LISBOA 2010
MAY 25/28

16th World Meeting

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Warm Mix Asphalts by Chemical Additives
Properties and Advantages

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Warm Mix Asphalts Technologies

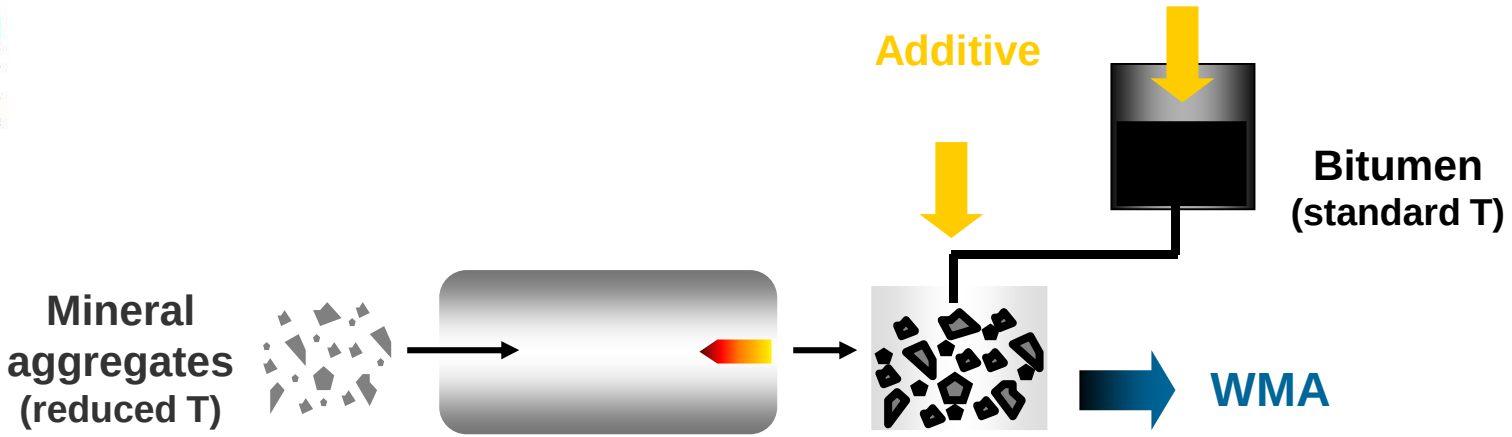
1) **Sequence of soft and hard bitumens** – A soft bitumen is used to cover a portion of the aggregates at lower temperatures and a foamed hard bitumen is used afterwards for the rest.

2) **Water Foam Processes** – Water is added to form a bitumen foam when it evaporates. (Zeolites, partial drying of mineral aggregates, emulsion, foaming nozzles, etc..)

3) **Waxes** – Solid additives (2-3 wt% used) that melt at paving temperatures (T > ~100℃), reducing the bitumen viscosity .

4) **Chemical Additives** – Liquid surfactant-based additives

WMA chemical additives

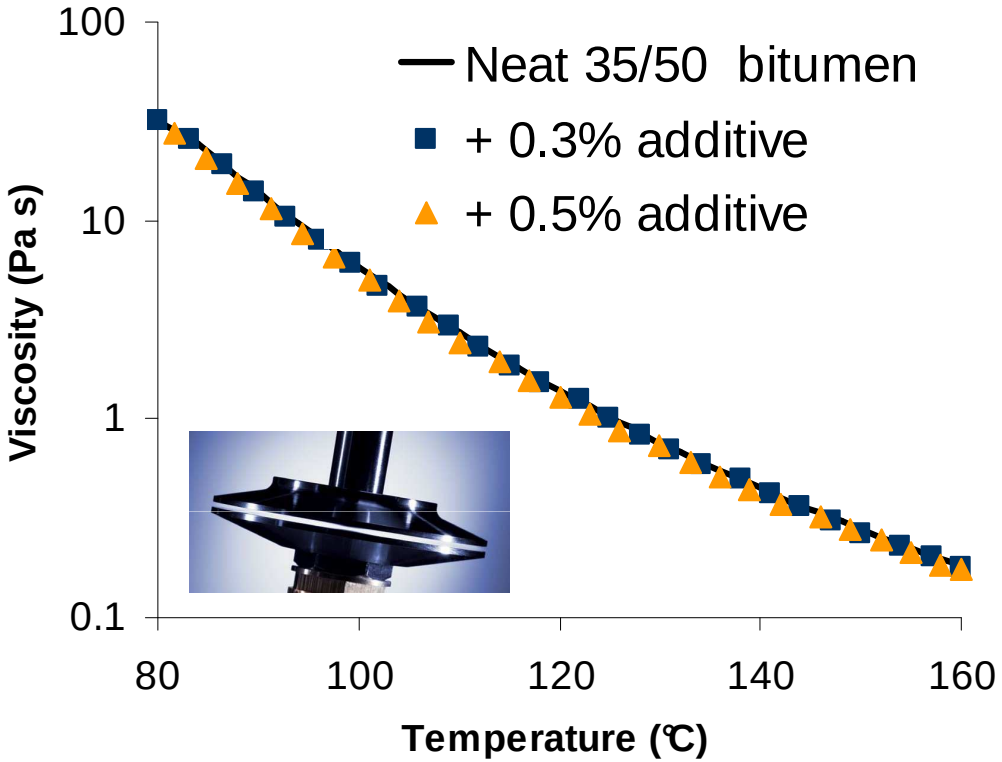


cecabase|rt

- **Liquid** surfactant-based formulations
- Control the bitumen/aggregate **interface** to reduce internal frictions.
- Only **0.2-0.6 wt%** (relative to the bitumen) is required
- **Reductions** on fabrication temperatures **up to 45℃** can be achieved.
- **No** plant **modification** is necessary

