Toxics Reduction Plan

Sulphuric Acid

Prepared by:

Brimac Anodising
542 Kipling Avenue
Toronto, ON
M8Z5E3

November 2012

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Statement of Intent

Brimac anodizing is committed to continuing to reduce the environmental impact of its manufacturing operations. Management will continue to explore options to reduce the usage of toxic substances while providing innovative solutions to our customers.

Brimac Anodizing has prepared this toxic substance reduction plan for sulphuric acid to investigate options to reduce the usage of sulphuric acid while supplying customers with products that meet their needs.

General Information

Toxic Substance	Sulphuric Acid
CAS#	7644-93-9
Number of full-time equivalent employees	30
NAICS	332810 Coating, engraving & heat treating activities
NPRI ID	632
UTM NAD83 coordinates (entrance)	619117, 4830040

Canadian Parent Company

Legal name	Brimac Anodizing Limited
Street address	542 Kipling Avenue Toronto, ON M8Z5E3
% owned by parent	100%
CCRA business number	100648740

Contact info

Owner and operator of facility	Brimac Anodizing Limited 542 Kipling Avenue Toronto, ON M8Z5E3
Highest ranking employee	Colin Brighton President (416) 255-4411 brimac@brimacanodizing.com

Person who coordinated preparation of plan	Colin Brighton President (416) 255-4411 brimac@brimacanodizing.com
Person who prepared plan	Wendy Nadan Nadan Consulting Ltd 151 Montgomery Blvd Orangeville ON L9W 5C1 519 940 4724 wendy@nadanconsulting.com
Public contact	Colin Brighton President (416) 255-4411 brimac@brimacanodizing.com
Technical contact	Wendy Nadan Nadan Consulting Ltd 151 Montgomery Blvd Orangeville ON L9W 5C1 519 940 4724 wendy@nadanconsulting.com

Planner

License number of planner	Wendy Nadan Nadan Consulting Ltd 151 Montgomery Blvd Orangeville ON L9W 5C1 519 940 4724 wendy@nadanconsulting.com TRSP 0092

1.0 Identification of Stages and Processes

Brimac Anodizing receives parts from customers, anodizes them and then returns them to the customer for further processing. Waste from the various baths is treated in a wastewater system before discharge to the sanitary sewer. See Figure 1 for a process flow diagram of the facility and Figure 2 for a flow diagram of the anodizing process.

Aluminum alloys are anodized to increase corrosion resistance, to increase surface hardness, and to allow dyeing (coloring), improved lubrication, or improved adhesion and to enhance the appearance. The anodic layer is non-conductive.

When exposed to air at room temperature, or any other gas containing oxygen, pure aluminum self-passivates by forming a surface layer of amorphous aluminum oxide 2 to 3 nm thick, which provides very effective protection against corrosion. Aluminum alloys typically form a thicker oxide layer, 5-15 nm thick, but tend to be more susceptible to corrosion. Aluminum alloy parts are anodized to greatly increase the thickness of this layer for corrosion resistance and provide a decorative finish.

Although anodizing produces a very regular and uniform coating, microscopic fissures in the coating can lead to corrosion. Further, the coating is susceptible to chemical dissolution in the presence of high and low pH chemistry, which results in stripping the coating and corrosion of the substrate. To combat this, various techniques have been developed either to reduce the number of fissures or to insert more chemically stable compounds into the oxide, or both.

Anodized coatings have a much lower thermal conductivity and coefficient of linear expansion than aluminum. As a result, the coating will crack from thermal stress if exposed to temperatures above 80 °C. The coating can crack, but it will not peel. The melting point of aluminum oxide is 2050 C, much higher than pure aluminum's 658 C. (This and the non-conductivity of aluminum oxide can make welding more difficult.) In typical commercial aluminum anodization processes, the aluminum oxide is grown down into the surface and out from the surface by equal amounts. So anodizing will increase the part dimensions on each surface by half the oxide thickness. For example a coating that is (2 µm) thick, will increase the part dimensions by (1 µm) per surface. If the part is anodized on all sides, then all linear dimensions will increase by the oxide thickness. Anodized aluminum surfaces are harder than aluminum but have low to moderate wear resistance, although this can be improved with thickness and sealing.

