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Possible Control Measures on Volatile Organic Compounds (VOC) Concentration Limits in Cutback Asphalt and Emulsified Asphalt

Discussion Paper and Considerations
for the Development of Possible Control Measures

Canada

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Possible Control Measures on Volatile Organic Compounds (VOC) Concentration Limits in Cutback Asphalt and Emulsified Asphalt

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1 Introduction

Environment Canada is considering a control instrument to establish volatile organic compounds (VOC) concentration limits for Cutback Asphalt and Emulsified Asphalt in Canada. Furthermore, Environment Canada wishes to establish a national approach for cutback asphalts and emulsified asphalt which would align, where possible, with United States Environmental Protection Agency and California Air Resource Board rules.

The purpose of this document is to provide background information and supporting rationale for the VOC concentration limits in the use of Cutback Asphalt and Emulsified Asphalt in Canada which would be the basis for possible control measures to be developed under the *Canadian Environmental Protection Act, 1999* (CEPA 1999).

2 Background

2.1 Volatile organic compounds (VOC)

Smog is an air quality issue that poses serious health and environmental concerns in Canada. Particulate matter (PM) and ground-level ozone[1] are the two principal components that comprise smog. PM and ozone can be transported by prevailing winds over long distances, making them not only a local urban issue but one that extends regionally in Canada into many smaller communities and rural areas.[2]

Ozone is formed by complex reactions between the precursor emissions, i.e. nitrogen oxides (NO_x) and VOCs, in the presence of sunlight. PM is released directly into the air by industrial activity and it is also formed in the atmosphere via complex chemical reactions involving the emissions of smog precursors, including sulphur dioxide (SO_2), NO_x, VOC and ammonia (NH_3). In order to reduce smog levels and improve air quality, it is necessary to control and reduce the direct PM and the precursor emissions of SO_2, NO_x, VOC and NH_3.

"Fine" PM or $PM_{2.5}$ and ozone are responsible for causing serious health problems for Canadians, primarily concerning the cardio-respiratory system. This includes thousands of premature deaths, hospital admissions and emergency room visits every year, leading to substantial economic costs. Recent studies have shown that air pollution is also associated with an increased risk of lung cancer and heart disease.

In addition to effects on human health, fine PM is also the main cause of reduced visibility which occurs when the particulate and other gases scatter and absorb light, creating "regional haze". Regional haze limits visibility and the distance one can see as well as degrading the colour, clarity, and contrast of scenes. The costs associated with poor visibility have been studied especially as they relate to loss of tourism revenue in areas where vistas are a key tourist attraction, such as in British Columbia's Greater Vancouver Area.[3]

Ozone's environmental effects include decreasing the productivity of some crops such as flowers and shrubs and a contribution to overall forest decline. Ozone can also damage synthetic materials, cause cracks in rubber, accelerate fading of dyes, and speed deterioration of some paints and coatings. As well, it damages cotton, acetate, nylon, polyester and other textiles.[4]

[1] Ozone is a gas that is found in different parts of the atmosphere. Ozone in the upper atmosphere, or stratosphere, is an essential gas that helps protect the Earth from the sun's harmful rays. Near the ground in the troposphere, ozone is harmful to both human health and the environment.

[2] Government of Canada. Government of Canada Five-year Progress Report: Canada-wide Standards for Particulate Matter and Ozone. January 2007. www.ec.gc.ca/Publications/default.asp?lang=En&xml=31B2381E-56BF-44CC-8D65-BF6FDB7125AD

[3] R. McNeill and A. Roberge. "The Impact of Visual Air Quality on Tourism Revenues in Greater Vancouver and the Lower Fraser Valley." Environment Canada. (2002)

[4] For further information, visit the website at www.ec.gc.ca/air/default.asp?lang=En&n=590611CA-1

2.2 Previous and current activities addressing VOCs

VOCs declared toxic under CEPA (1999)

On July 2, 2003, an Order[5] was published in the *Canada Gazette*, Part II adding ozone and PM precursors to Schedule 1 (List of Toxic Substances) of the *Canadian Environmental Protection Act, 1999* (CEPA 1999). Along with gaseous ammonia, nitric oxide, nitrogen dioxide and sulphur dioxide, VOCs were added to Schedule 1 due to their role as precursors in the formation of ground-level ozone and particulate matter. This listing of the precursors has given the Government of Canada the legislative authority under CEPA 1999 to control VOC emissions contributing to PM and ozone.

