Eliminating Deadbed: It's Payback Time!

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Abstract

Deadbed (commonly referred to as carry-back) buildup in production haul truck beds causes up to millions of dollars in lost productivity every year. A mine site in the U.S realized their potential to ramp up "free" tonnage and started using Alderox® ASA-12®, an environmentally friendly release agent, to help eliminate buildup in their truck beds. By penetrating into metal liners and creating a non-stick film, average productivity increases of up to 5% have been experienced at various mines. The author will explore the product's usage in the mining industry and the challenges associated with selecting the proper site-specific operating logistics to ensure that maximum tonnage benefit is achieved.

Executive Summary

Deadbed is ore buildup on mining equipment which robs equipment of performing at full capacity. A new product called Alderox® ASA-12® is able to eliminate deadbed when sprayed onto equipment surfaces by creating a non-stick film. The biggest payback for the product comes from applying it in haul truck beds to allow trucks to dump out a full load of fresh ore each time. Alderox® ASA-12®, a 100% biodegradable release agent, is comprised of a soybean oil base and has been tested by an independent EPA certified laboratory for environmental friendliness. Working with Environment Canada to create a release agent standard, Alderox® is also EcoLogo^{M} certified.

Without any capital expenditure as the automated or handheld applicator equipment is provided without cost, Alderox® offers a quick and easy solution to deadbed due to sticky ore, humid climates coupled with high heat, heavy precipitation, operator practices, truck bed design and/or other factors.

An underground 30,000 tons per day operation in the U.S. is gaining an extra 33,000 tons per month by implementing Alderox® into their standard operating procedure for haul trucks. Another underground copper mine in Mexico discovered that using Alderox® for skips and ore pockets allows them to operate without having to stop production and clean out equipment.

Factoring in the direct cost of the product as well as the indirect cost of equipment downtime (opportunity cost for product spray time), the average open pit copper mine with an average deadbed of five tons can expect to gain approximately $100,000 per day associated with using Alderox® (extra revenue minus extra cost).

The patented Alderox® formulation provides a solution for heavy production pressure without the need to purchase new equipment or to be a victim of long lead times.

Introduction

In today's world of mining, bigger equipment, better technology and newer designs are paving the way for increased productivity and enhanced safety. With long lead times for new equipment and a shortage of consumables, every mine superintendent is looking for ways to increase tonnage throughput without issuing a multi-million dollar purchase order. The entire industry is scrambling to re-open mines that once were a profit laughingstock and scouting new technology to better their bottom line. However, the industry is experiencing the world's largest human resource deficit and no mine has extra manpower to send out in search of new technology and formulize a business case – the tell-tale of bottom line calculations and economic viability. This paper explores a new breakthrough product in the mine industry that offers a clean and crisp production increase opportunity without any capital expenditure.

Deadbed Buildup

Deadbed (commonly referred to as carry-back) is ore buildup that can accumulate in different mining equipment such as haul trucks, chutes, hoppers, conveyor belts, ore pockets and loader buckets. It can be attributed but not limited to the following factors: type of ore (clays), climate (humidity and precipitation), moisture content in ore, truck cycle time and operator practices. Deadbed disables equipment from performing at full capacity and when the piece of equipment is associated directly with production, maximum possible throughout is compromised for the mine. Secondary effects of deadbed include higher maintenance dollars due to quicker material wear and extra downtime required to clean equipment.

In mines where production trucks are used, most commonly in open pit mines, deadbed robs the trucks from dumping out a fresh material each time to maximize payload (Figure 1). Instead, the truck scale might read 240 tons but only 235 tons are going into the crusher or onto the leach pad. Depending on the average amount carried, this problem quietly causes mines up to millions of dollars in lost productivity ever year.

An underground mine site in the U.S. realized their potential to gain "free" tonnage without purchasing new equipment or increasing runtime; they started using the Alderox® ASA-12® formulation to eliminate ore buildup in their truck beds. Due to confidentiality agreements, we will refer to the aforementioned mine as Mine X. Following a 60-day successful trial, Alderox® is now a part of Mine X's standard operating procedure. Another underground mine site in Mexico (Peñoles' Milpillas

underground copper mine) discovered another cost-savings application and started using Alderox® on their underground pockets and skips regularly.

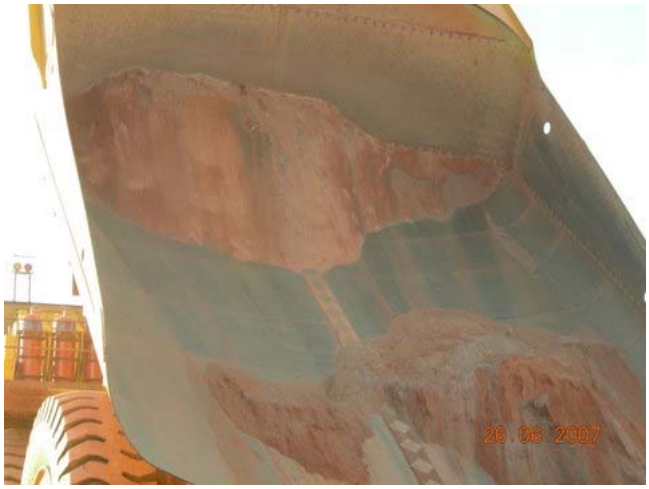

Figure 1. 240 ton haul truck with deadbed

An investigation on installation procedure, trialing method and operating logistics will be based on actual operating mine sites. However, a simulated typical open pit copper mine will be used instead to explore the financial breakdown behind using Alderox® ASA-12®.

