captg

Canadian Airfield Pavement Technical Group

Pavement Preservation using Asphalt Emulsions

September 9th, 2013

Ottawa, Ontario

Walker Industries

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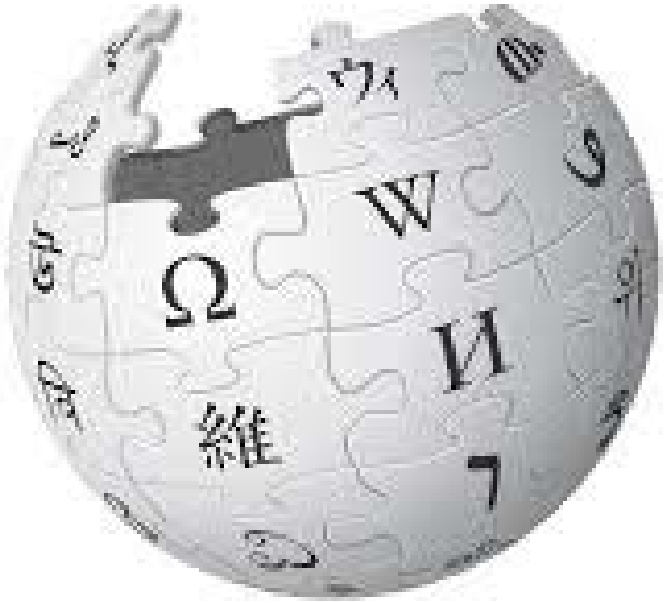
Acknowledgments



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Complicate

com·pli·cate /ˈkämpliˌkāt/

Verb

Make (something) more difficult or confusing by causing it to be more complex.

Introduce complications in (an existing condition): "smoking may complicate pregnancy".

Synonyms

perplex - entangle - involve - tangle

Complicate

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Simplify

To make easier to understand.

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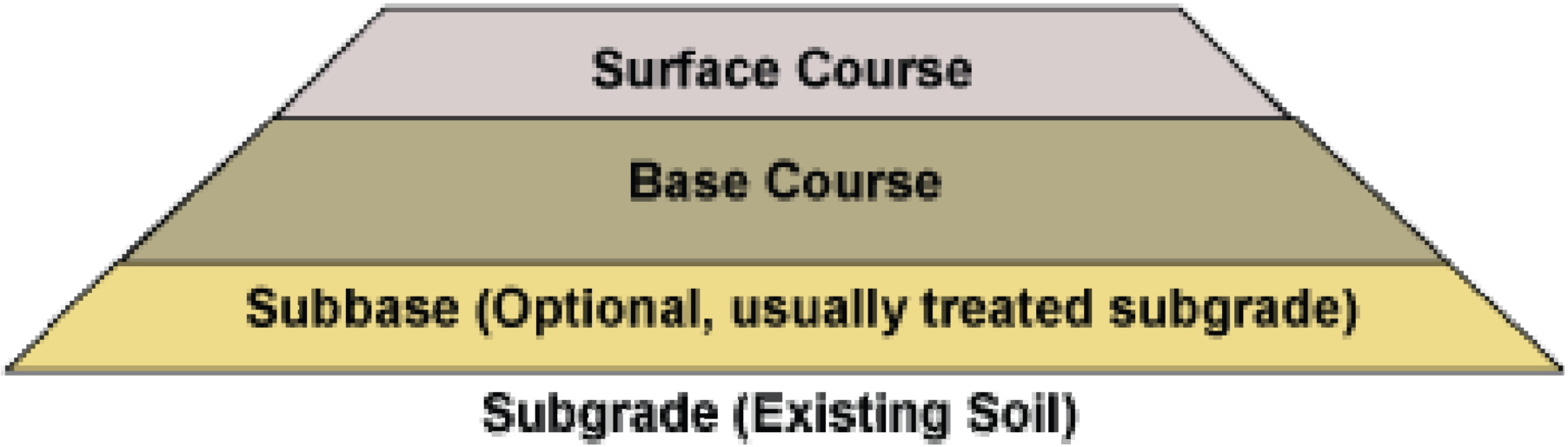
Pavement

the durable surface material laid down on an area intended to sustain vehicular or foot traffic, such as a road or walkway. In the past, gravel road surfaces, cobblestone and granite setts were extensively used, but these surfaces have mostly been replaced by asphalt or concrete.

Pavement



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Pavement

an American indie rock band that formed in Stockton, California in 1989. The group mainly consisted of Stephen Malkmus (vocals and guitar), Scott Kannberg (guitar and vocals), Mark Ibold (bass), Steve West (drums) and Bob Nastanovich (percussion and vocals). Initially conceived as a recording project, the band at first avoided press or live performances, while attracting considerable underground attention with their early releases. Gradually evolving into a more polished band, Pavement recorded five full length albums and nine EPs over the course of their decade-long career, though they disbanded with some acrimony in 1999 as the members moved on to other projects. In 2010, they undertook a well-received reunion tour.