Federal Agenda for Reduction of Emissions of VOCs from Consumer and Commercial Products

In March 2004, the Ministers of the Environment and of Health published the *Federal Agenda for the Reduction of VOC Emissions from Consumer and Commercial Products*[6]. The 2004 Federal Agenda outlined the Government Canada's plan to develop regulations under CEPA 1999 to set VOC emission standard for specific consumer and commercial products. The first step to implement the 2004 Federal Agenda was completed with the commitment to develop three sets of regulations for consumer and commercial products, as announced in the April 26, 2007, Regulatory Framework for Air Emissions[7]. This was followed by the development in 2008 and publication in 2009 of two new regulations to limit the VOC content in automotive refinish products and architectural coatings, and continuing work on the third regulation, which is for certain consumer products in Canada.

Potential Additional Measures to Reduce Emissions of VOCs

In June of 2010, Environment Canada published a discussion paper on the proposed renewal of the *Federal Agenda for the Reduction of Volatile Organic Compounds (VOCs) from Consumer and Commercial Products*[8]. The discussion paper outlines a number of possible initiatives for the Government of Canada to take in order to reduce VOC emissions from consumer and commercial products during the year 2010 to year 2020 period. The "Emulsified and Cutback Asphalt" category has been identified as one of the possible areas for the development of reduction measures by the Government of Canada.

[5] www.gazette.gc.ca/archives/p2/2003/2003-07-02/html/sor-dors229-eng.html
[6] www.ec.gc.ca/cov-voc/default.asp?lang=En&n=424DFC9B-1
[7] www.ec.gc.ca/doc/media/m_124/toc_eng.htm
[8] www.ec.gc.ca/cov-voc/default.asp?lang=En&n=424DFC9B-1

3 Information on emulsified asphalt (EA) and cutback asphalt (CA)

Emulsified asphalt (EA) and cutback asphalt (CA) are used for a number of applications involving road construction. In preparing these products, asphalt cement is mixed with either a petroleum diluent to produce CA or with emulsifiers, water, and sometimes petroleum diluent to produce EA. Once the liquefied asphalt cement is applied during road construction, the diluent (petroleum solvent in the case of asphalt cutbacks and water in the case of asphalt emulsions) evaporates leaving the residual asphalt cement to perform its function.

3.1 Emulsified asphalt (EA)

Emulsified asphalt is produced by dispersing tiny globules of asphalt cement into water treated with a small quantity of emulsifying agent. The water comprises the continuous phase and the globules of asphalt cement make up the discontinuous phase. Several types and grades of EA are produced to serve specific applications. Based on the choice of emulsifying agent, EA products may be anionic or cationic. Several grades are available within each of these categories.

The RS, MS, SS, and QS designations refer to the emulsion setting rate of rapid, medium, slow and quick setting, respectively. The C preceding some of the EA grades designates a cationic asphalt emulsion. The *h* that follows certain grades designates harder base asphalt in the product. The *HF* preceding some of the grades indicates a high-float product as measured by a float test specified under ASTM D139. High-float products generally contain added petroleum diluent such as fuel oil which permits a thicker film to adhere to the aggregate and promotes stronger bonding of the asphalt to the aggregate. HF products are often used with dusty or dense graded aggregate.

The emulsifying agent keeps the globules apart until the EA is applied, at which point the globules separate from the water phase by neutralization of the electro-static charges or by water evaporation. When the phase separation begins, the emulsion is said to “break” and the asphalt droplets coalesce and produce a continuous film on the aggregate or pavement. The speed of the coalescence is faster in rapid setting EA and slower in slow setting products.

EA products are used for road construction and for many specialty applications. RS and CRS products are generally used in spray applications such as aggregate (chip) seals and other surface treatment methods. The medium-setting grades are more commonly used for mixing with coarse aggregate for plant or road mix. The slow-setting grades are designed for maximum mixing stability and are used with dense-graded aggregate containing high fines which are used in soil stabilization, asphalt surface mixes, slurry seal applications and tack and prime coat applications. Quick-setting grades are specialized emulsions used for quick set slurry applications.

