

SPRING OPERATIONS SEMINAR

MARCH 23, 2023

WARM MIX ASPHALT IMPLEMENTATION: Production & Placement Considerations

BEST WESTERN BRANTFORD HOTEL
AND CONFERENCE CENTRE

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Presentation Summary

- WMA in Ontario Status and Future plans
- MTO NSSP BITU0029– Nov 21
 - High level Specification Overview
- Warm Mix or Compaction Aid ?
- Density at lower pavement temperatures
 - Extending Opportunity to Achieve Compaction
- Antistripping Additives
 - One Additive for both WMA and ASA
 - Terminal vs Plant addition
- Additive Odours
- Conclusions

WMA in Ontario Status and Future plans

- Current MTO Contracts allow use of Warm Mix at Contractors option
 - Specification is Permissive
 - WMA additives can be used at contractors cost.
 - Benefits understood but not routinely used
- Primary road block to contractors using WMA is cost
 - MTO and Industry agree that best way to see WMA used on all projects is to specify its use at tender
 - Levels bidding field

MTO NSSP BITU0029 – Nov 21

- Specification for **Mandatory** use of Warm Mix
 - Intent:
 - Control Green House Gas Emissions
 - Level the bidding field
 - Reduce paving crew exposure to fumes.
- Endorsed by Senior MTO Management as being preferred for future paving contracts
 - Currently with the MTO Regional Offices to implement on projects based on benefit.
 - Some projects tendered in 2022, additional this year
 - Eventual use of WMA on all MTO paving contracts in not so distant future.

High level Specification Overview

- List of approved Warm mx additives provided
 - Not a DSM – Potential for other additives but approval needed
- Production Requirements – Mix Temp Measured at Plant Discharge
 - Maximum 135 C or
 - 20 C below production temp of mx Without additive
 - Not Exceeding 150C
 - 1 hour start up allowance temps not to exceed 15C above allowable.
- When production temp exceeds allowable temperature
 - mix is non conforming
 - 3% payment reduction applied
- Temp Measured
 - 1 per hour at Plant Discharge
 - Every 250m during paving

High level Specification Overview

- Sampling Requirements as per hot mix PLUS:
 - Loose Samples for Moisture Sensitivity
 - 12 cores to reflect loose sample locations for performance testing
 - Warm Mix: 3 Sublots per mix type
 - Control : 1 Sublot per mix type
- Designer Fill-in may be added to spec
- Environmental monitoring by independent consultant
 - 4 Days Monitoring
 - Plant - Stack Emissions
 - Paving Crew – Tail Ender and Paver Operator
 - 3 Days with Additive, 1 day with Control (no Additive)

Warm Mix or Compaction Aid ?

- **WMA is Considered a Compaction Aid When....**
 - Mix Produced at : Normal Hot Mix temperatures. Or at..
 - Reduced Temperatures (< 20C below normal production)
 - Primary purpose of additive is to assist in achieving density
- Treated as Hot Mix – NOT Warm Mix
- WMA additive used as compaction aid can be used without restriction
 - Mix Design Submitted or Modified
 - New Compaction Temperature must be declared

Warm Mix or Compaction Aid ?

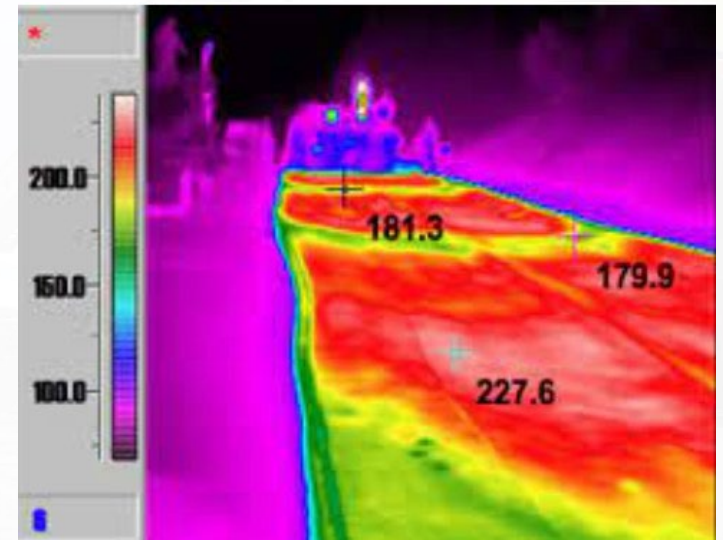
A WMA is both when

- Mixed at 20C or more Below Norm
- Benefit:
 - Reduction in fuel costs
 - Reduction in GHG / Noxious Emissions
 - Plant
 - Crew Exposure
 - Reduced Heat Oxidization of AC during mixing – Extends pavement life
- Production Challenges: Lower plant temps
 - Aggregate moisture will impact plant production rate.
 - Tarping or covering of piles
 - Good drainage of stock piles



Warm Mix or Compaction Aid ?

