24th May 2010

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Director of Roads & Bridges
Williamson County

Initial Foamed Asphalt Recycling Project Proposal

1. Project Outline:

The road is currently being maintained by Williamson County County and is typical of many miles of similar roads in the County.

As an alternative to current patching maintenance procedures it is proposed to Recycled the entire existing pavement and Stabilise with foamed bitumen:

Option 1: Recycle existing material
Option 2: Supplement existing in-situ material with RAP, & foam stabilise
Option 3: Supplement existing in-situ material with RAP, lime stabilise & foam stabilise

to a depth to be determined during a mix design procedure, this will eliminate all inherent weak areas in the base and form a new long lasting base suitable for sealing with either a chipseal or asphalt overlay.

2. CR424:

CR424 is shown as being in Poor to Bad condition.

The road section is approximately 15ft wide, generally made up of:

- 2 layers of chipseal
- 4ins river run aggregate
- Native black clay

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3. Material sampling:

Materials to a depth of 8ins were taken from 2 locations on CR424, unfortunately the different pavement materials were not taken in individual layers, therefore the samples for the lab were somewhat contaminated.

Test pits locations marked appox 0.28 miles South of Intersection with 423

4. Laboratory

The material taken from the job site were sent to the Wirtgen laboratory in Nashville for analysis and initial mix design procedure with lime & foamed asphalt

Samples from the test pits are subjected to laboratory testing, to establish the quality of the materials in the existing pavement payers, and in the underlying subgrade.

Typical tests include:

- Sieve analysis
- Plasticity, and
- CBR

The results from these tests together with samples of the materials are used to formulate the mix design.

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5. Laboratory Testing / Mix Design

Using a Wirtgen WLB10S, Foamed Asphalt Laboratory samples to be prepared by mixing materials taken from the test pits with various percentages of foamed asphalt & lime to determine the optimum percentage of foamed asphalt/lime to be added to meet the desired design requirement.

The WLB10S is used to:

- Determine the foaming properties of different AC types.
- Producing samples by injecting foamed asphalt directly into the laboratory pugmill mixer
- The quality of mixtures to be produced in the field can be defined exactly.
- Information on the material properties such as load bearing capacity can be obtained before the construction work starts.

i. Moist material **ii. Lime added** **iii. Mixed material**

At each percentage of foamed bitumen, briquettes were prepared using Marshall Method of compaction. The briquettes were extruded immediately from the mould and marked (as shown in the below picture).
The 100mm compacted specimens were then cured at 40 °C (104 deg F) for 3 days. After cooling to ambient temperature, 3 briquettes from each set were placed in water for 24 hours.

i. After compaction **ii. After curing** **iii. Soaking for 24 hours**

After curing and conditioning the briquettes were tested to determine their Indirect Tensile Strength (ITS) for both the dry and soaked specimens.

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Client:	Williamson County
Project:	Road 424
Sample Number:	1
Sample Delivered By:	
Job Card No	
Date Received	1900/1/0
Date Tested:	2012/5/19
Date Reported	

FOAMED BITUMEN MIX DESIGN REPORT - LEVEL 1

MATERIAL TO BE STABILISED		Aggregates		Bitumen	Filler
Location / Source:		Road 424			Supplied
Description		50% River Gravel + 50% Sandy Clay		64-22	Lime
Maximum dry density :	(kg/m3)		Optimum moisture content (%):		

BITUMEN FOAMING CONDITIONS

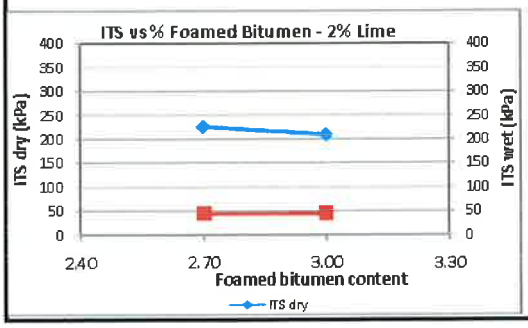
Foaming water added	(%)	2.50%	Bitumen temperature (°C)	160

