Highly-Modified (HiMA)
Micro Surfacing Emulsion Technology

Chris Lubbers
Tech. Sales and Market Development Manager – Emulsions
Kraton Performance Polymers, Inc.
15710 John F. Kennedy Blvd.
Suite 300
Houston, TX 77032
chris.lubbers@kraton.com
936-524-9262

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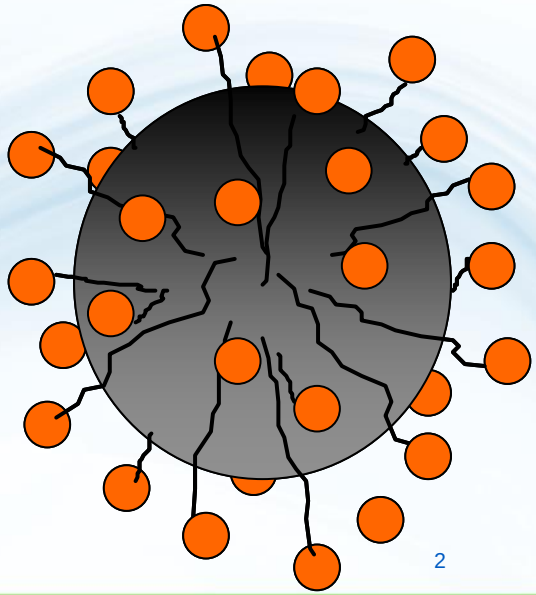
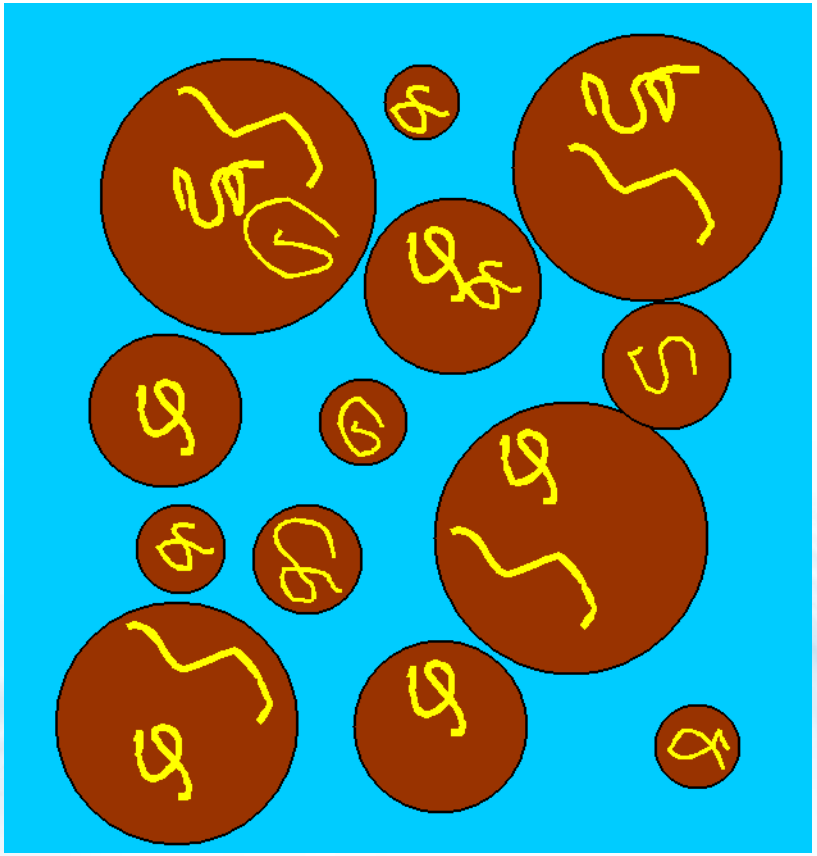
Outline

