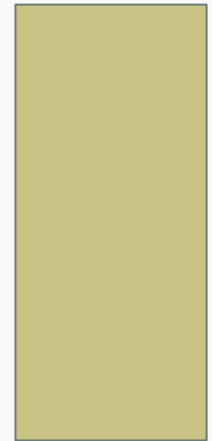


СОДЕРЖАНИЕ ДОРОГ В ТЕПЛЫЕ ПЕРИОДЫ ГОДА

УСТРОЙСТВО ЗАЩИТНЫХ СЛОЕВ, СЛОЕВ ИЗНОСА И
ПОВЕРХНОСТНОЙ ОБРАБОТКИ



НОРМАТИВНЫЕ ДОКУМЕНТЫ

Методические рекомендации по ремонту и содержанию автомобильных дорог общего пользования

Приказ МинТранса РФ № 402 от 8.06.2012 «Об утверждении классификации работ по капитальному ремонту, ремонту и содержанию АД» (с дополнениями по приказу № 267 от 9.08.2013)

Методические рекомендации по устройству защитного слоя износа из литых эмульсионно-минеральных смесей типа «Сларри СИЛ»

Рекомендации по устройству дорожных покрытий с шероховатой поверхностью

ОДМ 218.3.028-2013 «Методические рекомендации по ремонту и содержанию цементобетонных покрытий автомобильных дорог»

ЗАЩИТНЫЕ И ДРУГИЕ СЛОИ

Места выкрашиваний

Места шелушений

Места повышенного износа



Защитные слои

Шероховатые слои

Слои износа

РЕКОМЕНДУЕМЫЕ ОБЛАСТИ

Интенсивность выше 6000 авт/сут

Интенсивность 1000-6000 авт/сут

Устройство слоя из ЦМА

Устройство поверхностной
обработки

Устройство поверхностной
обработки с синхронным
распределением

Устройство ШТП

Устройство слоя из ЛЭМС

Устройство слоя с втапливанием
щебня

Интенсивность до 1000 авт/сут

Устройство поверхностной
обработки

УСТРОЙСТВО А/Б СЛОЯ

Весна $\geq +5$ °С Осень $\geq +10$ °С



Битум	0,5-0,8 / 0,2-0,3 л/м ²
Б.Эмульсия	0,6-0,9 / 0,3-0,4 л/м ²

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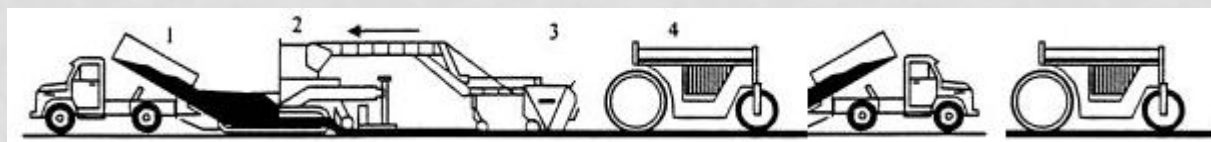
ВТАПЛИВАНИЕ ЩЕБНЯ

Весна $\geq +5\text{ }^{\circ}\text{C}$

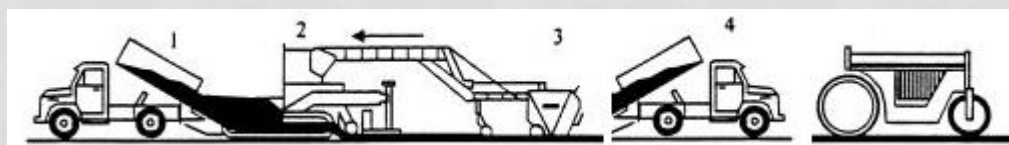
Осень $\geq +10\text{ }^{\circ}\text{C}$



Черный щебень
фракции 5-10 мм -
(0,9-1,1) м³ /100 м² ;
щебень фракции 10-15
мм - (1,1-1,2) м³ /100 м² ;
щебень фракции
15-20 мм - (1,2-1,4) м³
/100 м²



ГВК 6-8т (2-3пр)