Pavement

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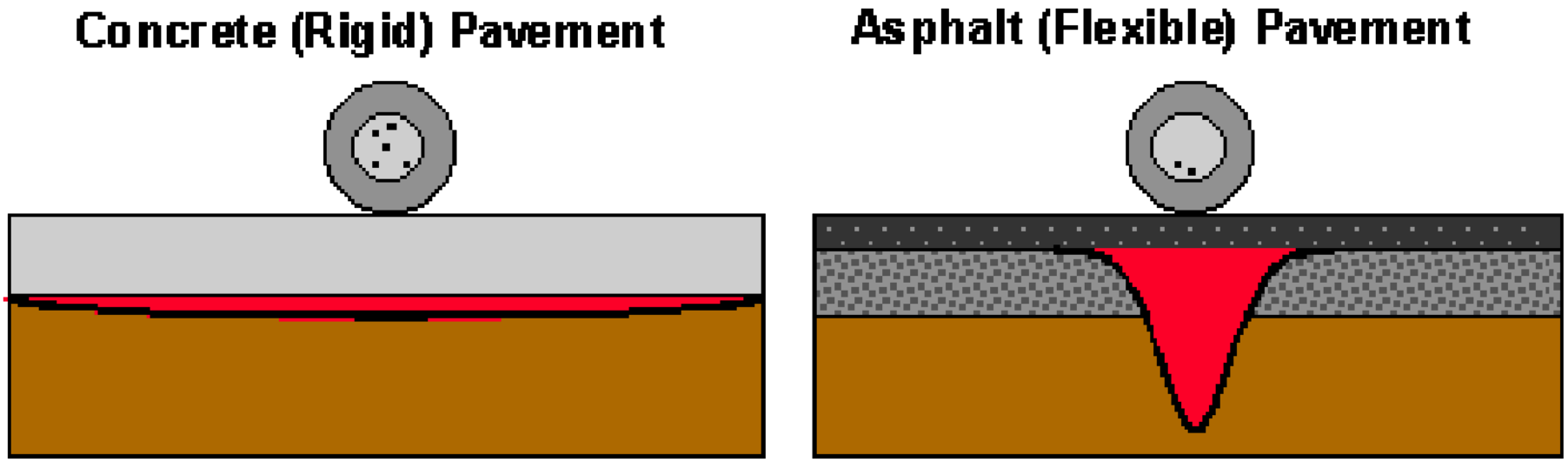
Rigid Pavements

Rigid pavements are so named because the pavement structure deflects very little under loading due to the high modulus of elasticity of their surface course. A rigid pavement structure is typically composed of a PCC surface course built on top of either (1) the subgrade or (2) an underlying base course. Because of its relative rigidity, the pavement structure distributes loads over a wide area with only one, or at most two, structural layers

Flexible Pavements

Flexible pavements are so named because the total pavement structure deflects, or flexes, under loading. A flexible pavement structure is typically composed of several layers of material. Each layer receives the loads from the above layer, spreads them out, then passes on these loads to the next layer below. Thus, the further down in the pavement structure a particular layer is, the less load (in terms of force per area) it must carry

Rigid Pavements Flexible Pavements



Concrete acts more like a bridge over the subgrade. Inch-for-inch much less pressure is placed on materials below concrete than asphalt pavements.

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Aggregate

Aggregate, is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. Aggregates are the most mined materials in the world.

Aggregate

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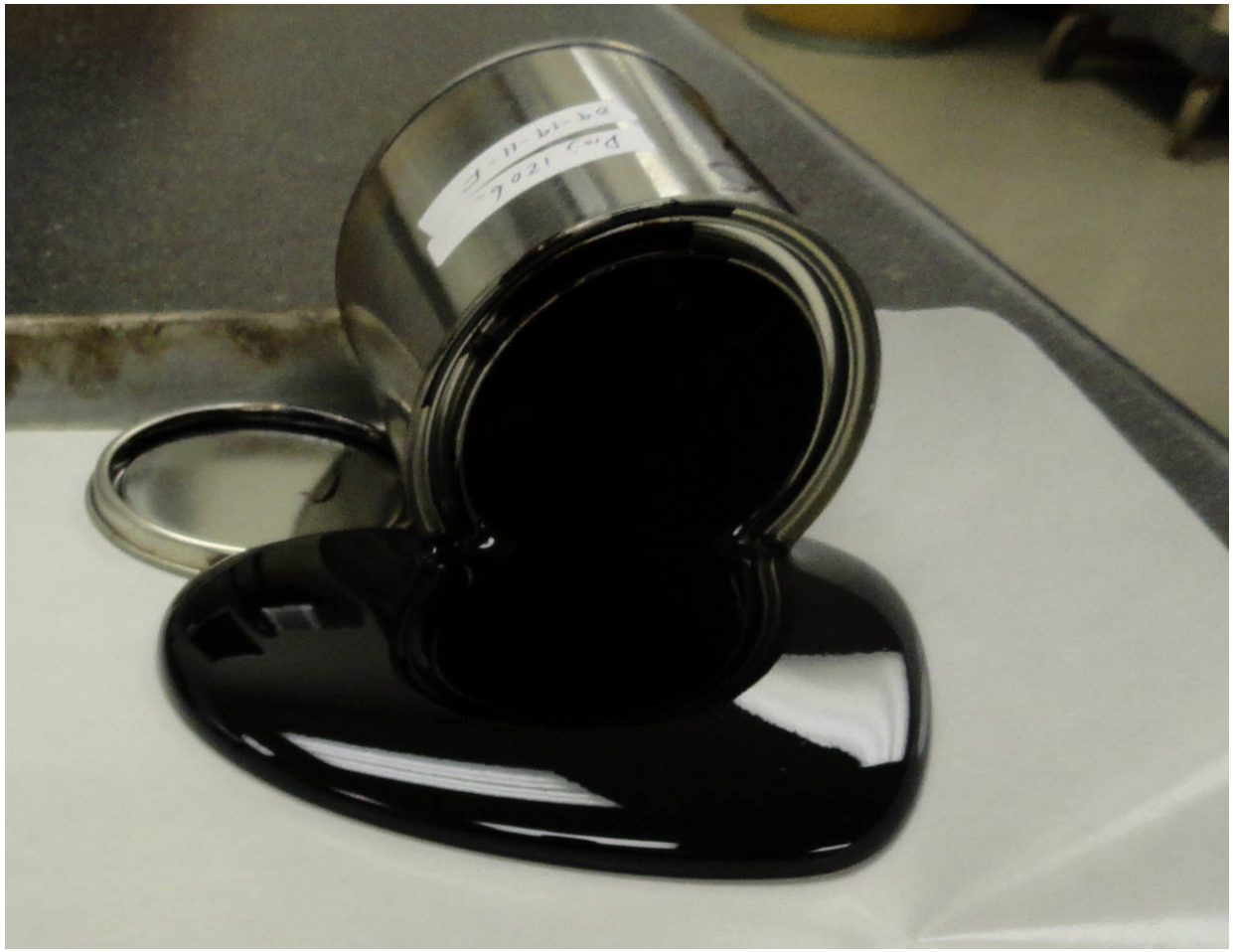
Asphalt Cement

