



SASOL

ASPHALT ADDITIVES

34th RPF – Warm Mix Asphalt



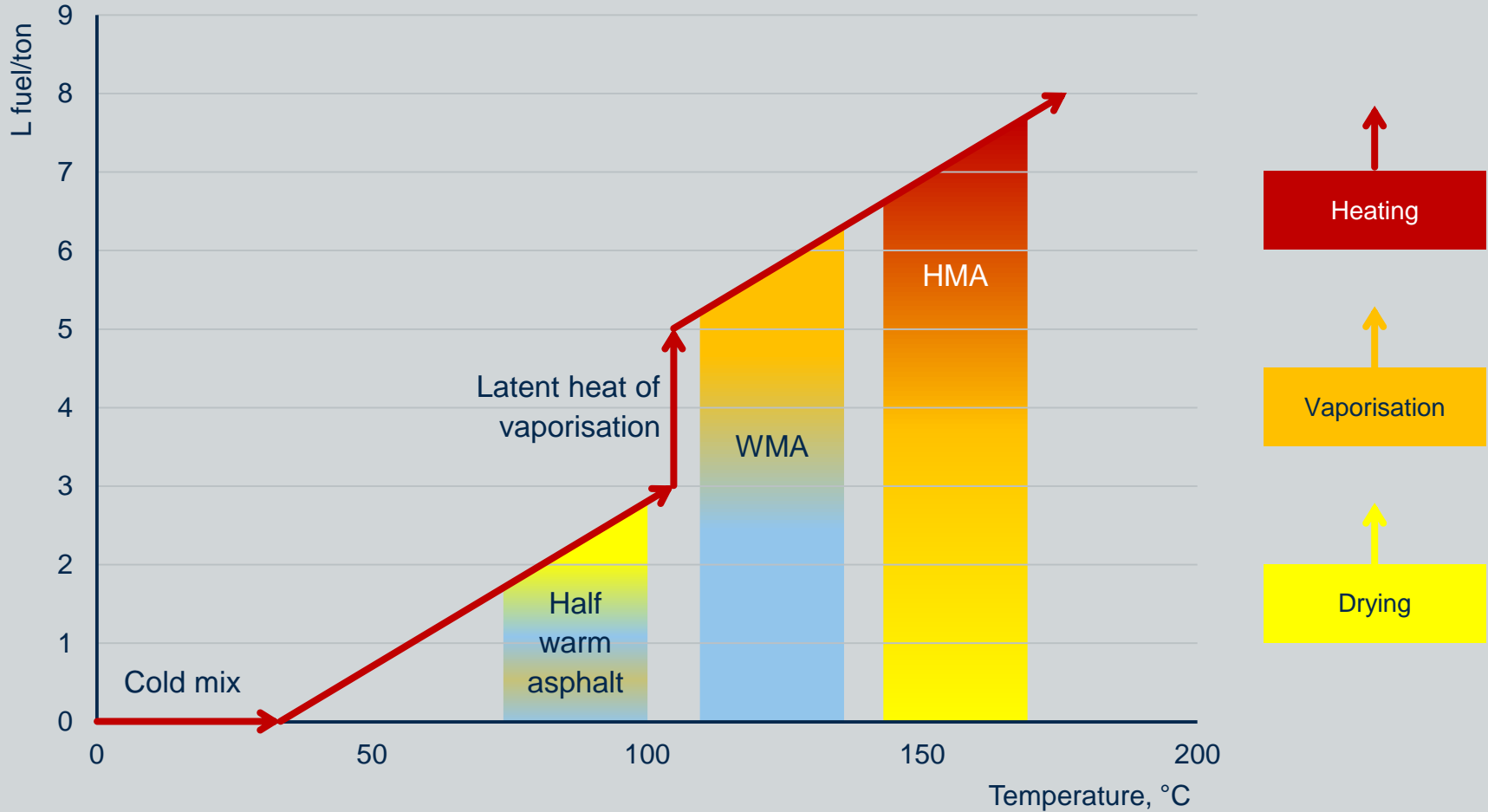
- Introduction to Warm Mix Asphalt (WMA)
- Benefits of WMA
- WMA technologies
- Problems encountered using WMA
- Status of WMA
 - Europe
 - South Africa
- References