- Compaction Aid Benefits Pavement Quality
 - Improved Joints and tighter mat
 - Heat loss impacts reduced
 - cooling of joints
 - general heat segregation and loss across the mat
 - Better density overall
 - Improved aggregate coating
 - Allows Higher RAP



Density at Lower Pavement Temperatures

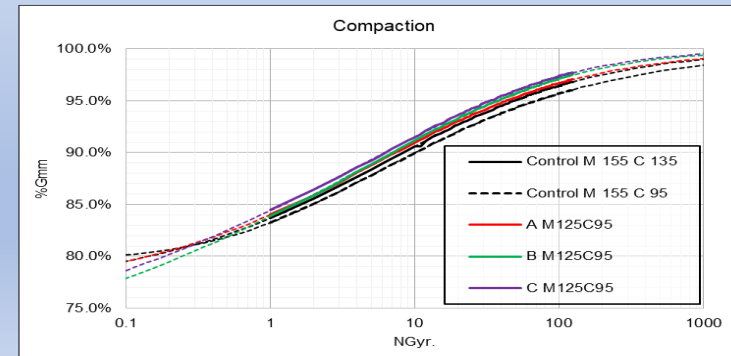
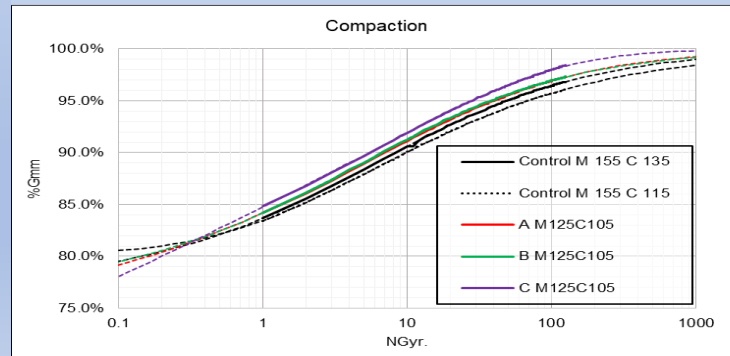
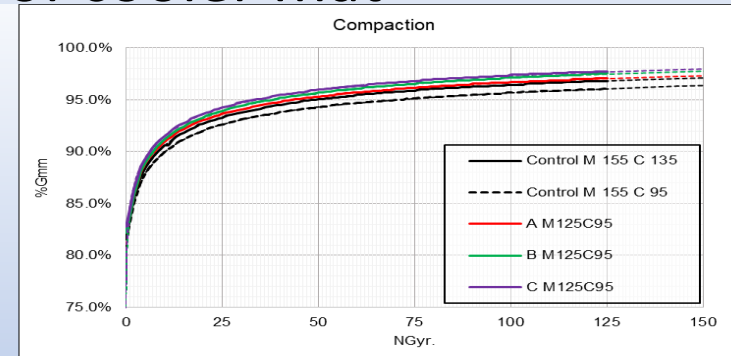
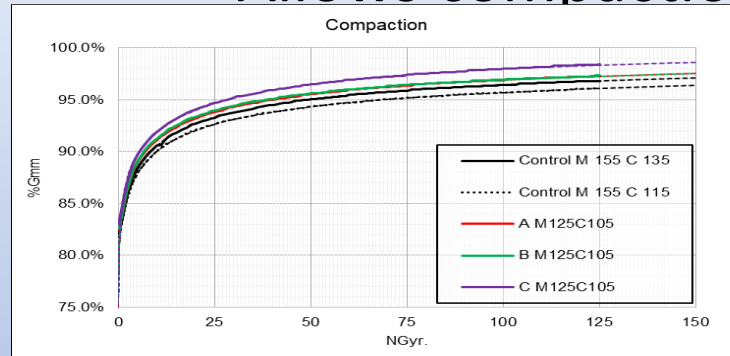
- Better density can be achieved
 - Warm mix tends to compact easier
 - Additives polarize Asphaltene molecules
 - Reduced surface tension of AC = consistent aggregate coating
 - Higher RAP Content
 - AC viscosity not affected
 - Best rolling practices need to be followed.
 - Crews need to be aware of pavement temp and conditions.
 - Temp zones should be established for rollers
 - Compaction trial Strips with QC densometer
 - Crews can modify rolling patterns depending on conditions
 - Rollers fall behind
 - Passes can be lengthened rather than speeding up and potentially missing passes