Asphalt US ˈ/ˈæsfɔːlt/ or UK /ˈæʃfælt/[1][2] also known as **bitumen** /bɪˈtuːmən, baɪ-/,[3][4] is a sticky, black and highly viscous liquid or semi-solid form of petroleum. It may be found in natural deposits or may be a refined product; it is a substance classed as a pitch.

Asphalt Cement



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Hot Mix Asphalt

Hot mix asphalt (commonly abbreviated as HMA) is produced by heating the asphalt cement to decrease its viscosity, and drying the aggregate to remove moisture from it prior to mixing. Mixing is generally performed with the aggregate at about 300 °F (roughly 150 °C)

Hot Mix Asphalt

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Asphalt Concrete

Asphalt concrete is a composite material commonly used in construction projects such as road surfaces, parking lots, and airports. Asphalt concrete consists of asphalt (used as a binder) mixed with mineral aggregate and then laid down in layers and compacted on top of a granular base, completing an asphalt pavement

Asphalt Concrete

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Pavement Preservation

The term ***"Pavement Preservation Programs and Activities"*** means programs and activities employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety, and meet user expectations".

Source: Section 1507 of Public Law 112-141, ***"Moving Ahead for Progress in the 21st Century" Act*** (MAP-21).

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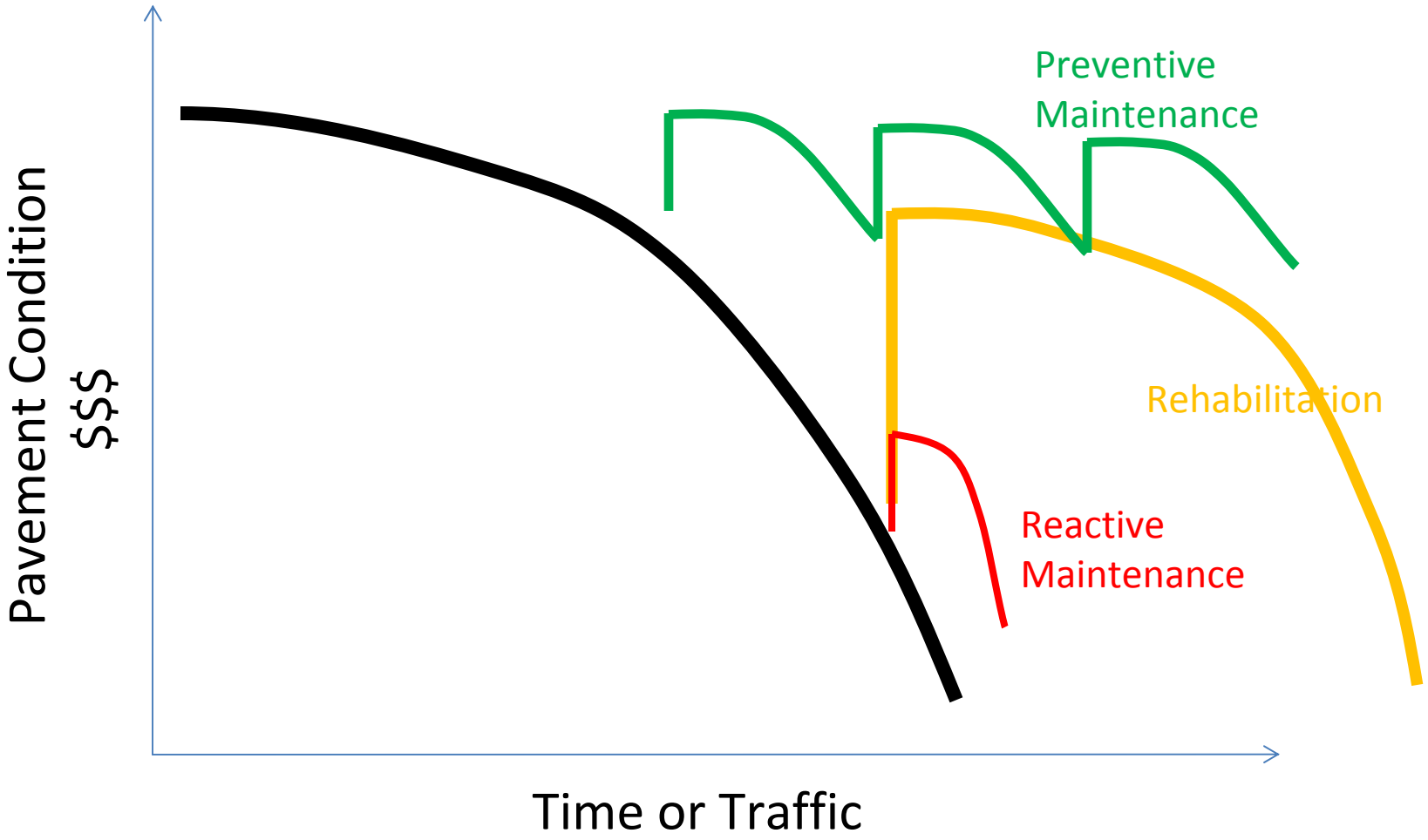
Pavement Preservation



