TOXIC SUBSTANCE REDUCTION PLAN

FOR

n'BUTYL ALCOHOL
CAS 71-36-3

2014 EMISSIONS

VACUUM METALLIZING LIMITED
30 DOVEDALE COURT
TORONTO, ON M1S 5A7

July 24, 2017

C.   TOXIC SUBSTANCE REDUCTION PLAN FOR n'BUTYL ALCOHOL (CAS 71-36-3)

n'Butyl alcohol is one of five toxic substances used at the facility for which Toxic Substance Reduction Plans (TSRP's) are required at the time of writing. These five solvents are all used in the same processes and in many situations are emitted together. To avoid unnecessary duplication, information common to all of the TSRP's is provided in a single Master Document and this Master Document is referenced by the TSRP for each toxic substance. Accordingly The Master Document and this TSRP for n'butyl alcohol comprise Vacuum Metallizing Limited's complete Toxic Substance reduction Plan for n'butyl alcohol.

1.   Facility Identification

See Master Document, Section 1.

2.   Contacts

See Master Document, Section 2.

3.   Intention to Reduce Use of n'Butyl Alcohol and Objective of This TSRP:

See Master Document, Section 3.

4.   Use of n'Butyl Alcohol

See Master Document, Section 4 for a description of how and where n'butyl alcohol and other solvents are used at Vacuum Metallizing Limited.

In 2014, 1,032 kg of n'butyl alcohol were used at the facility. Of this amount, 498 kg arrived in drums and was used to thin paints, while 563 kg arrived in the following purchased paints: 33C36, 3010-14, 3115-1, and 3093. The following chart illustrates how these paints are used:

	Spray Paint Application		Flowcoat Paint Application	
	Basecoat	Topcoat	Basecoat	Topcoat
33C36	X			
3010-14			X	X
3115-1		X		
3093	X			

4.1 Stages and Processes that Use n'Butyl Alcohol
See Master Document, Section 4.1 for a description of the stages and process at vacuum Metallizing Limited.

5. Tracking of n'Butyl Alcohol at the Process Level

See Master Document, Section 5 for a description of each stage and process at Vacuum Metallizing Limited. A process flow diagram is provided for each process to provide a visual illustration of:

- how n'butyl alcohol enters the process
- whether n'butyl alcohol is created, destroyed or transformed during the process
- how n'butyl alcohol leaves the process and what happens to it after it leaves the process

Notational references contained in this TSRP document (e.g. U, Int1, Int2, Dis1, A3) are the same as those used in the Master Document.

The processes in which any of the above-listed paints (including n'butyl alcohol thinner) is used are as follows:

- Receiving Stage - Solvent Receiving and Storage Process: All paints.
- Basecoat Stage/Spray Painting – Spray Painting Preparation, Spray Painting and Spray Paint Curing Processes: 33C36 and 3093.
- Basecoat Stage/Flowcoating - 3010-14.
- Basecoat Curing Process – All listed paints.
- Topcoat Stage/Flowcoating - 3010-14.
- Topcoat Curing Process – All listed paints.

6. Tracking and Quantification of n'Butyl Alcohol at the Process Level

In this section, the following information is identified or presented for each of the processes identified in Section 5 in which n'butyl alcohol is used:

- the method or combination of methods used to track and quantify n'butyl alcohol in the process
- why the method or combination of methods was chosen
- the quantification of n'butyl alcohol in the process
- an explanation of any discrepancy between the input quantity (use of n'butyl alcohol) and the output quantity (release and disposal of n'butyl alcohol)

All n'butyl alcohol used at Vacuum Metallizing Limited is ultimately released to air or disposed of and none is transformed, destroyed or contained in products (i.e. in cured coatings applied onto customer-supplied components). Some amount of n'butyl alcohol was retained in the company's inventory at the end of the year.

In this TSRP, individual releases and disposals of n'butyl alcohol exiting processes are not quantified and separated from cumulative releases where (a) the amount of an individual significant relative to the mass released/disposed by the primary source of release (e.g. the mass of n'butyl alcohol releases/disposals from maintenance activities as compared to the amount released/disposed from production activities). Measuring and quantifying these small releases would require source sampling and the associated expense would far

exceed the small amount of potential savings. Any meaningful toxic substance/cost reduction strategy would need to affect the use of paints and solvents in every process and would in any case not address these small individual release sources.