- High vinyl butadiene (Bd) SB/S technology overview
- Pre-modified asphalt base asphalt properties
- Pre-modified emulsion liquid properties
- HiMA micro surfacing program
  - 6 wt% HV SB in softer base AC
  - Job Stories – MN, MO, and TX



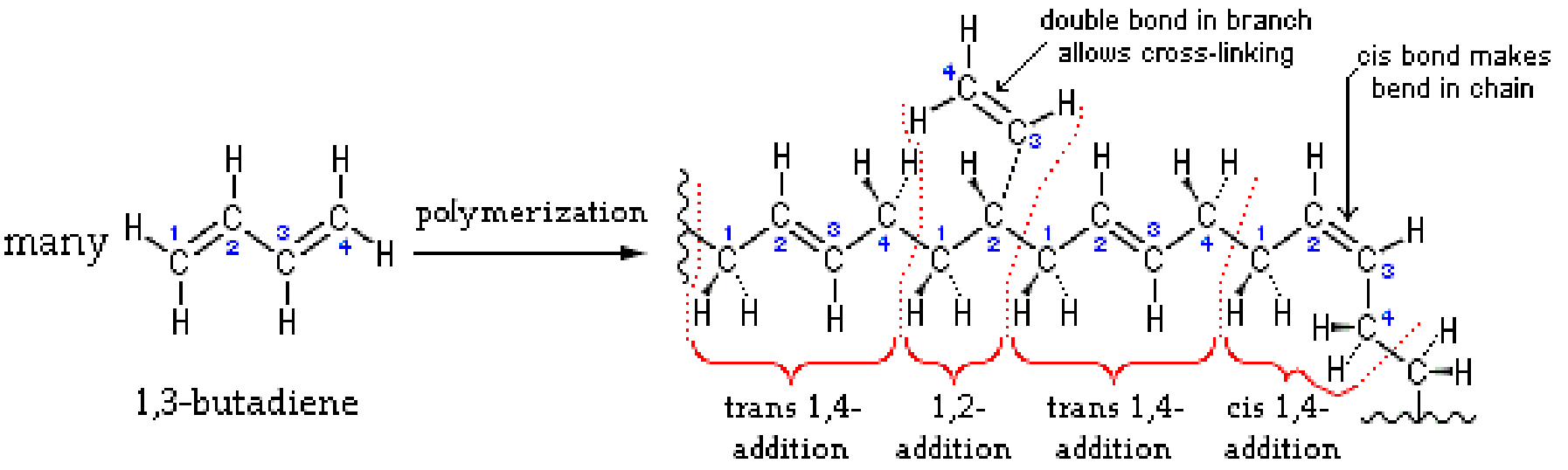
Polymer Modification of Asphalt Emulsions – SB/S

- **Emulsify polymer modified asphalt**
  - "Pre-modified" emulsion
  - Polymers – SBS, SB-
  - Higher mod. asphalt viscosity
    - Higher asphalt + mill temp.
  - **Exit temp. > 100°C**
  - **Heat exchanger, back P**
- **Polymer inside asphalt droplet**



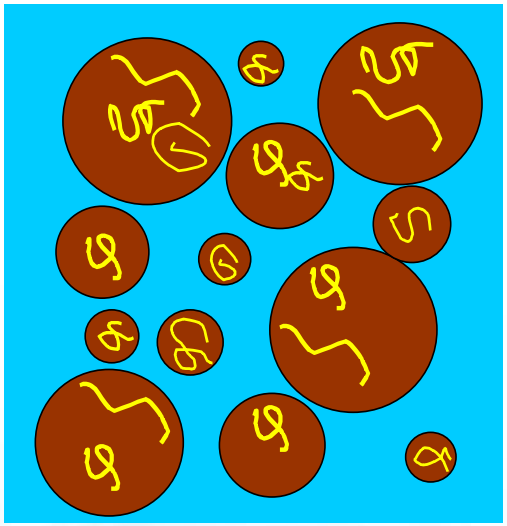
High Vinyl Butadiene SB/S Technology

- Butadiene monomer addition via 1,2 vs 1,4 polymerization
- Results in smaller effective molecular volume for same MW
- Thermal reactivity of 1,2 vinyl Bd pendant groups