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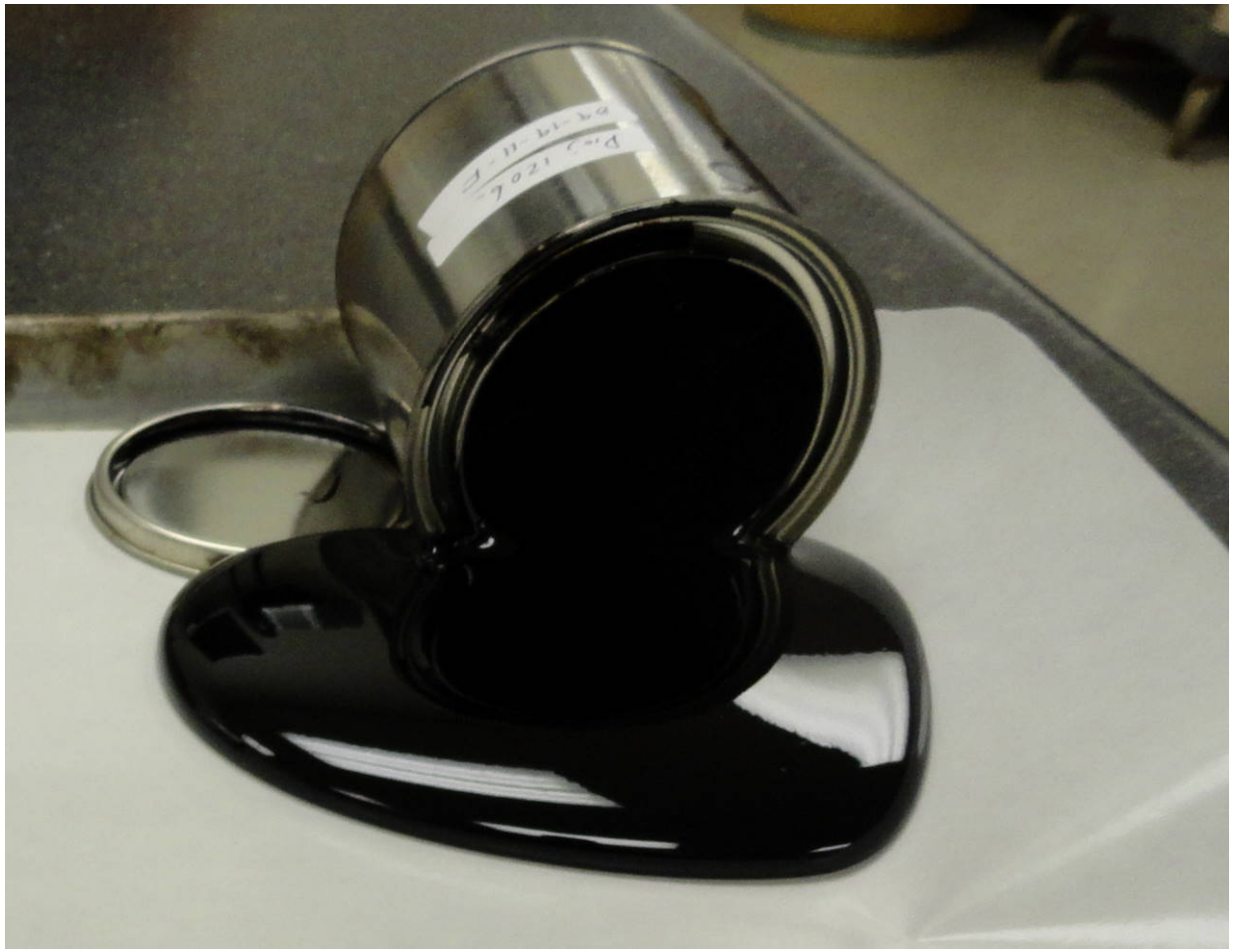
Asphalt Cement



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Asphalt Emulsion

Asphalt mixtures with water to turn the asphalt/bitumen into an emulsion. Asphalt emulsions contain up to 70% asphalt/bitumen and typically less than 1.5% chemical additives. There are two main types of emulsions with different affinity for aggregates, cationic and anionic.

Asphalt Emulsion

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Polymer modification

Improves Performance

- Stiffer at high temperatures
- Less brittle at low temperatures
- More adhesive
- Less susceptible to moisture damage
- Less susceptible to oxidization/aging
- More elastic – fatigue resistant

Engineer

Someone who solves a problem you didn't know you had in a way you don't understand.