Alderox® ASA-12®

Alderox ASA-12 is a non-stick release agent similar to the concept of PAM on a frying pan. This product is a blend of naturally occurring materials that work to film metal or wood surfaces to inhibit adhesion. Alderox® is applied to surfaces using atomizing spray systems. The product is comprised of a soybean oil base which gives it an edge over other water or ethanol based chemicals since Alderox® will not evaporate. It has been slowly replacing diesel oil on concrete forms and asphalt trucks over the past several years with the main customers being asphalt plants and pavers in Canada, US and Australia.

Recently discovering the mining industry, the product is finding different applications such as the following:

- Truck beds
- Skips
- Loaders
- Buckets
- Conveyors
- Crushing stations

- Chutes
- Vehicle undercarriages
- Drag chains

When used correctly, the product performs the following functions:

- Lubricates
- Creates a non-stick film
- Protects surfaces
- Stops rusting due to ore buildup (moisture retention)
- Prevents overheating (undercarriages)

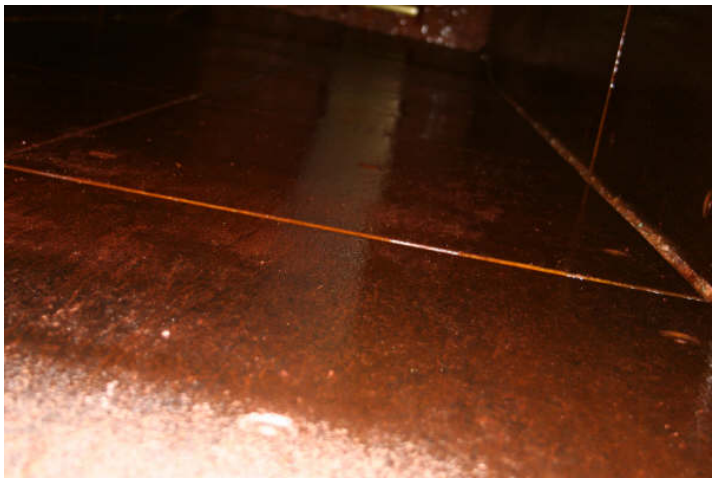

Figure 2. Surface of Skip treated with Alderox® ASA-12®

Environmental Concerns

Mining companies are constantly striving towards a zero incident rate for all employees and contractors on site; and full environmental stewardship. The concerns over the use of any chemicals or reagents are always rampant when introducing a new product on site. Mine runoff water cannot contain chemicals detrimental to the surrounding environment and wildlife; personnel health and safety cannot be compromised when using any chemicals.

The manufacturers of Alderox®, Reclamation Consulting and Applications Inc. (RCAI), worked together with Environmental Canada's Environmental Choice^{M} Program to create a standard for release agents in 2004 (Appendix 2). The national listing, CCD-143, is now a standard for environmental excellence and encourages all other release agents to manufacture products "that support the effort to improve environmental quality by reducing energy and materials consumption and by minimizing the impacts of pollution generated by the production, use and disposal of goods and services

available...” (CCD-143) All products that are certified by the Program bear the EcoLogo^{M} (Figure 3).

Figure 3. Environment Canada's Environmental Choice^{M} Program - EcoLogo^{M}

Alderox® has also been tested in an EPA certified laboratory against diesel oil using preparation Method SW846 5030A and analysis method SW846 8260B. This independent testing included VOCs (Volatile Organic Compounds) and Priority Pollutants with regard to soil contamination and over 70 parameters were measured.

As per laboratory procedure, a sample of clean soil was injected with Diesel Fuel and a second sample was injected with Alderox® ASA-12®. Only items that were tested positive are provided in Table 1 and Table 2; items not listed were non detectable. Concentrations were measured in mg/l and mg/kg respectively.

Mine X

Mine X is owned and operated by one of the world’s largest base metal producers. Mine X is a 30,000 tons per day (tpd) underground operation running approximately 11,000 truck cycles per month. With a measured average of 3 tons of deadbed per truck, Mine X would be able to gain an extra 33,000 tons per month by simply using Alderox® ASA-12® to eliminate deadbed and running the same amount of truck cycles.

Following a successful demonstration with a handheld sprayer with 120 psi, Mine X worked together with the manufacturer to build an automated applicator system and to run a 60 day trial to determine correct operating logistics.

The applicator system development was designed and built over three months. Various working models were tested but the final configuration included the following specifications:

- Heavy duty steel construction powder coated for durability
- Dual 150 psi diaphragm pumps

- 1500 lb electromechanical ram
- Able to be operated on any 110 volt power source
- Multiple spray nozzles to provide coverage to entire truck bed
- Safety sensors to ensure proper placement of spray head in truck bed
- Preprogrammed on-board computer system
- Activated remotely by truck drivers from the cabs of their trucks
- Able to select heavy or regular amounts of spray depending on the material being hauled
- Spray head is designed to slide out of truck bed in case of malfunction or power loss.

To eliminate the capital expenditure portion of the project, the automated applicator system (Figure 4) is supplied to Mine X at no charge by the manufacturer for as long as Mine X continues purchasing product.

The location of the sprayer was easy to determine since all operating trucks dump out at the crusher. The automated applicator system has the option of being trailer-mounted but Mine X decided on permanently installing it adjacent to the crushing station. To use the product, truck operators simply line up to a red laser beam and to activate the system, they press a button similar to a garage-door opener. The applicator will then lower into the truck bed and evenly mist Alderox® onto the metal liners. The applicator ensures that the correct amount of product is always applied, thereby eliminating overuse and allowing maximum performance of Alderox® ASA-12®.

The product requires no mixing/dilution and with every new container, the pump and lines only need to be primed before regular operation. The entire application process takes no longer than two minutes which include lining up to the spray system and actual spraying time.