Introduction

Full range from cold asphalt to HMA

EAPA position paper: the use of warm mix asphalt – January 2010



Cold asphalt

Binder cutback / emulsion / foamed bitumen

Half warm asphalt

Binder / mix temp. Between 70-100°C

Warm mix asphalt

Binder / mix temp. Between 100-140°C
- Equivalent performance to HMA

Hot mix asphalt

Mix temp. Between 140-190°C



Benefits of WMA

- Environmental benefits
- Paving benefits
- Asphalt workers – health and safety
- Economical benefits



Stack / lower production temp requires less fuel (20-40%)

- Less CO; SO_x; PAH; NO_x emissions
- Less dust extraction
- Less fumes; emissions

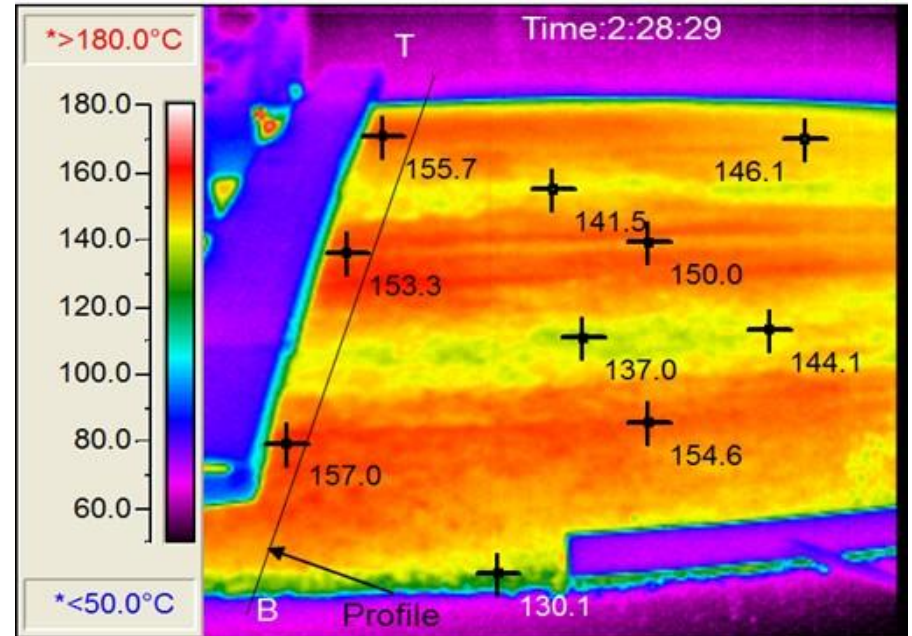
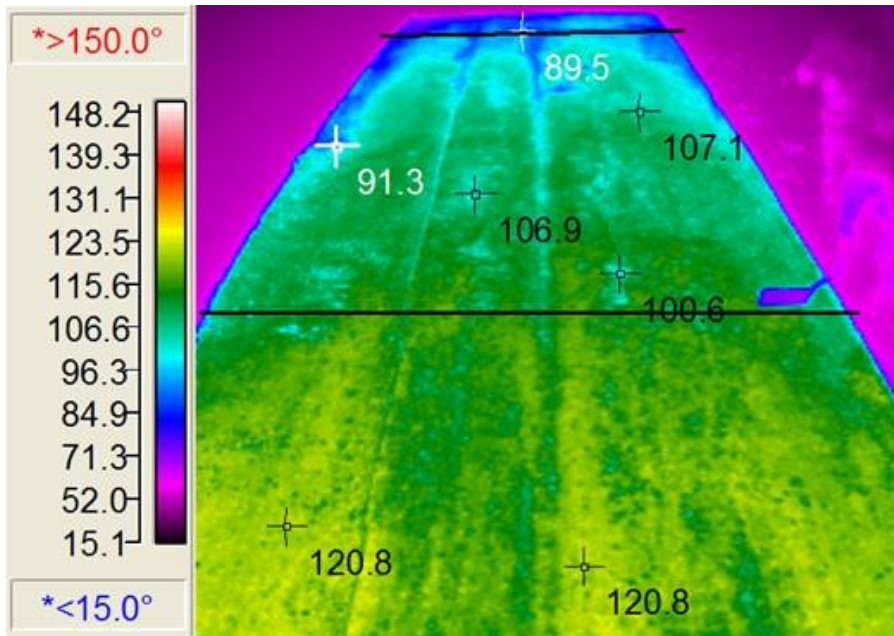
Paving – reduced TOM emissions below 140°C

