strategy to help us achieve these objectives and targets.
- We support and hold our contractors to the same HSE expectations and performance standards as our own employees.

EXCELLENCE: Rio Tinto Alcan is recognised for excellence in the way it manages HSE. We involve every employee in improving what we do in HSE.

- We learn from any mistakes and experiences related to major incidents so that we can prevent their recurrence.
- We encourage, develop, review and share HSE good practices both internally and externally
- Compliant with Rio Tinto HSE requirements, we continuously seek to minimise our environmental footprint by improving our energy efficiency and natural resource consumption as well as reducing, reusing and recycling materials to minimise waste and emissions.
- We also endeavour to protect biodiversity as well as identify and implement specific programmes to lower our greenhouse gas emissions.

Delivering our Health, Safety and Environment Policy by:

- Fostering a culture that does not tolerate threats to health, safety and the environment.
- Ensuring the real and active involvement of all employees and contractors.
- Holding our leaders accountable for improving HSE performance and providing the resources to do so.
- Supporting our teams with the right systems.

Alfredo Barrios, Chief executive, Rio Tinto Alcan
December 2014

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 100,000m^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 six inflows into B-Lagoon that discharges into the Douglas Channel.

These six inflows into B-Lagoon are: 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**).

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 2014, the average discharge rate was 36,396m^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 2014, there were six overflow events at F-Lagoon three of which resulted in elevated Total Suspended Solids (TSS) results that exceeded permitted limits. A more detailed description of the events can be found in Chapter 11, “a summary of non-compliances”.

Discharge measurements related to permit requirements and additional monitoring are described below in the following 2014 performance section.

2014 performance

Effluent water quality monitoring

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

Flow variability

Variability in the flow from B-Lagoon into the Douglas Channel is mainly a function of precipitation. As shown in **Figure 4.1**, peak rain events and flows occurred in January to March and in September through December. The total amount of rainfall in 2014 (2,665mm) was comparable to 2013 levels (2,440mm).

Long-term trends

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

In 2014 dissolved fluoride, dissolved aluminium and total suspended solids loads decreased in comparison to 2013 and 2012 levels. Decrease is associated to the closure and remediation of the lines 7&8 in preparation for KMP as well as the ongoing efforts and attention the reduction organization carries at source controlling raw materials from entering the storm drain network.

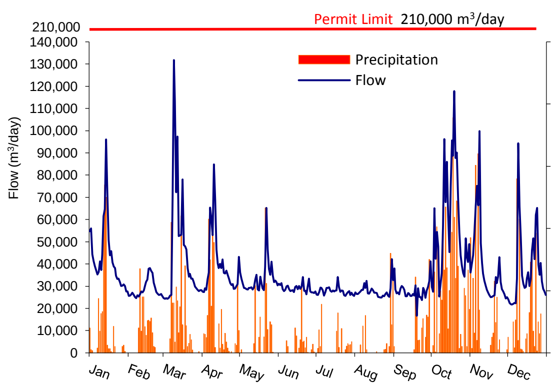


Figure 4.1 - Flow Variability, B-Lagoon 2014

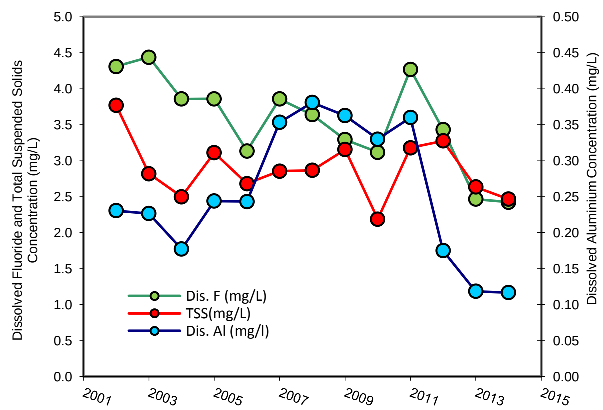


Figure 4.2 - Dissolved Fluoride, Dissolved Aluminium & Total Suspended Solids, B-lagoon 2014

Dissolved fluoride

Dissolved fluoride originates mainly from the leaching of a landfill formerly used to dispose of spent pot lining. Information on the spent pot lining 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 continuously through 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 2014. Average dissolved fluoride concentration for the year derived from composite sampling was 2.42mg/L. This value is lower than in 2013. The long-term trend is illustrated in **Figure 4.2**. The 2014 composite and grab sampling results (**Figure 4.3**) profile the higher concentrations that occurred during the higher precipitation and surface run-off events during the year.

Dissolved aluminium

Aluminium 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 aluminium.

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 aluminium and dissolved fluoride.

In 2014, concentrations of dissolved aluminium did not exceed the maximum permit limit of 3.0mg/L. The annual average of dissolved aluminium concentration was 0.12mg/L (**Figure 4.4**).

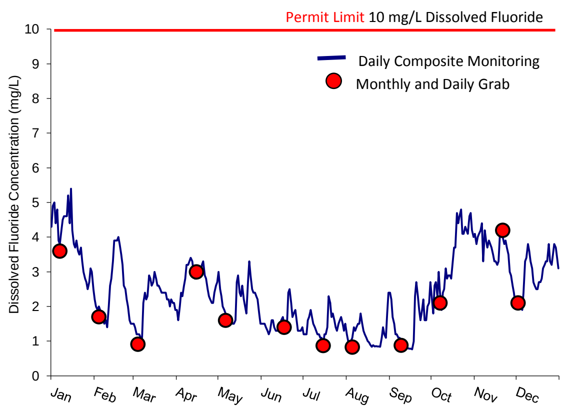


Figure 4.3 - Dissolved fluoride, B-Lagoon 2014

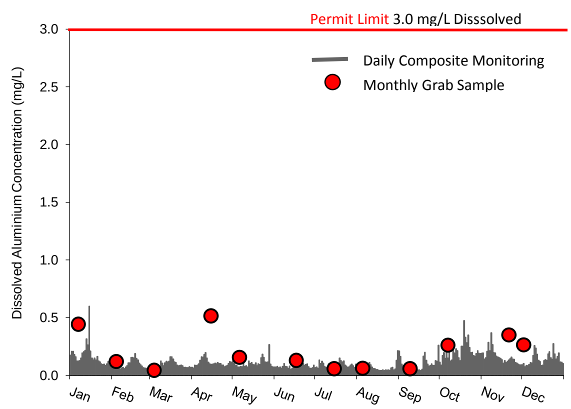


Figure 4.4 - Dissolved Aluminium, B-lagoon 2014

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 aluminium and polycyclic aromatic hydrocarbons (PAHs) 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 50mg per litre of TSS in effluent. Concentrations in 2014 were much lower than the permit level. The annual average concentration for the composite samples was 2.5mg/L (**Figure 4.5**).

Cyanide

Cyanide is formed during the electrolytic reduction process and retained in the cathode lining material known as spent pot lining (SPL). In the past, material in the cathode was deposited on-site at the SPL landfill. Today, all 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 source of the cyanide in B-Lagoon is from the J-Stream outlet.

The permit specifies a maximum concentration of 0.5mg 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 permit level was not exceeded in 2014. Weak acid dissociable cyanide is also monitored, although there is no permit requirement (**Figure 4.6**).

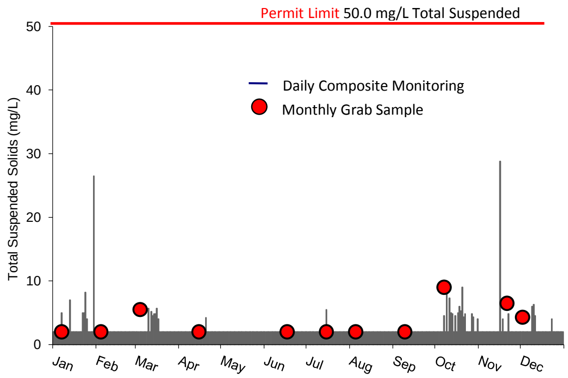


Figure 4.5 - Total suspended solids, B-Lagoon 2014

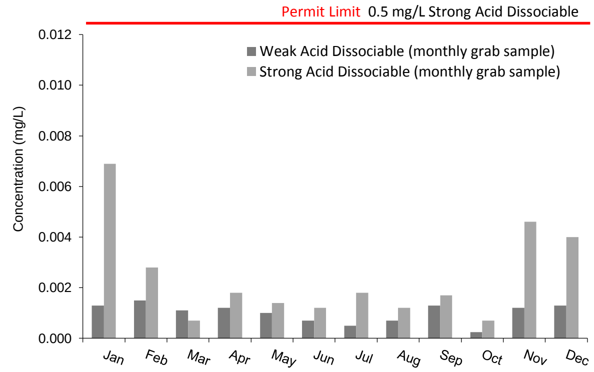


Figure 4.6 - Cyanide, B-lagoon 2014

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 2014 (**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 aluminium 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.

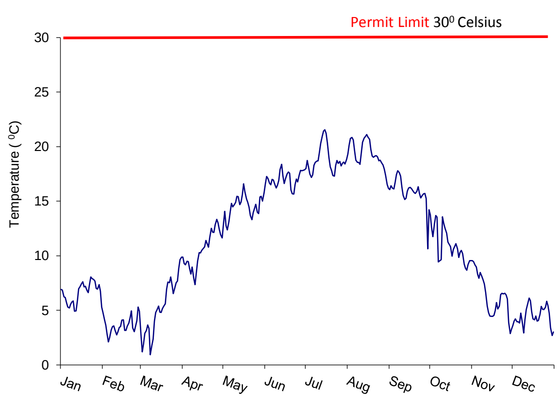


Figure 4.7 - Temperature, B-Lagoon 2014

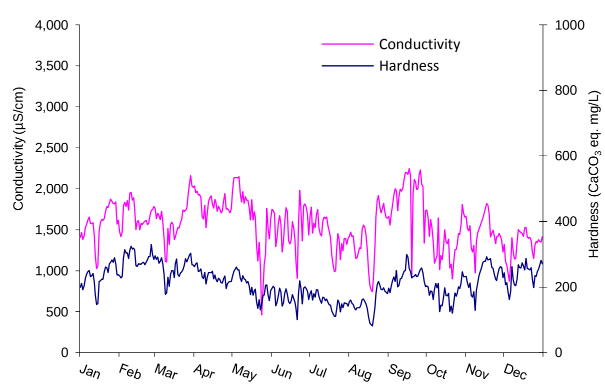


Figure 4.8 - Conductivity & Hardness, B-lagoon 2014

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 2014. In 2015, the monthly toxicity sampling for B-Lagoon effluent will be reduced to quarterly.