ПК 16т (6-10пр)+ГВК 10-13т (8-10пр)+ГВК 11-18 т (6-8пр)

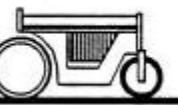
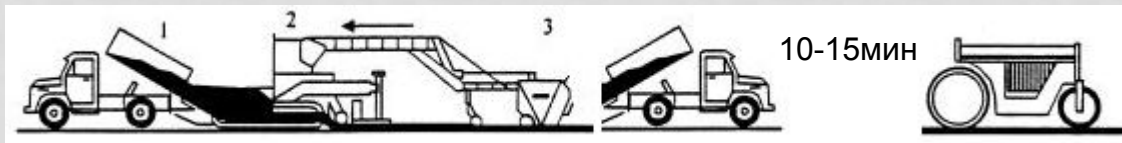
ШЕРОХОВАТЫЕ ТОНКОСЛОЙНЫЕ ПОКРЫТИЯ

Весна $\geq +5\text{ }^{\circ}\text{C}$

Осень $\geq +10\text{ }^{\circ}\text{C}$



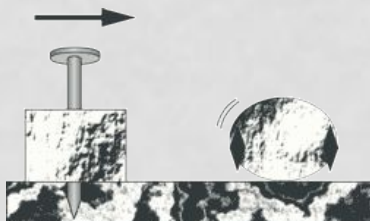
Черный щебень
фракции 5-15 мм



ГВК 1,5-3т

ПОВЕРХНОСТНАЯ ОБРАБОТКА

Щебень фр. 5-10, 10-15, 15-20, 20-25 (обработанный битумом БНД 60/90, 90/130 130/200, МГ 70/130, 130/200 и др., исключение – дороги N<1000 авт/сут, в случае использования катионных эмульсий)
1200
пластинчатых зерен не более 15 %, ПиГ не более 1 %



с использованием вязкого битума

Способ обработки	Фракция щебня, мм	Расход битума, л/м ²	Расход щебня	
			кг/м ²	м ³ /100 м ²
Одиночная	10—15	0,5—0,7	15—20	1,2—1,4
	15—20	0,7—0,9	20—25	1,3—1,5
	20—25	0,9—1,2	25—30	1,4—1,6
Одиночная с двукратной россыпью щебня	15—25	1,4	16—18	1,2—1,4
	Первая россыпь 5—10 Вторая россыпь 15—20 (20—25)	-	6—8	0,6—0,8
Двойная	Первая россыпь 5—10 (10—15) Вторая россыпь	1,1—1,3	20—25	1,3—1,5
		Первый розлив	(25—30)	(1,4—1,6)
		0,6—0,8 Второй розлив	12—15 (15—20)	0,9—1,1 (1,2—1,4)

Твозд ≥ +15°C

ПОВЕРХНОСТНАЯ ОБРАБОТКА

с использованием битумной эмульсии

Способ обработки	Размер щебня, мм	Расход щебня, м ³ /100 м ²	Расход эмульсии, л/м ² , при концентрации битума, %	
			60	50
Одиночная	5—10	0,9—1,1	1,3—1,5	1,5—1,8
	10—15	1,1—1,2	1,5—1,7	1,8—2,0
	15—20	1,2—1,4	1,7—2,0	2,0—2,4
Двойная	Первая россыпь		Первый розлив	
	15—20	1,1—1,3	1,5—1,8	1,8—2,2
	Вторая россыпь		Второй розлив	
5—10	0,7—1,0	1,3—1,5	1,5—1,8	