- Less compaction (20-30% fuel saving)



Paving benefits of WMA

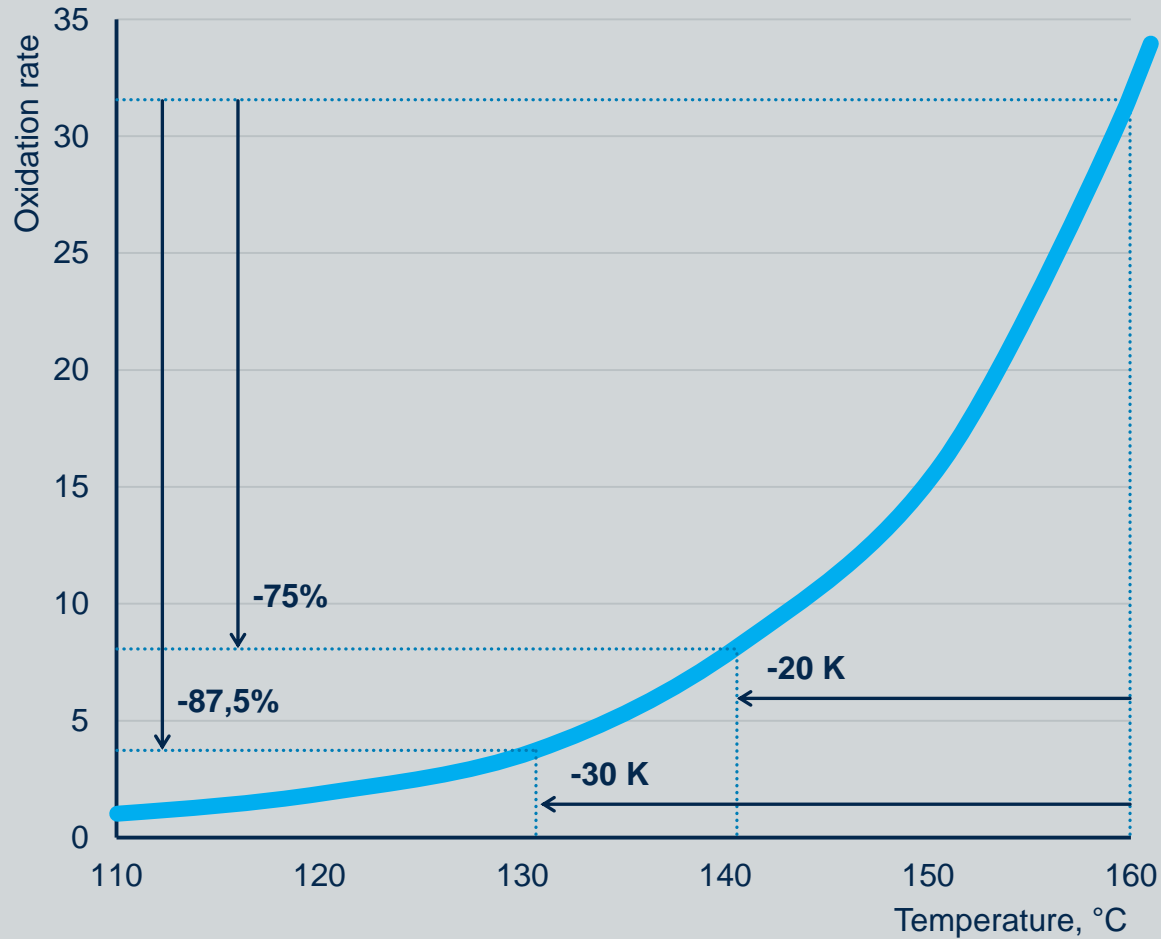
- Reduced paving temperature
- Improved workability
- Extended time – longer hauling and reduced compaction cycles
- Early traffic release
- Workers' health and safety – less heat, less fumes; comfort in enclosed areas – tunnels, bridges, shaded areas