Acidity

A variety of contaminants can influence the acidity of effluent, by either increasing or decreasing the pH levels. 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 alcaline).

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 2014 annual pH composite sample average was 7.4. All sample measurements were within the permit limits during 2014 (**Figure 4.9**).

Polycyclic aromatic hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) 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. PAHs originate in discharges primarily from potroom roof dust captured in precipitation and surface runoff. Other sources include raw materials (green coke and pitch) handling.

PAHs are monitored using two methods: weekly analysis of composite and monthly grab samples. PAHs 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 PAHs in effluent (**Figure 4.10**). ❖

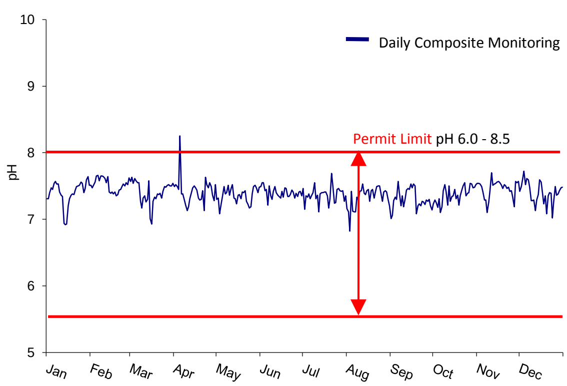


Figure 4.9 - Acidity, B-Lagoon 2014

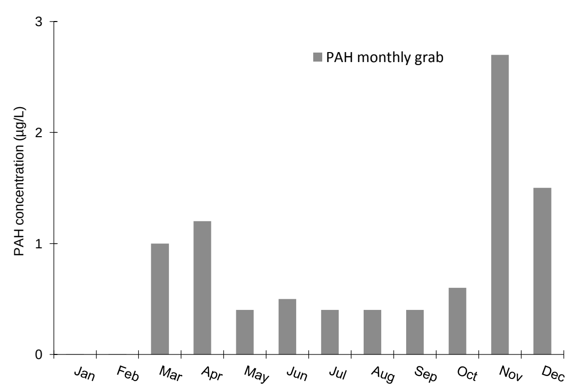


Figure 4.10 - Polycyclic Aromatic Hydrocarbons, B-lagoon, 2014

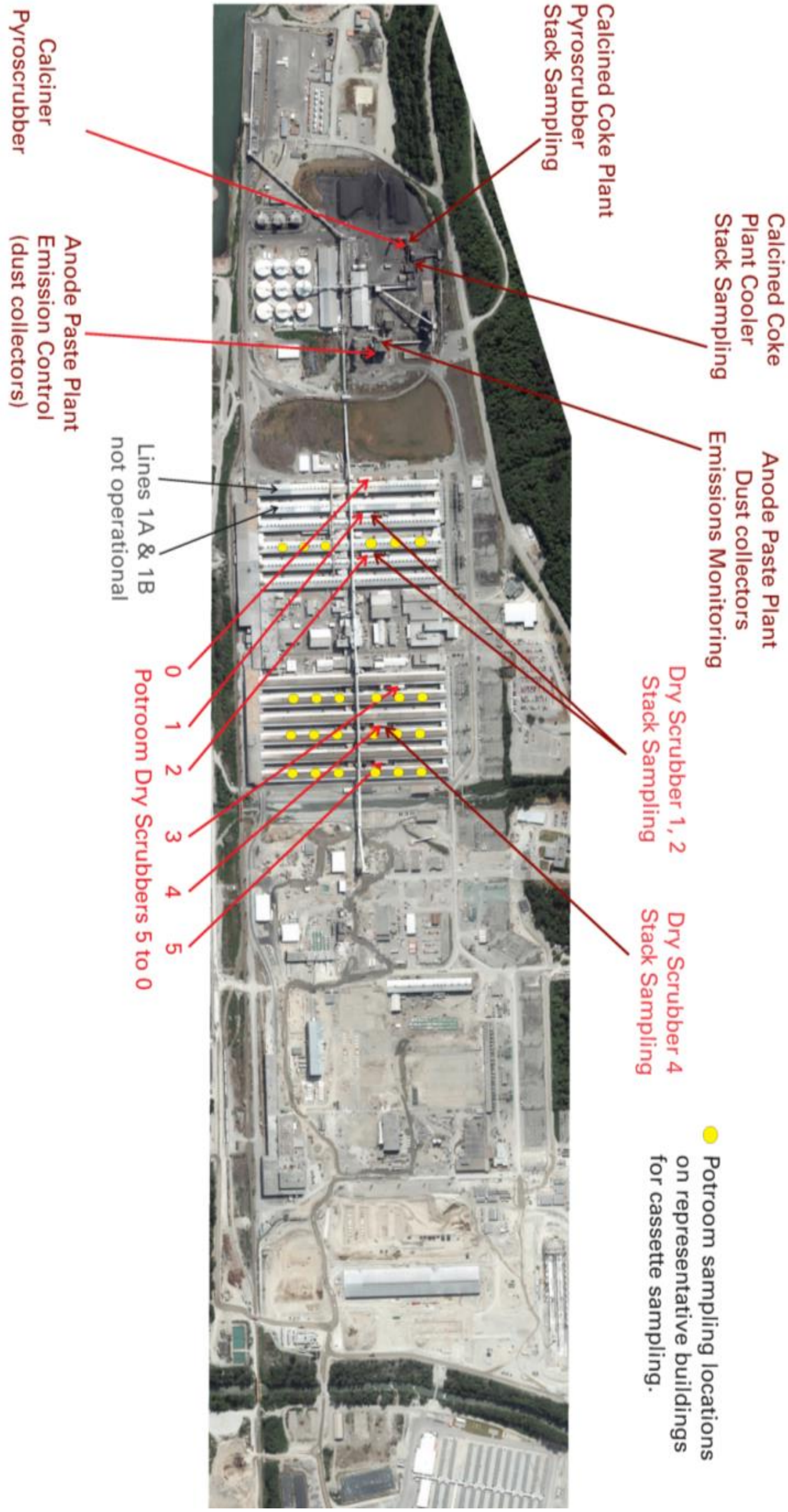


Figure 5.1 Potroom roof sampling locations

Emissions

Chapter 5

Introduction

This chapter describes the results of ongoing 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 (PAHs), nitrogen oxides (NOx), total particulates, and greenhouse gases (GHGs).

Sources

Major sources of air emissions at Kitimat Operations include the potroom 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.

2014 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**). Line 5B was idled in June 2014.

The molten bath dissolves the alumina ore by an electrolytic reduction process through which aluminium is produced. The bath is composed primarily of sodium fluoride and aluminium 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 they are referred to as "exception pots". Exception pots are associated to overheating and increased gas escape. 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.

In 2014 exception pots were higher in April and May, but were under control during the summer months. The average number of exception pots in 2014 (13.7%) was slightly higher than 2013 (13.5%). The gaseous fluoride emissions rate is tracked internally and showed a decrease in 2014 compared to 2013 (**Figure 5.2**).

In preparation for the potlines idling, 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 aluminium. The annual average fluoride emissions loading during 2014 was 24.3 tonnes gaseous fluoride per month compared to 37.8 tonnes gaseous fluoride per month in 2013. The reduction in net fluoride emission loading is associated with the idling of Line 5 and Line 1C in 2014. During 2014, there were no loading monthly exceedances of the gaseous fluoride emissions limit (**Figure 5.3**).

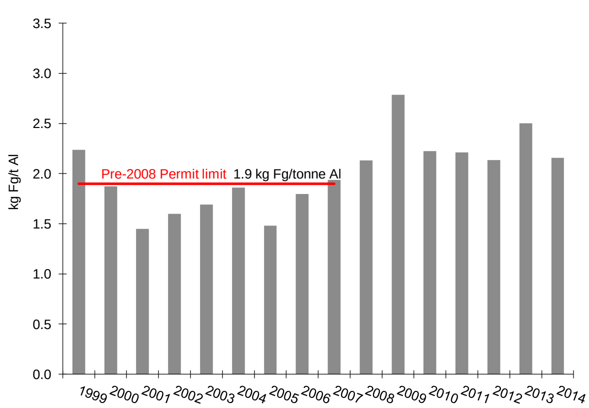


Figure 5.2 - Gaseous fluoride emissions, rate measurement potroom roofs1998-2014

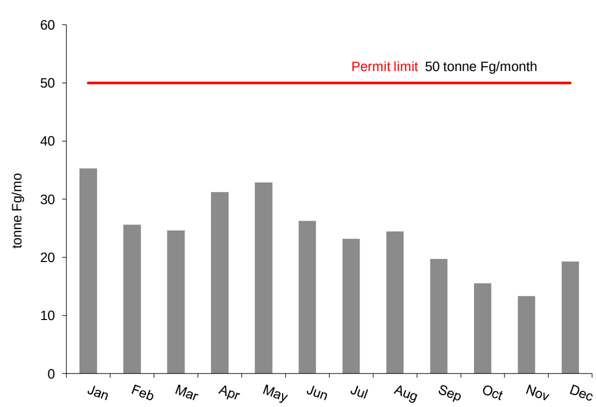


Figure 5.3 - Gaseous fluoride emissions, loading measurement Potroom roofs 2014

Gaseous fluoride is known to have negative impacts on the health of vegetation. The routine annual vegetation survey found the levels of fluoride in vegetation adjacent to the plant site were 4% higher than 2013 (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 aluminium is produced.