The information presented herein for each process refers to the process description and corresponding process flow diagram presented in the Master Document.

SOLVENT RECEIVING AND STORAGE PROCESS

As noted, all paints that are purchased are received and moved to the Paint Storage Room (input U). Drums of paint and solvent are placed in a horizontal position on racks and dispensed for use in a sprayed basecoat (Int2), a sprayed topcoat (Int3), a flowcoated basecoat (Int4) or a flowcoated topcoat (Int5). n'Butyl alcohol may on occasion also be used for rinsing metal parts prior to flowcoating in Pretreatment Process (Int1). n'Butyl alcohol may evaporate upon opening and dispensing the contents of a container, upon removing the bung in a drum and inserting a dispensing valve, from a dispensing valve that leaks because it does not thread in or close properly, and from a rag used to clean up the spilled paint (A1). n'Butyl alcohol may remain in the rag when it is thrown in the trash (Dis1).

Process input/output balance calculation: $U = Int1 + Int2 + Int3 + Int4 + int5 + A1 + Dis1$

a) n'Butyl alcohol that enters the process (U)

(i)   Quantification Method: Mass Balance

Supplier invoices provide the number of containers received and the net weight of each. The percentage of the paint that is n'butyl alcohol by weight or by volume is recorded in the supplier MSDS for each paint and this information is recorded in company documents supporting NPRI and ECA submissions.

(ii)   Best Available Method Rationale:

This information is accurate and the method is cost effective as it is obtained directly from accounting documents and information supplied from the manufacturers of the paints and no additional measurements are required. Containers are not opened or damaged during this sub- process and they do not leak so 100% of received material is moved to the Paint Storage Room.

(iii)   Data Quality:

The quality of the data is considered "High" for reasons presented above.

(iv)   Calculations of total mass of n'butyl alcohol that enters the process:

kg n'butyl alcohol used = (# containers of paint received) x (litres of paint per container) X (litres of n'butyl alcohol per litre of paint) X (mass of n'butyl alcohol per litre of n'butyl alcohol)

Calculations of total n'butyl alcohol used is in the process (U) are presented in table C1. The amount of n'butyl alcohol used was 1,032 kg and of this amount, 534 kg were received in paints and 498 kg were received in drums.

b) **n'Butyl alcohol exiting the process (Int1, Int2, Int3, Int4, Int5, D1, A1):**

(i) *Quantification Method : Combination of Mass Balance and Engineering Calculations*

As explained in the Master Document, amounts of n'butyl alcohol released to air (A1) other than that emitted in sprayed paints or the small amount that was spilled are considered to be negligible

Accordingly, A1 + Dis1 = 0

The total amount of n'butyl alcohol exiting the process (Int1+Int2+Int3+Int4+Int5+A1+D1) should be equal to the amount entering the process (U) less/plus any increase/decrease in the year-end inventory level versus the starting inventory level.

It is estimated that 41 pails, or 628.4 kg of n'butyl alcohol (41 x 18.9 litres x .811 kg/l) was used in the Pretreatment Process. (i.e. Int1 = 628.4.

For each of 33C36, 3010-14, 3115-1 and 3093, inventory records are not maintained to directly account for the amount of n'butyl alcohol that is used in each of the subsequent processes so estimated usages are determined using engineering calculations as follows:

n'Butyl alcohol usage = (number of production loads painted) x (percentage of paint that is n'butyl alcohol) x (percentage of paint in the reduced mix) x (litres of paint mix consumed per production load) x (density of n'butyl alcohol).

The total amount of n'butyl alcohol exiting the process and which enters a subsequent process is the sum of the calculated usages of n'butyl alcohol for all paints used in that subsequent process.

The number of production loads, paint mix formulas and consumption of paint mix per production load are obtained from operating and production records. The percentage of n'butyl alcohol in the paint and the density of n'butyl alcohol is obtained from supplier records.

(ii) *Best Available Method Rationale:*

This information is cost effective as it is obtained directly from accounting documents, NPRI/ECA documents, departmental supervisors and information supplied from the manufacturers of the paints and no additional measurements are required. In any event the method used is the only one available as the amounts of n'butyl alcohol drawn from inventory for use in each of the subsequent processes are not recorded and physical measurement is not effective because painted items vary considerably in

shape, size and quantity requiring constant modification of machine operating settings.