With one gallon of Alderox® covering approximately 1,000 square feet, only a very small amount is required per application. Mine X uses one half gallon per truck per spray and sprays approximately once every 25 truck cycles. In general, the applicator frequency and amount will vary throughout the year due to climate and precipitation pattern changes but since Mine X is an underground operation, they remain at a steady application frequency year round.

Outside of environmental and safety concerns, another main concern included possible negative effects of Alderox® on equipment, material, or downstream processing. To date, there have been no recorded negative effects on equipment and material. In regards to downstream processing, after review of the product ingredients and the quantity used per day, the chief engineer at Mine X’s processing plant stated that there are no anticipated recovery or grade effects on the processing circuit. To date, there are

no reports of a dramatic change in concentrate grade or recovery that has been attributed to using Alderox®.

Figure 4. Automated Applicator System

Mine X completed the 60 trial process in mid-June of 2007. The trial was successful and Mine X continues to implement the Alderox® procedure in their regular operations.

Industrias Peñoles S.A. de C.V. ('Peñoles')

Peñoles is one of Mexico's largest net exporters in the private sector, mining silver, gold, lead, zinc and copper. One of their mines, Milpillas Underground Copper Mine, discovered other applications for Alderox® in their operations. Using a handheld sprayer (Figure 5) with approximately 120 psi, they apply the product in the underground ore pockets and skips (Figure 6).

Following Milpillas' success, another Peñoles operation, La Herradura, started testing Alderox® in loader buckets, drill chains, truck undercarriages and truck fuel tanks. La Herradura is an open pit gold mine employing 190 ton production trucks. The mine recognized that Alderox® was best used on vehicle undercarriage to prevent overheating and rust issues. When the mud adheres to the truck undercarriage components, especially the fuel tank, it retains moisture and causes both overheating and rust. Alderox®, by eliminating ore buildup, is able to prevent such issues and indirectly increase equipment run-time before an unscheduled maintenance call.

Figure 5. Peñoles miners with handheld bucket top sprayer system

Figure 6. Peñoles Miner applying product in skip

Cost Analysis

In this part of the paper, we will utilize a typical open pit mine with the following data:

- 0.5% copper deposit
- Equivalent to 10lbs Cu/ton of ore
- 200,000 ton per day (tpd) goal
- 20x 240 ton trucks running at any given time
- Five ton average deadbed per truck
- Equivalent to actual payload: 235 ton
- Assume total ore (all waste is stripped already)
- 851 total mine-wide cycles per day (to make throughput goal)
- 43 cycles per truck per day

The following calculations have been simplified for the purpose of having a generic case study – mine-specific details are not included and all assumptions are either obvious or clearly noted.

At the current 235 ton payload, the mine is yielding their goal of 200,000 tpd. At full payload, if the mine runs the same number of truck cycles, it will yield 10,213 tons per truck per day making a total of 204,455 tons mine-wide per day. This will give the mine an extra 4,455 tons per day just by using Alderox®. An extra 4,455 tons of ore will yield an extra 42,550 lbs of Cu at 0.5% Cu. At an average price of USD$3.50/lb copper, the extra revenue associated with Alderox® ASA-12® is USD$148,936.

When we calculate the cost of using the product, we run into both direct (cost of product) and indirect (cost of downtime; opportunity cost for trucks during bed spray-down) costs. At USD$9/gal for the product and approximately five gallons required for a 240 ton truck, each truck will harbor a cost of USD$135 per day for the product with an initial estimation of three applications per truck per day. Hence the mine-wide direct cost will be USD$2700 per day for all 20 trucks.

Before we determine what the indirect cost of downtime is for spraying the product, we must examine how much is a truck making per minute. If we assume a 23¼ hour run time per day (15 minute for pre-shift inspection per 12 hour shift and 15 minutes to fuel up per day), that means that there are 1.8 truck cycles per hour at the original 235 tons payload. Trucks are hauling (and dumping) an average of 430 tons of ore per hour, an equivalent of 4300 lbs of copper per hour. Each hour, trucks are making revenue of USD$15,054 and therefore each minute, they are making USD$251. We can interpret that as saying that if a truck is idle for one minute, it is losing an opportunity of making USD$251 (exclusive of mining, processing, refining, transportation, generation & administration, etc. costs).

The open pit truck's automated applicator system requires the truck to back into the system; after operator training, it should take approximately one minute to back into the system and another minute to spray the product into the truck bed. The downtime for spraying the truck beds is hence calculated to be USD$1,505 per day per truck; with 20 trucks, the mine will lose the opportunity to make USD$30,108 per day.

Combining direct and indirect costs, the total mine-wide cost per day is USD$32,808.

The bottom line associated with using Alderox® ASA-12® is $116,129 per day (again, exclusive of mining, processing, refining, transportation, generation & administration, etc. costs) based on eliminating five tons of deadbed for a 240 ton mining haul truck.

Based on figures and mathematical logic above, Figure 7 shows a graph plotting amount of deadbed versus payback amount the mine can expect to yield. The chart is supported by data in Appendix 1 (Table 3 through Table 8).