From 1993 to 1999, the permitted sulphur dioxide emission was set at 20.7 tonnes per day on an annual average. In 2000 the permitted sulphur dioxide emission was set at 27 tonne per day on annual average to reflect the quality challenges observed in the global coke market. In April 2013 the operation permit was updated to reflect the new SO_2 emission permit limit (42.0 tonnes per day) in preparation to the modernized smelter production increase. The SO_2 emissions decreased from 13.9 tonnes per day in 2013 to 11.6 tonnes per day in 2014 associated to a reduced metal production and calciner maintenance shutdowns. 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**).

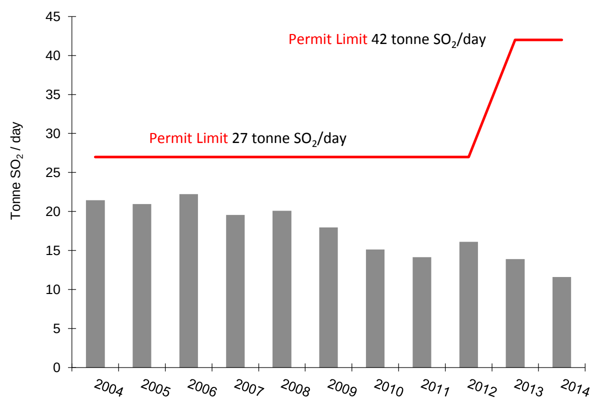


Figure 5.4 - SO_2 emissions, Kitimat Operations 2004-2014

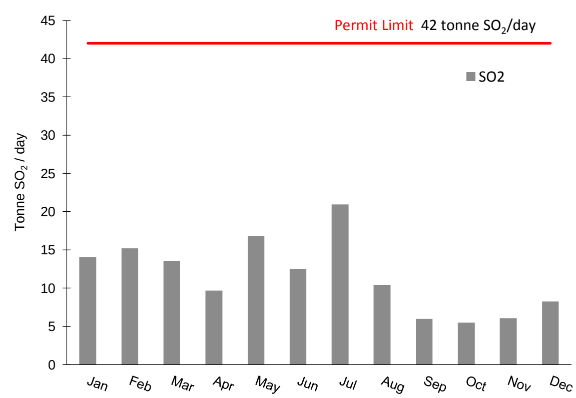


Figure 5.5 - SO_2 emissions, Kitimat Operations 2014

Polycyclic aromatic hydrocarbons (PAHs)

PAH 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 PAHs. PAHs content in the emissions from Kitimat Operations was lower in 2014 at 110.6 tonnes per year compared to 161.3 tonnes per year in 2013 (**Figure 5.6**).

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 BC (Kitimat) and Quebec (Shawinigan and Beauharnois). From 2008 to 2011, the environmental performance objective determined for Kitimat Operations was 0.8 kg per tonne.

In 2012 the objective was lowered to 0.75 kg per tonne aluminium. The average PAH emissions were lower in 2014 at 0.83 kg per tonne aluminium compared to 0.91 kg per tonne aluminium in 2013 (**Figure 5.7**). Although the average PAH emissions in 2014 were above the set environmental performance objective, during the second half of 2014 (July through November) the monthly PAH emissions were below the Environment Canada performance objective. The PAH performance agreement between Rio Tinto Alcan and Environment Canada ended in 2014.

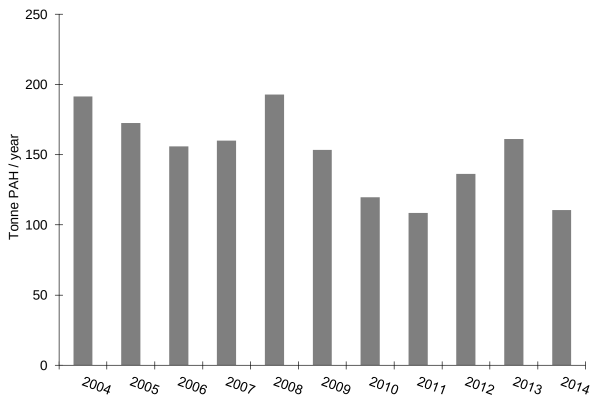


Figure 5.6 - PAH emissions, loading measurement potroom roofs 1999-2014

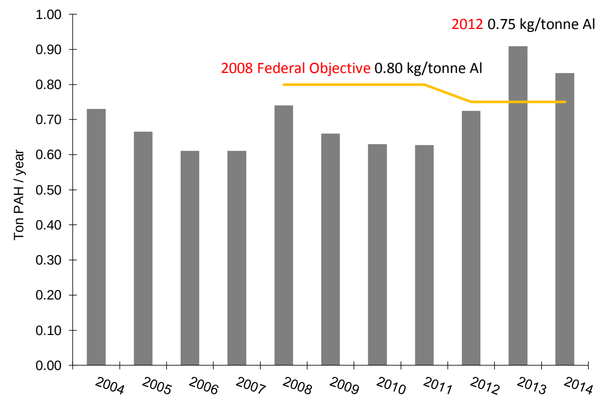


Figure 5.7 - PAH emissions, rate measurement, potroom roofs 2004-2014

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).

NOx emissions are estimated using a combination of actual measurements and US-EPA emission factors. In 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 2014 were estimated at 179 tonnes per year compared to 219 tonnes per year in 2013 (**Figure 5.8**). The coke calciner operated 184 days in 2014 down from 260 days in 2013.

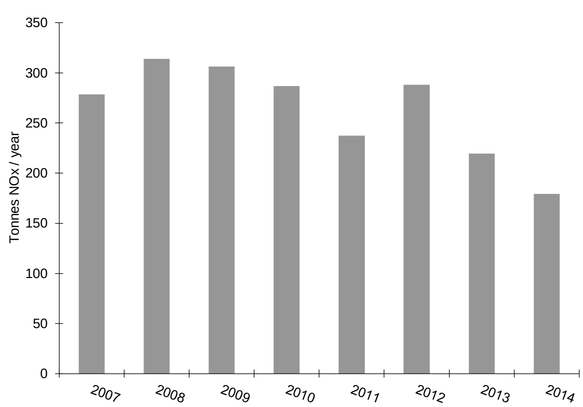


Figure 5.8 - Nitrogen oxide emissions, Kitimat Operations

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 2014, 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 2014.

Table 5.1 - Potroom dry scrubbers, annual stack tests 2014

Performance Measure	Dry Scrubber #		
	1	2	4
Date	12 May	16 May	9 May
Flow (m^3/min) Permit limit: 1,560 m^3/min	1306.3	1219.3	864.2
Total Particulates (mg/m^3) Permit Limit: 70 mg/m^3	25.8	27.7	31.8
Particulate Fluoride (mg/m^3) Permit Limit : None	0.9	1.6	0.8
Gaseous Fluoride (mg/m^3) Permit Limit: None	21.8	18.7	11.0
Sulphur Dioxide (mg/m^3) Permit Limit: None	676.3	416.0	823.5
Date	11 May	17 May	10 May
Polycyclic Aromatic Hydrocarbons (mg/m^3) Permit Limit: N/A	0.0858	0.0555	0.0227

Table 5.2 - Potroom dry scrubbers, downtime 2014

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

Total particulate emissions for 2014 were 1,208.2 Mg (tonnes) lower than 2013 at 1,447.6 Mg. This total includes all sources including the potroom roofs (**Figure 5.9**).

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 on a monthly basis (two sampling periods per month).

Monthly monitoring was implemented during Q3 of 2013 and was maintained in 2014. The increase in measured particulates may be due in part to measurement error. The idling of the potlines in preparation for the decommissioning of the VSS technology has affected the air flow rates in the pot rooms which are dependent on the heat generated by the pots. This change in airflow conditions may have led to an over sampling error (**Figure 5.10**).

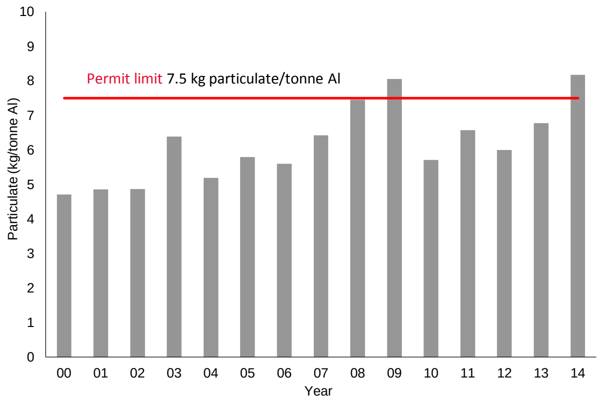


Figure 5.9 - Particulate emissions, potroom roofs 1999-2014

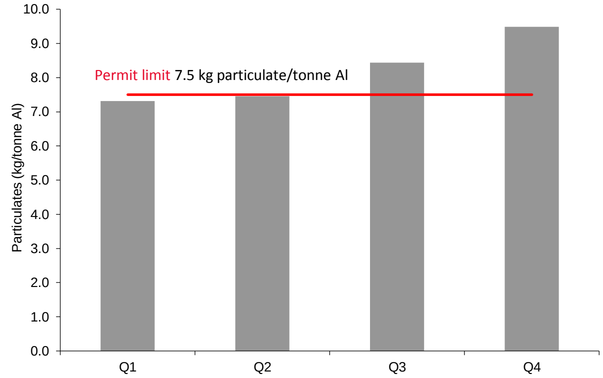
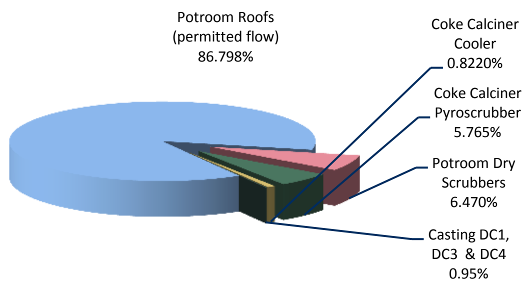


Figure 5.10 - Particulate emissions, potroom roofs, 2014

The annual average of potroom particulate emissions was above the 7.5 kg particulate per tonne Al permit limit for 2014 when calculated on a quarterly average (**Figure 5.10**). The annual average was 8.2 kg particulate per tonne Al which is an increase from 2013 at 6.8 kg particulate per tonne Al.