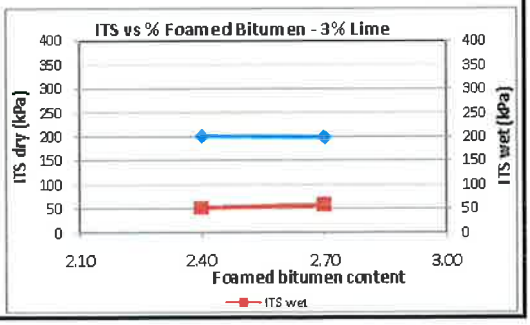
FOAMED BITUMEN STABILISED MATERIAL CHARACTERISTICS

Compactive effort		Marshall Compaction		**100mm**	diameter
Date moulded		15 May 2012			
Foamed bitumen added	(%)	2.70	3.00	2.40	2.70
Type and percent filler added	(%)	2% lime	2% lime	3% Lime	3% lime
Moulding moisture content	(%)	12.0	12.4	12.9	12.2

TEST RESULTS

ITS dry	(kPa)	**226**	**209**	**202**	**199**
Moisture content at break	(%)	2.5	2.5	2.6	2.6
Dry Density	(kg/m^3)	1920	1891	1900	1906
Temperature at break	(oC)				
ITS wet	(kPa)	**44**	**45**	**51**	**57**
Moisture content at break	(%)				
Dry Density	(kg/m^3)	1926	1911	1913	1913
Temperature at break	(oC)				
Retained ITS	(%)	19	21	26	29





6. Traffic

Very small ADT (150 VPD). Heavy grain trucks, about 10 to 15 a year. Approx. Weight = 130,000 lbs

7. General Comment

The samples performed better than expected. There was some soaked strength but it was low. The briquettes looked dry but had 2.6% moisture. This is an indication that active clay particles were still present.

If the pavement materials get wet then there is limited strength and this will lead to failure especially with the lack of support from the underlying black clay.

If adequate drainage measures are implemented, then this material will work especially if the layer thickness is reduced such that less clay is incorporated into the mix.

It should be noted that the gravel layer was wet. This is due to the cracked surfacing which allows water into the layer and the impervious clay beneath which does not allow for the water to permeate into the clays thereby trapping the water in this gravel layer. The underlying clays have also infiltrated into the gravel layer thereby making this layer plastic and susceptible to moisture ingress. The clay layer had 20% moisture but was firm indicating that the liquid limit of this material is very high which is normal for a clay.

The addition of foam to the gravel will reduce the susceptibility to moisture and prevent excessive moisture entering this layer.

8. Recycling Proposal

It is clear recycling the existing pavement is a viable solution to the existing problems on CR424 and other similar roads in the area.

As in all things economics have to be taken into consideration and therefore three options are proposed.

8.1 Option 1: Recycle existing material

Recycle & Stabilise the existing gravel layer with minimal clay ingress to a depth of 5ins, this will eliminate all surface cracking and prevent further ingress of water into the upper layer, provide a positive support base for a chipseal, greatly increase the life of the pavement at lowest cost.

Please note care should be taken to improve the side drainage

8.2 Option 2: Supplement existing in-situ material with RAP, & foam stabilise

By the simple addition of RAP onto the existing pavement surface, the quality of the recycled layer can be greatly enhanced and eliminate the introduction of the clay base into the mix.

Pre spread 2 to 3ins of RAP on existing pavement surface and recycle/stabilise with foamed asphalt to a depth of 7ins

** Requires new mix design

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8.3 Option 3: Supplement existing in-situ material with RAP, lime stabilise & foam stabilise

A total solution for the problems on CR424 and surrounding roads would be to:

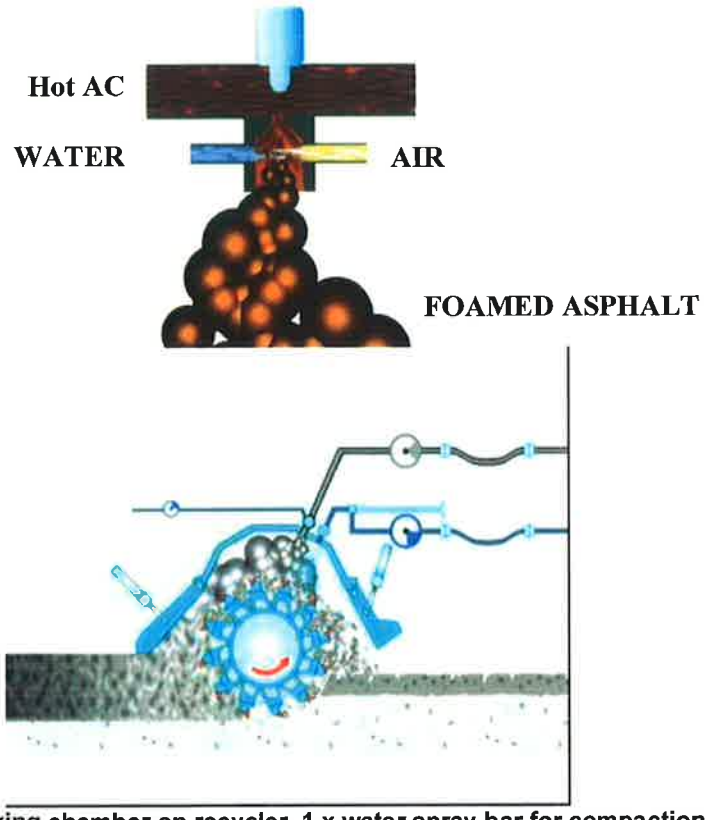
- Pre-treat the existing pavement with 4% lime, mix in place to a depth of 8ins, compact and roughly shape to grade.
- Import 4ins RAP, spread on lime treated surface
- Stabilise top 5ins with 2% foamed asphalt, compact and finish grade
- Apply surface chipseal.

This solution eliminates all existing cracks and weaknesses in the pavement, nullifies the action of the clay base by the introduction of lime and provides a total support structure for the chip seal.

** requires new mix design

9. Foamed Asphalt

Foamed asphalt is a means of dispersing the AC uniformly throughout the mix of materials by converting the stiff AC to a foam or bubble state allowing the AC to be mixed and form a flexible bound base.



View inside mixing chamber on recycler, 1 x water spray bar for compaction, 1 x foamed asphalt spray bar,

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10. Construction Method:

10.1 Option 1. Recycle Existing Material

i) Pre-Spread 2% lime onto existing pavement

ii) Using WR2400 Stabilise existing pavement to a depth of 5ins, simultaneously mixing lime and 3.0% foamed asphalt

iii) Recycling Train

1 x Water truck (compaction water), 1 x AC tanker, 1 x WR2400, 1 x Pad foot compactor (immediately behind recycler)

iv) Grade to levels

Following the initial compaction the recycled material will be cut to level using a motor grader.

At this point the road can be shaped to the optimum drainage profiles,

v) Finish Compaction

The cut to level recycled material to finish compacted using a HAMM vibratory steel drum roller.

vi) Lightly water

The finished compacted recycled pavement is lightly watered.

vii) Surface finish

While the surface of the recycled pavement is moist the HAMM PTR is used to create a slush on the surface with it's pneumatic tyres.

This slush brings fines to the surface creating a smooth finish ready for the final surface seal.

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viii) Sealing:

Once the moisture has been allowed to evaporate from the recycled pavement (normally 2 –3 days) the recycled surface can be sealed with either a:

- Chipseal
- Asphalt Overlay
- Slurry Seal

Note: It is possible to traffic the recycled pavement during this drying out period, the road is NOT closed to traffic.

10.2 Option 2: Supplement existing in-situ material with RAP, & foam stabilise

i) Pre-spread RAP 2ins to 3ins thick onto existing pavement

Follow construction sequence shown in 10.1, to completion

- Pre-Spread 2% lime onto existing pavement
- Using WR2400 Stabilise existing pavement to a depth of 7ins, simultaneously mixing lime and 3.0% foamed asphalt
- Recycling Train
- Grade to levels
- Finish Compaction
- Lightly water
- Surface finish
- Seal, possible chip seal

10.3 Option 3: Supplement existing in-situ material with RAP, lime stabilise & foam stabilise

i) Pre-treat the existing pavement with 3% lime, mix in place to a depth of 8ins, compact and roughly shape to grade.

Finish shaping and compacting, open to traffic and leave for 24 hours

2nd day follow construction sequence shown in 10.2