Preceding the anodization process, wrought alloys are cleaned in either a hot soak cleaner and in a hot acid cleaner and may be etched in sodium hydroxide (normally with added sodium gluconate) or brightened in a mix of acids.

The anodized aluminum layer is grown by passing a direct current through an electrolytic solution, with the aluminum object serving as the anode (the positive electrode). The current releases hydrogen at the cathode (the negative electrode) and oxygen at the surface of the aluminum anode, converting the aluminum surface to aluminum oxide.

Aluminum anodizing is usually performed in an acid solution which slowly dissolves the aluminum. The acid action is balanced with the oxidation rate to form a coating with nanopores, 10-150 nm in diameter. These pores are what allow the electrolyte solution and current to reach the aluminum substrate and continue growing the coating to greater thickness beyond what is produced by autopassivation. However, these same pores will later permit air or water to reach the substrate and initiate corrosion if not sealed. They are often filled with colored dyes and or tin sulphate /or corrosion inhibitors before sealing. Because the dye is only superficial, the underlying oxide may continue to provide corrosion protection even if minor wear and scratches may break through the dyed layer.

Sulphuric acid is received in bulk and pumped into a storage tank. It is pumped directly from the storage tank to the anodizing tanks.

Sulphuric acid is used in the anodizing tanks, the sobrite tank and the two step tin sulphate colouring tank. Aluminum parts are immersed in the tanks, anodized and then proceed to the next tank. Some of the sulphuric acid is lost during dragout and is transferred to the rinse tanks. The sulphuric acid in the anodizing tanks is recycled on site through an acid regeneration unit and returned to the tank for reuse. Rinse water is sent to the wastewater treatment system for treatment before being discharged to drain.

During anodizing, a current is applied to the tank. As the anodizing process is not 100 percent efficient, oxygen and hydrogen are also generated at the electrodes. The gas bubbles rise to the surface, burst and project a mist into the air. The mist is captured and routed to a wet scrubber. The water from the scrubber is discharged to the wastewater treatment system.

Sulphuric acid is also found in the acid mixture used in the sobrite bath. This is a passive dip process. The tank is never emptied. The rinse tank has a constant overflow that is collected in a storage tank and sent back to the supplier for recycling and reuse. As the tank is maintained close to boiling, there is significant loss from evaporation. The vapour is captured and routed through a wet scrubber on the roof. The water from the scrubber is sent to the wastewater treatment process. The two step colouring tank containing 18 % sulphuric acid is also never emptied and all dragout from the tank is treated in the waste water treatment process

Samples from the anodizing tank, brightening tank (sobrite tank) and two step colouring tank are analyzed daily to ensure that the acid and aluminum content remains within specification. The tank is adjusted to maintain optimum anodizing and brightening quality.

All the sulphuric acid used is dragged out into the rinse tank and subsequently destroyed during wastewater treatment, emitted to air or shipped offsite for recycling.

Sulphuric acid is used in the anodizing of aluminum in three process baths: anodizing tank, two-step tin colouring bath and a sobrite brightening bath. An acid is essential in the chemical process of anodizing and sulphuric acid provides the required properties of the oxide layer. Sulpuric acid is necessary in the two-step tin colouring bath to keep the tin sulphate in solution. Sulphuric acid is necessary in the brightening bath to remove the residual surface layer.

2.0 Material Accounting

See Figure 3 for the anodizing process flow chart.

The quantity of sulphuric acid input into the process is calculated from annual purchases and the composition of materials provided by suppliers. This is the best available method for quantifying inputs and the data quality is considered high.

The quantity of sulpuric acid contained in sobrite solution transferred offsite for recycling is calculated based on ten percent concentration and a measured weight. The percentage of sulphuric acid present is assumed based on the known concentration of the tank and is measured. The concentration is maintained by virgin phosphoric sobrite being added to the tank and very rarely is sulphuric acid from the bulk tank added to the brightening process tank. There will be some loss to air by evaporation however it has been assumed that this is negligible.

Emissions to air during anodizing have been assumed at one per cent of total use. There is no published emission factor for emissions from sulphuric acid anodizing however the US EPA emission factor for chromic acid anodizing may be adapted. This method was not used for the purposes of calculating air emissions but may provide a more accurate estimation of air emissions.