An **engineer** is a professional practitioner of engineering, concerned with applying scientific knowledge, mathematics, and ingenuity to develop solutions for technical problems. Engineers design materials, structures, and systems while considering the limitations imposed by practicality, regulation, safety, and cost

Engineer

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Aggregate

Asphalt Emulsion

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More Engineers

An engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude infinite strings of incomprehensible formulas calculated with micrometric precision from vague assumptions which are based on debatable figures taken from inconclusive experiments carried out with instruments of problematical accuracy by persons of questionable mentality and doubtful reliability for the avowed purpose of annoying and confusing a hopelessly chimerical group of esoteric fanatics referred to altogether too frequently as technicians.

Specifications

Aggregates

TABLE 2
Physical Requirements

MTO Laboratory Test	MTO Test No.	Class 1 (Note 1)	Class 2 (Note 1)	Class 3 (Note 1)	Class 4	Class 5 (Note 1)	Class 6 (Note 1)
Loss by Washing, Pass 75 µm sieve, % maximum	LS-601	1.3 (Note 2)	--	1.3 (Note 2)	--	1.3 (Note 2)	1.3 (Note 2)
Absorption, % maximum	LS-604	1.75	--	2.0	--	1.75	1.75
Unconfined Freeze-Thaw Loss, % maximum (Note 3)	LS-614	6	15	6	--	6	6
Percent Crushed, % minimum	LS-607	60	60	60	--	60	60
Flat and Elongated, % maximum	LS-608	20	20	20	--	20	20
Petrographic Examination, % non-carbonate of retained 4.75 mm (minimum)	LS-609	60 (Note 4)	60 (Note 4)	60 (Note 4)	--	60 (Note 4)	60 (Note 4)
Micro-Deval Abrasion (Coarse Aggregate), % loss maximum	LS-618	17	25	17	--	17	17
Micro-Deval Abrasion (Fine Aggregate), % loss maximum	LS-619	--	30	--	25	--	--
Plasticity Index, maximum	LS-704	--	0	--	0	--	--
Alternative Requirement to Unconfined Freeze-Thaw Loss, LS-614							
Magnesium Sulphate Soundness (coarse aggregate), % max loss	LS-606	12	15	12	--	12	12

Notes:
1. Class 1, 2, 3, 5, and 6 physical requirements noted above are for the material retained on the 4.75 mm sieve, except for lab test LS-619.
2. When control charts (n > 20) are used for LS-601, the average value shall not exceed the specification maximum, 1.3%, with no single value greater than 1.7%. When quarried rock is used as a source of coarse aggregate, a maximum of 2.0% passing the 75 µm sieve shall be permitted. When control charts (n > 20) are used for LS-601 for quarried rock, the average value shall not exceed the specification maximum, 2.0%, with no single value greater than 2.4%.
3. The requirements shall be waived by the Owner when the aggregate meets the alternative unconfined freeze-thaw requirements (LS-614).
4. This requirement is applicable to surface course aggregates in the area to the north and west of a boundary defined as follows:

   The north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph's Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay, excluding Manitoulin Island, along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly along a highway to Calabogie and easterly to Arnprior and the Ottawa River.

   When the coarse aggregate for surface course is obtained from a gravel pit or quarry containing more than 40% limestone and dolostone in the retained 4.75 mm portion of the coarse aggregate, then blending with aggregate of non-carbonate rock type shall be required. The blend shall be such as to increase the non-carbonate rock type content to 60% minimum of the retained 4.75 mm portion, as determined by petrographic examination, LS-609. When the coarse aggregate for surface treatment is obtained from a non-carbonate source, blending with carbonate rocks, limestone and dolostone, shall not be permitted. The method of blending shall be such as to produce uniform blending and shall be subject to approval by the Owner. In cases of dispute the acid insoluble residue test shall be used, LS-613, with a minimum acid insoluble residue of 60%.