3.2 Cutback asphalts (CA)

Cutback asphalts are classified into three groups depending on the relative speed of evaporation (Asphalt Institute, 2007):

- Rapid-curing (RC): asphalt cement combined with a light petroleum diluent of high volatility, generally with a boiling point similar to gasoline or naphtha. Grades include RC-30, RC-70, RC-250, RC-800, and RC-3000. The higher number indicates a higher viscosity.
- Medium-curing (MC): asphalt cement combined with a petroleum diluent of intermediate volatility, generally with a boiling point similar to kerosene. Grades include MC-30, MC-70, MC-250, MC-800, and MC-3000.
- Slow-curing (SC): asphalt cement combined with a petroleum diluent of low volatility, generally with a boiling point similar to fuel oil. Grades include SC-70, SC-250, SC-800, and SC-8000.

Cutback asphalts can be used with cold aggregates requiring little or no heat. They are most commonly used in road mixing operations, stockpile mixes, and spray applications such as prime, tack and seal coats.

3.3 Cutback asphalts and emulsified asphalt applications

EA and CA products are used in a variety of road construction applications. The applications include:

- Plant mix (open-graded, dense-graded, sand)
- Road mix (mixed in place), including mining with open- and dense-graded aggregate, sand, sandy soil)
- Surface treatment, including fog, sand, chip, sandwich, and slurry seals, micro surfacing and cape seal.
- Asphalt applications including prime and tack coat, dust palliative, crack filler
- Maintenance mix
- Cold in place recycling, and
- Full-depth reclamation

As noted, there are numerous grades of EA and CA products that can be used for a given application. The product grade selected for a given road construction project varies depending on project and performance objectives, agency specifications, as well as field conditions including available aggregate, weather, temperature, and performance.

For the purpose of this discussion paper, products with common applications have been grouped together as follows:

- **RS-1 RS-2, HFRS-2, HFRS-2h, CRS-1, CRS-2, CRS-2h:** rapid-set emulsified asphalt used primarily for surface treatment such as chip and sand seals. The "-2"means higher viscosity to prevent runoff. These products can also be used for fog seal, tack and dust palliative.

- **MS-1, MS-2, CMS-2, CMS-2h**: medium-set emulsified asphalt designed for use in open graded aggregate road and plant mix and are also used in cold in-place recycling**.** They are formulated not to break immediately upon contact with aggregate.
- **SS-1 and SS-1h, CSS-1, CSS-1h:** slow-set emulsified asphalt used in road mix and plant mix containing dense graded aggregate with high fines content, sand and sandy soil. They can also be used in liquid applications such as fog seal, prime coat, tack coat, dust palliative, and crack filler.
- **HF Surface Treatment Emulsions, including HF 100, 150, 200, and 250:** emulsified asphalt products used in seal coat operations including chip seal, sand seal, sandwich seal, and cape seal.
- **HF Mixing Grade, including HF 500M and –HR and HF 1000M and HR:** emulsified asphalt products typically used as plant and road mix comprised of dusty and dense graded aggregate.
- **RC-30, -70:** cutback asphalt typically used for prime and tack coat applications and driveway sealants.
- **MC-30, -70:** cutback asphalt typically used for prime coat applications.
- **MC-250, -800**: cutback asphalt used in road mix applications and in stockpile mixes and cold patching
- **SC-250, -800:** cutback asphalt used in road and plant mix applications for low volume roads, stock pile mixes, and cold patching.

3.4 Source of VOCs from emulsified and cutback asphalt

Different types of EA and CA products are associated with different emission factors. For example, low or no VOC emulsions, such as RS, CRS, SS, CSS, are estimated to have an emission factor of 0.5% whereas, the emission factor for the mixing grade emulsions are estimated to be 3%. Similarly, for CA, the emission factor for RC-30 is estimated to be 28%, whereas that for SC-250 is assumed to be 3.5%.