(iii)   Data Quality

The quality of the data is considered "Average" as quantifications are derived from fundamental scientific principles, relevant empirical data and judgment based on extensive observation. (Although the data quality associated with the distribution of n'butyl alcohol usage between the subsequent processes may not be as high as one would like, the data quality for the sum of the individual usages is "High"). See *Data Quality* in Section 6 of the Master Document.

(iv)   Calculations of total mass of n'butyl alcohol *that exits the process:*

As noted, 628.4 kg are used in the pretreatment process, released to air or disposed of. Accordingly, the value of Int1 is = A1 = Disp1 = 628.4. Calculations for the amounts of n'butyl alcohol exiting the process and which form usage inputs for subsequent processes are shown in Table C2. These amounts are as follows:

Int1 = 145.6 kg; Int2 = 188.8 kg; Int3 = 78.0 kg; Int4 = 4.9 kg; Int5 = 4.9. After accounting for changes in the net inventories of paint containing n'butyl alcohol, the input usage amount (U) of 411 kg closely equals the output amount (Int1+Int2+Int3+Int4+Int5) of 392.4 kg. Reasons for this minor difference are: (1) input and output amounts are estimated using different methods. Input amount are based on purchasing and inventory records (which are precise) whereas output amounts are based on cost accounting/engineering calculations (which use estimated production rates, average paint reduction rates/paint concentrations, etc.), (2) the amount of paint contained in drums is estimated (rather than measured) when drums are not full and volumes are rounded to the nearest convenient fraction, and (3) plant operating records are not always completed as accurately as management would like.

PRETREATMENT PROCESS

N'Butyl alcohol is used in the Pretreatment Process to rinse oils from metal parts. Ultimately, all of this material ends up evaporating and released to air. Accordingly:
Int1 = 76.6 (used)
A2 = 76.6 (released to air)
Dis2 = 0 (disposed of)
Rec1 = 0 (recycled internally for reuse)

PAINT PREPARATION PROCESSES

Paint mix for use in a spray or flowcoating application is blended in or in front of the Paint Storage Room in open containers which are transported by hand or using a dolly to the spray booth or flowcoater. n'Butyl alcohol is released to air during the time that ingredients are being dispensed and transported to the work station. If a paint spill occurs during dispensing/transport, n'butyl alcohol is released to air from the spilled material

and from rags used to wipe up the spill. n'Butyl alcohol remaining in the rags is disposed of when the rags are discarded.

Process input/output balance calculations:

Spray Paint Basecoat Preparation Process: $Int2 = Int6 + A3 + Dis3$

Spray Paint Topcoat Preparation Process: $Int3 = Int7 + A4 + Dis4$

Flowcoat Paint Basecoat Preparation Process: $Int4 = Int8 + A5 + Dis5$

Flowcoat Paint Topcoat Preparation Process: $Int5 = Int9 + A6 + Dis6$

a) n'Butyl alcohol that enters the process (Int2, Int3, Int4, Int5):

$Int1 = 76.6$ kg; $Int2 = 228.0$ kg; $Int3 = 78.0$ kg; $Int4 = 4.9$ kg; $Int5 = 4.9$ kg. Refer to Solvent receiving and Storage Process (b)(iv), above.

b) n'Butyl alcohol exiting the process (Int6+A3+Dis3, Int7+A4+Dis4, Int8+A5+Dis5, Int9+A6+Dis6):

Some small amount of n'butyl alcohol that enters the process evaporates when paint is dispensed and blended or when paint mix is spilled during dispensing/blending and transport to the painting machine and from rags used to clean up this spill (collectively A_x). Any n'butyl alcohol remaining in the rags is discarded along with the rags (Dis_x). No measurements are taken or records maintained to record spills because a spill occurs infrequently and involves a relatively small and insignificant amount of paint. Because pails are left open for only a few, the amount of a solvent lost through evaporation in this process is not significant, measured or recorded.

(i) Quantification Method : Combination of Mass Balance and "Best Guess" Estimates

Mass Balance because input amounts equal or almost equal output amounts. The amounts of n'butyl alcohol exiting to air or disposed of are provided from the memory and opinions of departmental supervisors.