Density at lower pavement temperatures

- WMA Additive
 - Extends the opportunity to achieve density
 - Allows compaction of cooler mat

Compaction
Temp =
105C

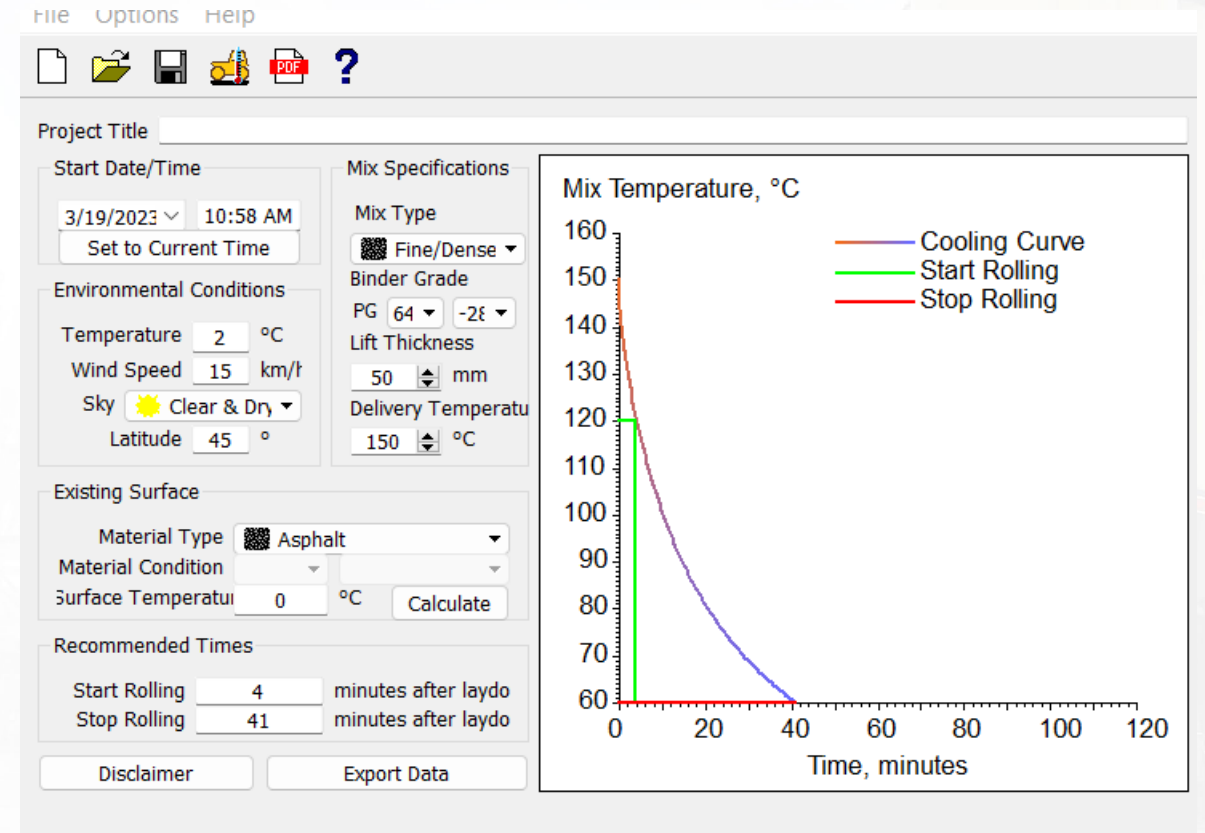
Density
+2% over
control



Compaction
Temp = 95C

Extending Opportunity to Achieve Compaction

- WMA Additive allows compacting at lower mat temp.
- Cooling time of mix can be estimated using MinDot PaveCool App
- Mat Temp to Stop Compaction
 - No Additive: ~79C (HMA)
 - With Additive : ~60 C (WMA)



i. Download from: <http://www.dot.state.mn.us/app/pavecool/>
ii. Available for PC, Android, and iPhone/iPad 3.0