Table 1. Estimated Emission Factors for Product Groupings

Product Group	Emission Factor [9]
Emulsified Asphalt	
Low or No VOC Emulsions[1]	0.5%
High Float Surface Treatment Emulsions[2]	1.5%
High Float Mixing Grade Emulsions[3]	3.0%
Cutback Asphalt	
Rapid cure (RC)[4]	28%
Medium cure (MC)[5]	15%
Slow Cure (SC)[6]	3.5%

[1] includes CRS-1, CRS-1h, CRS-2, CRS-2h, CRS-2P, CQS-1h, CQS-1hP, RS-1, RS-1h, RS-2, RS-2h, RS-2P, SS-1, SS-1h, SS-1hh and equivalent products.
[2] includes RS-1M, HF100, HF100P,HF150, HF150P, HF150M, HF150MP, HF200, HF200P, HF250
[3] includes CMS-2, CMS-2h, CSS-1, CSS-1h, MS-2, MS-2h, HF500M, HF1000M
[4] includes RC-30,-70, driveway sealer, foundation coating, damp-proofing
[5] includes MC-30, -70, -250, -800
[6] includes SC-250, -800, and spec crude

[9] Technical and Economic Study on VOC Emissions from Emulsified and Cutback Asphalts in Canada, Environmental Health Strategies, October 2010.

4 Cutback asphalt and emulsified asphalt in Canada.

Here are some of the key observations that were found on the asphalt sector from an Environment Canada study[10] and end user survey sent to industry in 2010:

- Most products are sold in bulk to the industrial market for use during the summer season. Product prices range from $463/m3 to $850/m3 and vary by supplier and by product grade;
- Suppliers indicated that, generally, CA products are more costly that EA products due to price increases in crude oil over the last few years. Information provided in the "Asphalt Industry Study", published by the Freedonia Group[11], confirms this observation: the average unit price for CA is $US 304/ton versus $US 244/ton for EA products, reflecting a 25% higher cost for CA product. Suppliers expect the price of CA to continue to rise with the price of oil;
- Dealing with CA is more complicated: transport of CA requires Transport of Dangerous Goods (TDG) certification. The truck can't be left unattended because of CA's flammability;
- Typically, April to October is the demanding period for this sector;
- Suitable alternatives exist that can be used to replace the identified VOC emitting products. The alternatives are readily available, high performing, with comparable curing times during warmer weather. They are more environmentally friendly with fewer odours and no safety hazards. However, some alternatives are less suitable for use in colder weather (i.e. $<10^{o}C$) especially those that do not contain a petroleum based diluent;
- VOC emission reductions associated with the alternative (EA) products generally range from 50 to 100%;
- End-user training is a key factor in the performance of EA relative to CA products;
- Curing times of some EA alternatives may be slightly longer than their CA counterparts and curing may be more affected by colder weather;
- Canadian suppliers are currently manufacturing EA based alternatives with lower VOC emissions compared to CA. Their products are being applied in all regions of Canada in a variety of applications therefore, there would not be significant cost impacts should CA be replaced by EA alternatives;
- According to manufacturers / distributors of road building equipment, the use of EA alternatives (to CA) does not require additional or different equipment, for most applications (e.g, tack coat, prime coat on granular base, chip sealing). Some contractors spray CA one day then EA the next;
- Labour costs for application of EA or CA are expected to be roughly the same, though differences (for truck operators, highway flag persons) might result from EA's typically longer curing times: some contractors spray EA earlier in the day, and adjust times accordingly;
- Roughly equal volumes are required for a job whether applying EA or CA;

[10] Technical and Economic Study on VOC Emissions from Emulsified and Cutback Asphalts in Canada, Environmental Health Strategies, October 2010.
[11] Asphalt, Industry Study 2544, The Freedonia Group Inc., October 2009.

- In general, the price for CA is 5 to 30% higher than the alternative EA, which is consistent with the information provided in Asphalt Industry Study", published by the Freedonia Group[12], which estimates the average price to be about 25% higher;
- AC and AE products are generally not imported into or exported from Canada. The majority of what is consumed in Canada is manufactured in Canada.