Particulate emissions from the potroom roofs accounted for 82.2 per cent of total particulate emissions for Kitimat Operations in 2014 (**Figure 5.11**). Four non-compliances were reported associated to permitted particulate rate exceedances; details are described in Chapter 11.

Figure 5.11 - Particulate emissions, Kitimat Operations

Calcined Coke Plant

The two emission sources at the Calcined Coke Plant (the pyroscrubber and the cooler) are monitored relative to permit limits for particulate content. In 2014 the pyroscrubber was not tested due to shutdowns and construction activities. The cooler was tested once (**Table 5.3**).

Table 5.3 - Calcined Coke Plant, annual stack test, 2014

Emissions performance measure	Calcined Coke Plant pyroscrubber	Calcined Coke Plant cooler
Particulates (kg/hour) Permit Limit	Not Sampled Not Sampled 21.1	1.78 (May) Not Sampled 3.9
SO_2 (kg/hour) Permit Limit	Not Sampled Not Sampled n/a	1.35 (May) Not Sampled n/a
NOx (kg/hour) Permit Limit	Not Sampled Not Sampled n/a	n/a n/a n/a

Table 5.4 - Anode Paste Plant, annual stack test, 2014

Source	Particulate permit limit (mg/m^3)	Particulate emissions (mg/m^3)
Dust Collector DC10	120	13.4
Dust Collector DC11	120	14.5
Dust Collector DC12	120	6.4
Dust Collector DC13	120	34.6
Dust Collector DC14	120	7.2
Dust Collector FC 3	120	42.1
Dust Collector DC111	50	30.4

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 2014.

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 US Environmental Protection Agency (US-EPA). Plant-wide in 2014, consumption decreased by 7.4 per cent (**Table 5.5**).

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	26 June 2014	9 October 2014
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 Particulates mg/m^3	157.4	140.5

Table 5.7 - Liquid pitch incinerator stack test, 2014

Emissions performance measure	2014*
Polycyclic aromatic hydrocarbons (mg/m^3)	Not Sampled
Total Particulates mg/m^3	Not Sampled

*See Chapter 11 – Non-Compliances

Chlorine consumption

Chlorine was used during the process of casting aluminium ingots. The permit limit for chlorine consumption is 300kg per day. This limit has not been exceeded since 1999. Over the past years, the use of chlorine was reduced and finally eliminated in April 2014 (**Figure 5.12**).

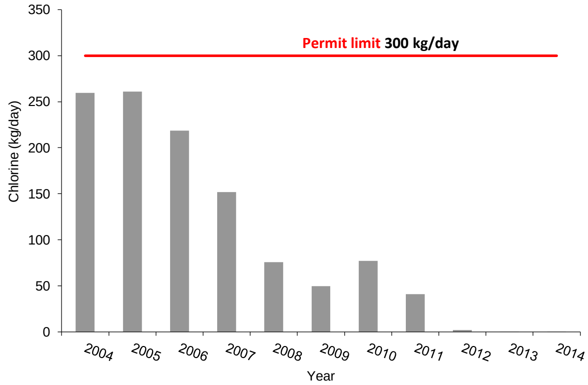


Figure 5.12 - Chlorine consumption, casting 2004-2014

Sulphur hexafluoride (SF_6) consumption

SF_6 is used during the process of casting aluminium ingots. In 2013 the casting centers that used this gas were shut down so there was no SF_6 reported from casting in 2014.

Greenhouse gas emissions

There are a number of sources of greenhouse gas (GHG) emissions at Kitimat Operations (**Figure 5.13**). Most emissions occur during the smelting process, and most smelting-related emissions are attributable to anode effects (**Figure 5.14**). Anode effects produce perfluorocarbons (PFC), a form of GHG with a particularly high carbon dioxide equivalency.

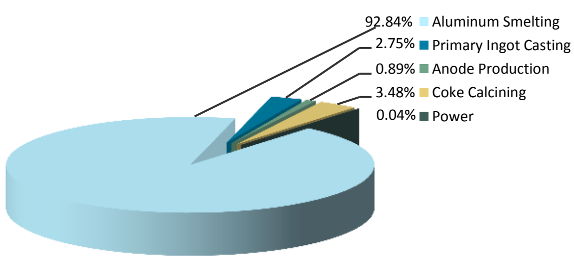


Figure 5.13 - Total GHG emissions by source, 2014

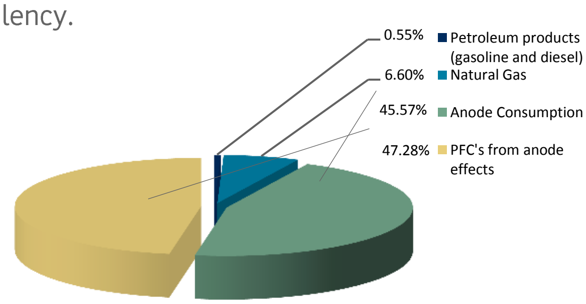


Figure 5.14 - Breakdown of aluminium smelting GHG by source 2014

Kitimat Operations GHG 2014 emissions stayed the same as 2013 at 4.34 tonne of CO_2 equivalent, per tonne of aluminium production (**Figure 5.16 & 5.17**). The total amount of CO_2 emitted in 2014 excluding anode effects was 277,678 tonnes of CO_2^e. ❖

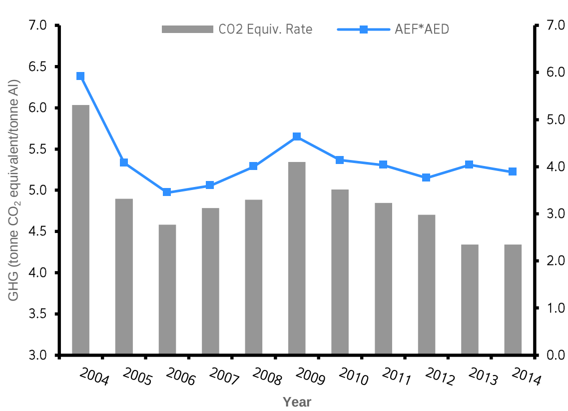


Figure 5.15 - GHG emissions, Kitimat operations 2004-2014

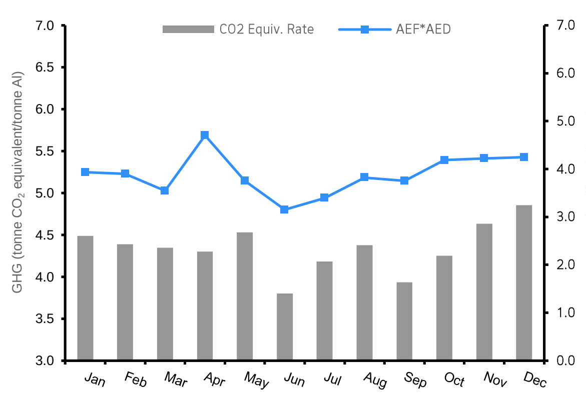


Figure 5.16 - GHG emissions, Kitimat Operations, 2014

Air quality monitoring

Chapter 6

Network overview

BC Operations conducts continuous ambient air quality monitoring at five stations in the lower Kitimat valley and one specialized station at Lakelse Lake. The 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	Lakelse lake
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 (PAHs), 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 air quality 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 in 2013. 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 BC Operations is carried out to meet 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 instruments 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 two-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. In 2014, this replacement and upgrade plan was completed with the replacement of the meteorological tower at the Haul Road station.

2014 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 and Kitamaat Village stations 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 0.8 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 the provincial or federal maximum desirable levels occurred in 2014 **(Table 6.3).**

Table 6.2 - Hydrogen fluoride monitoring, 2014

Station	Annual average of 24 hour concentrations (ppb)
Riverlodge	0.1
Kitamaat Village	0.1
Kitimat Smeltersite Road*	0.8

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

Table 6.3 - SO_2 monitoring, 2014

Station	Annual average of 24-hour concentrations (ppb)	Days above the Maximum Desirable Concentration Level (BC Level A)
Riverlodge	0.3	0
Haul Road	1.9	0
Kitamaat Village	0.3	0
Kitimat Smeltersite Road*	3.3	0

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

Fine particulates have a wide variety of sources, both natural and human-caused. In northern BC, 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 ($\mu g/m^3$). The Canada-wide standards established in 2009 defined the 24 hour limit for $PM_{2.5}$ as $25 \mu g/m^3$ and the annual arithmetic mean as $8 \mu g/m^3$.

The Kitimat Smeltersite Road station, which is considered a fence line station, had two exceedances of the $PM_{2.5}$ objective during 2014. Two exceedances of the $PM_{2.5}$ objective and one exceedance of the PM_{10} objective during 2014 were observed at the Riverlodge station. The Whitesail station had two exceedances of the $PM_{2.5}$ objective in 2014. The Kitamaat Village station had three exceedances of the $PM_{2.5}$ objective during 2014. All of those exceedances were associated with a smog event generated by open wood burning north of Kitimat in November, which was not related to BC Operations **(Table 6.4)**.