Pavement Cooling Estimates : PaveCool

Sunny Clear and Dry	Summer Time		Cooler Weather (Spring / Fall)		Cold Weather / Mix at full HMA temperature	
Paving on Binder	No Additive	With Additive	No Additive	With Additive	No Additive	With Additive
Lift Thickness (mm)	50	50	50	50	50	50
Air Temperature	25	25	12	12	7	7
Base Temperature	25	25	12	12	0	0
Wind	8 Kmh	8 Kmh	8 Kmh	8 Kmh	8 Kmh	8 Kmh
Delivery Temp (°C)	150	130	150	130	150	150
Stop Comp Temp	79	60	79	60	79	60
Time to Compact (min.)	33	59	26	39	23	46

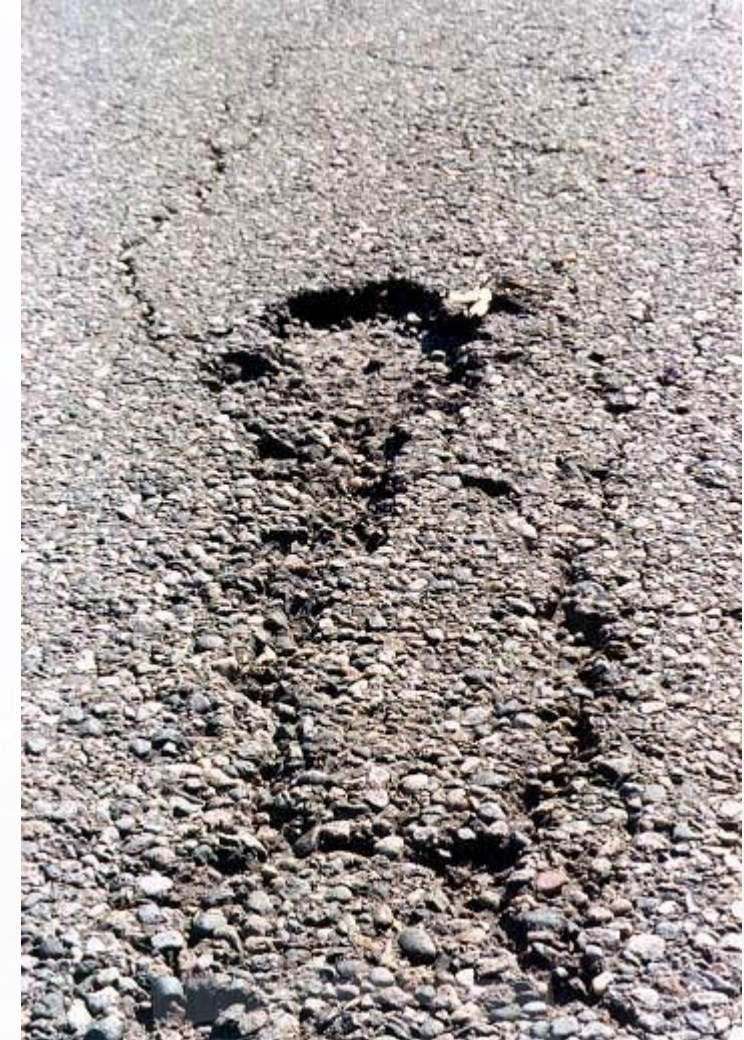
With Additive + 26 min

With Additive + 13 min

With Additive & Higher Temp
+ 23 min

Antistripping Additives

- Required when aggregates used in mix are moisture sensitive.
 - Some aggregates are not fully coated with AC when mixed
 - AC strips off when exposed to water
 - Tensile strength Ratio < 80% requires ASA use
- MTO Northern Region Projects
 - ASA required in all mixes regardless of TSR
 - Many sources in Northern Region require ASA
 - Polymer Modified AC's can fool the TSR test
 - TSR > 80% at Design but pavement strips in time
 - MTO's broad brush approach. All mixes to use ASA at minimum dosage shown in DSM 3.05.10 for the additive used.



One Additive for both WMA and ASA

- Using an ASA and a different WMA additive increases additive cost
 - 1 cost for ASA + 1 cost for WMA
- Currently NSSP BITU0029 Specification lists 5 approved WMA additives
 - CWM
 - Evotherm M1
 - Rediset LQ-1200A
 - WarmGrip N1
 - Zycotherm SP2

Cost Benefit if One additive can provide Moisture Resistance and Benefits of a WMA additive

Additive			Min For ASA / DSM 3.05.10	WMA Use Range	Type
A	CWM		N/A	0.2 to 0.7%	Amine
B	Evotherm M1		0.5	0.25 to 0.75%	Amine
C	Rediset LQ- 1200A		N/A	0.3 to 0.8%	Amine
D	WarmGrip N1		0.5	0.25 to 0.75%	Amine
E	Zycotherm SP2		0.075%	0.07% - 0.15%	Organo silane