3.0 Cost of Using Sulphuric Acid

Raw material cost	$5,386.52
Wastewater treatment	$36,669.88
Anodizer hydro cost	$123,200
Cost to chill anodizer tanks	$3,180
Cost to heat phosbrite tank	$61,162.80
Labour	$324,062.90
Total	**$553.662.10**

4.0 Identification of Options to Reduce the Use of Sulphuric Acid

The following options were identified to reduce the usage of sulphuric acid:

Category	Description
Material substitution	Option 1: Use an alternate material in the anodizing bath. Anodizing can be carried out using organic acids, phosphoric acid or borate/tartrate baths. Different acids can be used in the anodizing bath however each acid confers different properties on the product. US military specifications define three types of aluminum anodizing. Type I uses chromic acid which is another toxic substance. Type II is sulphuric acid anodizing and Type III is sulphuric acid hardcoat anodization. Sulfuric acid is the most widely used solution to produce anodized coating. Coatings of moderate thickness 1.8 µm to 25 µm (0.00007" to 0.001") are known as Type II in North America, as named by MIL-A-8625, while coatings

	thicker than 25 µm (0.001") are known as Type III, hardcoat, hard anodizing, or engineered anodizing. Very thin coatings similar to those produced by chromic anodizing are known as Type I. Thick coatings require more process control, and are produced in a refrigerated tank near the freezing point of water with higher voltages than the thinner coatings. Hard anodizing can be made between 13 and 150 µm (0.0005" to 0.006") thick. Anodizing thickness increases wear resistance, corrosion resistance, ability to retain lubricants and PTFE coatings, and electrical and thermal insulation. Anodizing can produce yellowish integral colors without dyes if it is carried out in weak acids with high voltages, high current densities, and strong refrigeration. Shades of color are restricted to a range which includes pale yellow, gold, deep bronze, brown, grey, and black. Some advanced variations can produce a white coating with 80% reflectivity. The shade of color produced is sensitive to variations in the metallurgy of the underlying alloy and cannot be reproduced consistently. Anodization in some organic acids, for example malic acid, can enter a 'runaway' situation, in which the current drives the acid to attack the aluminum far more aggressively than normal, resulting in huge pits and scarring. Also, if the current or voltage is driven too high, 'burning' can set in; in this case the supplies act as if nearly shorted and large, uneven and amorphous black regions develop. Integral color anodizing is generally done with organic acids, but the same effect has been produced in laboratory with very dilute sulfuric acid. Integral color anodizing was originally performed with oxalic acid, but sulfonated aromatic compounds containing oxygen, particularly sulfosalicylic acid, have been more common since the 1960s. Thicknesses up to 50µm can be achieved. Organic acid anodizing is called Type IC. This option would result in a reduction in use of 12,460kg or 59%, reduce air emissions by 21kg or 100% and offsite transfers by 1,937kg or 100% a year. Option 2: substitute sulphuric acid in the tin sulphate bath. Sulphuric acid is used in this dip bath at a concentration of one to two percent. Substitute a different acid in this bath. This option will result in a reduction in use of 4kg of sulphuric acid or less than 1%.
Product Design	Brimac Anodizing does not own the design of the product. Material for

	anodizing is supplied by the customer and returned to the customer. Hence an option is not available in this category.
Process modification	See material substitution above.
Spill and leak prevention	Sulphuric acid for anodizing is received in bulk and pumped directly into the process tanks. The two step tin sulphate containing 1 to 2 percent sulphuric acid is received in 205 liter drums. All the tanks have secondary containment however there have been no significant spills in the past several years. It is not expected that there can be any significant reductions in usage by reducing spills and leaks.
Reuse or recycling	As wastewater is discharged to the sanitary sewer at a pH greater than 7, all of the sulphuric acid that is used is destroyed. Hence it cannot be reused or recycled. Sulphuric acid in the anodizing baths is currently recycled on site using an acid regeneration unit. The introduction of this unit several years ago reduced acid usage by over 90%. Option 3: Rinse water from the phosbrite tank is collected and recycled offsite. It can be recycled onsite using a similar process to that for the sulphuric acid. This option would result in a reduction in offsite transfers of 1.937kg a year or 100%.
Inventory management	Sulphuric acid is received in bulk. It is transported by tanker truck and hence is ordered in a fixed quantity. There are no losses during storage and hence it is not expected that there can be any reduction in use by ordering a different quantity or receiving in different containers.
Training	Option 4: Operators move the racks manually between baths. Dragout increases if the racks are moved quickly from a sulphuric acid containing bath into the first rinse tank. Allowing the rack to drip back into the tank for one extra minute will reduce the amount of sulphuric acid lost to the wastewater treatment system. Rinse water from the sobrite tank is recycled offsite so this option will not result in any reduction in use from the sobrite tank. Reduction in use is estimated at 1% or 1,246kg with the same reduction in the quantity destroyed.