$T_{\text{возд}} < 20$ $T_{\text{возд}} > 20$

$T_{\text{эм}} = 40-50$ °С °С

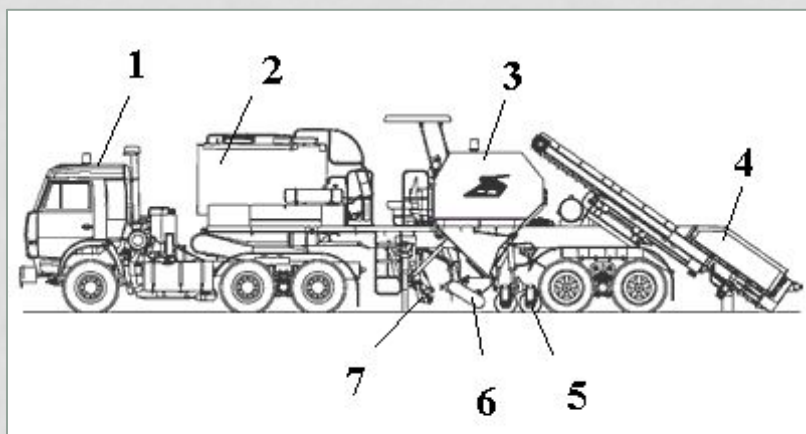
$T_{\text{возд}} \geq +15$ °С (анионные) +5 °С (катионные)

1. Смачивание поверхности (0,4-0,5 л/м²)
2. Розлив эмульсии (30 %)
3. Россыпь щебня (70 %)
4. Розлив эмульсии
5. Россыпь щебня
6. Укатка (6-8т за 3-4пр)
7. Уход

ПОВЕРХНОСТНАЯ ОБРАБОТКА



ГВК 6-8т (4-5пр)
+ГВК 10-12т (2-4пр)



СЛОИ ЛЭМС

Щебень до 15мм (1200)

Песок

Мин.порошок

Цемент

Бит.эмульсия (катион.)
50-55% битума

Вода

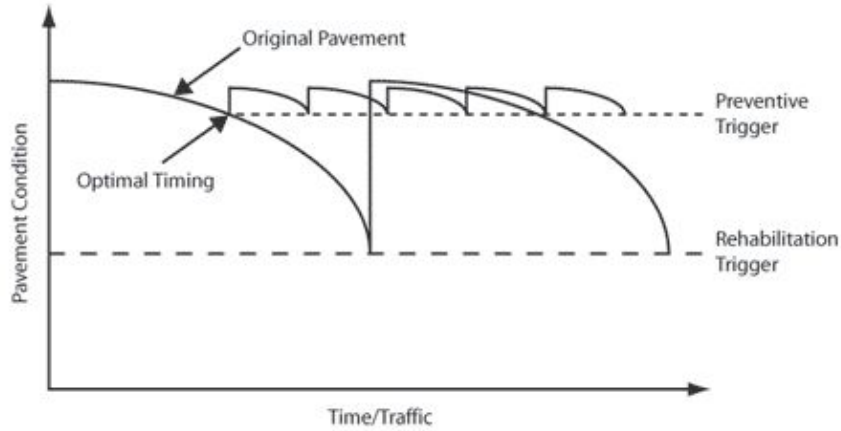
Добавки

Подгрунтовка (б.эмульсия/БНД 200/300) – 0,3-0,4л/м²на битум
Увлажнение (на свежих покрытиях) – 0,4-0,5л/м²