Table 6.4 - PM_{10} and $PM_{2.5}$ monitoring, 2014

Station	PM_{10}		$PM_{2.5}$	
	Annual average (of 24-hour concentration) $\mu g/m^3$	Days above reference level $50 \mu g/m^3$	Annual average (of 24-hour concentrations) $\mu g/m^3$	Days above Reference Level $25 \mu g/m^3$
Whitesail	-	-	5.0	2
Riverlodge	10.8	1	6.2	2
Haul Road	-	-	6.9	0
Kitamaat Village	-	-	7.7	3
Kitimat Smeltersite Rd*	-	-	9.1	2

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

Polycyclic aromatic hydrocarbons (PAHs)

PAHs are generated by the incomplete combustion of organic material. Various procedures at Kitimat Operations generate PAHs, 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.

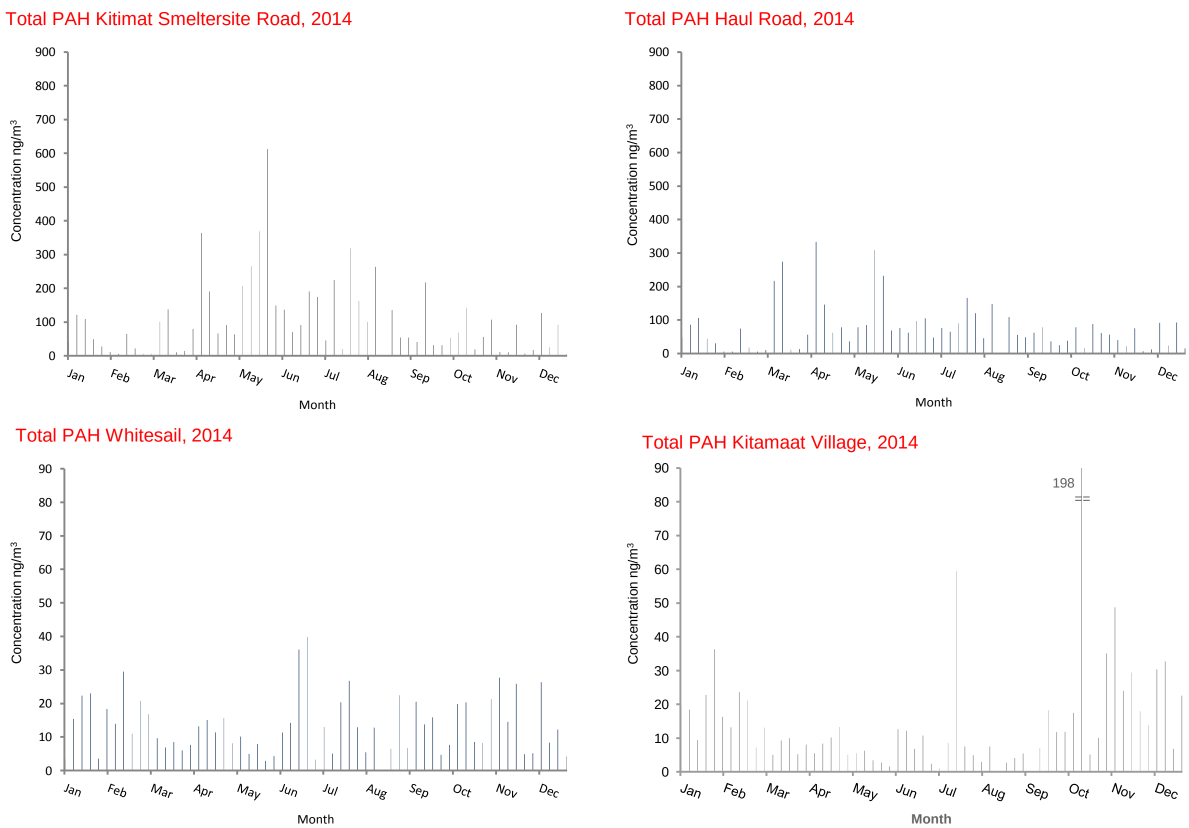


Figure 6.1 - Total PAH, 2014 ambient air stations

Ambient air monitoring is conducted to test for the presence of some of the most common PAHs, 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 2014, total PAH showed a high degree of variability **(Figure 6.1)**. This is typical when compared to previous years. The distribution of PAHs 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 observed at Haul Road station was lower in 2014 (51 ng/m^3) than in 2013 (110 ng/m^3). At the Whitesail station, the PAH concentration was slightly lower in 2014 (11 ng/m^3) compared to 2013 (17 ng/m^3). At the Kitamaat Village station PAH concentrations were lower this year (10 ng/m^3) compared to 2013 (14 ng/m^3). PAH at the Smeltersite Road station was lower in 2014 (60 ng/m^3) than in 2013 (134 ng/m^3) **(Table 6.5)**. This reduction is associated with the progressive idling of the Vertical Söderberg lines and the related reduction of the emission loads in 2014.

Table 6.5 - Geometric mean PHA concentrations, 2013 & 2014

Station	PAH Concentrations (ng/m^3) 2014	PAH Concentrations (ng/m^3) 2013
Haul Road	51	110
Kitimat Smeltersite Rd	60	134
Whitesail	11	17
Kitamaat Village	10	14

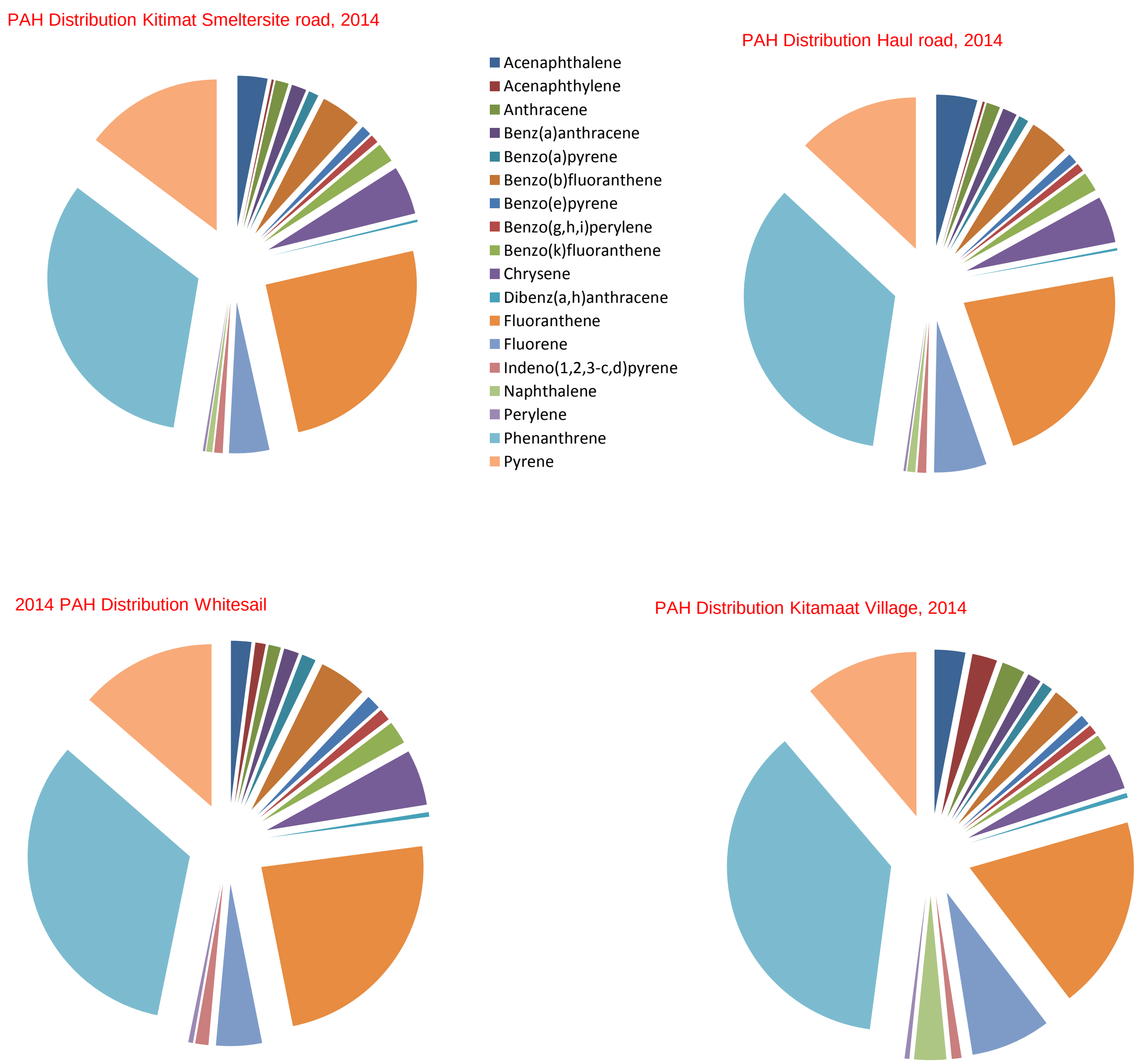


Figure 6.2 - PAH distributions, 2014

Rain chemistry

Precipitation samples are collected on a weekly basis from the Haul Road and Lakelse Lake stations. Rain chemistry monitoring has been conducted since 2000 and was expanded to include Lakelse Lake in 2013. Rainfall quantity is recorded. Samples are assessed 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** and **Table 6.7**. 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 2008- 2014