4.1 Usage of cutback asphalt and emulsified asphalt in Canada.

Based on the Environment Canada Study[13] and 2010 end user survey the following information concerning usage of cutback asphalt and emulsified asphalt in Canada is summarized below:

- 301 kilotonnes (kt) of liquefied asphalt was used, of which;
  - 256 kt was emulsified asphalt;
  - 45 kt was cutback asphalt.

These quantities can also be broken down to represent each product group within the emulsified and cutback asphalt. It is important to indentify these as distinct or particular categories because each of these categories has particular VOC emission factors. Table 2 provides the values of the use of the different categories of emulsified and cutback asphalt.

Table 2. Emulsified and Cutback Asphalt Usage in Canada by Grouping, 2009 (T/y)

Emulsified Asphalt				Cutback Asphalt			
Low or no VOC Emulsions	HF Surface Treatment Emulsions	HF/MS/CMS Mixing Grade Emulsions	**Total**	RC	MC	SC	**Total**
76000	145500	34500	**256000**	10750	8900	25400	**45050**

The following observations are notable in Table 2:

- 85% of the market is in emulsified asphalt;
- Cutback asphalt only represents 15% of the market.

It is to be noted that:

- 66% of the use of Cutback asphalt comes from Alberta and Ontario;
- And Alberta and Ontario are also the biggest market for asphalt.

Based on the information in Table 2 and the emission factors in Table 1, the VOC emissions are calculated as follows in Table 3.

[12] Asphalt, Industry Study 2544, The Freedonia Group Inc., October 2009
[13] Technical and Economic Study on VOC Emissions from Emulsified and Cutback Asphalts in Canada, Environmental Health Strategies, October 2010.

Table 3. Emulsified and Cutback Asphalt VOC emission in Canada by Grouping, 2009 (T/y)

Emulsified Asphalt				Cutback Asphalt			
Low or no VOC Emulsions	HF Surface Treatment Emulsions	HF/MS/CMS Mixing Grade Emulsions	**Total**	RC	MC	SC	**Total**
380	2183	1035	**3598**	3010	1335	889	**5234**

We can observe the following interesting details from table 3:

- Cutback asphalt is responsible for 60% of the total emissions of VOCs
- Rapid cure group is responsible for 34% of the total emissions of VOCs.

4.2 Forecast of VOC emissions

The Freedonia Group[14] forecasts average annual growth rate (AAGR) of 2.6% for EA and 1.2% for CA. Applying the AAGRs to the VOC emissions from CA and EA, projected VOC emissions are articulated in Table 4.

Table 4. Forecast of VOC emissions based on Freedonia report projections

VOC emissions (tonnes/year)			
	Cutback Asphalt	**Emulsified Asphalt**	**Total**
2009	5234	3598	8832
2015	5623	4197	9820
2020	5968	4772	10740

[14] Asphalt, Industry Study 2544, The Freedonia Group Inc., October 2009

5 Actions in other jurisdictions

In Canada:

British Columbia; has regulated the use of CA between May 1 and September 30[15] (the ozone season). It also regulates the asphalt plants. In Ontario, Ontario Ministry of Transportation has phased out use of CA during the ozone season, meaning it favours emulsified asphalt in its procurement policies rather than cutback asphalt. In Québec, CA restrictions during the ozone season are specified by the "Ministère des Transports".

The California Air Resources Board (CARB):

The most stringent regulations in the US are those which have been promulgated by the California districts. In these districts, rules are specified for rapid cure CA, medium cure CA, slow cure CA, and EA. In most cases, medium- and slow- cure solvent content and/or boiling temperature are specified, while rapid cure is prohibited altogether. The percentage petroleum solvent content is typically specified for EA grades.

As an example here are parts of the Regulations for the San Luis Obispo County, Rule 420, explaining the requirement of the prohibitions. Most of the California districts have a similar approach on their controls of emulsified and cutback asphalts.

- A person shall not sell, offer for sale, use, or apply for paving, construction, or maintenance of parking lots, driveways, streets, or highways, any cutback asphalt material which contains more than 0.5 percent by volume VOCs which evaporate at 260 degrees Celsius (500 degrees Fahrenheit) or less.
- A person shall not sell, offer for sale, use, or apply for paving, construction, or maintenance of parking lots, driveways, streets, or highways, any emulsified asphalt material which contains more than 3.0 percent by volume VOCs which evaporate at 260 degrees Celsius (500 degrees Fahrenheit) or less.