Asphalt Emulsion

TABLE 8
Polymer-Modified Emulsified Asphalts

Requirements	Type	Anionic				Cationic		High Float								Test Method
	Grade	RS-1P		RS-2P		CRS-2P		HFMS-2P(ON)		HF-100SP		HF-150SP		HF-150MP		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Tests on Emulsion																
Viscosity, Saybolt Furol Seconds: at 25 °C at 50 °C		20 --	100 --	-- 75	-- 300	-- 75	-- 400	-- 50	-- 300	-- 35	-- 150	-- 35	-- 150	-- 50	-- --	LS-219
Residue by Distillation to 204.4 °C, % by Mass		55	--	60	--	65	--	62	--	62	--	62	--	62	--	LS-216 LS-226
Settlement, 24 h, % by Mass		--	1	--	1	--	1	--	--	--	--	--	--	--	--	LS-221
Demulsibility, % - 35 ml, 0.02 N $CaCl_2$ - 35 ml, 0.8% Dioctyl Sodium Sulfo-Succinate Solution - 50 ml 0.1 N $CaCl_2$		60 -- --	-- -- --	60 -- --	-- -- --	-- 40 --	-- -- --	-- 40 --	-- -- --	-- -- 75	-- -- --	-- -- 75	-- -- --	-- -- --	-- -- --	LS-220
Oil Portion of Distillate, % by Volume/Mass		--	--	--	--	--	--	0.5	3	0.5	4	0.5	4	1	6	LS-217
Sieve Test, % by Mass		--	0.20	--	0.20	--	0.2	--	0.10	--	0.10	--	0.10	--	0.10	LS-223
Particle Charge		Negative or Neutral				Positive		Negative		--		--		--		LS-218
Coating Test		--		--		--		Pass		Pass		Pass		Note 1		LS-224
Storage Stability, 24 h, % by Mass		--	--	--	--	--	--	--	--	--	1.5	--	1.5	--	1.5	ASTM D 6930
Tests on Residue																
Penetration (at 25 °C, 100 g, 5 s), 0.1 mm		100	200	100	200	100	250	90	200	90	150	150	250	150	250	LS-200 LS-226
Solubility in Trichloroethylene, % by Mass (Note 2)		97.5	--	97.5	--	97.5	--	97.5	---	97.5	--	97.5	--	97.5	--	LS-204
Float Test at 60 °C, s		--	--	--	--	--	--	1200	--	1200	--	1200	--	1200	--	LS-226 LS-207
Ash Content, % by Mass of Residue (Note 2)		--	1.0	--	1.0	--	1.0	--	1.0	--	1.0	--	1.0	--	1.0	ASTM D 2939
Elastic Recovery (at 10 °C), %		55	--	55	--	55	--	55	--	55	--	50	--	50	--	LS-208
Force Ductility at 800% Elongation, 5 cm/min. Pull Rate at 4 °C, kg		0.5	--	0.5	--	0.5	--	0.5	--	0.5	--	--	--	--	--	LS-205

Notes:
1. Follow LS-224, except that the mixture of aggregate and emulsified asphalt shall be mixed vigorously for 5 min. then allowed to stand for 3 hours after which the mixture shall be capable of being mixed an additional 1 min. The mixture shall then be rinsed twice with approximately its own volume of tap water, without showing appreciable loss of bituminous film. After the second mixing the aggregate shall be at least 90% coated.
2. The ash content shall be determined when the manufacturer indicates that the polymer additive is not soluble in trichloroethylene.

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Endless Possibilities ??

Pavement Condition	Parameters	Thin Hot Mix Overlay	Bonded Wearing Course	Fog Seal	Sand Seal	FiberMat™ Reinforced Chip Seal	Chip Seal	Slurry Seal	Micro-Surfacing	FiberMat™ Reinforced Interlayer (SAMI)[2]	Cold Recycled Mix[2]	Open Graded Mix
Traffic (ADT)[1,2]	<1000	●	●	●	●	●	●	●	●	●	●	●
	1000 - 4000	●	●	●	●	●	●	●	●	●	●	●
	>4000	●	●	◖	○	●	●	◖	●	●	◖	●
Ruts	<5mm	●	●	●	●	◖	●	●	●	◖	◖	◖
	5mm - 25mm	◖	◖	○	◖	○	◖	◖	●	○	◖	◖
	>25mm	○	○	○	○	○	○	○	◖	○	◖	◖
Cracking Fatigue[3]	Low	●	●	○	●	●	●	◖	◖	●	●	●
	Moderate	●	●	○	◖	●	●	○	○	●	●	●
	High	◖	◖	○	○	◖	○	○	○	◖	◖	◖
Cracking Longitudinal	Low	●	●	◖	●	●	●	◖	◖	●	●	●
	Moderate	●	●	○	◖	●	●	○	○	●	●	●
	High	◖	◖	○	○	◖	○	○	○	◖	◖	●
Cracking Transverse	Low	●	●	◖	●	●	●	●	●	●	●	●
	Moderate	●	●	○	◖	●	●	◖	◖	●	●	●
	High	◖	○	○	○	◖	○	○	○	◖	◖	●
Surface Conditions	Dry	●	●	●	●	●	●	◖	●	●	◖	●
	Flushing	●	●	○	◖	●	●	◖	●	●	◖	●
	Bleeding	●	◖	○	○	◖	◖	◖	◖	◖	◖	●
	Concrete	●	●	○	○	◖	○	○	◖	◖	○	○
Ravelling	Low	●	●	●	●	●	●	●	●	●	○	●
	Moderate	●	●	◖	●	◖	●	●	●	◖	○	●
	High	●	●	◖	◖	◖	◖	◖	◖	◖	○	●
Potholes	Low	●	●	○	●	○	●	●	●	○	○	●
	Moderate	●	◖	○	◖	○	◖	○	◖	○	○	●
	High	●	◖	○	○	○	○	○	○	○	○	◖
Texture	Rough	●	●	○	◖	●	◖	●	●	●	◖	◖
Ride	Poor	●	◖	○	○	●	○	◖	◖	○	◖	◖
Drainage	Poor	○	●	○	○	○	○	○	○	○	◖	●
Snow Plow Damage	High	●	●	●	●	●	◖	●	●	○	○	○
Skid Resistance	Low	●	●	○	●	●	●	●	●	n/a	n/a	◖

● = Recommended

◖ = Provisionally Recommended (dependent on road conditions)

○ = Not Recommended

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Chip Seal

- Chip Seal
- Surface Treatment
- Tar & Chip
- Spray application of asphalt emulsion
- Covered with aggregate
- Rolling to seat the aggregate
- Sweeping

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Chip Seal

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Chip Seal

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Chip Seal

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Chip Seal

Pros

- Portable
- Easy to apply (fast)
- Traffic ready within minutes
- Inexpensive
- Any aggregate
- Numerous contractors