Твозд $\geq +5^{\circ}\text{C}$

PREVENTIVE MAINTENANCE



FOG SEALS



SLURRY SEALS



THIN HOT-MIX
ASPHALT OVERLAYS
ULTRATHIN FRICTION
COURSES



CHIP SEALS



MICROSURFACING



SCRUB SEALS

FOG SEAL



FOG SEALS	EVALUATION FACTORS			
	Climate	Traffic	Conditions Addressed	Contraindications
<p>Description: Fog seals are placed primarily to seal the pavement, inhibit raveling, enrich the hardened/oxidized asphalt, and provide some pavement edge-shoulder delineation.</p> <p>Fog seals are very light applications of a diluted asphalt emulsion placed directly on the pavement surface with no aggregate. Typical application rates range from 0.23 to 0.45 liters per m² (0.05 to 0.10 gal per yd²).</p>	<p>Treatment performs well in all climatic conditions. Actual performance will vary according to factors that affect weathering and raveling of bituminous surfaces.</p>	<p>Increased ADT or truck levels can increase surface wear, particularly in states that permit studded tires.</p>	<p>Functional/Other</p> <ul style="list-style-type: none"> ▪ Longitudinal, transverse, and block cracking (M) ▪ Raveling/weathering (loose material must be removed) ▪ Asphalt aging, oxidation and hardening ▪ Moisture infiltration <p>Structural</p> <p>Adds no structural benefit, but can help reduce moisture infiltration through fatigue cracks (if their severity is low)</p>	<ul style="list-style-type: none"> ▪ Structural failure (such as significant fatigue cracking) ▪ Flushing/bleeding (M) ▪ Friction loss (M-H) ▪ Thermal cracking (H)
Site Restrictions	Not appropriate for surfaces with poor skid resistance, as it will lower the skid resistance even more.			
Construction Considerations	Typically, a slow-setting emulsion is used which requires time to "break," the pavement is sometimes closed for 2 hours for curing before being re-opened to traffic.			
Expected Life	1 to 2 years when placed in a preventive maintenance mode.			
Typical Costs	\$0.36 to \$0.54 per m ² (\$0.30 to \$0.45 per yd ²) of pavement surface area.			

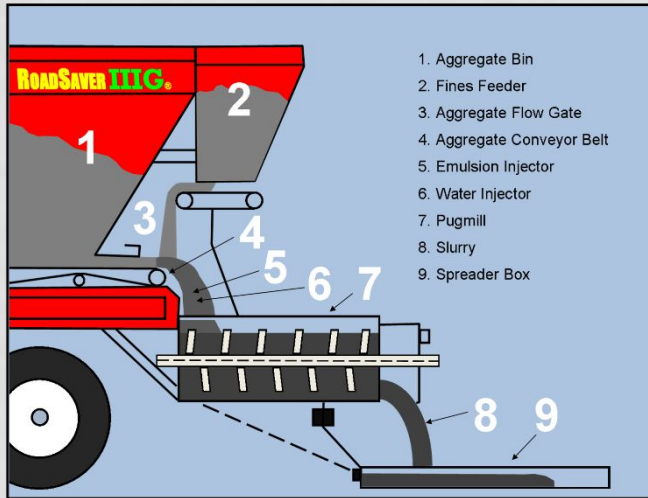
SLURRY SEAL



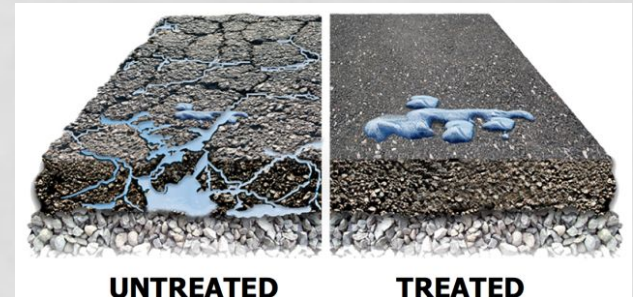
SLURRY SEALS	EVALUATION FACTORS			
	Climate	Traffic	Conditions Addressed	Contraindications
<p>Description: A mixture of well-graded aggregate (fine sand and mineral filler) and asphalt emulsion that is spread over the entire pavement surface with either a squeegee or spreader box attached to the back of a truck. It is effective in sealing low-severity surface cracks, waterproofing the pavement surface, and improving skid resistance at speeds below 64 km/h (30 mph). Thickness is generally less than 10 mm (0.4 in.).</p>	<p>Treatment performs effectively in all climatic conditions. However, best performance occurs in warm climates with low daily temperature changes.</p>	<p>Performance in terms of surface wear is affected by increasing ADT and truck traffic levels.</p> <p>Slurry mix properties (i.e., aggregate quality, gradation and emulsion content) can be modified to accommodate the higher traffic volumes.</p>	<p>Functional/Other</p> <ul style="list-style-type: none"> ▪ Transverse, longitudinal and block cracking (L) ▪ Raveling/weathering (loose material must be removed) ▪ Asphalt aging, oxidation and hardening ▪ Friction loss ▪ Moisture infiltration <p>Structural</p> <p>Adds no structural capacity; however, can temporarily seal cracks (if severity is low) or serve as a rut-filler (if the ruts are not severe and are stable)</p>	<ul style="list-style-type: none"> ▪ Structural failure (such as significant fatigue cracking and deep rutting) ▪ Thermal cracking (H) ▪ Can accelerate the development of stripping in susceptible HMA pavements
Site Restrictions	Pavement is often closed for several hours to allow the emulsion to cure.			
Construction Considerations	Surface must be clean. Aggregates must be clean, angular, durable, well-graded, and uniform (prefer 100% crushed). Avoid placement in hot weather (potential flushing problems) and premature opening to traffic. Do not place when freezing temperatures are expected.			
Expected Life	3 to 5 years when placed in a preventative maintenance mode.			
Typical Costs	\$0.84 to \$1.14 per m ² (\$0.70 to \$1.00 per yd ²).			
Additional Information	Three slurry types with different aggregate gradations and application rates are used: Type I for lower traffic volume (3.3 to 5.4 kg/m ² [6.1 to 10.0 lb/yd ²]) Type II for heavy traffic (5.4 to 8.1 kg/m ² [10.0 to 15.0 lb/yd ²]) and Type III for irregular surfaced pavements (8.1 kg/m ² [15.0 lb/yd ²]).			