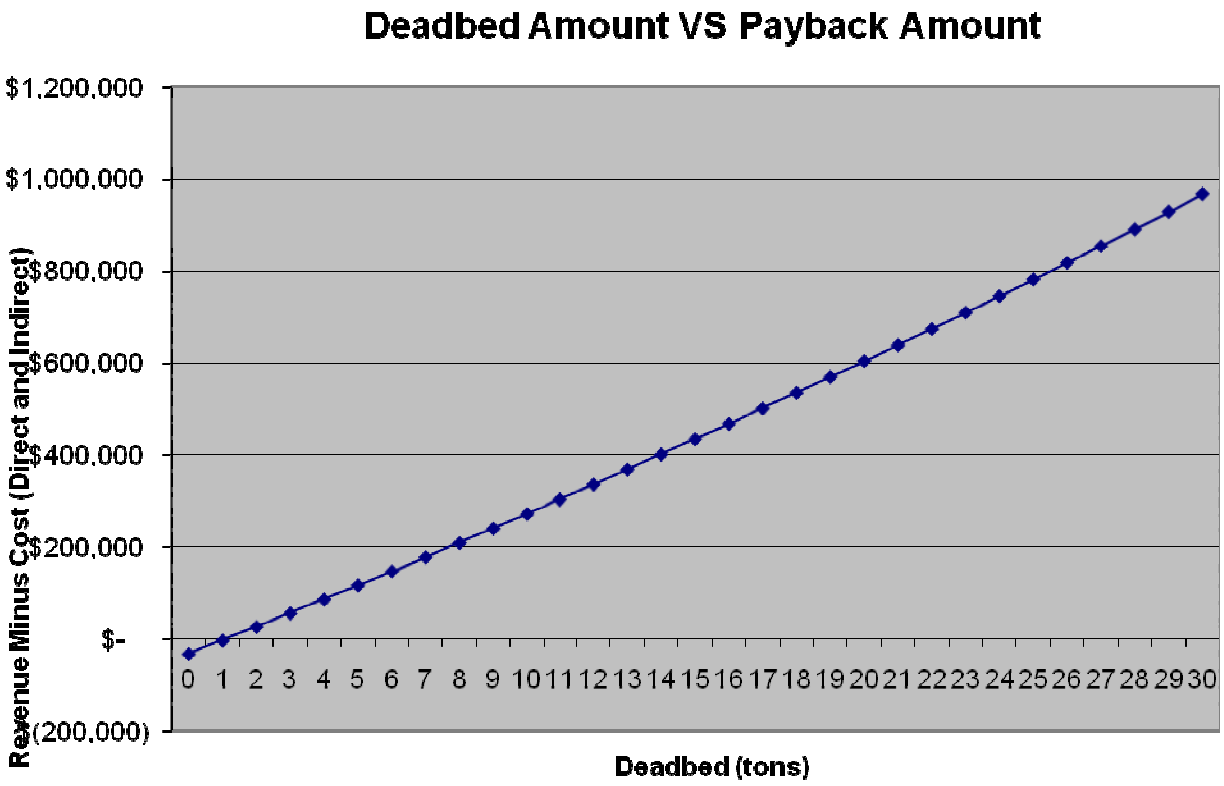

Figure 7. Deadbed VS Payback Amount

Challenges

Various challenges were faced during the initial launching of Alderox® ASA-12® into the mining industry. Challenges include the following:

- Location of Applicator Equipment Install
- Determining correct frequency and amount
- Changing the mindset of mines
- Rugged nature of the mine environment
- Subzero climates (thickening of product)

To ensure that each challenge above plus any mine-specific obstacles were addressed, RCAI's research and development team worked closely with the mines and developed the following solutions to address the above challenges:

- For mines that required a mobile automated spray system, the system is mounted in a trailer and easily accessible.

- RCAI worked together with the mines to develop the correct spray frequency and amount depending on issues such as weather, climate, ore type and throughput of mine. Only when the product is applied correctly will it maximize tonnage benefit; the product in abundance or scarcity will compromise effectiveness.
- RCAI worked together with distributors who already had a good relationship with the mines to help change the mindset of gaining throughput without purchasing new equipment or having a capital expenditure.
- RCAI's design team is comprised of highly experienced individuals who have come together from various industries that strive for safety and durability. All systems are tested for safety and contain fail-safe mechanisms as not to disrupt production should the applicator system stop working.
- For harsh subzero weather climates, coils are installed in product containers to prevent the product from thickening; and a re-circulating system is built into automated applicator system.

Conclusion

In conclusion, the global mining industry is under the highest pressure in history to maximize production and reduce costs. Properties that were deemed not economically feasible to develop only a few years ago are now being mined in the hopes of producing huge profit margins. Over the long history of equipment and technology development in the mining industry, virtually every path has been explored in the quest to increase the bottom line. The high costs associated with material build-up in haul truck beds, on machinery and on equipment are overlooked often; environmentally unsafe solutions such as diesel oil were used to put a band-aid on the problem. A 100% biodegradable release agent for the prevention of materials build-up represent an entirely new approach to significantly increasing mine productivity and do so at very little cost and in very little time.

Appendix 1: Tables

Table 1. Alderox® ASA-12® vs. Diesel Comparison Data

Analyte	Diesel	Alderox® ASA-12®
Benzene	5.13	ND
Sec-Butylbenzene	454	ND
Tert-Butylbenzene	58.3	ND
Ethylbenzene	199	ND
Isopropylbenzene	170	ND
p-Isopropyltoluene	421	ND
Naphthalene	1,390	ND
n-Propylbenzene	496	ND
Toluene	344	ND
1,2,4 – Trimethylbenzene	4,180	ND
1,3,5 – Trimethylbenzene	1,880	ND
O – xylene	708	ND
M,p – xylenes	2,240	ND

Table 2. Soil Testing

Analyte	Soil	Soil + Diesel	Soil + Alderox® ASA 12®
MTBE	ND	ND	ND
Benzene	ND	ND	ND
Toluene	ND	4.46	ND
Ethylbenzene	ND	8.09	ND
Xylenes	ND	72.4	ND
Naphthalene	ND	4.09	ND