High Vinyl Butadiene SB/S for Emulsions

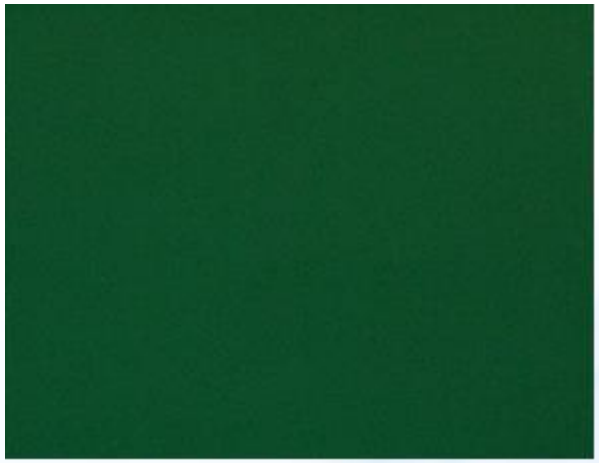
- **Hi vinyl SB diblock copolymer**
  - Low shear processing
  - Requires thermal or chemical x-linking
- **Hi vinyl SBS triblock copolymer**
  - High shear processing
  - No thermal or chemical x-linking required



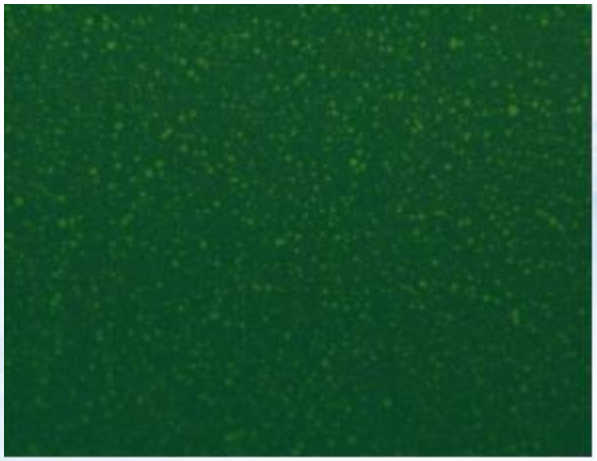
- **High vinyl Bd microstructure leads to:**
  - Improved compatibility in pre-modified base asphalt
  - Substantially reduced viscosity at a given loading level
  - **Eliminates emulsification issues associated with SB/S**
  - **No need for specialized equipment, storage, or handling**

Pre-Modified Asphalt Props.

- Base asphalt – PG 52-34/200 dmm PEN
  - Calumet Specialty Refining, LLC – Superior, WI
  - 3 wt% dry polymer loading on asphalt
  - Vs conventional linear SBS
- Improved compatibility – HV SB vs Linear SBS