- Less fuel
 - Manufacture (20-40%)
 - Compaction (20-30%)
- Lower production temperature – less wear on plant
- Extended paving window – higher production
- Extended hauling – better utilisation of satellite / production site
- Reduced binder aging



Temperature reduction / oxidation rate



Van't Hoff equation

The oxidation rate halves for every 10 K in temperature reduction

Foaming technology
– decreases bitumen viscosity
by increasing bitumen volume

- Direct water introduction: water based technology
- Indirect water introduction: zeolites

Chemical additives
– reduces inter surface tension
between binder and aggregate

- Adhesion promoters / surfactants / emulsifiers – water

Organic additives
– decrease bitumen viscosity

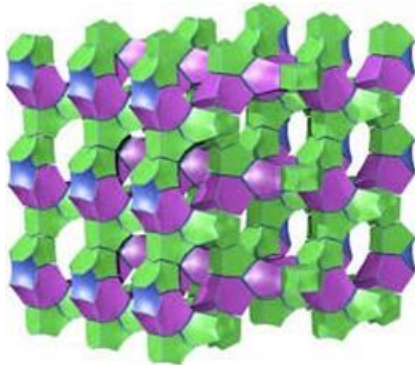
- Waxes



- Water is either forced through injection nozzles into bitumen or water is added to aggregate
- Surfactant can be used to improve aggregate / binder adhesion
- When water/steam evaporates – foam collapses
 - Critical water requirement and above Boiling Temperature of Water to remain effective
- Bitumen emulsion / hard and soft bitumen combination



- Zeolites
 - Microporous sodium aluminium Silicates
 - Crystalline structure
 - Moisture absorbents
- Water is gradually released at temp
 - 5/7 hours foam stability
- Molecular sieves – moisture traps



Reduces inter surface tension between binder and aggregate

Surfactants / polymers / emulsifiers

This technology improves adhesion / wettability of aggregate

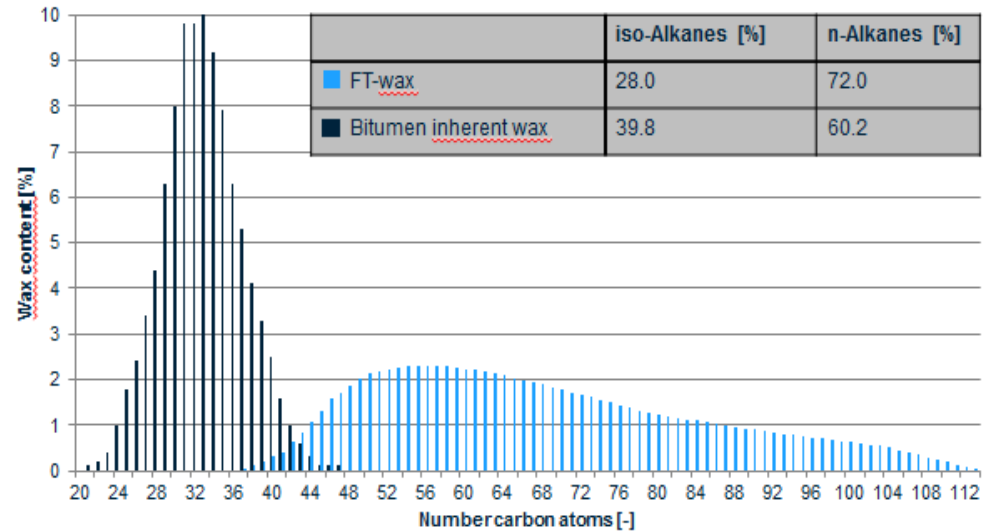
Low dose of water can be introduced

Dosages of additive are low (0,3-0,7%)