(ii) Best Available Method Rationale: No data is recorded concerning the frequency and volume of spilled paints so this information is based on the memory and opinions of the painting department supervisors.

(iii) Data Quality:

Because the output mass of n'butyl alcohol is almost equal to input mass (i.e. significant loss to spills is not experienced), the quality of the data for the process output is no better or worse than that of the input. Accordingly the data is considered "Average".

(iv) Calculations of total mass of n'butyl alcohol that exits the process:

Assumptions:

- No amount of n'butyl alcohol is released to air during dispensing and transport unless a spill occurs

- Spills occur on average once per week during blending or transport
- Each spill involves approximately one litre of material
- Only paint mix is spilled (as it less viscous than unreduced paint carried further)
- No spills occur when dispensing solvent used in the pretreatment process. (A solvent inventory is kept at the rinsing station so occasions to transport pails of solvent are limited).
- Spills of paint mix spills are distributed among all mixes/processes in accordance with their relative usages.

The formula for calculating mass of n'butyl alcohol exiting the process due to spills is as follows:

kg n'butyl alcohol used = (49 spills per year) x (distribution factor for paint/process combination) x (1 litre of paint mix per spill) x (% of paint mix that is n'butyl alcohol) x (density of n'butyl alcohol)

Calculations for the amounts of n'butyl alcohol exiting the process on account of spills are shown in Table C3. These amounts (in kg) are as follows:

$(A3+Dis3) = 0.5$ kg, $(A4+Dis4) = 0.1$ kg, $(A5+Dis5) = 0.0$ kg, $(A6+Dis6) = 0.0$ kg

Amounts exiting each process which are in turn inputs for subsequent painting processes are as follows:

Spray Paint Basecoat Preparation $\quad$ $(Int6 = Int2 - A3 - Dis3) = 228.0 - 0.5 = 227.5$ kg
Spray Paint Topcoat Preparation $\quad$ $(Int7 = Int3 - A4 - Dis4) = 78.0 - 0.1 = 77.9$ kg
Flowcoat Paint Basecoat Preparation $\quad$ $(Int8 = Int4 - A5 - Dis5) = 4.9 - 0.0 = 4.9$ kg
Flowcoat Paint Topcoat Preparation $\quad$ $(Int9 = Int5 - A6 - Dis6) = 4.9 - 0.0 = 4.9$ kg

SPRAY PAINTING AND FLOWCOATING PROCESSSES

In both spraying and flowcoating processes, n'butyl alcohol is released to air in/from the painting machine while paint mix is being applied onto components and from the uncured coating on painted components which are being staged for the subsequent convection curing process. In the spray painting process, some amounts of n'butyl alcohol are released to air from daily and periodic machine maintenance operations and from the disposal of associated waste materials. In the flowcoating process, some amounts of n'butyl alcohol are released from paint remaining in the paint sump when the flowcoater is not in use. Releases/disposals are quantified as $(A7+Dis7)$ from spray painting basecoats, $(A8+Dis8)$ from spray painting topcoat, A9 from flowcoating basecoats and A10 from flowcoating topcoats.

Some amount of n'butyl alcohol is used to rinse paint lines and spray guns and flowcoater plumbing.

Process input/output balance calculation:

Basecoat Spray Painting Process: $\quad$ $Int6 = Int10 + A7 + Dis7$
Topcoat Spray Painting Process: $\quad$ $Int7 = Int11 + A8 + Dis8$

Basecoat Flowcoating Process: $Int8 = Int12 + A9$
Topcoat Flowcoating Process: $Int9 = Int13 + A10$

No recycled n'butyl alcohol is used in the flowcoating processes so $Rec1 = 0$ kg.

a) n'Butyl alcohol that enters the process (Int6, Int7, Int8, Int*9):

$Int6 = 227.5$ kg, $Int7 = 77.9$ kg, $Int8 = 4.9$ kg, $Int9 = 4.9$ kg. Refer to Paint Preparation Process (b) (iv), above.

b) n'Butyl alcohol exiting the process (Int10+A7+Dis7, Int11+A8+Dis8, Int12+A9, Int13+A10):

The greatest amount of n'butyl alcohol exiting the process is released to air during paint application. A lesser amount exiting the process is contained in uncured paints on parts that are moved to the Curing Process (int10, Int11, Int12, Int13). Less significant amounts of n'butyl alcohol evaporate from the surface of coated parts collecting on carts (until the carts are filled at which time they are moved to the curing oven and are released/disposed of from maintenance activities).

