

# **What is Warm Mix Asphalt ?**

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# Warm-Mix Asphalt (WMA)

Warm Mix Asphalt is defined as any Asphalt Concrete produced below 275°F (135°C), and above the boiling point of water 212°F (100°C),

- Below the typical evaporation point of light ends in asphalt binder.
- Typical production of HMA ranges from 150°C – 165°C (300 - 325°F)

# Benefits of WMA

- Decreased emissions and fumes
- Decreased energy usage
- Increased Workplace Health and Safety
- Better compaction
- Superior workmanship
- More uniform mixture of higher quality!
- Works great with RAP and polymer modified asphalt.

# Warm Mix Technology

- There are many Warm-Mix asphalt technologies...And they are all Different
- They do different things and behave differently!
- Choose the right technology for the right application

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# Types of WMA

- **Free Water Foaming Systems** (Double Barrel Green, Gencor Ultrafoam)
  - Material foaming additives (Advera)
  - Viscosity Modifiers (Sasobit)
- **Chemical Packages** (Hypertherm, Cecabase, Evotherm)

# Free Water Foaming Technologies

Small amounts of water are injected into the hot Liquid asphalt causing it to foam.

- Significantly increases the volume of asphalt around each particle, making it appear wet.
- Allows for easier compaction much like having a “wet mix”.
- Foam dissipates through time, pressure or temperature, generally improves compaction significantly on the first roller pass.

# Free Water Foaming Technologies

## Pros

- No ongoing cost – water is free – Capital cost only.
- Improves Mixing and compaction at all temperature ranges.

## Cons

- Works in the upper temperature ranges of what is considered warm-mix
- Benefits are limited to mixing and initial compaction along with temperature reduction.
- No significant benefits in cold weather.

# Chemical Packages

A chemical additive is added to the liquid asphalt. Either by the asphalt supplier, or directly at the plant.

- Chemical packages contain some sort of surfactant, and sometimes an antistrip component.
- Reduces the surface tension of the liquid asphalt (lubricity) allowing aggregate particles to slide amongst one another.
- Typically exhibits improved workability and compaction at temperature ranges as low as 80°C (165°F)



# Chemical Packages

## PROS

- Active throughout the workable life of HMA
- Significant improvement in workability at lower temperatures.
- Creates superior joints and reduces defects.
- Reheats and is active for 7 to 10 days
- Works well in cold weather paving increasing the window for hauling and compaction.