	Parameter		2008	2009	2010	2011	2012	2013	2014
Precipitation	Precipitation Depth (mm)	average	44.1	30.0	33.2	43.6	18.1	47.8	49.93
		geomean	25.3	11.1	10.6	24.7	13.4	29.5	25.2
Acidity	Rain (pH)	average	4.9	5.4	5.3	5.1	5.1	4.4	4.7
		geomean	4.9	5.3	5.3	5.0	5.1	4.3	4.6
	Acidity (to pH 8.3) $CaCO_3$ (mg/L)	average	7.3	6.0	6.8	5.2	5.5	4.4	3.4
		geomean	6.3	5.0	4.8	3.5	4.0	3.2	2.7
	Acidity - Free (μeq/L)	average	27.9	12.5	12.1	17.6	18.5	24.5	15.3
		geomean	12.2	4.4	4.9	8.5	7.7	16.7	7.6
	Alkalinity - Total $CaCO_3$ (mg/L)	average	1.8	2.2	1.5	0.5	0.6	0.3	0.7
		geomean	1.2	1.7	1.2	0.4	0.4	0.3	0.7
Concentration of specific substances (mg/L)	Chloride (Cl)	average	1.0	1.0	1.1	0.6	1.2	0.3	0.4
		geomean	0.9	0.9	1.0	0.5	0.8	0.2	0.2
	Fluoride (F)	average	2.3	2.4	1.6	1.6	1.7	1.9	0.6
		geomean	2.0	1.7	0.9	1.1	1.3	1.4	0.4
	Sulphate (SO_4)	average	3.8	5.2	3.0	1.4	1.9	1.4	1.2
		geomean	2.9	3.2	1.8	1.0	1.5	1.1	0.7
	Ammonia Nitrogen (N)	average	0.098	0.135	0.122	0.082	0.078	0.049	0.057
		geomean	0.084	0.075	0.074	0.044	0.067	0.039	0.043
	Nitrate Nitrogen (N)	average	0.048	0.066	0.057	0.033	0.054	0.156	0.156
		geomean	0.042	0.049	0.047	0.024	0.044	0.127	0.128
	Total Dissolved Phosphate (P)	average	0.031	0.035	0.006	0.006	0.018	0.007	0.008
		geomean	0.017	0.012	0.005	0.003	0.010	0.006	0.005
	Aluminium (D-Al)	average	0.574	0.621	0.412	0.488	0.458	0.462	0.145
		geomean	0.452	0.372	0.218	0.305	0.338	0.241	0.101
	Calcium (D-Ca)	average	0.668	0.686	0.301	0.147	0.257	0.224	0.078
		geomean	0.463	0.449	0.195	0.099	0.196	0.108	0.056
	Magnesium (D-Mg)	average	0.083	0.079	0.098	0.037	0.054	0.059	0.028
		geomean	0.078	0.074	0.086	0.032	0.043	0.039	0.019
	Potassium (D-K)	average	0.2	0.4	0.320	0.163	0.343	0.155	0.018
		geomean	0.202	0.216	0.185	0.062	0.154	0.058	0.014
	Sodium (D-Na)	average	1.293	2.101	1.172	0.743	1.330	0.536	0.307
		geomean	1.114	1.513	0.752	0.551	1.026	0.364	0.220

Table 6.7 - Rain chemistry monitoring – Lakelse Lake Station 2013- 2014

	Parameter		2013	2014
Precipitation	Precipitation Depth (mm)	average	23.636	31.968
		geomean	11.351	14.181
Acidity	Rain (pH)	average	5.07	5.24
		geomean	5.06	5.22
	Acidity (to pH 8.3) $CaCO_3$ (mg/L)	average	1.02	1.77
		geomean	0.94	1.16
	Acidity - Free (μeq/L)	average	5.31	9.92
		geomean	4.52	3.30
	Alkalinity - Total $CaCO_3$ (mg/L)	average	0.82	0.90
		geomean	0.82	0.82
Concentration of Specific Substances (mg/L)	Chloride (Cl)	average	0.090	0.149
		geomean	0.055	0.104
	Fluoride (F)	average	0.03	0.20
		geomean	0.03	0.03
	Sulphate (SO_4)	average	0.457	0.390
		geomean	0.355	0.218
	Ammonia Nitrogen (N)	average	0.056	0.126
		geomean	0.021	0.019
	Nitrate Nitrogen (N)	average	0.158	0.164
		geomean	0.130	0.129
	Total Dissolved Phosphate (P)	average	0.016	0.078
		geomean	0.004	0.004
	Aluminium (D-Al)	average	0.004	0.026
		geomean	0.004	0.007
	Calcium (D-Ca)	average	0.040	0.043
		geomean	0.029	0.030
	Magnesium (D-Mg)	average	0.013	0.016
		geomean	0.008	0.011
	Potassium (D-K)	average	0.047	0.051
		geomean	0.017	0.011
	Sodium (D-Na)	average	0.052	0.091
		geomean	0.030	0.059

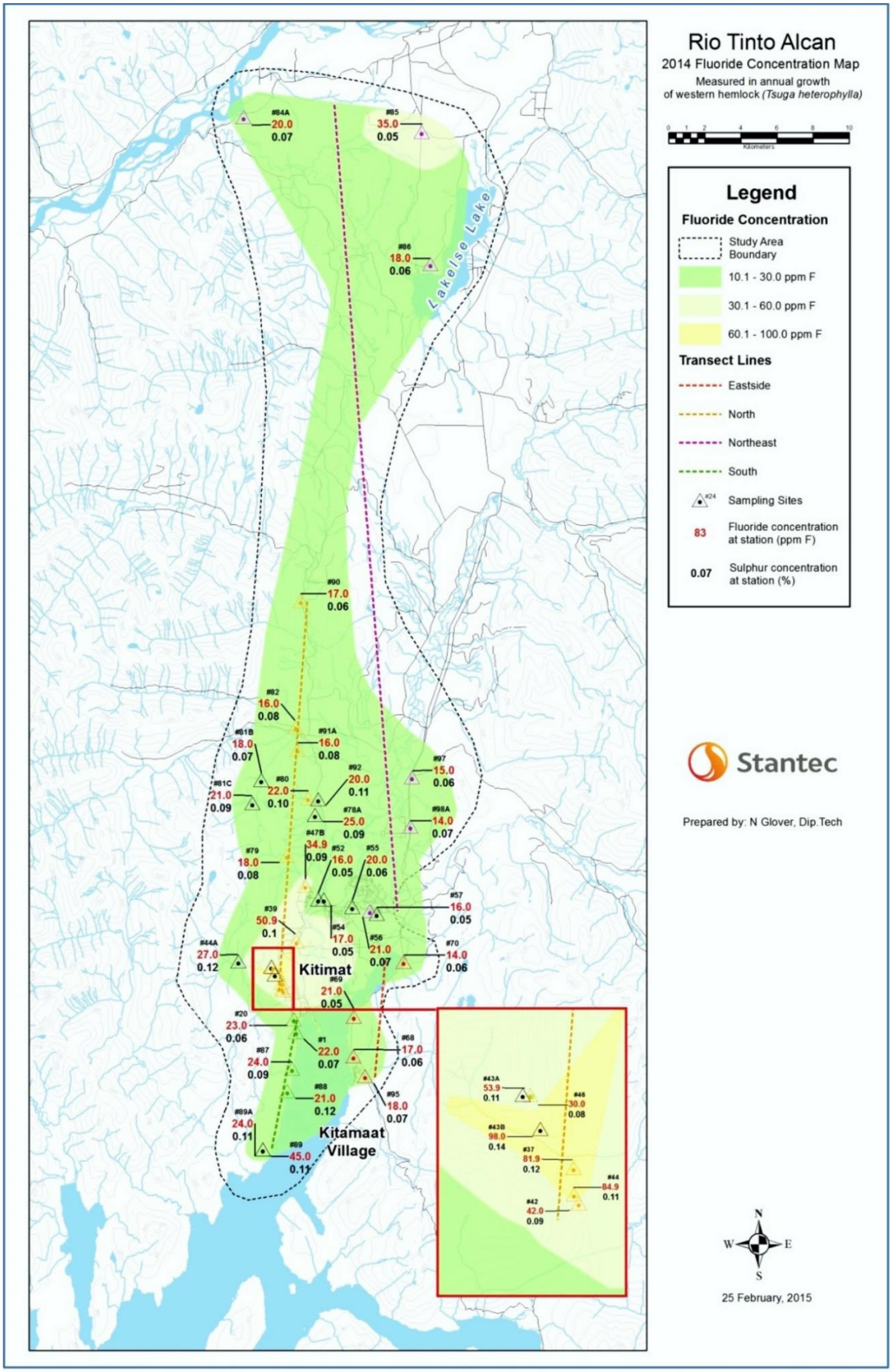


Figure 7.1 - Fluoride and sulphur concentration map, Kitimat-Terrace Area, 2014

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 BC 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 centred 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 allow 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.

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 2014 all 38 samples were collected over four days. They were then refrigerated in their collection bags until processing. Field sampling occurred between 17th to 20th August.

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 2014.

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.

2014 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 2014, fluoride concentration in hemlock samples averaged 29 ppm, which is slightly higher than the 28 ppm observed in 2013 (**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 2014.

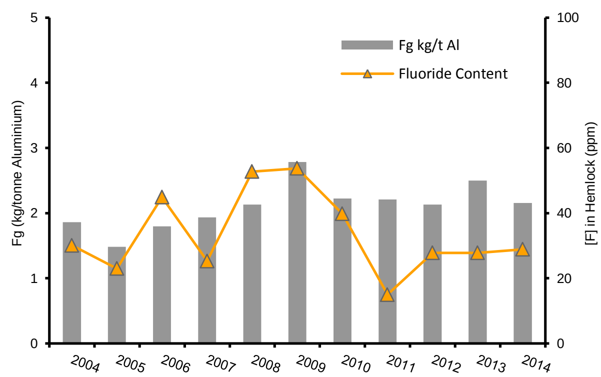


Figure 7.2 - Western hemlock fluoride content and gaseous fluoride emissions, potroom roofs 2004- 2014

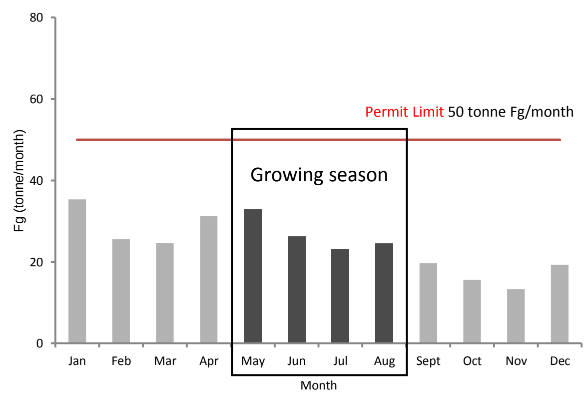


Figure 7.3 - Gaseous fluoride loading, potroom roofs, 2014

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 colour-coded concentration ranges.