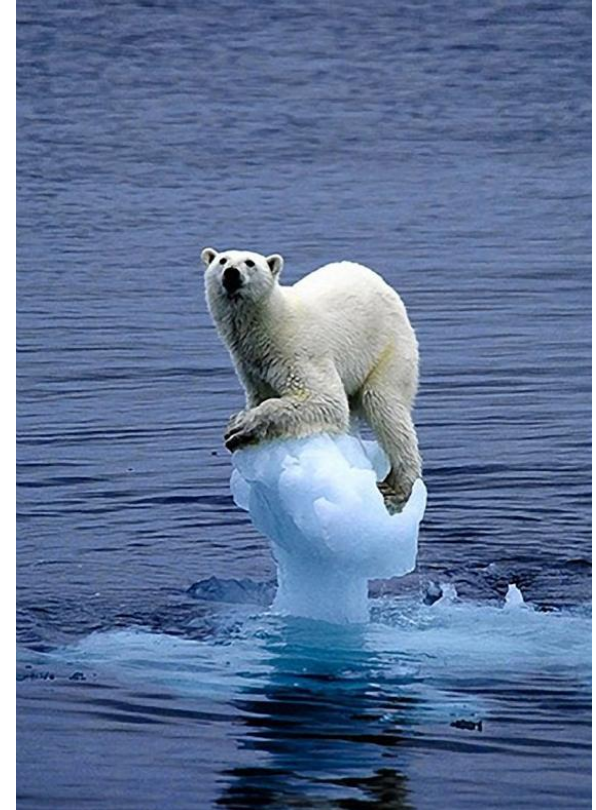
Paving at 90°C



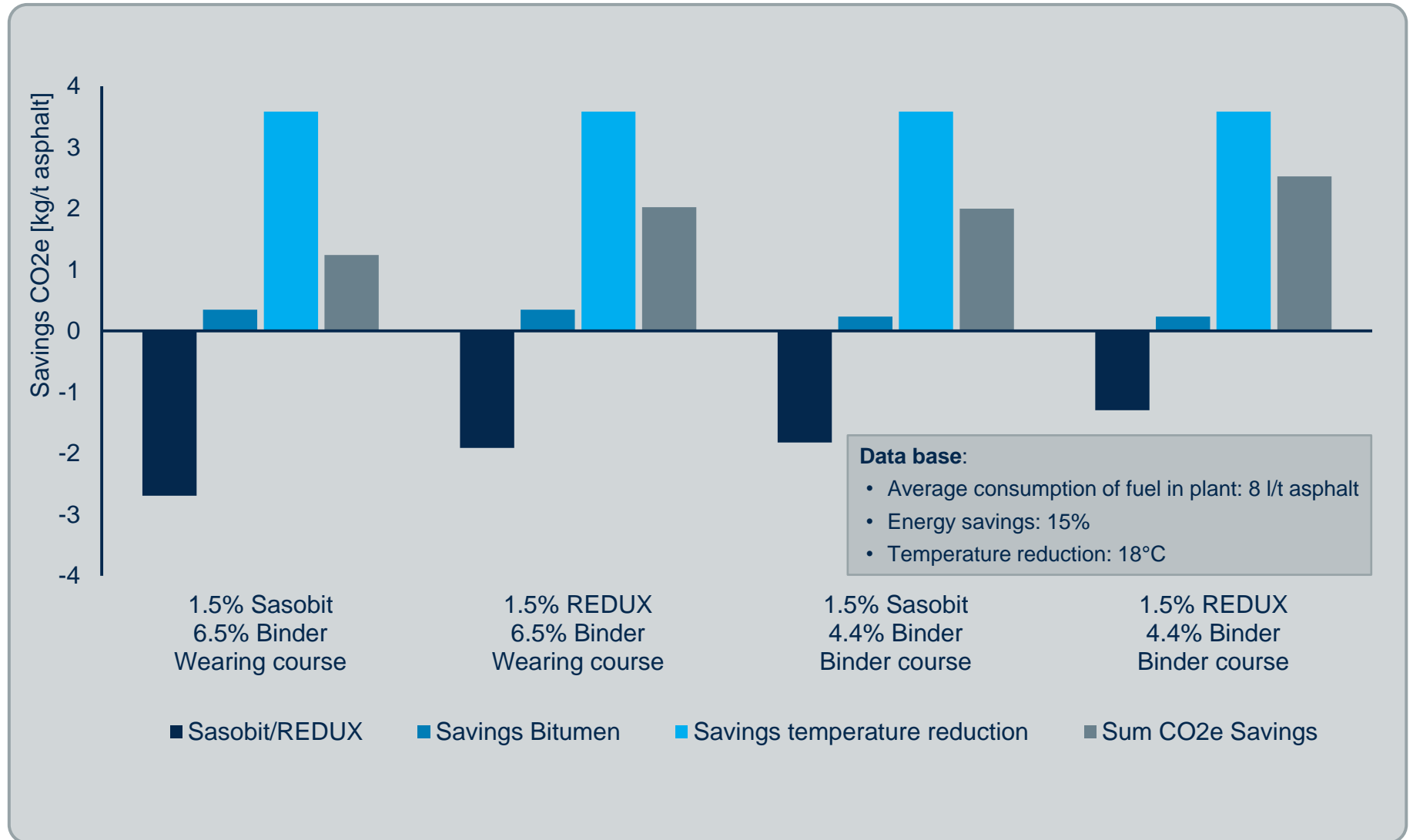
- Reduces viscosity of bitumen
- Hydrocarbon:
 - Good compatibility bitumen
 - Anti-ageing properties
 - Chemically inert
 - Water resistant
 - High fuel resistance
 - Good lubrication
 - Better aggregate coatability
 - Better workability
 - Crystalline – deformation resistance paving between 90-125°C