The Ozone Transport Commission (OTC):

The OTC made recommendations as part of a suite of "Candidate Control Measures" for OTC states to demonstrate plans for the 8-hour ozone National Ambient Air Quality Standards (NAAQS). These recommendations included prohibiting the use of cutback asphalt during the ozone season, and limiting the use of emulsified asphalt during the ozone season to that which contains not more than 0.25% VOC from a 200 mL sample as determined using ASTM Method D244. OTC members include: Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia.

[15] www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/13_217_97#section18

The United States:

The US EPA Control Technique Guidelines recommends the use of emulsified asphalt instead of cutbacks, with some exemptions for outside the ozone season. It also set concentration limits for maximum oil distillate in emulsified asphalt.

With some minor variation, all of these states Wisconsin, Texas, Pennsylvania, Ohio, New York, New Jersey, Michigan, Massachusetts, Maryland, Indiana, Illinois have promulgated regulations which "prohibit the use of cutback asphalt entirely or with more than 5%-7% (by weight) petroleum solvent boiling at less than 500°F from May 1 to September 30 except for prime coating and for stockpile storage of patching mixes".

The United Kingdom or European Union:

There are no regulations in place at this time for CA or EA products.

In Asia:

Cutback asphalts have been phased out entirely in Japan, Singapore and South Korea and only asphalt emulsions are being used at this time.

6 Possible benefits of a control measure

Level Playing Field

A possible control measure could act to provide a "level playing field" for manufacturers. The regulatory approach provides assurance for purposes of business decision-making that all manufacturers must meet the same requirements for these products. Other types of control measure could possibly also influence the market and encourage VOC reductions on cutback asphalt products.

National Approach

Although smog is a regional issue, with areas of concern including the Windsor-Quebec corridor in Ontario and Quebec, the lower mainland of British Columbia and the Atlantic Provinces, it would be extremely difficult to implement control measures on asphalt cutback and emulsified asphalt developed on a regional or provincial basis. Such an approach could result in different limit requirements in different regions. Therefore a national approach should be considered while developing control measures.

Alignment with the U.S.

One of the intentions of a possible control measure is to align where possible with regulations existing in the U.S. EPA and CARB. The U.S. has a history of establishing regulatory limits on the asphalt cutback products. Aligning the possible Canadian measures with existing measures in the U.S. would facilitate consistency in product requirements in the North American market.

VOC reductions

Given that VOC emissions are precursor to ground ozone and PM, continued action on the reduction of VOC emissions is required to contribute to improving air quality. While investigating which control measure should be developed it is important to keep this in mind. The potential reduction in VOC emissions is estimated at more than 3 kilotonnes and up to almost 5 kilotonnes depending on the choice of reduction strategies.

Health and environmental benefits

Reductions in emissions resulting from measures taken generate environmental and health benefits that could be translated into economic terms. For example health benefits could be translated into avoided costs to the health care system as well as improved individual well-being.

7 Considerations for a possible control measure

Intent

The intent could be to control manufacturing, sales, offer for sale, importations of asphalt cutback and possibly emulsified asphalt materials for the paving, construction and maintenance of streets, highways, parking lots and driveways. The measure could apply to manufacturers, processors, wholesale distributors, importers of asphalt cutback and emulsified asphalt.

By controlling the asphalt cutbacks in a similar fashion as the US EPA or CARB, we could significantly reduce the VOC emission from this industry. Adoption of the CARB regulations offers the greatest potential reduction of VOC emissions, possibly reducing overall emissions by up to 90%. The requirements of these Regulations would have to be verified to see if they are directly applicable in Canada.

Cutback Asphalt Categorization

The control measure would apply to asphalt cutback of rapid, medium and slow cure type. Cutback asphalts are paving grade asphalts liquefied with petroleum distillate. Cutbacks are also further defined by the American Society for Testing and Materials (ASTM) specification as follows: rapid cure type (ASTM Method D 2028), medium cure type (ASTM method D 2027) and slow cure type (ASTM method D 2026).