Table 3. Typical Open Pit Copper Mine

Typical Open Pit Copper Mine (Shovel/Truck Compatible)								
Mine tpd Goal	# Trucks Running at any given time	Size of Trucks (t)	Ton of Deadbed	Ore Grade (Cu %)	Price of Cu ($/lb)	Revenue per ton	Actual Payload	Cycles per day per truck
200000	20	240	0	0.50%	$ 3.50	$ 35.00	240	42
200000	20	240	1	0.50%	$ 3.50	$ 35.00	239	42
200000	20	240	2	0.50%	$ 3.50	$ 35.00	238	42
200000	20	240	3	0.50%	$ 3.50	$ 35.00	237	42
200000	20	240	4	0.50%	$ 3.50	$ 35.00	236	42
200000	20	240	5	0.50%	$ 3.50	$ 35.00	235	43
200000	20	240	6	0.50%	$ 3.50	$ 35.00	234	43
200000	20	240	7	0.50%	$ 3.50	$ 35.00	233	43
200000	20	240	8	0.50%	$ 3.50	$ 35.00	232	43
200000	20	240	9	0.50%	$ 3.50	$ 35.00	231	43
200000	20	240	10	0.50%	$ 3.50	$ 35.00	230	43
200000	20	240	11	0.50%	$ 3.50	$ 35.00	229	44
200000	20	240	12	0.50%	$ 3.50	$ 35.00	228	44
200000	20	240	13	0.50%	$ 3.50	$ 35.00	227	44
200000	20	240	14	0.50%	$ 3.50	$ 35.00	226	44
200000	20	240	15	0.50%	$ 3.50	$ 35.00	225	44
200000	20	240	16	0.50%	$ 3.50	$ 35.00	224	45

200000	20	240	17	0.50%	$ 3.50	$ 35.00	223	45
200000	20	240	18	0.50%	$ 3.50	$ 35.00	222	45
200000	20	240	19	0.50%	$ 3.50	$ 35.00	221	45
200000	20	240	20	0.50%	$ 3.50	$ 35.00	220	45
200000	20	240	21	0.50%	$ 3.50	$ 35.00	219	46
200000	20	240	22	0.50%	$ 3.50	$ 35.00	218	46
200000	20	240	23	0.50%	$ 3.50	$ 35.00	217	46
200000	20	240	24	0.50%	$ 3.50	$ 35.00	216	46
200000	20	240	25	0.50%	$ 3.50	$ 35.00	215	47
200000	20	240	26	0.50%	$ 3.50	$ 35.00	214	47
200000	20	240	27	0.50%	$ 3.50	$ 35.00	213	47
200000	20	240	28	0.50%	$ 3.50	$ 35.00	212	47
200000	20	240	29	0.50%	$ 3.50	$ 35.00	211	47
200000	20	240	30	0.50%	$ 3.50	$ 35.00	210	48

Table 4. "Extra" Revenue Using Alderox ASA-12

"Extra" Revenue Using Alderox ASA-12				
With Alderox: new Payload (t)	**With same cycles, tpd per truck**	**Total tons per day**	**Total Extra Tonnage**	**Total Revenue from Extra Tonnage**
240	10000	200000	0	$ -
240	10042	200837	837	$ 29,289
240	10084	201681	1681	$ 58,824
240	10127	202532	2532	$ 88,608
240	10169	203390	3390	$ 118,644
240	10213	204255	4255	$ 148,936
240	10256	205128	5128	$ 179,487
240	10300	206009	6009	$ 210,300
240	10345	206897	6897	$ 241,379
240	10390	207792	7792	$ 272,727
240	10435	208696	8696	$ 304,348
240	10480	209607	9607	$ 336,245
240	10526	210526	10526	$ 368,421
240	10573	211454	11454	$ 400,881
240	10619	212389	12389	$ 433,628
240	10667	213333	13333	$ 466,667
240	10714	214286	14286	$ 500,000
240	10762	215247	15247	$ 533,632
240	10811	216216	16216	$ 567,568
240	10860	217195	17195	$ 601,810
240	10909	218182	18182	$ 636,364
240	10959	219178	19178	$ 671,233
240	11009	220183	20183	$ 706,422
240	11060	221198	21198	$ 741,935
240	11111	222222	22222	$ 777,778
240	11163	223256	23256	$ 813,953
240	11215	224299	24299	$ 850,467
240	11268	225352	25352	$ 887,324
240	11321	226415	26415	$ 924,528
240	11374	227488	27488	$ 962,085
240	11429	228571	28571	$1,000,000

Table 5. Product Cost

Product Cost				
# Applications per day	# gals per truck	Product Cost (per gal)	Product cost per truck per day	Total product cost per day
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
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3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700
3	5	$ 9	$ 135	$ 2,700

Table 6. How much is a truck making every minute?

How much is a truck making every minute?					
Truck run time per day (hrs)	Truck Cycles per hour	Truck payload per hour	Lb Cu per truck per hour	Truck Revenue per hour	Truck Revenue per minute
23.25	1.8	430	4301	$ 15,054	$ 251
23.25	1.8	430	4301	$ 15,054	$ 251
23.25	1.8	430	4301	$ 15,054	$ 251
23.25	1.8	430	4301	$ 15,054	$ 251
23.25	1.8	430	4301	$ 15,054	$ 251
23.25	1.8	430	4301	$ 15,054	$ 251
23.25	1.8	430	4301	$ 15,054	$ 251
23.25	1.8	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	1.9	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251
23.25	2.0	430	4301	$ 15,054	$ 251

Table 7. Downtime Cost Associated with Alderox ASA-12

Downtime Cost Associated with Alderox ASA-12					
Time to back into applicator system (min)	Time to spray (min)	Total downtime (min)	Total downtime cost per truck per spray	Total downtime cost per truck per day	Total downtime cost per day
1	1	2	$ 502	$ 1,505	$ 30,108
1	1	2	$ 502	$ 1,505	$ 30,108
1	1	2	$ 502	$ 1,505	$ 30,108
1	1	2	$ 502	$ 1,505	$ 30,108
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1	1	2	$ 502	$ 1,505	$ 30,108
1	1	2	$ 502	$ 1,505	$ 30,108
1	1	2	$ 502	$ 1,505	$ 30,108