Cons

- Loose aggregate
- Little strength

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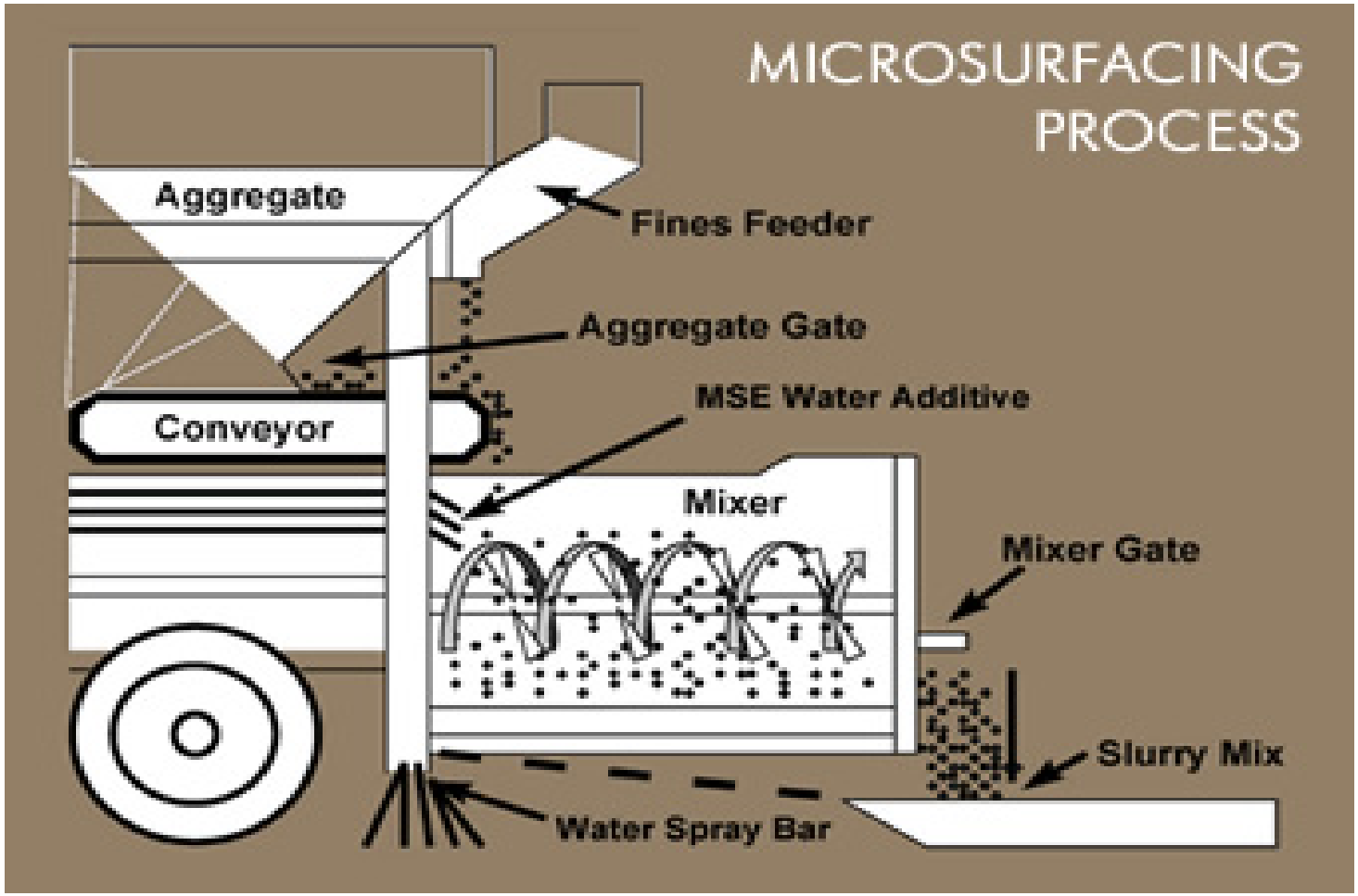
Slurry Seal/Micro-Surfacing

Slurry seal consists of graded aggregate, an asphalt emulsion binder, fillers (such as Portland cement or hydrated lime), blended together according to a laboratory's design-mix formula. It cures from a thick fluid to a hard wearing surfacing for pavement preservation, adhering to an existing hard surface.

Micro-surfacing is a cold mixed asphalt as well. It consists of a high quality graded aggregate, a polymer modified asphalt emulsion binder, fines and additives. It is a hard wearing surfacing for pavement preservation and rehabilitation.

While conventional slurry seal is used around the world as an economical treatment for sealing and extending the service life of roads, micro-surfacing has added capabilities, thanks to the use of higher quality, carefully monitored materials.