Samples of emulsified asphalt containing VOC can be analyzed in accordance with ASTM Distillation Method D 244.

Monitoring and Reporting

It is anticipated that by taking a concentration limit approach to controlling VOC emissions from cutback asphalt and emulsified asphalt products, monitoring or reporting would not be required.

Economic considerations

Since an alternative is already available, and the cost of this alternative is from 5-30% lower than the cutback asphalt related product, and considering that the same machinery can be used for either product, it is believed that any control measure would not have a negative economic impact on industry.

Effective Date

The effective date for the possible control measure will be determined through the consultation process. A phase-in of different VOC concentration limits could also be an option.

8 Potential VOC reduction strategies and their impacts

8.1 Possible VOC reduction strategies for emulsified asphalt:

1. Limit the volatile portion to ≤3% at ≤500^{o}F as determined by ASTM D244 (California);
2. No higher than 7 percent oil distillate as maximum allowable solvent content in emulsified asphalt, as determined by ASTM distillation test D244; or
3. Allow use of certain grades or applications of emulsified asphalt with the following maximum solvent contents as determined by ASTM D244:
   - 3 percent limit for seal coats used in early spring or late fall;
   - 3 percent limit when chip seals used with aggregate that is dusty or dirty;
   - 8 percent limit when mixing with open graded aggregate that is not well washed; and
   - 12 percent limit when mixing with dense graded aggregate.

VOC reductions are summarized in Table 5.

Table 5. Estimated VOC Reductions Associated with VOC Reduction Strategies for Emulsified Asphalt

Estimated VOC Emissions (T/y)				
Option	**Baseline**	**Reduction**	**Calculated Emissions**	**% Réduction**
Option 1	3598	Minimal	3598	Minimal
Option 2	3598	Minimal	3598	Minimal
Option 3	3598	Minimal	3598	Minimal

Emulsified asphalt impacts on suppliers and end-users

Most EA products already meet the requirements of Options 1, 2, and 3, are readily available, technically feasible and are currently be used in a variety of applications across Canada, with good performance at a reasonable price. Reductions in VOC emissions associated with the requirements of Options 1, 2, and 3 are expected to be minimal as most products are already compliant with Option 1.

Impacts on suppliers

EA products that may not meet the requirements of Option 1 include:

- HF mix grade products, which contain between 2 and 5 % volatiles;
- Some emulsified prime products may contain 5-15% VOCs.

These products would require reformulated by substitution with a diluent that has a narrower upper boiling point range. According to information provided by suppliers, reformulation efforts and costs are not expected to be onerous to the manufacturer.

Impacts on end-users

End-users currently using EA in road construction applications are not expected to be impacted by these requirements.

8.2 Possible VOC reduction strategies for Cutback Asphalt:

1. Prohibit use of cutback asphalt during ozone season except for prime, stockpile, and patching (several U.S. states);
2. Prohibit use of asphalt cutbacks with more than 0.5% (California) by weight of petroleum solvent boiling at less than 500^{o}F (ASTM D402);
3. Prohibit use of asphalt cutbacks with more than 5% (Massachusetts, Wisconsin) by weight of petroleum solvent boiling at less than 500^{o}F (ASTM D402).

VOC reductions are summarized in Table 6.

Table 6. Estimated VOC Reductions Associated with VOC Reduction Strategies for Cutback Asphalt

Estimated VOC Emissions (T/y)				
Option	**Baseline**	**Reduction**	**Calculated Emissions**	**% Réduction**
Option 1	5234	3193	2041	61%
Option 2	5234	4711	523	90%
Option 3	5234	3926	1308	75%

Cutback Asphalt- Impacts on Suppliers and End-Users

Impacts on suppliers

With the exception of the 0.5% requirement for SC under Option 2, the requirements of all three options will not have a substantial impact on suppliers as most already manufacture suitable EA substitutes that are technically feasible and readily available. Loss of sales of CA associated with these options will be replaced by increased sales of EA alternatives.

Impacts on refineries that sell CA are expected to be minimal as the raw ingredients used in making the products are in high demand in the manufacture of other products.