Table 8. Bottom Line

Bottom Line			
Total cost per day (direct and indirect)	**Total extra revenue per day**	**Revenue Minus Cost**	**Payback?**
$ 32,808	$ -	$ (32,808)	no
$ 32,808	$ 29,289	$ (3,519)	no
$ 32,808	$ 58,824	$ 26,016	yes
$ 32,808	$ 88,608	$ 55,800	yes
$ 32,808	$ 118,644	$ 85,837	yes
$ 32,808	$ 148,936	$ 116,129	yes
$ 32,808	$ 179,487	$ 146,680	yes
$ 32,808	$ 210,300	$ 177,493	yes
$ 32,808	$ 241,379	$ 208,572	yes
$ 32,808	$ 272,727	$ 239,920	yes
$ 32,808	$ 304,348	$ 271,540	yes
$ 32,808	$ 336,245	$ 303,437	yes
$ 32,808	$ 368,421	$ 335,614	yes
$ 32,808	$ 400,881	$ 368,074	yes
$ 32,808	$ 433,628	$ 400,821	yes
$ 32,808	$ 466,667	$ 433,859	yes
$ 32,808	$ 500,000	$ 467,192	yes
$ 32,808	$ 533,632	$ 500,825	yes
$ 32,808	$ 567,568	$ 534,760	yes
$ 32,808	$ 601,810	$ 569,002	yes
$ 32,808	$ 636,364	$ 603,556	yes
$ 32,808	$ 671,233	$ 638,425	yes
$ 32,808	$ 706,422	$ 673,614	yes
$ 32,808	$ 741,935	$ 709,128	yes
$ 32,808	$ 777,778	$ 744,970	yes
$ 32,808	$ 813,953	$ 781,146	yes
$ 32,808	$ 850,467	$ 817,660	yes
$ 32,808	$ 887,324	$ 854,516	yes
$ 32,808	$ 924,528	$ 891,721	yes
$ 32,808	$ 962,085	$ 929,278	yes
$ 32,808	$1,000,000	$ 967,192	yes

Appendix 2

Environmental Choice[M] Program - CERTIFICATION CRITERIA DOCUMENT (CCD-143)

Product: Asphalt and Concrete Release Agents

Environment Canada's Environmental Choice[M] Program is pleased to publish the following national guideline on **asphalt and concrete release agents**.

The Environmental Choice[M] Program is designed to support a continuing effort to improve and/or maintain environmental quality by reducing energy and materials consumption and by minimizing the impacts of pollution generated by the production, use and disposal of goods and services available to Canadians.

The construction and road-building industries use considerable amounts of asphalt and concrete; these materials naturally adhere to both the equipment (trucks, mixers, etc.) used to produce and transport them and the forms used to contain and shape them. Traditionally, the industry used petrochemicals such as diesel oil or kerosene as the "release agent" to "unstick forms" and wash excess asphalt and concrete out of this equipment. Using fuels for this purpose presents health and safety risks (ie., from air emissions) to workers and can contaminate the surrounding soil with a variety of hazardous chemicals, including, *inter alia*, benzene, toluene, xylenes and naphthalene; in addition to contaminating adjacent soils, these compounds may percolate down into the groundwater. Finally, as petrochemical derivatives, diesel or kerosene use necessarily requires the depletion of a non-renewable resource.

The construction industry has responded to concerns over fuel oil use by promoting the development and use of alternative release agents. Such alternatives must reduce the harmful impacts associated with diesel, while maintaining its desired level of efficacy.

Based on a review of currently available life cycle information, the product category requirements will produce an environmental benefit through:

- a reduction in VOC and other toxic emissions to the environment; and
- a reduction in the use of non-renewable resources.

Life cycle review is an ongoing process. As information and technology change, the requirements will be reviewed and possibly amended.

Environment Canada anticipates that **asphalt and concrete release agents** conforming to this certification criteria document will apply to the Environmental Choice[M] Program for verification and subsequent authority to label the qualifying services with the Environmental Choice[M] EcoLogo[M].

Notice

Throughout this document, any reference to a standard or guideline means to its latest edition.

The Environmental Choice[M] Program (ECP) reserves the right to accept equivalent test data for the test methods specified in this document.

Interpretation

1. In this set of requirements, please note the following definitions:

"**asphalt**" means a black semisolid substance composed of bitumen (which is, in turn, derived from petroleum distillation) and inert mineral matter (generally gravel); used in road-surfacing, roofing and other construction materials for waterproofing and general preservation;

"**asphalt or concrete release agent**" means a substance designed to enable asphalt or concrete to separate easily from containment/forming materials, truck beds and other production/transportation equipment. It is understood that, in the case of concrete, the release agent is generally applied to the forms used to contain the setting concrete, while asphalt release agents are generally applied to the asphalt equipment. It is generally understood that such agents are generally marketed as “ready-to-use” products;

"**asphalt equipment**" means equipment used in the construction industry to make, transport, spread and form asphalt used in road paving building construction and other related activities. Such equipment includes, *inter alia*, trucks, trailers, mixers, pavers, spreaders and rollers;

"**concrete**" means a mixture composed of cement (powdered binding material), inert mineral matter (aggregate) and water; used in a wide variety of construction applications, including, *inter alia*, foundations and support walls, bridges and other support structures and water/sewage distribution systems;

“ASTM” means American Society for Testing and Materials;

“bioaccumulating” means that an ingredient has a bioconcentration factor (BCF) greater than 100 (or log BCF > 2) when tested according to one of the following:

- *Code of Federal Regulation* 40CFR797.1520,
- ASTM E-1022-84 *Standard Practice for conducting bioconcentration test with fishes and salt-water bi-valve mollusk*,
  or
- OECD *Guidelines for Testing of Chemicals*, 305C, *Bioaccumulation: Degree of Bioconcentration in Fish*;

The following ingredients are considered non-bioaccumulative do not have to be tested for BCF:

- those that are readily biodegradable;
- those that have a water solubility greater than 1500 mg/L when tested using a method consistent with ASTM E1148-87, *Standard Test Method for Measurement of Aqueous Solubility*, and
- those that have an octanol-water partition coefficient of log P less than 3 when calculated, or tested using the *OECD Guidelines for Testing of Chemicals*, method 117 or 107.