5.0 Assessment of Technical Feasibility

Each of the options identified above were screened for technical feasibility using the following criteria:

- Availability and reliability of technology
- Impacts on quality, reliability, functionality
- Impact on production rate
- Compatibility with customer requirements
- Availability of employee training
- Compatibility with existing processes
- Space within facility
- Time required for change

Option	Assessment of Feasibility	Feasible
Option 1: Use a different acid in the anodizing bath	Chromic acid or type I anodizing uses a different toxic substance so will not result in any reduction in usage of toxic substances. Organic acids do not produce the same specifications on the surface and have an adverse effect on the quality of the product. Some acids produce a different colour than desired. Properties of the finished product are specified by the customer and cannot be changed by Brimac without customer approval. Changes in appearance will not be accepted by the customer.	No No
Option 2: Replace the sulphuric acid in the tin sulphate bath	The tin sulphate bath is a dip process after anodizing. The tin sulphate fills in the pores in the aluminum oxide layer and adds colour to the surface. The bath requires the sulphuric acid to keep the sulphate in solution. No other acid can be substituted to maintain the tin sulphate in solution.	No
Option 3: Recycle phosbrite rinse water onsite.	An acid regeneration unit similar to that used for sulphuric acid can not be used to recycle sobrite rinse water on site as the sulphuric acid content will not allow the regeneration equipment to work.	No
Option 4: train operators to slow tank transfer	This option will slow the production rate significantly and cause an unacceptable drop in productivity.	No

6.0 Economic Feasibility

There are no technically feasible options.

7.0 Implementation of Options

Due to customer requirements, there are no technically feasible options available to reduce the use of sulphuric acid.

8.0 Planner Recommendations

As the planner has worked with the facility throughout the development of the plan, information provided by the facility has been clarified and revised based on the options identified. Hence there are no recommendations to improve the plan.

9.0 Certification

As of December 12, 2012, I, Colin Brighton, certify that I have read the toxic substance reduction plan for sulphuric acid and am familiar with its contents, and to my knowledge the plan is factually accurate and complies with the Toxics Reduction Act, 2009 and Ontario Regulation 455/09 (General) made under that Act.

Colin Brighton *December 6 2012*

Colin Brighton, President Date

As of December 3, 2012, I, Wendy Nadan certify that I am familiar with the processes at Brimac Anodizing that use sulphuric acid, that I agree with the estimates referred to in subparagraphs 7 iii, iv and v of subsection 4 (1) of the Toxics Reduction Act, 2009 that are set out in the plan dated November 30, 2012 and that the plan complies with that Act and Ontario Regulation 455/09 (General) made under that Act.

December 6, 2012

Wendy Nadan, Toxic Substance Reduction Planner Date

Plan Summary Preview

Company Details

Company Legal Name:

Brimac Anodizing Ltd.

Company Address:

542 Kipling Avenue, Toronto (Ontario)

Report Details

Facility:

BRIMAC ANODIZING (1985) LIMITED

Facility Address:

542 Kipling Avenue, Toronto (Ontario)

Update Comments:

Activities

Select the Facility Contacts

Contacts

Public Contact:*

Colin Brighton

Highest Ranking Employee:

Colin Brighton

Person responsible for Toxic Substance Reduction Plan preparation:

Colin Brighton

Organization Validation

Company and Parent Company Information

Company Details

Company Legal Name:*	Brimac Anodizing Ltd.
Company Trade Name:*	Brimac Anodizing Ltd.