- Technical issues
 - Repeatability with foam technology
 - field vs laboratory testing
 - Moisture susceptibility – fatigue cracking in winter months
 - Premature deformation failure
 - Skill deficit using WMA
- Economic issues
 - Relatively low cost of fuel
 - Cost of WMA additives
- Some technology is less than 20 years
- No advantage in the total integrated environmental carbon footprint from the WMA technology
- Lack of stewardship within the asphalt industry



Total integrated carbon footprint – FT Wax



International airports such as:

- South Africa: Johannesburg, Cape Town, Durban
- Germany: Frankfurt, Munich, Berlin, Hamburg and Airbus Hamburg
- Austria: Vienna Airport
- United Kingdom: Cambridge
- Sweden: Umea, Sturöman
- Singapore: Changi



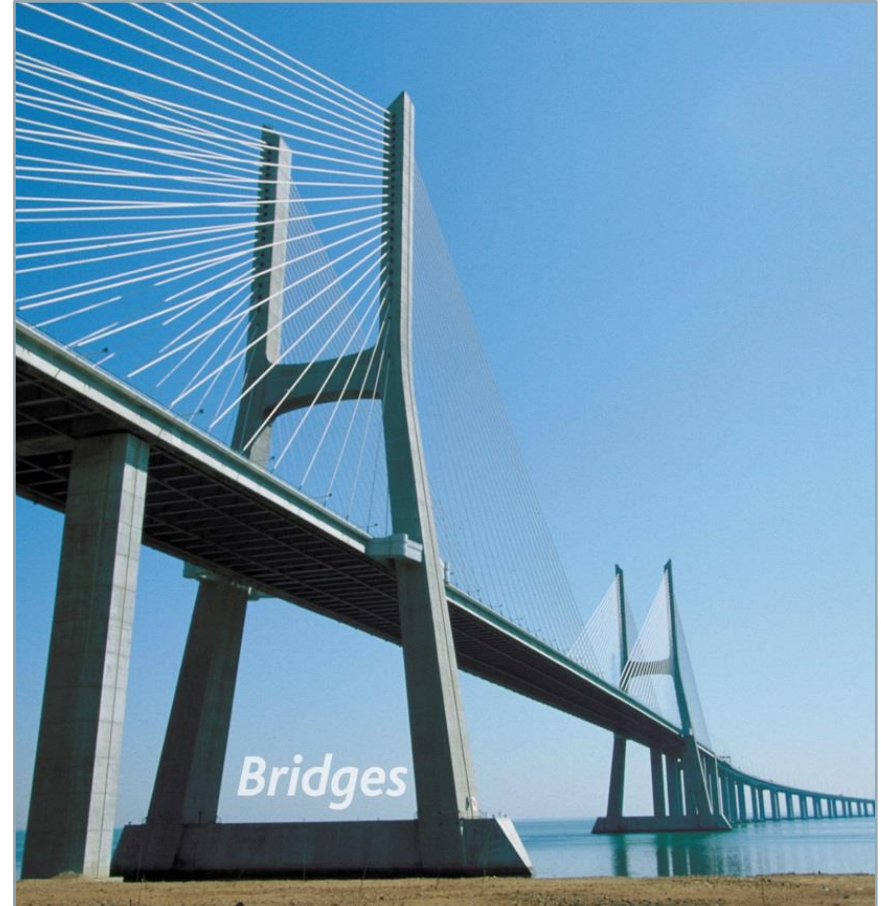
High profile highways such as:

- South Africa: N1, N2, N3, N4, N17
- Mozambique: N4
- Germany: A1, A3, A7, A25
- Saudi Arabia: Riyadh – Dirhab Road
- United Kingdom: Oxford and Bond streets, London
- Russia: Moscow City roads
- USA: Several trials
- Malaysia: Kuala Lumpur Highway No.1
- China: Shandong, Guangdong Province, Shanghai



Bridges such as:

- China: LUPU suspension bridge in Shanghai
- Bridges in Fujian, Tianjing, Guangxi, Shandong, Anhui
- Germany: A7 Hochbrucke, A3 Schaldinger, Danube



Race tracks such as:

- USA: 4 NASCAR
 - Homestead
 - Miami
 - Talladega
 - Daytona
- Qatar: Doha Speedway



- 200 000 annual flights
- Concrete surface showed signs of cracks after 35 years
- Project can only be performed at NIGHT
- Reconstruction started on 22 April 2003
- Size of the project
 - Duration 300 nights
 - Runway 4 000 meters long and 60 meters wide
- Night work = 15 x 60 meters sections per shift
- Runway closed between 22:30 and 06:00 (7,5 hours ONLY)
- First aircraft lands immediately after 06:00
- Allocation of work:
 - 1,5 hours for demolition and excavation
 - 4,5 hours for paving
 - 1,5 hours for marking and cleaning up

- Work was performed as follows:
 - First Phase: two asphalt base courses of 24 cm were laid
 - Following the first phase a 12 cm thick AC binder course
 - Final Phase 40mm wearing course
- 3 mixing plants were used
- 1 500/mt of asphalt was stored in silo at site
- Equipment used:
 - 8 x 44 ton excavators with 2-3 ton chisels
 - 1 400 tons of rubble was daily loaded onto 26 lorries
 - 2 Voegele Type Super 2100 of 7,5 meters were used
 - 4 Hamm DV-8 tandem rollers
- Asphalt temperature delivered to site not to exceed 120-125°C
- Total cost of reconstruction = €38m
- No accidents occurred

The value proposition of WMA Technology

- Higher recycled asphalt use
- Premature rutting (insufficient binder aging)
- Reduce binder content in design mix
- The better “wettability” of binder – binder / aggregate ratio can be reduced
- Chip and Spray Application (un/modified)
- Extended paving window. Chip at lower surface temperature $>15^{\circ}\text{C}$
- Co-modification in High PG
- High polymer content requires viscosity modifier for ease of use of Pmb / crumbed rubber / plastomers, etc.
- Environmental stewardship
- Impact on our environment



- EAPA position paper The Use of Warm Mix Asphalt – January 2010
- Journal of Cleaner Production 24 (2012) 76-84
- NAPA – Quality Improvement Publication 125; Second Edition
- Assessing the potential and possibilities for the use of WMA in Latvia
 - Martins Zaumanis, Viktors Hatitonovs; Gruntis Brencis; Juris Smirnovs; Riga Technical University
- M. Carmen Rubio, German Martinez, Luis Baena, Fernando Moreno
 - Construction Engineering Laboratory, University of Cranada, C/Severo Ochoa s/n; 18071 Cranada, Spain





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Thank you for your time and interest