HV SB Dispersion



Linear SBS Dispersion

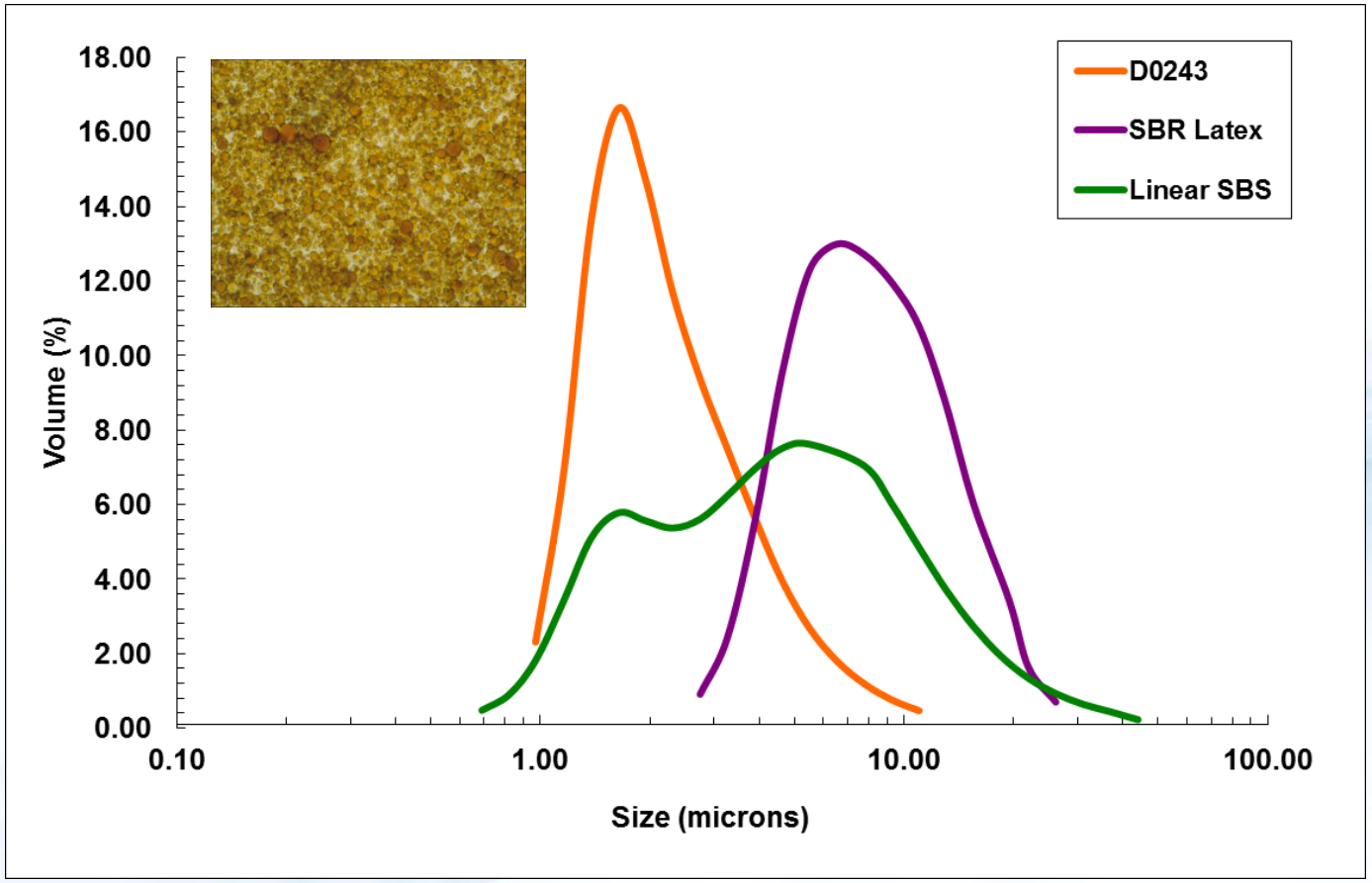
Pre-Modified Asphalt Props.

- Substantially reduced asphalt viscosity

Property		Test Method	Spec	Sample ID		
D0243 + Linear SBS Pre-Mod Emulsion Base Asphalt				58-28	52-34	
				Latex	D0243	Lin SBS
Brookfield Viscosity, cps	280°F	AASHTO T316	Report	-----	**365**	592
	300°F		Report		**232**	367
Softening Point	°F	AASHTO T53	Report		125	114
Elastic Recovery, %	25°C	AASHTO T301	Report		66	68
G*/sinδ, 10 rad/sec, kPa	58°C	AASHTO T315	1.0 min		-	1.79
	64°C				1.49	0.89
	70°C				0.79	-----
Limiting Stiffness Temp	°C	AASHTO T315	Report		67.8	63.0