Impacts on end-users

It is not possible to estimate the cost differences associated with the use of alternative products because costs depend substantially on specific project objectives and field conditions. In some instances, costs may be somewhat higher while in other they may be lower. In general, the use of EA alternatives is cost competitive with CA products and does not require additional investment in capital for application equipment.

End users who are not familiar with alternative products will require training before they will become comfortable with alternative applications.

Under Options 1 and 2, the use of Spec Crude and SC-250 as dust suppressant would require replacement with alternative products such as calcium chloride or EA alternatives, which may result in higher costs for this application.

9 Path Forward

9.1 Proposed recommendation

Alignment with California rules appears to offer the greatest potential for VOC emission reductions. The impact on suppliers and end users also appears to be negligible. Therefore, the following proposal is recommended:

Emulsified Asphalt:

- A person shall not manufacture, import, sell, or offer for sale any emulsified asphalt material which contains more than 3.0 percent by volume VOCs which evaporate at 260 degrees Celsius (500 degrees Fahrenheit) or less as determined by ASTM D244. (Based on CARB)

Cutback Asphalt:

- A person shall not manufacture, import sell, or offer for sale, any cutback asphalt material which contains more than 0.5 percent by volume VOCs which evaporate at 260 degrees Celsius (500 degrees Fahrenheit) or less as determined by ASTM D402. (Based on CARB)

9.2 Consultation Meeting

Environment Canada will be holding a consultation meeting concerning the possible approaches on VOC emission reductions in CA and EA in Canada. The purpose of the meeting is to assess the possibilities for introducing measures for establishing Volatile Organic Compounds (VOCs) concentration limits in CA and EA by:

1. Presenting background information gathered to support a possible control measure;
2. Obtaining feedback on elements of possible control strategies and;
3. Clarifying the next steps in the process.

Since the focus of this possible control measure is for cutback asphalt and emulsified asphalt, stakeholders in the consultation process may include Canadian manufacturers, importers and sellers of asphalt products, associations representing manufacturers, importers, sellers and applicators of coatings including: Canadian Technical Asphalt Association (CTAA). Other stakeholders may include government departments and environmental non-governmental organizations (ENGOs). The meeting is scheduled for Tuesday March 27, 2012, in Toronto.

During the consultation session, a number of questions will be raised and stakeholders will be encouraged to provide any feedback or comments they may have.

Questions to be addressed during the consultation include:

- Why is cutback asphalt still in the Canadian market place since an alternative is already available at lower cost, that is less dangerous for human health, the environment and that doesn't require permits for the transport of dangerous goods?

- It seems that emulsions have taken over the asphalt market and that cutbacks may be on their way out of the market, would it be plausible to assume that cutback will disappear from the Canadian market place? Or will Cutback market keep on growing in the future?
- Can emulsified asphalt function in every application that cutback asphalt has been used for? If not is it foreseeable that in the near future emulsified asphalt will be able to replace cutback in all applications?
- What concerns, if any, would you have if Canada were to adopt similar controls as CARB for cutback asphalt and emulsified asphalt?

There are two control measures that are proposed to manage the risk associated with the cutback asphalt and emulsified asphalt products. The following risk management tools will be considered and discussed during the consultation:

- Regulation - to set VOC concentration limits in cutback asphalt and emulsified asphalt products;
- Code of Practice – to set VOC concentration limits in cutback asphalt and emulsified asphalt products.

Feed back on the possibilities:

- What are the "pros" or strengths with each approach?
- What are the "cons" or weaknesses?
- Is there a preferred option?

Next Steps

- How to continue the dialogue?

Stakeholders will be encouraged to provide written comments on the possible control measure following the consultation process. After reviewing the comments, if a regulation would be chosen as possible control measure, then a draft regulation and the RIAS will be published in *Canada Gazette*, Part I. The RIAS provides a clear explanation of the regulation, its purpose, the analysis substantiating it and its expected impacts. This publication would be followed by a sixty day public comment period during which stakeholders would have an opportunity to provide comment on the proposed regulation. Publication of the final regulation in *Canada Gazette*, Part II would follow the receipt of stakeholder comments.

10 Contact information

For further information on this discussion document or to find out how to get involved in the public consultation activities for the possible control measure, please contact:

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