2014 results show that higher concentrations of fluoride in hemlock foliage continue to be measured in samples collected from areas located immediately downwind of the smelter site, and generally decrease in concentration with increasing distance from the smelter. In 2014 an outlier with moderate-low fluoride concentration was measured at a site near 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.

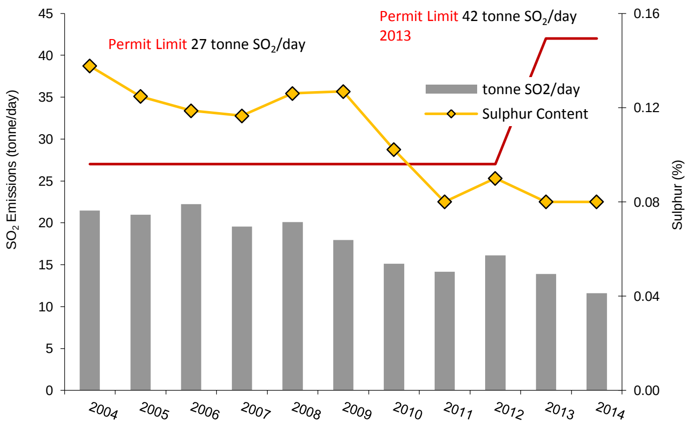


Figure 7.4 - Western hemlock sulphur content and sulphur dioxide emissions, Kitimat operations, 2004-2014

The average sulphur concentration in hemlock for 2014 was 0.08 per cent which was the same as in 2013 (**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 conducted during the 2014 sampling season and reported in 2014. Some of the observations reported are as follows.

- The condition of vegetation in the vicinity of the Kitimat smelter was about the same as that observed in 2012, although minor injury due to Fg was observed at more locations.

No injury to vegetation was observed at sites north of the Service Centre, south of Hospital Beach, on the east side of Minette Bay, in Kitamaat Village, or at the remote sites near Terrace. ❖

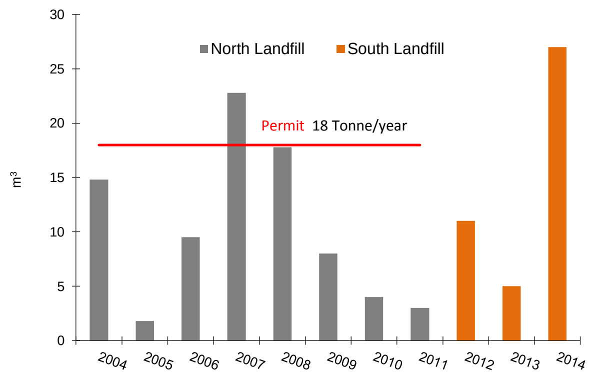


Figure 7.5 - Asbestos and RCF disposal, 2004-2014

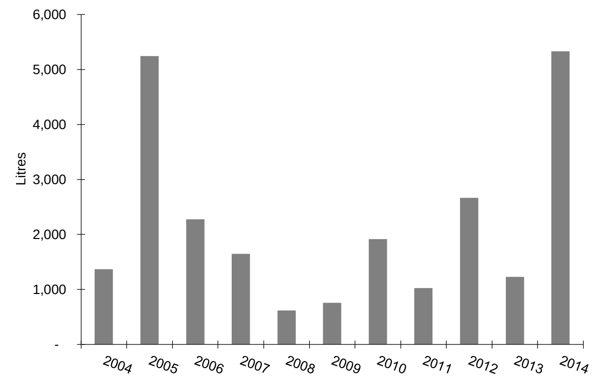


Figure 7.6 - Waste sludge, 2004- 2014

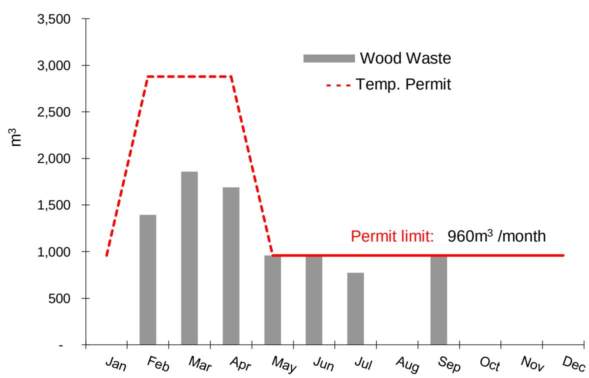


Figure 7.7 – 2014 Wood waste burns

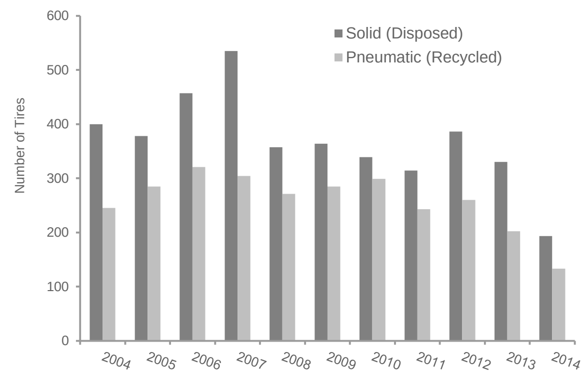


Figure 7.8 – Tires disposed and recycled, 2004-2014

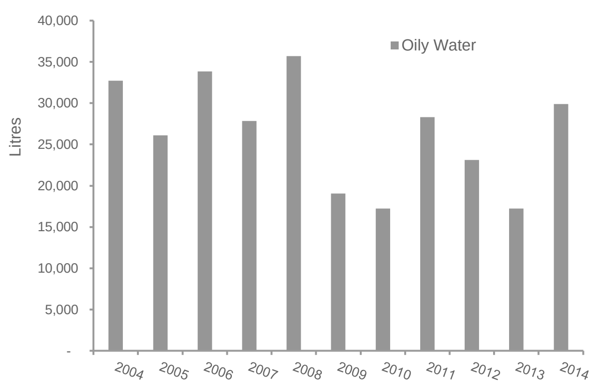


Figure 7.9 - Oily water recovery, 2004-2014

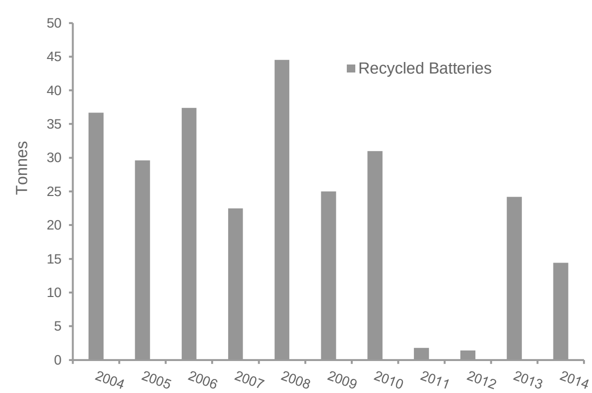


Figure 7.6 - Recycled lead batteries, 2004-2014

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.

2014 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 aluminium industry.

Alternative treatment and disposal options continue to be investigated, while efforts to increase potlining lifespan (and thereby reduce SPL generation) continue. During 2014 a total of 253 tonnes of SPL were shipped off-site for treatment and permanent disposal in a secure landfill compared to the 5,318.7 tonnes in 2013. The reduction is associated to the idling of the VSS technology in preparation of the new plant with anode baked technology.

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 2014, 27m^3 of asbestos and ceramic fibers materials were collected and disposed associated with smelter maintenance and major equipment overhaul activities as part of the modernization activities. The material was disposed of at the South Landfill and no RCF was sent to the North Landfill in 2014 (**Figure 8.1**) (refer to Kitimat Operations map **Figure 2.1** for waste storage, disposal and managed sites).

Waste sludge

Grease sludge is collected and sent off-site for environmentally safe disposal. Grease sludge is generated from the use of grease in various mechanical applications. Volumes of grease sludge fluctuate depending on the levels of particular activities at the smelter site in any given year. In 2014, the grease sludge volume was 5,330 litres (**Figure 8.2**).

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. Seven burns were conducted in 2014. Given the poor venting conditions during the 2014 winter; a temporary allowance was requested to carry additional burns during the February to April period during good venting index conditions. Burns were suspended during summer due to provincial fire bans and later poor venting conditions observed during fall. There were no non-compliances reported in 2014. A total of 8,576m^3 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 326 tires (193 solid and 133 pneumatic) were disposed of or sent for recycling in 2014 (**Figure 8.4**).

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 29,890 litres sent for recovery in 2014 (**Figure 8.5**).

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 14.4 tonne of lead batteries were sent for recycling in 2014 (**Figure 8.6**).

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 2014 for KMP related wastes and operations were 6,128 m^3. ❖

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 2014, 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.

2014 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 460,000m^3 of SPL were 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.

Groundwater monitoring has been carried out in accordance with the requirements of the multi-media permit and the SPL management plan. The existing program consists of a quarterly monitoring program where selected wells are visited to monitor water level trends. In addition to monitoring water levels a geochemical sampling campaign that occurs in the fall of each year also occurs as part of the annual program. The information collected is used to assess groundwater quality for any significant changes in chemistry that may exceed previous year's results.

Dredgeate cells and SPL overburden cell

The wharf dredgeate cells consist of two lined cells located north of Anderson Creek. They contain approximately 2,000m^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 PAHs 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 2014. The samples were analyzed for dissolved fluoride and dissolved aluminium. The 2014 contaminant monitoring results are consistent with historical trends and are within the expected seasonal variation (**Figure 9.1**).