CRS-2P Emulsion – Part. Size/Distribution

- HV SB req'd lowest feed T + gen'd lowest/narrowest PS/PSD
- Needed back-pressure and heat exchange for linear SBS
  - Generated poor quality emulsion at high residue content



HiMA Micro Surfacing Emulsion Program

- 6 wt% HV SB in PG 58-28 base AC
  - Standard AC for conventional micro emulsion – PG 64-22
  - Softer base for colder climates – i.e. PG xx-34 in Minnesota
  - ***More durable, fatigue resistance mat***
  - ***Improved resistance to reflective and thermal cracking?***
- **Participating contractors**
  - ASTECH – St. Joseph, MN
  - Vance Brothers, Inc. – Kansas City, MO
  - Viking Construction – Georgetown, TX

MN HiMA Micro Surfacing Job Story

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ACPA western builder Edition

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INSIDE

MNDOT FURTHERS PAVEMENT MICRO SURFACING RESEARCH

Agency's District 3 tries new highly polymer modified asphalt emulsion in demonstration on section of Trunk Highway 23 near St. Cloud

By Paul Fournier

ASTECH Corporation applies micro surfacing containing emulsified highly polymer modified asphalt to a section of Trunk Highway 23 for Minnesota DOT.

Minnesota's Department of Transportation continues its practical research of pavement preservation techniques with the recent demonstration of micro surfacing containing emulsified highly polymer modified asphalt (HiMA) on a section of Trunk Highway 23.

ASTECH Corporation of St. Joseph, Minn., applied the micro surfacing on a one-mile section of the two-lane highway near the city of St. Cloud, the county seat of Stearns County and the largest population center in the state's central region. Bisected by the Mississippi River, St. Cloud is a regional transportation hub in Minnesota, with major roadways including Interstate Highway 94, U.S. Highway 10, and Minnesota State Highways (Trunk Highways) 15 and 23 passing through the municipality.

Located about 65 miles northwest of Minneapolis-St. Paul, the city of St. Cloud lies within MnDOT's District 3, which has the largest population base outside of the Twin Cities metropolitan area. District 3 encompasses all or part of 14 counties, and its personnel plan, design, construct and maintain roughly 1,650 centerline miles (nearly 4000 lane miles) of Interstate, U.S. and trunk highways.

Sophisticated Pavement Research

The June 2012 TH23 application was the first time MnDOT used HiMA emulsion in the micro surfacing process, although the agency did approve the installation of hot mix asphalt modified with HiMA on a section of TH100 west of Minneapolis last year, as part of its continuing search for advanced products capable of retarding pavement reflection cracks.

Minnesota's trunk highway system of 11,000 miles ranks it the fifth largest in the nation, and its DOT is considered to be in the forefront of highway maintenance, research and construction practices. In connection with this, the agency owns and operates MnROAD, a sophisticated pavement test track built to study various research materials and pavements. MnROAD works in conjunction with MnDOT's Materials Lab located in Maplewood, Minn. (See sidebar on last page.)

Jerry Geib, MnDOT research operations engineer, suggested the use of HiMA in the 2011 TH100 mill-and-fill hot mix asphalt operation. That application went without incident, with the paving crew noting there was no difference between handling HiMA mix and MnDOT's usual 12.5mm Superpave mix. The asphalt binder used in this mix was dosed at 7.5-percent SBS polymer.

MN HiMA Micro Surfacing Project – 6/2013

- **Emulsion producer – Flint Hills Resources – Wichita, KS**
  - 6 wt% HV SB in PG xx-34 base AC – >200 dmm PEN
    - **SP – 156°F**
    - **PEN – 122 dmm at 25C**
  - Control – 3.5 dry wt% cationic SBR latex in PG 64-22 base AC
  - Two trial sections
    - MN Road Cell #1 – Interstate 94 – **16 wt% emulsion** with no control
    - ADT – 28,000 vehicles/day including heavy truck traffic
    - TH 23 – **13 wt% emulsion** with control
    - ADT – >5000 vehicles/day
    - PCC slab (original) + 6 in. of bit. concrete ('98) + chip seal ('04)
- **Contractor – ASTECH Corporation – St. Joseph, MN**
  - Leveling course and surface course applied to trial sections
  - Type II gradation
  - Application rate – net 30 lbs/yd^2