Business Number:*	100648740

Mailing Address

Delivery Mode:	General Delivery
PO Box or Rural Route Number:	
Address Line 1:	542 Kipling Avenue
City:	Toronto
Province/Territory:	Ontario
Postal Code:	M8Z5E3

Physical Address

Address Line 1:	542 Kipling Avenue
City:	Toronto
Province/Territory:	Ontario
Postal Code:	M8Z5E3
Additional Information:	
Land Survey Description:	
National Topographical Description:	

Parent Companies

Facility Validation

Facility Information

Facility:*	BRIMAC ANODIZING (1985) LIMITED
NAICS Id:*	332810
NPRI Id:*	0000000632
ON Reg 127/01 Id:	

Mailing Address

Delivery Mode:	General Delivery

PO Box or Rural Route Number:	
Address Line 1:	542 Kipling Avenue
City:	Toronto
Province/Territory:	Ontario
Postal Code:	M8Z5E3

Physical Address

Address Line 1:	542 Kipling Avenue
City:	Toronto
Province/Territory:	Ontario
Postal Code:	M8Z5E3
UTM Zone:	17
UTM Easting:	619117
UTM Northing:	4830040
Latitude:	43.61280
Longitude:	-79.52360
Additional Information:	
Land Survey Description:	
National Topographical Description:	

Contact Validation

Contacts

Public Contact:

First Name:*	Colin
Last Name:*	Brighton
Position:*	president

Telephone:*	4162554411
Ext:	
Fax:	
Email:*	brimac@brimacanodizing.com

Mailing Address

Delivery Mode:	General Delivery
PO Box or Rural Route Number:	
Address Line 1:	542 Kipling Avenue
City:	Toronto
Province/Territory:	Ontario
Postal Code:	M8Z5E3

Highest Ranking Employee:

First Name:*	Colin
Last Name:*	Brighton
Position:*	President
Telephone:*	4162554411
Ext:	
Fax:	
Email:*	brimac@brimacanodizing.com

Mailing Address

Delivery Mode:	General Delivery
PO Box or Rural Route Number:	
Address Line 1:	542 Kipling Avenue
City:	Toronto

Province/Territory:	Ontario
Postal Code:	M8Z5E3

Person responsible for the Toxic Substance Reduction Plan preparation:

First Name:*	Colin
Last Name:*	Brighton
Position:*	President
Telephone:*	4162554411
Ext:	
Fax:	
Email:*	brimac@brimacanodizing.com

Mailing Address

Delivery Mode:	General Delivery
PO Box or Rural Route Number:	
Address Line 1:	542 Kipling Avenue
City:	Toronto
Province/Territory:	Ontario
Postal Code:	M8Z5E3

Employees

Employees

Number of Full-time Employees:*

30

Substances

7664-93-9, Sulphuric acid

7664-93-9, Sulphuric acid

Substances Section Data

Statement of Intent

Use

Is there a statement that the owner or operator of the facility intends to reduce the use of the toxic substance at the facility?:*

No

If 'yes', exact statement of the intent that is included in the facility's TRA Plan to reduce the use of the toxic substance at the facility:**

If 'no', reason in the facility's TRA Plan for no intent to reduce the use of the toxic substance at the facility:**

No technically feasible options were identified in the plan.

Creation

Is there a statement that the owner or operator of the facility intends to reduce the creation of the toxic substance at the facility?:*

No

If 'yes', exact statement of the intent that is included in the facility's TRA Plan to reduce the creation of the toxic substance at the facility:**

If 'no', reason in the facility's TRA Plan for no intent to reduce the creation of the toxic substance at the facility:**

Sulphuric acid is not created in the facility

Objectives, Targets and Description

Objectives

Objectives in plan:*

none

Use Targets

What is the targeted reduction in use of the toxic substance at the facility?*

			Quantity	Unit
☒	No quantity target	or		

What is the targeted timeframe for this reduction?*

☒	No timeline target	or		years

Description of targets:

Creation Targets

What is the targeted reduction in creation of the toxic substance at the facility?*