The SPL overburden cell is located west of the wharf dredgeate cells. The SPL material is composed of approximately 10,500m^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.

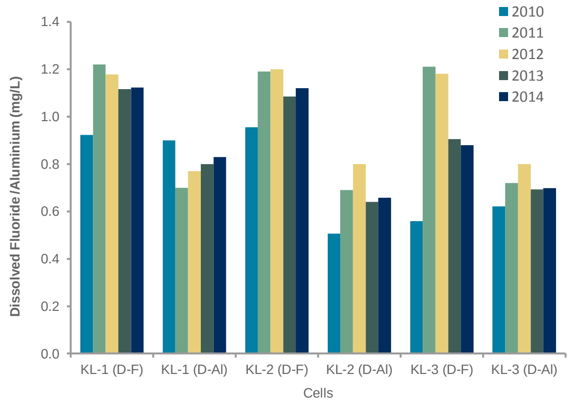


Figure 9.1 - Dissolved fluoride & aluminium, wharf dredgeate monitoring cells

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 2014 approximately 26.5m^3 were pumped out 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 town site 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.

2014 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 Biological Oxygen Demand (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. In 2014 all effluent discharge permit measurements were in compliance. BOD was non-detectable for the last three quarters in 2014 (**Figure 10.1**).

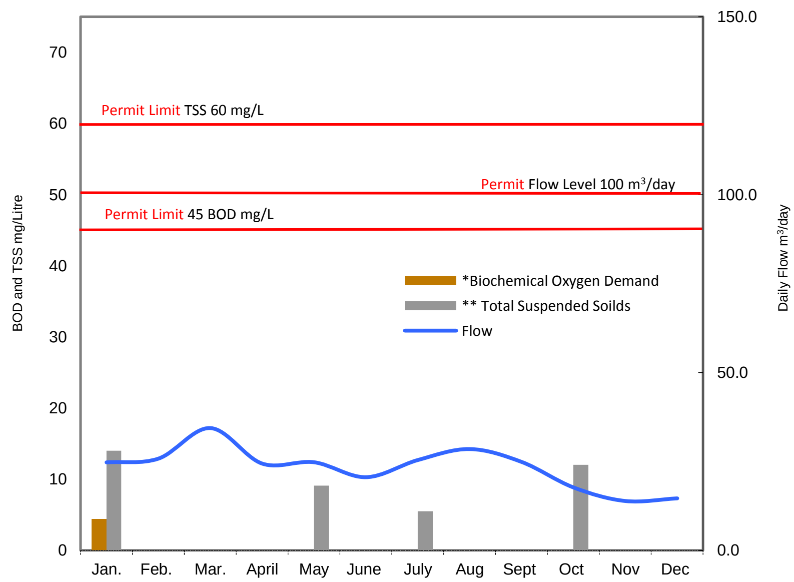


Figure 10.1- Effluent discharge Kemano 2014

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 2014 permit requirements were in compliance.

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 300m^3. In 2014 11.20m^3 of refuse was 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 900m^3 of treated sludge per year. In 2014, 265.4m^3 of sludge was disposed which is a large decrease from the 757.0m^3 in 2013. This decrease can be explained by the decrease in population through 2014.

Seekwyakin camp effluent discharge

Seekwyakin construction camp, located three kilometres north of Kemano, was historically used by West Fraser Timber Co. Ltd. and BC Operations. Effluent sewage discharges from the camp require a permit when the camp has more than 25 residents. In 2014, Seekwyakin camp saw very little activity and usage remained well below 25 residents. ❖

Summary of non-compliance and spills

Chapter 11

2014 performance

Non-compliance summary

In 2014, there were a total of twelve non-compliances for Kitimat and zero non-compliance for Kemano. These non-compliances are summarized with a brief description of their causes and the corrective actions that are either being assessed or implemented at the time this report was prepared (**Table 11.1**).

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 2014, three 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 2014. ❖

Table 11.1 - Summary of non-compliances, 2014

# of N/C	Non-Compliance	Occurrence date	Impact	Permit Requirement	Cause	Implemented Corrective Actions
Kitimat						
1	Roof particulate emissions	January	7.6 kg/Ton Al	7.5 kg/Ton Al Particulate emissions	Process upsets	Short term: Detailed investigation - *completed* Interim: ECP (Escalation Control Plan) focus on: - Best operational practices - Metal management - Left over studs management Long term: Modernized smelter start up - *under construction*
2	Total suspended solids found to be above the permit limit during F-Lagoon overflow events	14 January 21 October 9 December	Jan; 204 mg/L Oct: 90 mg/L Dec: 105 mg/L	75 mg/L	Sediments and silt coming from the KMP construction site through the storm water system	Short term: Detailed investigation - *completed* Interim: Maintain erosion and sediment controls at the KMP construction site - *ongoing* Long term: Final grading and landscaping of construction site
3	Pitch fume release	11 May	10 minutes bypass	No unauthorized bypass requested	Change in the control logic of the equipment	Short term: Bring the incinerator online - *completed* Long term: Review set up of the tanks and incinerator with the start-up of the new equipment in 2015 Communication to employees on new equipment programing - *completed*
4	Missed sample after a conductivity drop at B-Lagoon	24 May	Control logic deprogramed – no data reading available	Hardness sample required after conductivity drop	Monitoring equipment failed to track the conductivity drop	Short term: Detailed investigation -*completed* Corrective action: Coaching session on sampling procedure with employees - *completed*
5	Hazardous Waste temporarily stored at the South Landfill	28 May	Mislabelled waste temporally stored at the South Landfill	Hazardous waste unauthorized at the South Landfill	Waste material was not clearly identified	Short term: Temporary closure of the southwest corner of the landfill. Sampling of material - *completed* Corrective actions: Removed unauthorized material from the landfill. Communication of the landfill requirements to KMP contractors – *completed*
6	Roof particulate emissions	May	8.2 kg/Ton Al	7.5 kg/Ton Al Particulate emissions	Abnormally high result for only one cassette that brought the plant wide average up	Short term: Detailed investigation –*completed* The detailed investigation highlighted the result from only one cassette bringing the plant average up. High result from that cassette not associated to any process or operational causes. Interim: ECP (Escalation Control Plan) focus on: - Best operational practices - Metal management - Left over studs management Long term: Modernized smelter start up - *under construction*
7	Roof particulate emissions	Q3 July August September	Q3 Average: 8.4 kg/Ton Al - Jul: 7.6 - Aug: 7.8 - Sep: 9.9	7.5 kg/Ton Al Particulate emissions	Idling of Lines 1 and 5 impacted the potroom air flow inducing oversampling situation *(particulate emissions oversampled)*	Short term: Detailed investigation - *completed* Interim: ECP (Escalation Control Plan) focus on: - Best operational practices - Metal management - Left over studs management Long term: Modernized smelter start up - *under construction*
8	Roof particulate emissions	Q4 October November December	Q3 Average: 9.5 kg/Ton Al - Oct: 7.1 - Nov: 9.5 - Dec: 11.9	7.5 kg/Ton Al Particulate emissions	Idling of Lines 1 and 5 impacted the potroom air flow inducing oversampling situation *(particulate emissions oversampled)*	Short term: Detailed investigation - *completed* Interim: ECP (Escalation Control Plan) focus on: - Best operational practices - Metal management - Left over studs management Long term: Modernized smelter start up - *under construction*
9	Failure to collect the PAH Ambient Air sample	21 August	No sample collected due to shortage of canister	Weekly sample	Lack of sampling equipment due to long turnaround time at laboratory	Short term: Detailed investigation - *completed* Corrective action: New procedure establish with laboratory to avoid sampling equipment shortage -*completed*

# of N/C	Non-Compliance	Occurrence date	Impact	Permit Requirement	Cause	Implemented Corrective Actions
10	Failure to collect the PAH Ambient Air sample	14 September	No sample collected	Weekly sample	Equipment failure due to a GFCI tripped	Short term: Sampling equipment inspected and restarted - *completed* Corrective action: Equipment and waterproofed and regularly checked - *completed*
11	Failure to collect the during F-Lagoon overflow	19 October	No grab sample collected	Grab sample at F-Lagoon during overflow event	Misunderstanding of procedures	Short term: Detailed investigation - *completed* Corrective action: Coaching session on sampling procedure with all Plant Protection teams - *completed*
12	Failure to collect stack sample at the pitch tank incinerator	Q4 2014	No sample collected	Stack sampling	Sample not collected due to a planning problem and a reduced amount of pitch boats in 2014	Short term: Investigation with contractor - *completed* Corrective action: Improvement of sampling schedule and improved communication with contractor about number of pitch boats planned for the year - *planned*

Table 11.2 - Summary of reportable spills, 2014

Occurrence	Substance	Amount	Environmental Media	Causes	Corrective Actions
27 January	Sewage	1,000L	Gravel	Faulty sensor	Area cleaned and contaminated gravel removed.
2 May	Sewage	10L	Gravel	Faulty overflow alarm	Area cleaned and contaminated gravel removed.
19 June	Sewage	9,000L	Gravel, soil	Excavator struck an underground sewage line.	Area cleaned and contaminated soil and gravel removed.

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 aluminium.

Anode effects

A chemical reaction that occurs when the level of alumina in a pot falls below a critical level, resulting in reduced aluminium production and the generation of perfluorocarbons (PFCs) – 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 equivalency (CO_2^e)

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 aluminium.

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 50mL 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 aluminium oxide to form aluminium 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 BC 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 (PAHs)

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 pot lining (SPL)

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.

Report compiled by:
Environmental Services department

Front cover photograph:
Al Colton

Electronic version available at:
www.riotintoalcaninbc.com

To receive additional
information about the contents
of this report please contact:

Rio Tinto Alcan

Rio Tinto Alcan Primary Metal
BC Operations
1 Smeltersite Road
Kitimat, B.C. V8C 2H2
www.riotintoalcaninbc.com

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