HiMA Micro Emulsion Application
Mn Road Cell #1 – Before/After – 6/2013

Before

Passing Lane – PG 58-28 Asphalt Concrete – 12 yrs old over PCC slab

Slow Lane – PG xx-34 Asphalt Concrete – 6 yrs old over PCC slab

MO HiMA Micro Surfacing Job Story

Volume 113 Number 1 • JANUARY 2013

ACP MIDWEST CONTRACTOR Edition

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MISSOURI CITY SEEKS TOUGHER CUL-DE-SAC PAVEMENTS

Lee's Summit tries highly modified asphalt micro surfacing to counter damaging wheel loads of trash trucks

By Paul Fournier

Vance Brothers' Bergkamp continuous mix paver applies micro surfacing made with highly polymer modified asphalt emulsion in Lee's Summit, Mo.

Missouri's sixth largest city is testing a new type of micro surfacing in hopes it will better resist wheel loads of heavy trash trucks that damage pavement surfaces in the community's many cul-de-sacs.

Lee's Summit, a city of 91,000 people located in Jackson and Cass Counties in the western part of the state, approved the use of micro surfacing made with highly polymer modified asphalt emulsion for 20 cul-de-sacs in an upscale residential area abutting scenic Raintree Lake.

The city's pavement management program, financed by a ½-cent transportation tax, utilizes a number of scheduled programs to maintain or restore paved road surfaces including its annual micro surfacing contract. Vance Brothers, based in Kansas City, Mo., which has this year's micro surfacing contract, was asked if they could produce a tougher pavement treatment for the cul-de-sacs.

"The city has been looking but so far hasn't found anything to use in these cul-de-sacs," said Howie Snyder, Slurry/Micro Surfacing operations manager for Vance Brothers. Snyder said their contract includes not only cul-de-sacs but major thoroughfares and residential streets as well. He noted that conventional micro surfacing performs well on streets but not on cul-de-sacs, especially those in the Raintree Lake area, where unusually heavy truck traffic damages the pavement surface treatment.

"A number of private companies provide trash pickup for residents in this area, so on any one day, you could have 2- to 5 trucks with 40,000-pound front-axles going around the cul-de-sacs," he said.

Conventional micro surfacing has failed to withstand the tremendous pressure of turning tires that knead and smear the surface treatment. What's more, the higher than normal temperatures plaguing the Mid-West this year have exacerbated these detrimental effects.

Micro Surfacing Benefits and Limits

Micro surfacing, a pavement preservation method, is used to extend the life of existing, structurally sound asphalt pavements. It is a cold-mix material, made on site by a continuous mix paver that combines mineral aggregate (usually #4 minus), Portland cement or other type of mineral filler, and a polymer-modified asphalt emulsion. Capable of being spread in different thicknesses, micro surfacing can be used as a leveling or scratch course, to fill pavement wheel ruts, or placed as a thin wearing course, or seal, to protect the underlying pavement.

INSIDE

MO HiMA Micro Surfacing Project – 7/2013

- **Emulsion producer – Vance Brothers – Kansas City, MO**
  - 6 wt% HV SB in PG 58-28 base AC
    - **SP – 180+°F, PEN – 65-70 dmm at 25C**
  - Control – 3.0-3.5 dry wt% cationic SBR latex in PG 64-22 base AC
    - **SP – 140+°F, PEN – 40-90 dmm at 25C**
  - Trial sections – 13 wt% emulsion
    - 20 cul-de-sacs in Lee's Summit, MO – suburb of Kansas City, MO
    - Residential neighborhood, BUT
      - Two to five, 40,000 lb front-axle trash trucks per day
      - Control micro surfacing mat failed
- **Contractor – Vance Brothers – Kansas City, MO**
  - Single course applied
  - Type II gradation
    - HiMA – Limestone aggregate
    - Control – Granite aggregate
  - Application rate – 24-25 lbs/yd^2