MICROSURFACING



MICROSURFACING	EVALUATION FACTORS			
	Climate	Traffic	Conditions Addressed	Contraindications
<p>Description: Microsurfacing consists of a mixture of polymer-modified emulsified asphalt, mineral aggregate, mineral filler, water, and additives applied in a process similar to slurry seals. Used primarily to inhibit raveling and oxidation of the pavement surface. Also effective at improving surface friction, and filling minor irregularities and wheel ruts (up to 40 mm [1.6 in.] deep) in one pass.</p>	<p>Effective in all climate conditions. However, best performance occurs in warm climates with low daily temperature changes. May not set up quickly if applied in cool climates.</p>	<p>Very successful on both low- and high-volume roadways.</p>	<p>Functional/Other</p> <ul style="list-style-type: none"> ▪ Longitudinal and transverse cracking (L) ▪ Raveling/weathering (loose material must be removed) ▪ Bleeding (L-M) ▪ Roughness (L) ▪ Friction loss ▪ Moisture infiltration <p>Structural</p> <p>Adds limited structural capacity. Temporarily seals fatigue cracks (if severity is low) and can serve as a rut-filler (if the existing ruts are stable)</p>	<ul style="list-style-type: none"> ▪ Structural failure (i.e., extensive fatigue cracking) ▪ Extensive pavement deterioration, little remaining life ▪ Thermal cracks (H) ▪ Can accelerate the development of stripping in susceptible HMA pavements
Site Restrictions	None.			
Construction Considerations	Avoid placement in hot weather if there is potential for flushing problems. Placement in cool weather can lead to early raveling, not to be placed when freezing temperatures are expected.			
Expected Life	4 to 7 years when placed in a preventive maintenance mode.			
Typical Costs	\$1.05 to \$2.00 per m ² (\$0.90 to \$1.70 per yd ²).			
Additional Information	Typical mix proportions: 82 to 90% aggregate, 1.5 to 3.0% mineral filler, and 5.5 to 9.5% residual asphalt.			