(i)   Quantification Method: Engineering Estimates

Emission factor common in the painting industry is used to separate emissions to air during paint application from those emitted during curing process.

(ii)   Best Available Method Rationale:

A common convention used in the painting industry is that 80% of solvents are released from an applied coating during the coating process with the remaining 20% released during the curing process. This analysis uses this convention to determine the mass of n'butyl alcohol exiting the process to air and moving to the Curing Process. Because no data is available quantifying n'butyl alcohol exiting the process from maintenance activities or from uncured coating on standing parts, amounts of releases to air and disposals are calculated in the aggregate.

(iii)   Data Quality:

The quality of the data is considered "Average" because the analysis uses a common industry convention which does not take into account the specific processes and materials used at VML.

(iv)   Calculations of total mass of n'butyl alcohol that exits the process:

Convention: 80% of n'butyl alcohol in applied paint is released in the process and 20% is released in the subsequent curing process.

Amounts exiting each process are as follows:

Basecoat Spray Painting Process: $Int10 = 0.2 \times Int6 = 0.2 \times 227.5 = 45.5$ kg
                                     $(A7 + Dis7) = .8 \times Int6 = 182.0$ kg
Topcoat Spray Painting Process: $Int11 = 0.2 \times Int7 = 0.2 \times 77.9 = 15.6$ kg
                                     $(A8 + Dis8) = 0.8 \times 0.0 = 62.3$ kg

Basecoat Flowcoating Process:	$Int12 = 0.20 \times Int8 = 0.20 \times 4.9 = 1.0$ kg
	$A9 = 0.8 \times Int8 = 3.9$ kg
Topcoat Flowcoating Process:	$Int13 = 0.2 \times Int9 = 0.2 \times 4.9 = 1.0$ kg
	$A10 = 0.8 \times Int9 = 3.9$ kg

SPRAY PAINT AND FLOWCOAT PAINT CURING PROCESSSES

All painted coatings are full cured in a convection oven and it is assumed that 100% of n'butyl alcohol entering this process exits the process to air.

Process input/output balance calculation:

Spray Painting Basecoat Curing Process:	$Int10 = A11$
Spray Painting Topcoat Curing Process:	$Int11 = A12$
Flowcoating Basecoat Curing Process:	$Int12 = A13$
Flowcoating Topcoat Curing Process:	$Int13 = A14$

a) n'Butyl alcohol that enters the process (Int10, Int11, Int12, Int13):

$Int10 = 45.5$ kg, $Int11 = 15.6$ kg, $Int12 = 1.0$ kg, $Int13 = 1.0$ kg. Refer to Spray Painting and Flowcoating Processes (b)(iv), above.

b) n'Butyl alcohol exiting the process (A11, A12, A13, A14):

(i) Quantification Method: Engineering Estimates

Emission factor common in the painting industry is used to separate emissions to air during paint application from those emitted during curing process.

(ii) Best Available Method Rationale:

See Spray Painting and Flowcoating Processes (b)(ii).

(iii) Data Quality:

See Spray Painting and Flowcoating Processes (b)(iii). Because the output mass of n'butyl alcohol is equal to input mass, the quality of the data for the process output is no better or worse than that of the input. Accordingly the data is considered "Average".

(iv) Calculations of total mass of n'butyl alcohol that exits the process:

Amounts exiting each process are the same as those entering the process as follows:

Spray Painting Basecoat Curing Process:	$A11 = Int10 = 45.5$ kg
Spray Painting Topcoat Curing Process:	$A12 = Int11 = 15.6$ kg
Flowcoating Basecoat Curing Process:	$A13 = Int12 = 1.0$ kg
Flowcoating Topcoat Curing Process:	$A14 = Int13 = 1.0$ kg

FACILITY-WIDE ACCOUNTING

There is a difference of 62 kg between the mass of n'butyl alcohol purchased in 2106 as reported to the MOE/NPRI (1,013 kg) and the mass calculated to have been received into inventory (i.e. entering the process) in this TSRP (1,075 kg). This is due to the fact that NPRI/MOE calculations are based only on the mass of n'butyl alcohol purchased in 2016 and do not reflect net additions or deductions from inventory for the year whereas TSRP calculations take this into account. The amount of n'butyl alcohol calculated as entering the process after adjusting for net changes to paint and solvent inventory levels (1,075 kg) exceeds the amount calculated as having been used (1,056 kg) by 33 kg. This variance can be explained by the fact that masses calculated in Table C1 were based on inventory/purchasing records, while those calculated in Table C2 were calculated based on engineering calculations.