			Quantity	Unit
☒	No quantity target	or		

What is the targeted timeframe for this reduction?*

☒	No timeline target	or		years

Description of targets:

Reasons for Use

Why is the toxic substance used at the facility?:*

As a manufacturing aid

Summarize why the toxic substance is used at the facility:**

Sulphuric acid is used in the anodizing of aluminum in three process baths: anodizing tank, two-step tin colouring bath and a sobrite brightening bath. An acid is essential in the chemical process of anodizing and sulphuric acid provides the required properties of the oxide layer. Sulpuric acid is necessary in the two-step tin colouring bath to keep the tin sulphate in solution. Sulphuric acid is necessary in the brightening bath to remove the residual surface layer.

Reasons for Creation

Why is the toxic substance created at the facility?:*

This substance is not created at the facility

Summarize why the toxic substance is created at the facility:**

Toxic Reduction Options for Implementation

Description of the toxic reduction option(s) to be implemented:

Is there a statement that no option will be implemented?:*

Yes

If you answered “No” to this question, please add the option(s) under the appropriate Toxic Substance Reduction Categories (e.g. Materials or feedstock substitution, Product design or reformulation, etc.). If you answered “Yes” please provide an explanation below why your facility

is not implementing an option.
Explanation of the reasons why no option will be implemented:**

No technically feasible options were identified in the plan.

Materials or feedstock substitution

Product design or reformulation

Equipment or process modifications

Spill or leak prevention

On-site reuse, recycling or recovery

Improved inventory management or purchasing techniques

Good operator practice or training

Rationale for why the listed options were chosen for implementation:

General description of any actions undertaken by the owner and operator of the facility to reduce the use and creation of the toxic substance at the facility that are outside of the plan:

License Number of the toxic substance reduction planner who made recommendations in the toxic substance reduction plan for this substance (format TSRPXXXX):*

TSRP0092

License Number of the toxic substance reduction planner who has certified the toxic substance reduction plan for this substance (format TSRPXXXX):*