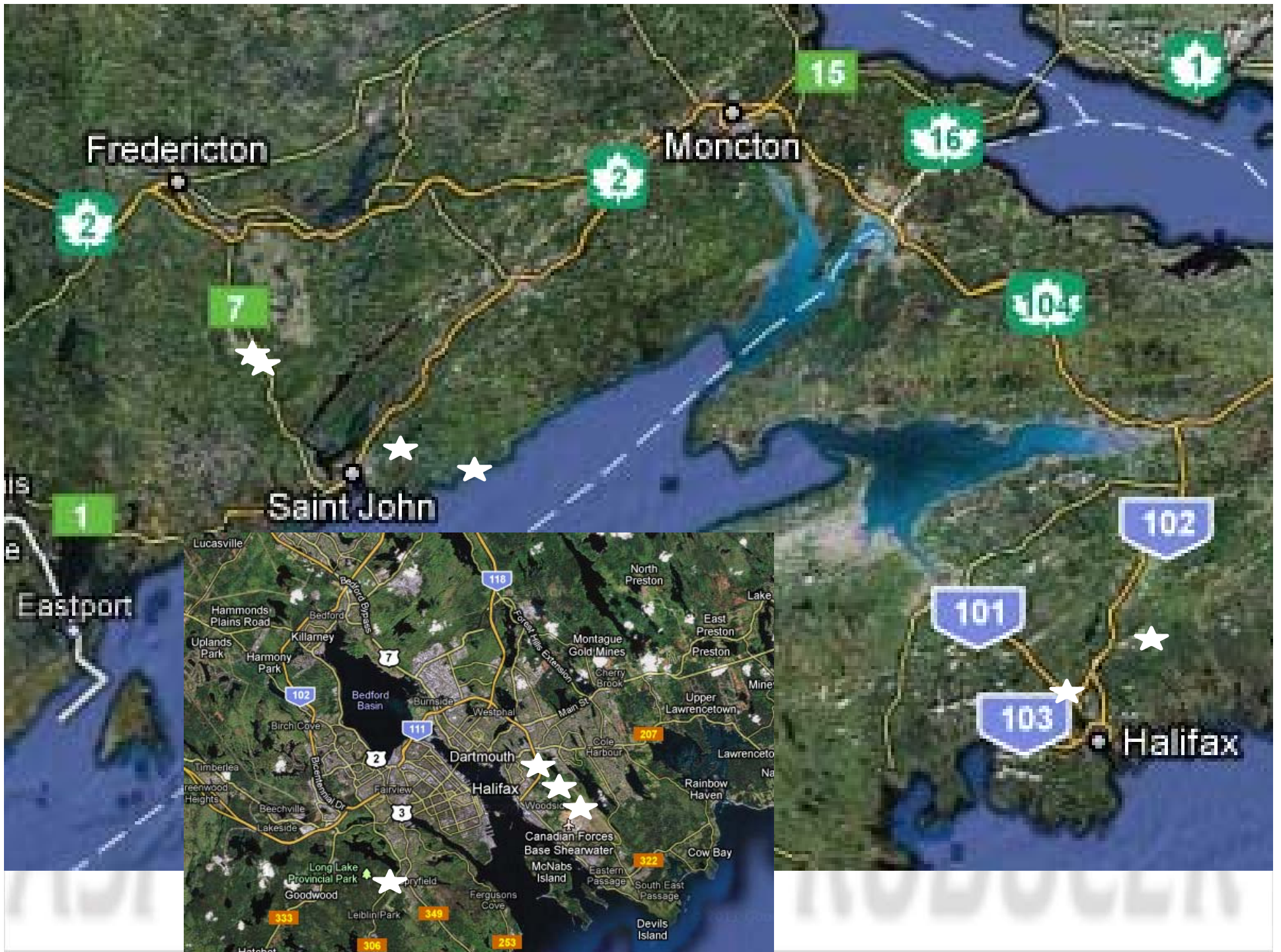
## CONS

- Chemical additives have an ongoing cost.
- Handling of chemicals may be an issue.
- Producing at lower temperatures could cause production challenges.

# Products Used in the Maritimes

- Evotherm
- Hypertherm
- Advera
- Gencor UltraFoam
- Astec Double Barrell Green
- Cecabase

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# WARM MIX ASPHALT

NSTIR Perspective

2011 NSUPA Annual Seminar

April 14<sup>th</sup>, 2011

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# Attractive WMA Benefits

- Reduction in emissions (fumes) at the plant and the placement site
- Reduced energy consumption
- Placement at lower mix & ambient temperatures (late season paving)
- Increased haul distance
- Compaction aid for difficult mixes
- Incorporation of higher percentages of RAP

# NSTIR Trial Projects – Products Used

- Two products have been used in NS
  - Meadwestvaco (MWV) Evotherm™ 3G
  - Gencor The Green Machine Ultrafoam GX2™
- Evotherm™ 3G is a binder additive that can be added at either the asphalt rack during loading or through in-line mixing at the plant in a similar manner as LAS additives.
- The Green Machine Ultrafoam GX2™ is a plant add-on system. The system injects water into the asphalt binder line and permitted to expand prior to addition with the aggregates.

# NSTIR Trial Projects To Date

- 2009
  - Trunk 2, from Route 224 O/P to Gibb Road
- 2010
  - Route 212, from Antrim Road to 2-km east of Oldham Road (8.30-km)
  - Margeson Drive Interchange
  - Route 374, from Trunk 7 northerly (4.50-km)
  - Old Post Road, from Trunk 2 to Oldham Road (0.73-km)
  - Cooks Brook Road, from Route 224 to Route 357 (1.30-km)
  - Route 357, from Route 224 southerly (1.00-km)

# 2009 Trial Project Overview

- The goal of the first trial was to conduct a side by side comparison with conventional HMA
- The only WMA additive available in the Maritimes at the time of the trial was MWV's Evotherm™ 3G product.
- HCS looked for a contractor willing to conduct the trial voluntarily.

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# 2010 Trial Project Overview

- The Department attempted to have multiple trial projects tendered for 2010. Three projects were isolated as suitable sites.
- The projects were tendered such that all asphalt was to be WMA.
- The tenders did not indicate what type of additive or process to use for the three projects.
- The contractors had the option to produce the mix at lower production temperatures.

# Issues Encountered - 2009

- Complaints from workers regarding the odor of the product
  - WMA product used is very similar to an anti-strip additive
  - Contractor's crew not accustomed to working with anti-strip additives
- High dust content in the mix
  - Due to reducing the production temperatures, there was insufficient draw to remove the dust typically removed during normal HMA production temperatures.

# Issues Encountered - 2010

- Rejection of loads of asphalt at the paver
  - Some loads that arrived at the spreader/MTV were too cool to be placed, little guidance to a definitive temperature
- Mix tenderness observed during placement
  - Shear cracking and chatter were noted
- Ambient temperature for placement
  - Question as to what ambient temperature to use to permit paving operations with WMA

# Future of WMA in Nova Scotia

- TIR/HCS will continue to monitor the sections placed to date and compare to nearby asphalts paved with conventional HMA
- Revision of the Special Provisions used for WMA to take into account rejection temperatures for:
  - Unloading of trucks
  - Ambient air temperature
- Mandatory use for late season paving
- Increase the allotted tonnage for the trial when the production temperatures are reduced
- Explore other technologies as they become available to the local marketplace

## WMA – QC/QA Consultants Viewpoint

### Three Projects:

- Trunk 2, Hants County – 2009  
(2009-145, Type C-HF base & surface courses)
- Hwy 101 / Margeson Road, Halifax County – 2010, 2011  
(2010-080, Type B-HF base & intermediate, Type CHF surface course)
- Route 212 (Old Guysborough Rd.), Halifax County – 2010  
(2010-082, Type C-HF base/leveling & surface courses)

## Trunk 2, Hants County, 2009

- Contractor: Basin Contracting Limited.
- Department wanted to have first official trial of WMA.
- Chose to pave approximately one-days production on surface course with WMA – ultimately ~1600 tonnes.
- EVOtherm™ was metered in-line at plant to begin, later pre-mixed binder was purchased.
- WMA was mixed at lower temperatures (used as warm-mix).