HiMA Micro Emulsion Application
Cul-de-Sac – Lee's Summit, MO – 7/2013

TX HiMA Micro Surfacing Job Story

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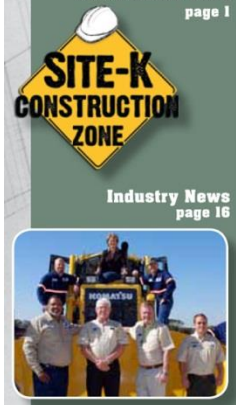
INSIDE



Also in this Issue:

- Machine Control Selection
- Using Telematics to Help Reduce Insurance Costs
- Tax Reform

DALLAS TESTS NEW STREET MAINTENANCE TECHNOLOGY

Slurry seal preventive maintenance treatment gets a boost from advanced highly modified asphalt emulsion in street trials

By Paul Fournier

Viking Construction applies micro surfacing containing advanced HiMA emulsion on a Dallas residential street as part of annual preventive maintenance program.

The city of Dallas recently applied micro surfacing containing an advanced asphalt emulsion as part of its annual preventive maintenance program.

Highly modified asphalt (HiMA) emulsion was substituted for latex modified asphalt emulsion by the Department of Street Services in the micro surfacing of 4-½ lane miles of local streets.

Responsible for maintaining 11,800 lane-miles of streets serving the city's 1.2 million residents, Street Services has an annual operating budget of more than $70 million that includes a substantial allotment for preventive maintenance. This funding allows the department to treat about 245 lane-miles of pavement each year with slurry seal and micro surfacing. These surface treatments play important roles in the city's preventive maintenance program, according to Ben Cernosek, P.E., Assistant Director of Street Services.

"Over the last several years our budgets have included the financial resources approved by the City Council to not only keep our streets from deteriorating but to improve their overall condition. A big reason for this is our use of micro surfacing and slurry seal," said Cernosek.

He said they have a systematic approach to pavement management that utilizes sophisticated sensors and instruments to read and record various pavement characteristics. This approach enables them to rate street pavements, establish maintenance and repair priorities, and choose the most cost-effective treatments to correct problematic conditions.

"With this type of approach we've been able to continuously upgrade the overall condition or our city streets, from an evaluation of 60% satisfactory in the 1990s, to approximately 87% satisfactory this year.

"We really believe in preventive maintenance because it can extend the service life of pavements by a factor of three at one tenth the cost of a hot mix overlay," Cernosek said.

"And we're always looking for ways to improve, to try ways that can extend the life of our pavements even longer. That's why we decided to apply the HiMA micro surfacing on a trial basis," he said.

TX HiMA Micro Surfacing Project – 7/2013

- **Emulsion producer – Ergon, Inc. – Jackson, MS**
  - 6 wt% HV SB in PG 58-28 base AC
  - Control – 3.0 dry wt% cationic SBR latex in PG 64-22 base AC
  - Trial sections – 12 to13 wt% emulsion
    - City of Dallas, TX
    - Collector road as well as residential street
- **Contractor – Viking Construction – Georgetown, TX**
  - Single course applied
  - Type II gradation
  - Application rate – 26 lbs/yd^2

HiMA Micro Emulsion Application
City Street – Dallas, TX – 9/2013

HiMA Micro Surfacing Projects
Field Observations

- HiMA emulsion handled/applied/cured ~ control systems
  - No special requirements for storage/handling/application
- Initial durability/toughness of HiMA mat >> control systems
- Resistance to reflective cracking ~ control systems

- **4th HiMA Trial w/Ergon/Sealcoating, Inc. - Hingham, MA**
  - Applied end of season in much cooler, wet conditions in the NE
  - HiMA micro emulsion can extend application window vs control?

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