Facility-level quantification data for n'butyl alcohol used at Vacuum Metallizing Limited in year 2016 is outlined in Table C4.

7. *Opportunities for Reducing the Use of n'Butyl Alcohol*

Refer to Master Document, Section 7 for a general discussion about opportunities for reducing solvent use at Vacuum Metallizing Limited, for a list of options that were considered and evaluated.

Technically feasible options applying to n'butyl alcohol are:

(i)   Replace n'butyl alcohol with an equivalent non-VOC solvent
(ii)   Purchase n'butyl alcohol in smaller quantities

8. *Economic Analysis of Opportunities for Reduction in Use of n'Butyl Alcohol*

Direct cost: Annual purchases of n'butyl alcohol: 1,075 kg x $2.48/kg = $2,666

Indirect Costs: Receiving and storing n'butyl alcohol
Dispensing n'butyl alcohol
Paying supplier Invoices
Building overheads associated with plant storage area
Equipment maintenance costs
Spill cleanup costs
Personal protective equipment cost
Compliance reporting cost
Employee training cost
Limitation on production output due to MOE emission limits

Note that for each option, the possible impact of each of the above indirect costs was considered and that where an indirect cost does not appear in the analysis, it was determined that the indirect cost had a negligible impact, or that the indirect cost was not applicable to the subject option.

(i) Option (c): Replace n'butyl alcohol with an equivalent non-VOC solvent:

No direct replacement non-voc solvent for n'butyl alcohol was found to be available. However, assuming such replacement solvent exists, that it is priced the same as xylene and assuming required volume of this replacement solvent would be the same as required for n'butyl alcohol:

Cost of n'butyl alcohol non-voc replacement solvent:
= 1.075 kg ÷ 0.811 kg/l = 1,326 litres x $4.41/litre = $5,846.

The increase in cost associated with Option (c) (before supplier markups) would be $5,846 - $2,666 = $3,180. However, 334 kg of n'butyl alcohol used at the facility was contained in supplied paints and suppliers will likely mark up the cost of the n'butyl alcohol ingredient by 50% to 100%. At 100% markup, the added increase to direct cost is calculated as follows: 334 kg ÷ 0.811 kg/l = 412 litres x 4.41/litre = $1,817. Accordingly, the annual cost increase associated with this option is projected at $4,089 to $4,997.

Identified potential indirect cost savings and an evaluation of each are as follows:

Potential Savings: Ability to increase production output without exceeding MOE emission limits

Evaluation: *No impact as company is operating under the limit and is unlikely to exceed it.*

Potential Savings: Reduced compliance reporting costs.

Evaluation: *Cost would not decrease with the implementation of this option because replacements are not available for all toxic substances used at the facility so compliance reporting would still be required. In addition, the cost of compliance reporting is not variable because reporting is performed by the company president who whose pay would remain the same regardless of whether or not he performs this function or how many hours he works.*

Conclusion: *Option is not economically feasible because it would result in significant increase in cost.*

ii) **Options (i) and (j): Recapture, recycle on-site/off-site and reuse solvents used to clean spray guns and paint lines:**

Options do not apply to n'butyl alcohol.

iii) **Option (n): Purchase paints in smaller quantities:**

This option would reduce the amount of n'butyl alcohol received and held in inventory by reducing the number of drums of 33C36 (from Schwartz Chemical) and 3010-14, 3115-1 and 3093 (from Color Coatings) purchased at any one time and held in inventory.