Slurry Seal/Micro-Surfacing



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Slurry Seal/Micro-surfacing

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Slurry Seal/Micro-surfacing

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Slurry Seal/Micro-surfacing

Pros

- Portable
- Early traffic ready
- Relatively inexpensive
- No loose aggregate
- No rolling necessary
- Nice black finish
- Ability to fill ruts

Cons

- Minimal structural strength
- Select aggregates
- Limited number of contractors

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FIBERMAT

- Patented process that incorporates fiberglass strands, polymer-modified asphalt emulsion and aggregates.
- Provides additional tensile strength and crack resistant properties.
- Delays reflective cracking
- Placed as a wearing surface or interlayer

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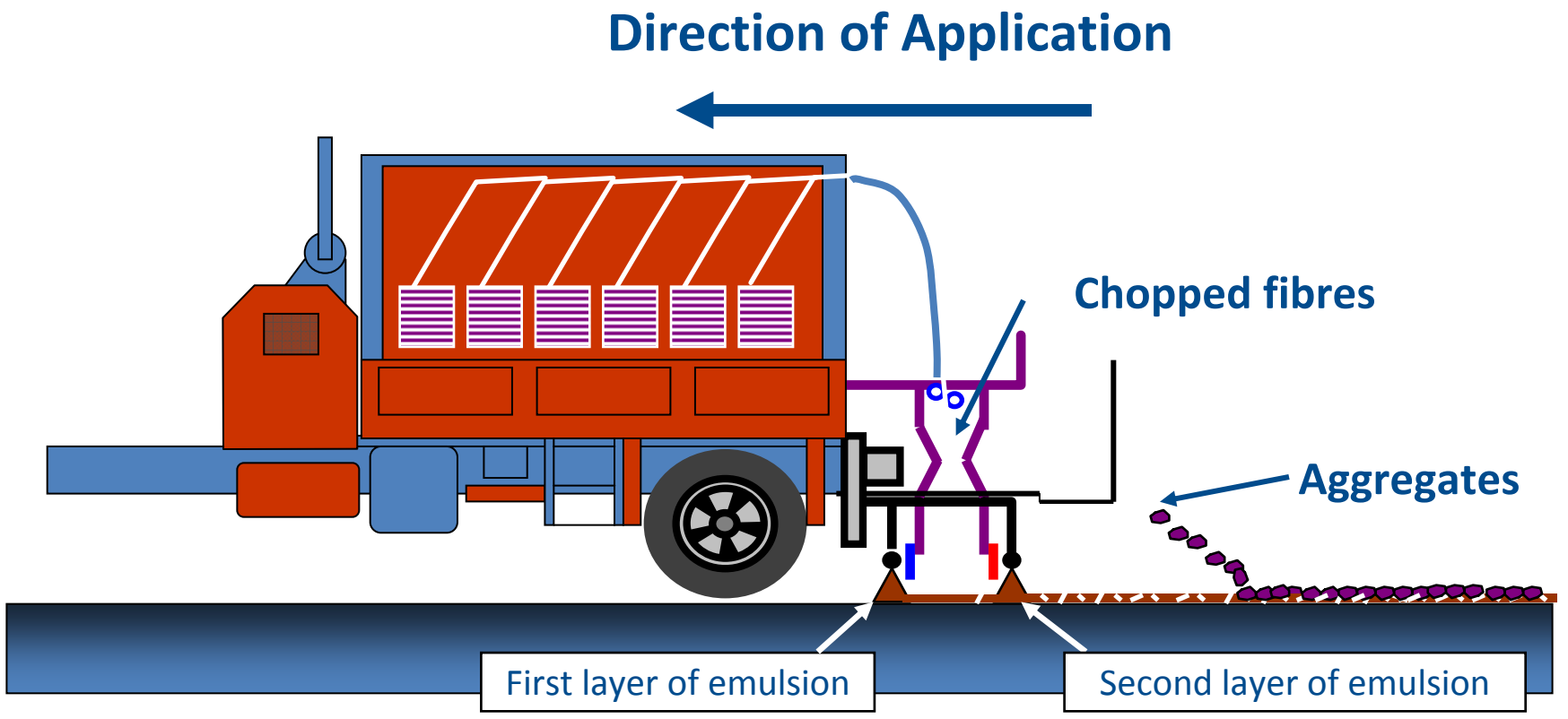
FIBERMAT



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FIBERMAT

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Pros

- Portable
- Easy to apply (fast)
- Tensile strength
- Crack resistant
- Delays reflective cracking
- Surface or interlayer

- Competitive systems

Cons

- Patented process - limited number of contractors
- Some loose aggregate

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Cold Mix Asphalt Pavement

- Blending of asphalt emulsion and aggregates to create a flexible base
- Ability to use 100% RAP (reclaimed asphalt pavement)
- Portable pug mill
- Mix Paver (incorporates tank & pug mill)
- Requires surface seal

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Cold Mix Asphalt Pavement

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Cold Recycled Mix (100% RAP)

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Cold Recycled Mix (100% RAP)

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Cold Recycled Mix (100% RAP)

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Cold Recycled Mix (100% RAP)

100% Cold Recycled Mix

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Cold Mix Asphalt Pavement

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Cold Mix Asphalt Pavement

Pros

- Portable
- Local aggregates
- 100% Recycled
- Structural Strength

- Numerous Contractors

Cons

- Curing time
- Requires a surface

- Limited Expertise

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Ultra-Thin Bonded Wearing Course

Bonded Wearing Course (BWC) is a gap graded, ultra thin hot mix asphalt (HMA) applied over a thick polymer modified asphalt emulsion membrane with a specialized paver.

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Ultra-Thin Bonded Wearing Course

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Ultra-Thin Bonded Wearing Course

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Ultra-Thin Bonded Wearing Course

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Ultra-Thin Bonded Wearing Course

Pros

- Inexpensive
- Durable
- Crack-Resistant
- Excellent skid resistance
- Superior bond (concrete)
- Smooth
- No loose aggregate

Cons

- Limited number of contractors
- Requires Hot Mix Plant

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Sometimes the questions are

COMPLICATED

and the answers are

SIMPLE!

–Dr. Seuss

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