UNTREATED

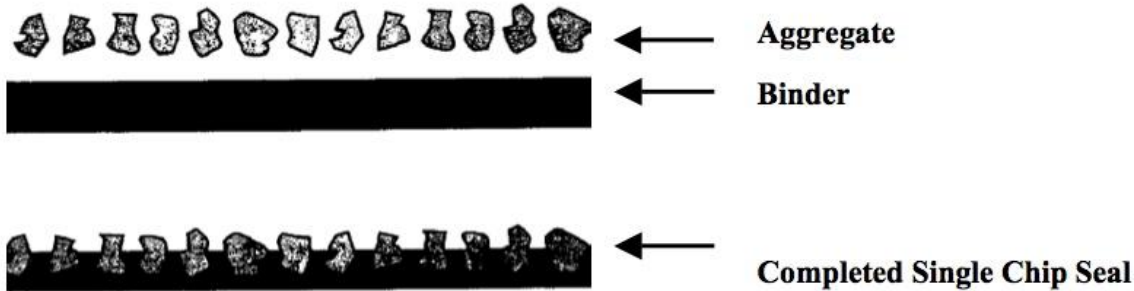
TREATED

SCRUB SEAL



SCRUB SEALS	EVALUATION FACTORS			
	Climate	Traffic	Conditions Addressed	Contraindications
<p>Description: A four-step process intended to rejuvenate the asphalt surface and to fill voids and surface cracks: (1) application of a layer of polymer-modified asphalt emulsion that is broomed into the voids and cracks of the pavement, (2) application of sand or small-sized aggregate, (3) a second application of polymer-modified asphalt (by brooming), and (4) rolling with a pneumatic-tired roller.</p>	Can be effective in all climates, but works best in hot, arid climates.	Good performance has been observed on lower-volume roads (less than 7,500 ADT)	<p>Functional/Other</p> <ul style="list-style-type: none"> ▪ Transverse, longitudinal and block cracking (L) ▪ Raveling/weathering (loose material must be removed) ▪ Moisture infiltration <p>Structural</p> <p>Adds no structural capacity; however, can help seal cracks (if severity is low)</p>	<ul style="list-style-type: none"> ▪ Structural failure (such as significant fatigue cracking) ▪ Thermal cracking (H)
Site Restrictions	Do not apply on tight surfaces as this may reduce skid resistance of the pavement.			
Construction Considerations	Surface must be clean; special equipment is required for brushing.			
Expected Life	1 to 3 years when placed in a preventive maintenance mode.			
Typical Costs	\$0.90 to \$1.49 per m ² (\$0.75 to \$1.25 per yd ²).			
Additional Information	Generally easy to apply and relatively inexpensive.			

CHIP SEAL



CHIP SEALS	EVALUATION FACTORS			
	Climate	Traffic	Conditions Addressed	Contraindications
<p>Description: Asphalt (commonly an emulsion) is applied directly to the pavement surface (1.59 to 2.27 L/m² [0.35 to 0.50 gal/yd²]) followed by the application of aggregate chips (8 to 27 kg/m² [15 to 50 lb/yd²]), which are then immediately rolled to imbed chips (50 to 70 percent). Application rates depend upon aggregate gradation and maximum size. Treatment seals pavement surface and improves friction.</p>	<p>Treatment performs well in all climatic conditions.</p>	<p>With proper design and placement, chip seals can perform well on high-volume roads.</p> <p>However, use is primarily limited to lower-speed, lower-volume roads because of the propensity for loose chips to crack windshields.</p>	<p>Functional/Other</p> <ul style="list-style-type: none"> ▪ Longitudinal, transverse and block cracking ▪ Raveling/weathering (loose surface material must be removed) ▪ Friction loss ▪ Roughness (L) ▪ Bleeding (L) ▪ Moisture infiltration <p>Structural</p> <p>Adds almost no structural capacity. However, effective at sealing fatigue cracks (M) in comparison with other treatments.</p>	<ul style="list-style-type: none"> ▪ Structural failure (i.e., extensive fatigue cracking and/or deep rutting) ▪ Thermal cracking (H) ▪ Extensive pavement deterioration, little or no remaining life ▪ Can accelerate the development of stripping in susceptible HMA pavements
<p>Site Restrictions</p>	<p>High-speed, high-volume roadways are often avoided, although a number of approaches are being used to extend the applicability of these treatments.</p>			
<p>Construction Considerations</p>	<p>Surface must be clean. Treatment should be placed during warm weather with chip spreader immediately behind asphalt distributor and rollers close behind the spreader. Approximately 2 hours required before roadway may be re-opened to normal speed traffic. Brushing is usually required to remove loose chips.</p>			
<p>Expected Life</p>	<p>4 to 7 years when placed in a preventive maintenance mode.</p>			
<p>Typical Costs</p>	<p>\$0.90 to \$1.08 per m² (\$0.75 to \$0.90 per yd²) for a single application and \$1.32 to \$1.49 per m² (\$1.10 to \$1.25 per yd²) for a double application.</p>			
<p>Additional Information</p>	<p>A second chip seal may be placed to achieve improve performance. Total thickness may approach 25 mm (1 in.).</p>			