Estimated annual direct savings associated with a 50% decrease in purchase amounts:
On average, amount of paint used

and purchased would be unchanged   ($ 0)

Estimated annual indirect savings:
 Capital cost saving associated with reduction:
 2 drums 33C36 @ $2,926 ea. x 2.0% $117
 2 drums 3010-14 @ $2,117 ea. x 2.0%   85
 2 drum of 3115-1 @ $1,923 ea. X 2.0%   77
 1 drum of 3093 @ $1,884 ea. X 2.0%   38
   Total savings from freed-up capital (317)
Savings from freed-up inventory area   (0)

Cost increases associated with making six
additional paint shipments per year (2 per supplier):
 Freight @ $450 per shipment $2,700
 Generate six additional invoices per year
  @ $25 ea.   150
 Receive six additional shipments per year -
  20 minutes each @ $20/hr.   40
 Total cost increases   2,890

Net cost increase/(decrease) $ 2,573

Evaluation: Implementation of option would increase cost without reducing usage.

Conclusion: Option is not economically feasible.

9. *Implementation of Opportunities for Reducing the Use of n'Butyl Alcohol*

Vacuum Metallizing Limited does not plan to implement any of the identified options to reduce the usage of n'butyl alcohol at the facility because no option was found to be both technically and economically feasible at the present time for reasons presented in the Master Document. That said, the company does intend to purchase a solvent recycling system to recycle and reduce the use of MEK and mineral spirits and this system will likely be used to recycle some amount of paint mix containing n'butyl alcohol resulting in a minor (and currently unquantifiable) reduction in the use of this solvent.

As noted, the company will continue to seek additional opportunities for reducing its use of VOC solvents by monitoring the cost of a non-VOC replacement for n'butyl alcohol and investigating new spray gun technology. Any additional opportunity that is determined will be identified in a future TSRP update.

10. Certifications

Certification by highest-ranking employee of the facility having management responsibilities relating to the facility:

I, Jeffrey Sugar, certify that during 2017, a review of the toxic substance reduction plan for n'butyl alcohol was conducted in accordance with the *Toxics Reduction Act, 2009* and Ontario Regulation 455/09 (General) made under that Act. As of April 30, 2017, I also certify that I have read the toxic substance reduction plan dated June 1, 2017 for n'butyl alcohol and am familiar with its contents and to my knowledge the version of the plan is factually accurate and complies with the *Toxics Reduction Act, 2009* and Ontario Regulation 455/09.

Jeffrey Sugar, President
Vacuum Metallizing Limited

Certification by Toxic Reduction Planner:

As of _Aug 21, 2017_, I Kaleem Muhammad certify that I am familiar with the processes at Vacuum Metallizing Limited that uses or creates the toxic substance n'butyl alcohol, that I agree with the estimates referred to in subparagraphs 7 iii, iv and v of subsection 4(l) of the *Toxics Reduction Act, 2009* that are set out in the plan for n'butyl alcohol dated June 1, 2017 and that the plan complies with the act and Ontario Regulation 455/09 (General) made under that Act.

Kaleem Muhammad   License #TSRP0252

TABLE C1

CALCULATION OF THE MASS OF n'BUTYL ALCOHOL ENTERING THE PROCESS
CALENDAR YEAR 2014

Purchased Paint Containing n'Butyl Alcohol	Volume Per Container (litres)	No. Containers Received	Paint Usage (litres)	n'Butyl Alcohol in Paint by Volume (%)	n'Butyl Alcohol Usage (litres)	Density of n'Butyl Alcohol (kg/litre)	n'Butyl Alcohol Usage (kg)	Starting Inventory	Ending Inventory	Inventory Incr/(Decr) Units	(kg butanol)	Total Usage (kg)
33C36	208.2	8	1,666	15.0%	394.9	0.811	320	3.0	0.0	-3.0	-76	396
3010-14	208.2	16.1	3,352	9.0%	64	0.811	52	0.0	3.0	3	46	7
3093	208.2	6	1,249	5.2%	64	0.811	52	2.0	2.0	0	0	52
3115-1	208.2	12	2,498	3.6%	89	0.811	73	2.0	1.0	-1	-6	79
					1,474		497				-36	534

n'Butyl Alcohol Purchases	kg per Container	No. Containers		n'Butyl Alcohol Usage (kg)	Starting Inventory	Ending Inventory	Inventory Incr/(Decr) Units	kg Butanol	Total Usage (kg)
Butanol	166	3		498	1	1	0	0	498

TOTAL n'BUTYL ALCOHOL ENTERING THE PROCESS	995	-36	1,032

TABLE C2

AMOUNT OF n'BUTYL ALCOHOL EXITING THE SOLVENT RECEIVING AND STORAGE PROCESS (AMOUNTS ENTERING SUBSEQUENT PROCESSES)
CALENDAR YEAR 2014