TSRP0092

What version of the plan is this summary based on?:*

New Plan

Figure 1: Overall Process Flow Diagram

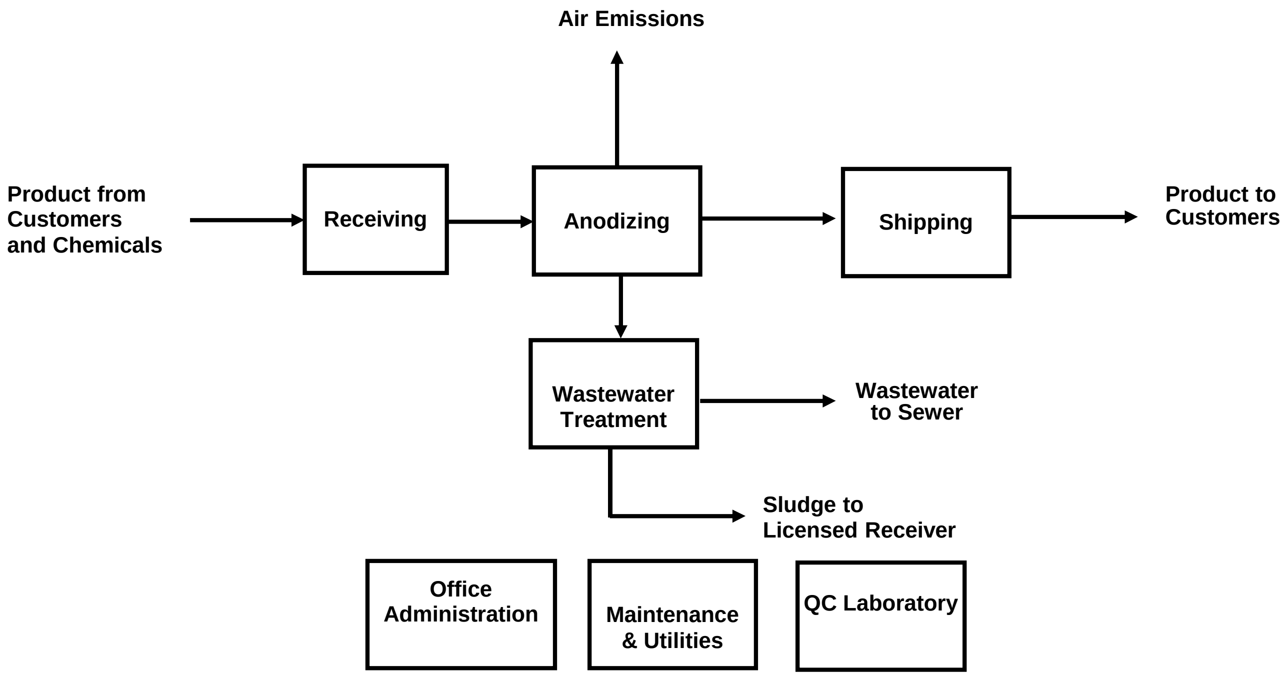


Figure 2: Anodizing Process Flow Diagram

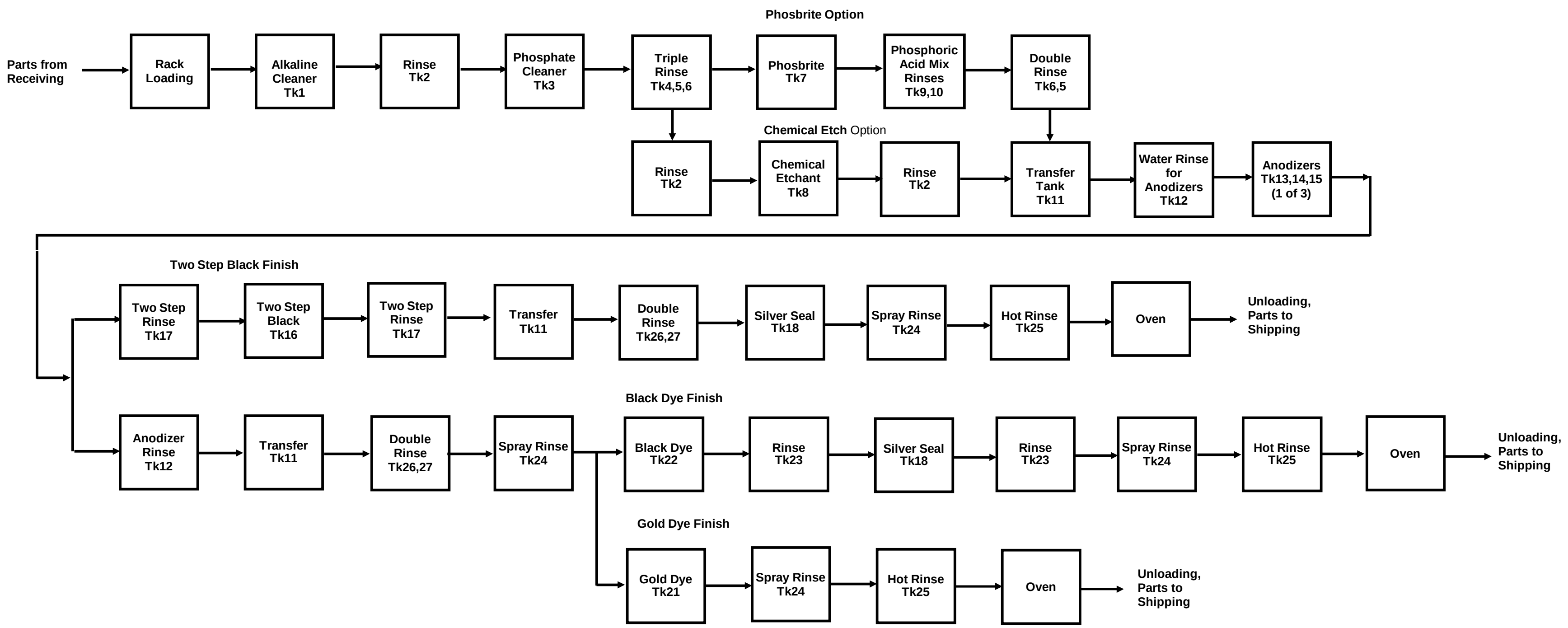
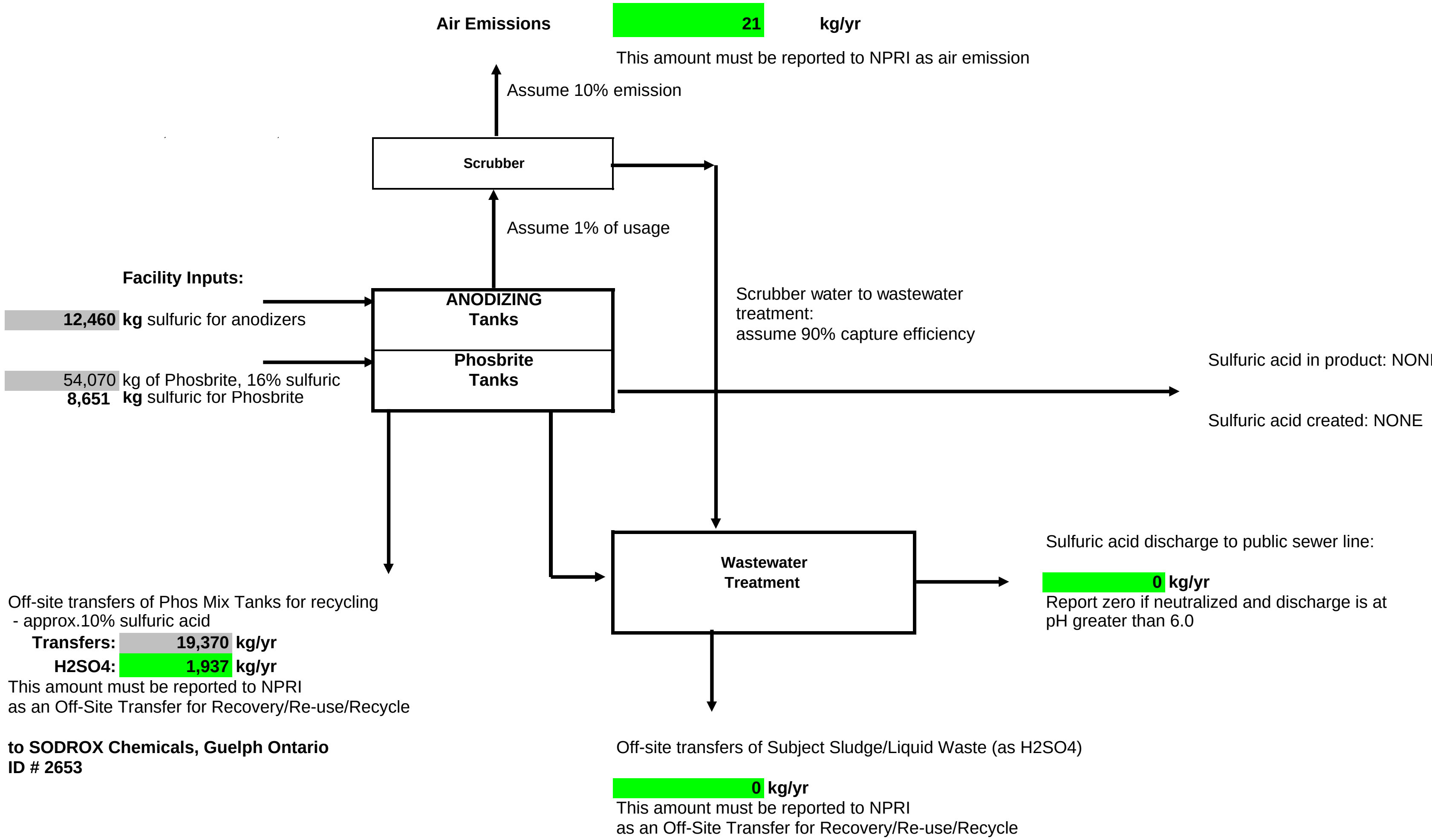


Figure 3: Sulfuric Acid



Material Balance

Purchased	Created	Contained in Product	Shipped Off-Site	On-site Releases	Destroyed	Discrepancy
21,111	0	0	1,937	21	19,153	0

Comment: **Material balance is perfect, since amount destoyed is obtained by difference between purchased and transfers/releases**