NOVACHIP (ULTRATHIN FRICTION COURSES)

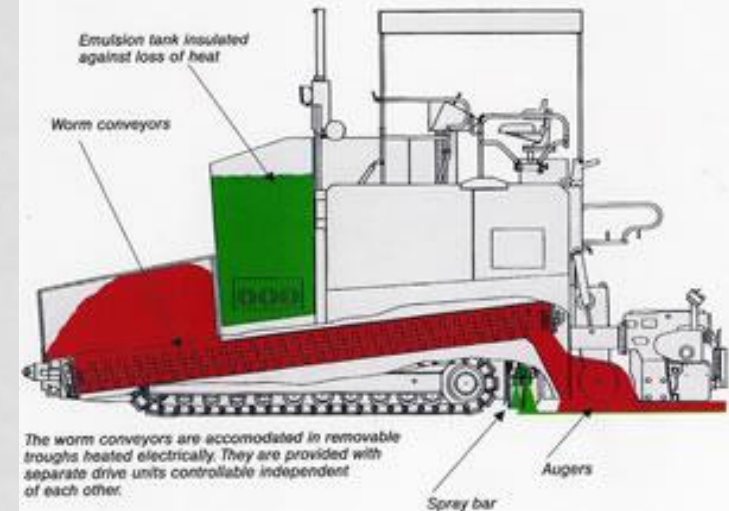


The emulsion membrane “wicks up” around the HMA aggregates

The emulsion cures, bonding the mix & pavement



ULTRATHIN FRICTION COURSES	EVALUATION FACTORS			
	Climate	Traffic	Conditions Addressed	Contraindications
Description: Relatively new treatment in the U.S. Consists of a gap-graded, polymer-modified 10 to 20 mm (0.4 to 0.8 in.) HMA layer placed on a tack coat formed by the application of a heavy, polymer-modified asphalt emulsion. Treatment effectively addresses minor surface distresses and increases surface friction.	Treatment should perform well in all climatic conditions.	Capable of withstanding high ADT volumes and truck traffic better than other thin treatments.	Functional/Other <ul style="list-style-type: none"> Longitudinal, transverse and block cracking (L). Higher severities can be addressed with cold milling. Raveling/weathering (loose surface material must be removed) Friction loss (H) Roughness (L) Bleeding (L) Structural Provides some increased capacity and retards fatigue cracking. Not suited for rutted pavements.	<ul style="list-style-type: none"> Structural failure (i.e., significant fatigue cracking and/or deep rutting) Extensive pavement deterioration, little remaining life Thermal cracking (H)
Site Restrictions	Ultrathin overlays should only be placed on structurally sound pavements. Localized structural problems should be repaired prior to overlay application.			
Construction Considerations	Requires special paving equipment to place the mix and a license to apply it.			
Expected Life	7 to 10 years when placed in a preventive maintenance mode.			
Typical Costs	\$3.00 to \$3.59 per m ² (\$2.50 to \$3.00 per yd ²), or about 50 percent more than thin, dense-graded HMA overlay.			
Additional Information	A proprietary treatment is known in the U.S. as “Novachip.”			



ЭФФЕКТ ОТ ПРИМЕНЕНИЯ

Treatment	Roughness	Friction	Noise	Life Extension	Moisture Reduction
<i>Bituminous-Surfaced Pavements</i>					
Crack Sealing				X	✓
Fog Seals				X	✓
Scrub Seals				✓	✓
Slurry Seals	✓	✓	✓	✓	X
Microsurfacing	✓	✓	✓	✓	X
Chip Seals	✓	✓		✓	X
Ultrathin Friction Course	✓	✓	✓	✓	✓
Thin Overlays	✓	✓	✓	✓	✓
<i>PCC Pavements</i>					
Joint and Crack Sealing				X	✓
Diamond Grinding	✓	✓	✓	✓	

✓ = Major effect

x = Minor effect