PAINT	SUBSEQUENT PROCESS	PROCESS ID	BUTANOL IN PAINT (% by vol)	PAINT IN MIX (% by vol)	BUTANOL IN MIX (% by vol)	MIX PER PRODUCTION LOAD (litres)	BUTANOL PER PRODUCTION LOAD (litres)	DENSITY OF BUTANOL (kg/litre)	BUTANOL PER PRODUCTION LOAD (kg)	PRODUCTION LOADS	KG BUTANOL USED (kg)
33C36	Spray - Basecoat	Int2	15.0%	60.0%	9.0%	2.71	0.24	0.811	0.198	1604	317.7
3093	Spray - Basecoat	Int2	5.2%	38.5%	2.0%	3.04	0.06	0.811	0.049	1079	53.2
Subtotal	Spray - Basecoat	int2									370.9
3115-1	Spray - Topcoat	Int3	3.6%	55.6%	2.0%	2.92	0.06	0.811	0.047	825	39.1
3010-14	Flowcoat - Basecoat	Int4	9.0%	40.0%	3.6%	1.14	0.04	0.811	0.033	86	2.9
3010-14	Flowcoat - Topcoat	Int5	9.0%	40.0%	3.6%	1.14	0.04	0.811	0.033	86	2.9
Pretreatment	Flowcoat - Basecoat	Int1	100.0%	100.0%	100.0%	18.90	18.90	0.811	15.328	41	628.4
TOTAL											1,044.2

TABLE C3

ALLOCATION AMONG PROCESSES OF n'BUTYL ALCOHOL EXITING PAINT PREPARATION PROCESSES DUE TO SPILLS

CALENDAR YEAR 2014

PAINT DISPENSED IN PAILS	SUBSEQUENT PROCESS	PROCESS ID	TOTAL MIX SPILLED (litres)	DIST'N FACTOR (Table A2)	ALLOCATED SPILL VOLUME (litres)	BUTANOL IN SPILLED MIX (%)	ALLOCATED BUTANOL IN PAINT (litres)	DENSITY OF BUTANOL (kg/litre)	BUTANOL IN SPILLED PAINT (kg)
33C36	Spray - Basecoat	A3+Dis3	49	8.4%	4.1	9.0%	0.37	0.811	0.3
3093	Spray - Basecoat	A3+Dis3	49	21.3%	10.4	2.0%	0.21	0.811	0.2
Subtotal	Spray - Basecoat	A3+Dis3							0.5
3115-1	Spray - Topcoat	A4+Dis4	49	17.0%	8.3	2.0%	0.17	0.868	0.1
3010-14	Flowcoat - Basecoat	A5+Dis5	49	0.4%	0.2	3.6%	0.01	0.868	0.0
3010-14	Flowcoat - Topcoat	A6+Dis6	49	2.2%	1.1	3.6%	0.04	0.868	0.0

| TOTAL | | | | | | | | | 0.6 |

FACILITY-WIDE ACCOUNTING FOR n'BUTYL ALCOHOL
CALENDAR YEAR 2014

Form of Involvement at the facility	Solvent Receiving and Storage	Pretreatment	Spray Paint Basecoat Preparation	Spray Paint Topcoat Preparation	Flowcoat Paint Basecoat Preparation	Flowcoat Paint Topcoat Preparation	Basecoat Spray Painting	Topcoat Spray Painting	Basecoat Flowcoating	Topcoat Flowcoating	Spray Painting Basecoat Curing	Spray Painting Topcoat Curing	Flowcoating Basecoat Curing	Flowcoating Topcoat Curing	All Processes
Enters (use)	1062														1062
Created		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Released to air		146.0	0.5	0.1	0.0	0.0	188.8	78.0	4.9	4.9	45.5	15.6	1.0	1.0	486
On-site disposal		0.0	incl.	incl.	incl.	incl.	incl.	incl.	incl.	incl.	incl.	incl.	0	0	incl.
Released to land		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Released to water		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Off-site disposal		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Transferred for recycling off-site		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Contained is shipped product		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Transformed		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Destroyed at facilty		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Unaccounted	-590														
Removed/(Added) to inventory	-14														

PROCESS

* This is also the variance between the amount reported to NPRI which was the amount purchased.