"biodegradable" for a component, is determined using:

- any of the six test methods described in *OECD Guidelines for Testing of Chemicals*, 301A-301F; for a whole formulation, is determined using one of the methods described in *OECD Guidelines for the Testing of Chemicals*, provided that all measurements and calculations are based on the carbon content of the mixture and its degradation, i.e. dissolved organic carbon (DOC) removal (301A or 301E), CO2 evolution (301-B) or oxygen consumption in the presence of an inhibitor of nitrogen metabolism (301C, 301D or 301F); or
- any of the methods described in *OECD Guidelines for Testing of Chemicals*, 302 Series.

"EC50" means median effective concentration;

"EDTA" means ethylene diaminetetraacetic acid, or ethylene dinitrilotetraacetic acid and any of its salts;

"**halogenated organic solvents**"means any organic solvent containing halogens including fluorine, chlorine, bromine and iodine;

"**IC50**" means the inhibiting concentration for a 50 percent effect;

"**NTA**"means nitrilotriacetic acid or any of its salts;

"OECD" means the Organization for Economic Co-operation and Development;

"potentially bioaccumulating" means ingredients that meet one of the following:

- a water solubility less than 1500 mg/L when tested using a method consistent with ASTM E1148-87, *Standard Test Method for Measurement of Aqueous Solubility*, or
- an octanol-water partition coefficient of log P greater than 3 when calculated, or tested using the *OECD Guidelines for Testing of Chemicals*, method 117 or 107;

"**solvent**" is a general term for a chemically diverse range of liquid substances which dissolve other materials;

"volatile organic compound" or **"VOC"** means any organic compound which participates in atmospheric photochemical reactions. It excludes those organic compounds which the ECP designates as having negligible photochemical reactivity; and

Category Definition

2. This category includes all **asphalt and concrete release agents** as further defined in the subcategories in this section.

(a) **asphalt release agents**; and
(b) **concrete release agents**.

Note: Other sub-categories may be added at a later date. The ECP reserves the right to determine which sub-category will be assigned to a particular applicant..

General Requirements

3. To be authorized to carry the EcoLogo^{M}, the **asphalt or concrete release agent** must:

(a) meet or exceed all applicable governmental and industrial safety and performance standards;
and
(a) be provided in such a manner that all steps of the process, including the disposal of waste products arising therefrom, will meet the requirements of all applicable governmental acts, by laws and regulations including, for facilities located in Canada, the *Fisheries Act* and the *Canadian Environmental Protection Act* (CEPA).

Product Specific Requirements

4. To be authorized to carry the EcoLogo^{M}, the **asphalt or concrete release agent** must:

(a) not be formulated or manufactured with soaps or detergents containing:
  i) phosphates;
  ii) NTA;
  iii) EDTA;
  iv) APEOs;
  v) any chemicals that are included in the International Agency for Research on Cancer (IARC) lists for proven (Group 1), or probable (Group 2A) carcinogens;
(b) not contain solvents that are wholly or partially comprised of :
  i) halogenated organic compounds,

ii) butoxy-ethanol; or

iii) any ethylene glycol ether listed as being a reproductive risk (see Appendix 2b);

(c) be biodegradable as determined by whole formulation testing;

(d) have a flash point of at least 190 OC, as measured by ASTM D-93: Standard Test Method for Flash-Point by Pensky-Martens Closed Cup Tester or other method acceptable to the Environmental Choice^{M} Program; and

(e) not be toxic to aquatic life as measured by whole formulation short-term sensitive toxicity test performed on all of the following:

i) on *Ceriodaphnia* according to *Biological Test Method: Test of Reproduction and Survival using the Cladoceran Ceriodaphnia dubia,* Report EPS 1/RM/21, February 1992, Environment Canada, with a resulting IC50 > 4000 mg/L,

ii) on a fresh water green algae *Selenastrum capricornutum,* according to *Biological Test Method: Growth Inhibition Test Using the Freshwater Alga Selenastrum capricornutum,* Report EPS 1/RM/25, November 1992, Environment Canada, with a resulting IC50 > 2000 mg/L, and

iii) on the bacteria *Photobacterium phosphoreum*, according to *Biological Test Method: Toxicity Test Using Luminescent Bacteria (Photobacterium phosphoreum),* Report EPS 1/RM/24, November 1992, Environment Canada, with a resulting IC50 > 1000 mg/L.

5. To be authorized to carry the EcoLogo^{M}, the **asphalt or concrete release agent** must also meet criteria specific to its subcategory.

5.1 **Asphalt release agents** must:

(a) effectively remove asphalt residues from asphalt equipment, as determined by an acceptable test method (see Appendix 2a);

(b) not damage or degrade asphalt surfaces, as demonstrated by an acceptable test method (see

(a) Appendix 2a);

(b) not use non-renewable resources as the main base ingredient;

(c) not be formulated or manufactured with diesel or other petroleum distillates; and

(d) not contain volatile organic compounds in excess of 5.0% by weight as measured by:

i) EPA Method 24-24A, 40 C.F.R., Part 60, Appendix A (1991),

ii) Method 18,48 Federal Register 48, no. 202, October 18, 1983,

iii) Method 1400 NIOSH Manual of Analytical Methods, Volume 1, February 1984,

iv) Environmental Protection Agency Method 8240 GC/MS Method for Volatile Organics, September 1986; or

v) as demonstrated through calculation from records of the amounts of constituents used to make the product.