## Hwy. 101 - Margeson Drive Interchange, Halifax County, 2010-11

- Paving Contractor: Basin Contracting Limited.
- Project called for WMA for full tonnage – WMA technology was not specified.
- Project had December 31, 2010 completion date.
- Gencor Green Machine™ foaming kit was used at plant.
- WMA was mixed at hot-mix temperatures. B-HF mix also incorporated 20% RAP content.
- Project scheduled for completion of surface course early in 2011 season.

## Route 212, Halifax County, 2010

- Paving Contractor: S.W. Weeks Construction.
- Project called for WMA for full tonnage – WMA technology was not specified.
- Project had October 31, 2010 completion date.
- EVOtherm™ was pre-mixed in purchased binder.
- WMA was mixed at hot-mix temperatures.
- Project involved lengthy transport of asphalt – approximately 105 kilometres.



## Asphalt Mix Design

- WMA with chemical additive (e.g. EVOtherm™) – can easily complete trial mix design using pre-mixed binder.
  - For 2009 WMA trial (Tk.2), verification point was mixed and tested at hot-mixed asphalt proportions, using pre-mixed binder and combined / compacted at Manufacturer's recommended temperatures. Mix properties were statistically similar for HMA and WMA.
  - For 2010 project (Rte 212), only hot-mixed asphalt mix design was submitted.
- WMA by foaming (e.g. Green Machine™) – can not easily complete trial mix design, although there have been trials using Wirtgen cold-in-place mill.
  - For 2010 project (Hwy101-Margeson), only hot-mixed asphalt mix design was submitted.

## Plant Observations

- Working with mix – no real difference evident from ‘normal’ mix .
- WMA with chemical additive was compacted at lower temperatures, while WMA by water-injection samples were compacted at HMA temperatures.
- Quicker turnaround of chemical-additive sample testing, due to less reheating required.
- Some odour noted with chemical – similar to LAS.
- No problems noted regarding moisture content of mixed asphalt samples.
- Depending on plant set-up, running at lower temperatures may cause mix issues, such as increased dust.

## Road Observations

- Allowed extended haul (Rte. 212) and late season paving (Hwy 101-Margeson), although there were some loads rejected at paver and possible mix tenderness issues.
- Loads rejected for low temperature at Hwy 101 arrived at temperatures less than those specified as workable range by manufacturer.
- Difficult to assess mix tenderness issues at Rte 212, due to other issues. Paving over very poor quality roadway. Top lift exhibited no similar issues. Also, mix compaction was relatively low, again, more notably on the bottom leveling course.
- Similar to plant observations – no real difference from HMA.



# Contractor's Perspective

Warm Mix

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# Questions

- What are the benefits?
- Are there savings on Fuel?
- How does it affect our plant production/settings?

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# NBDOT Contracts 10-077

- 9.1 km Warm Mix Contract on Rte 7 twinned highway near Petersville Hill
- Contract was paved in June 2010
- Why Warm Mix??
- Quality Control / Quality Assurance
- Air Voids( Does Foaming impact Air voids)

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06/15/2010

# ASTECC Double Barrel Green





# Will Air Voids Vary During Delayed Testing?

- To evaluate field mixtures, allow WMA to cool to  $< 60$  degrees C and reheat to ensure accurate air void results, as the entire foaming effect is dissipated below the steaming point of water (80 degrees C). Compact laboratory specimens at temperatures equivalent to conventional Hot-Mix Asphalt recommended by temperatures viscosity charts.

## Airvoids Comparison Contract 10-0777

	NBDOT(Delayed)	Dexter Instant	Dexter Delayed
<b>Lot #</b>			
<b>1</b>	<b>3.2</b>	<b>3.5</b>	<b>3.6</b>
<b>2</b>	<b>4.1</b>	<b>4</b>	<b>4.4</b>
<b>3</b>	<b>3.2</b>	<b>3.8</b>	<b>3.5</b>
<b>4</b>	<b>3.5</b>	<b>3.6</b>	<b>3.8</b>

# Compaction

- Lot 1 93.0%
- Lot 2 93.8%
- Lot 3 95.3%
- Lot 4 94.4%

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# Observations

- Stable, Workable , Compactable Mix
- Mix Was Similar In Texture to Conventional Hot Mix From Same Aggregate Source
- Low Odour
- Plant Operators and Paving Crew Were Able To Work Normally
- More Comparison Testing Needed for Air Voids

Questions?