WMA additives B, D and E are approved for use as an ASA

One Additive: WMA and ASA

- Additives B and D provide WMA properties at dosages below dosage required for Stripping Resistance
 - Dosage needs to be increased for Stripping resistance.
 - Increased Cost
 - Mix Impacts

Additive		Min For ASA / DSM 3.05.10	WMA Use Range	Type
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C	Rediset LQ- 1200A	N/A	0.3 to 0.8%	Amine
D	WarmGrip N1	0.5	0.25 to 0.75%	Amine
E	Zycotherm SP2	0.075%	0.07% - 0.15%	Organosilane

One Additive : WMA and ASA

- Additive E: Zycotherm SP2 provides WMA properties at the same dosage as required for ASA at No increase in cost.
- Exact dosage based on aggregate type and mix
 - 0.075% approved for ASA use and provides WMA properties for most aggregate blends.
 - Quartzite and Sandstone mixes may require 0.1% for WMA

Additive		Min For ASA / DSM 3.05.10	WMA Use Range	Type
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D	WarmGrip N1	0.5	0.25 to 0.75%	Amine
E	Zycotherm SP2	0.075%	0.07% - 0.15%	Organo Silane

- Using Additive E
 - Reduced Production Temp = Savings
 - Can be used at lower dosage as Compaction aid - 0.05% to 0.07%

Terminal vs Plant addition

- MTO and OPSS specifications allow addition of ASA and WMA additives either:

At Terminal

- Requires AC weigh bill to state type and dosage of additive
 - Most convenient for HMA producer
 - May limit availability of preferred additive.
 - Requests can be made
- Cost



Terminal vs Plant addition

At Plant: Reduced Cost – Direct Purchase of Additives

- Impact of Additive on PGAC must be submitted
 - AC or additive supplier may provide this information.
- Documentation verifying amount of ASA added must be provided to the CA
 - Can be added directly to storage tank
 - Can be metered into AC line during offloading or mixing
 - Pump seals must be compatible with additive
 - Viton seals required for Zycotherm SP2 , Others ??



Additive Odour



- Amine WMA and ASA additive odour
 - Paving crews will have more exposure with implementation
 - Different tolerance for different people
- In Ontario, All ASA and WMA additives approved are Amine based with the exception of Zycotherm SP2

Allowed AST-AC / DSM 3.05.10		BITU/NSSP 0029 Allowed WMA Additives	
Additive	Type	Additive	Type
Ad-here LOF 6500	Amine	CWM	Amine
Ad-Here LOF 77-00	Amine	Evotherm M1	Amine
WarmGrip N1	Amine	Rediset LQ-1200A	Amine
Hyper-Stick 2000	Amine	WarmGrip N1	Amine
Pavebond	Amine	Zycotherm SP2	Organo Silane
Evotherm M1	Amine		
Redicote C-2914	Amine		
Zycotherm SP2	Organo Silane		

Additive Odour



- Nova Scotia has an ongoing Action Plan for use of Amine based ASA due to fumes:
 - Based on studies conducted 1995 to 2010
 - **All workers exposed to Amine fumes at plant or at the paver must wear masks or full face respirators depending on degree of exposure.**
 - Site Specific Safety Plan
 - Plant location and production restrictions.
 - Newer Amine odour is lower but protocol is still enforced
- **Organo Silane Additives (Zycotherm SP2) exempt** from protocol due to lower fumes.

Conclusion

- Warm Mix Asphalt is expected to become the norm on paving contracts
 - Environmental Benefits / Reduced Emissions
 - Quality Benefits / Better Compaction
 - Extended time for compaction in cooler weather
 - Workers exposure to noxious fumes reduced
 - Additive type dependent

Conclusion

- Some WMA additives also are approved as Anti Stripping Additives
 - Cost savings benefit if single additive selected that provides both ASA and WMA benefits
 - Zycotherm SP2 provides ASA and WMA performance at the same dosage
 - Cost competitive with other additives single dosage.
 - Northern region mandatory ASA specification
 - Benefit to using one approved ASA additive with Warm Mix / Compaction Aid properties.

Conclusion

- Industry and Senior MTO Management support use of WMA
 - May take time for full implementation as there are cost impacts
 - Some MTO Contracts with mandatory WMA use being tendered for 2023
 - MTO may give more details at OAPC PIQ Seminars in April.



THANK YOU

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