5.2 **Concrete release agents** must:

(a) effectively remove concrete residues from concrete equipment, as determined by an acceptable test method (see Appendix 2a);
(b) not damage or degrade concrete surfaces, as demonstrated by an acceptable test method (see Appendix 2a);
(c) not be formulated or manufactured with more than 55% diesel or other petroleum distillates;
(d) not contain any non-renewable resources within its non-petroleum-based ingredients; and
(e) not contain volatile organic compounds in excess of 450 g/litre, as measured by:
(i) EPA Method 24-24A, 40 C.F.R., Part 60, Appendix A (1991),
(ii) Method 18,48 Federal Register 48, no. 202, October 18, 1983,
(iii) *Method 1400 NIOSH Manual of Analytical Methods, Volume 1, February 1984,*
(iv) *Environmental Protection Agency Method 8240 GC/MS Method for Volatile Organics, September 1986*; or
(v) as demonstrated through calculation from records of the amounts of constituents used to make the product.

Verification

6. To verify a claim that a product meets the criteria listed in this document, the ECP will require access, as is its normal practice, to relevant purchasing records, quality control and production records and the right of access to production facilities on an announced basis.

7. If applicable, compliance with requirement 2(b) shall be attested to by a signed statement of the Chief Executive Officer or the equivalent officer of the licensee. The ECP shall be advised in writing immediately by the licensee of any noncompliance which may occur during the term of the license.

On the occurrence of any noncompliance, the license may be suspended or terminated as stipulated in the license agreement.

Conditions for EcoLogo^{M} Use

8. The EcoLogo^{M} may appear on wholesale or retail packaging, or on the product itself, provided that the product meets the requirements in this document.

9. All licensees and authorized users must comply with the ECP's *Guide to Proper Use of the EcoLogo*^{M} regarding the format and usage of the EcoLogo^{M}.

10. Any accompanying advertising must conform with the relevant requirements stipulated in this guideline, the license agreement and the ECP's *Guide to Proper Use of the EcoLogo*[M].

11. It is recommended that a criteria statement appear with the EcoLogo[M] whenever the EcoLogo[M] is used in association with the **asphalt or concrete release agent** . The intent of this statement is to provide clarification as to why the product was certified and to indicate constraints to which the certification is limited. This is to ensure no ambiguity over, or misrepresentation of, the reason(s) for certification.

The criteria statement must be specific to the product's sub-category. For sub-category 2(a) the criteria statement is "*Asphalt Release Agent*"; and for sub-category 2(b) the criteria statement is "*Concrete Release Agent*". The licensee may propose other wording for the criteria statement, but any such proposed wording must be approved by the Environmental Choice[M] Program.

For additional copies of this guideline or for more information about the Environmental Choice Program, please contact: TerraChoice Environmental Services Inc., 1280 Old Innes Road, Suite 801, Ottawa, Ontario, K1B 5M7

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Appendix 2a

Acceptable Test Methods for Form release agents

At the time of publication, the ECP had yet to confirm the existence of one, single, internationally and/or nationally accepted test method available to evaluate the efficacy of form release agents. The ECP will thus accept efficacy test data that indicate the product is able to effectively remove asphalt residues from truck beds or other relevant examples of construction equipment. For example, certain Provincial/State

Transportation Ministries/Departments may have developed evaluation protocols which meet reasonable expectations for product performance; ECP will consider such protocols for suitability to the Program's intent.

In the case of form release agents, efficacy includes both the ability to remove asphalt or concrete from target surfaces and the ability to do so without compromising the integrity of the asphalt or concrete.

Whatever method is employed, efficacy testing must comply with the following general conditions:

- Testing must be performed by an accredited third-party laboratory.
- Testing must be carried out under controlled, replicable conditions; in situ or anecdotal data is not acceptable for ECP certification.
- Generated test data must be objective and quantified in recognized metric units; subjective observations are not generally acceptable for ECP certification, unless accompanied by at least one independent objective measure.
- If performance test results cannot be compared to an accepted test standard's criteria, they must be compared to the performance of functionally equivalent products
- All control conditions must be specified;
- A complete copy of the testing protocol and final report must be made available to the ECP.

Appendix 2b

Proscribed Ethylene Glycol Ethers

Ethyne glycol ethers (EGE's) are versatile solvents, but the EGE's listed below are believed to have reproductive and developmental toxicity based on the results of animal studies. Recent studies indicate that these glycol ethers could have similar effects at very low exposure levels in humans.

a) ethylene glycol ethyl ether (EGEE; ethylene glycol monoethyl ether; ethoxyethanol; Cellosolve)
b) ethylene glycol ethyl ether acetate (EGEEA; ethylene glycol monoethyl ether acetate; ethoxyethanol acetate; Cellosolve Acetate)
c) ethylene glycol methyl ether (EGME; ethylene glycol monomethyl ether; methoxyethanol; Methyl Cellosolve)
d) ethylene glycol methyl ether acetate (EGMEA; ethylene glycol monomethyl ether acetate; methoxyethanol acetate; Methyl Cellosolve Acetate)
e) ethylene glycol dimethyl ether (EGDME)
f) ethylene glycol diethyl ether (EGDEE)
g) diethylene glycol dimethyl ether (DEGDME)
h) diethylene glycol diethyl ether (DEGDEE)
i) triethylene glycol dimethyl ether (TEGDME)

Source: UC Davis Environmental Health and Safety, "Safety Net"