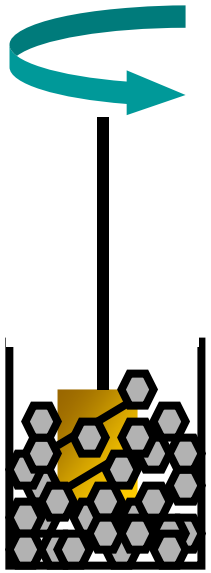
Bitumen properties

- **No change** in bitumen **viscosity**, **penetration** grade or **R&B** temperature

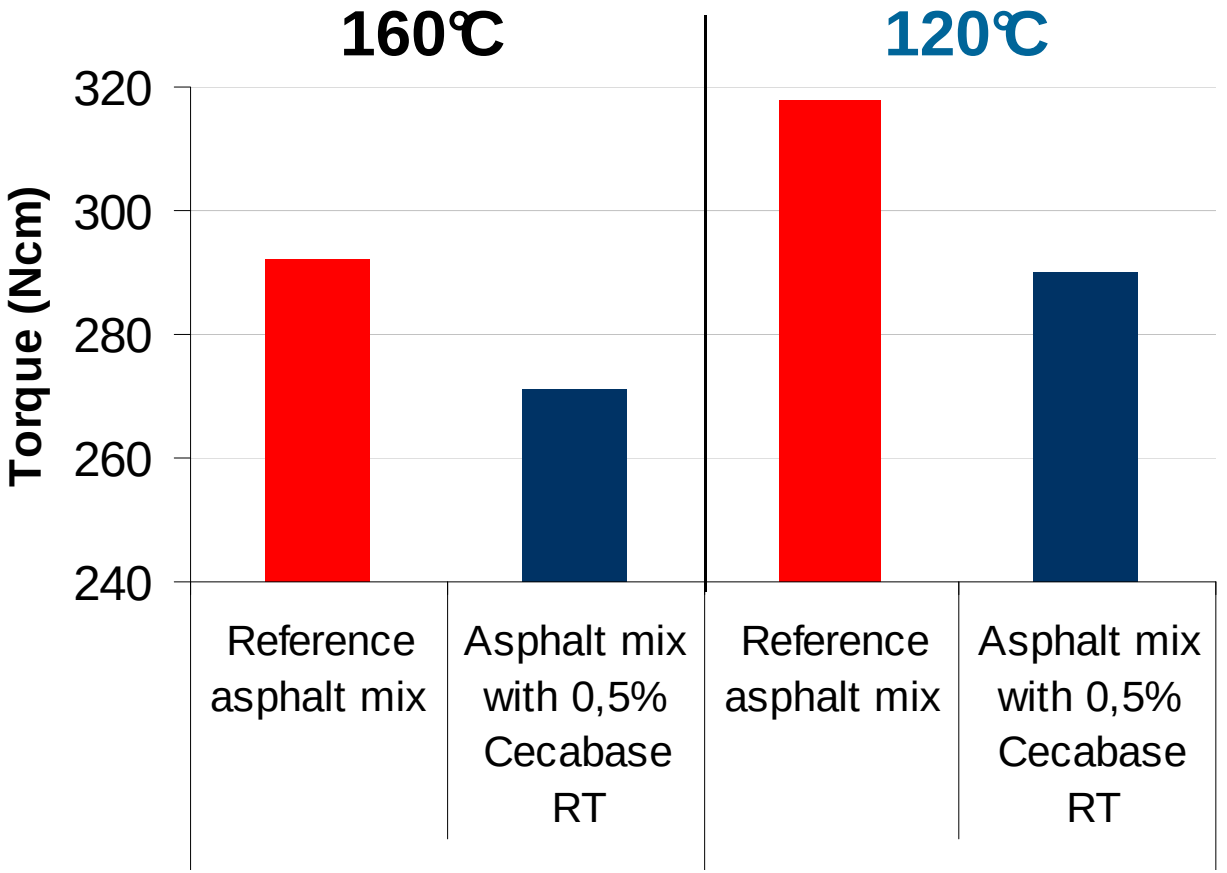


	50/70 Bitumen	50/70 Bitumen + 0.5% additive
Penetration (1/10mm)	51	50
Ring and Ball (℃)	51.2	50.8

Asphalt Mix Properties



Baustofflabor Hamburg, Germany



- Significant improvement of mix **workability**

Laboratory Tests

Materials used

Aggregates Fraction (mm)	Wt %
Filler	2.5
0/2	33.5
2/6	20
6/10	44

5.3% bitumen with 0.4 wt% of Cecabase RT® additive

		HMA (160℃)	WMA (110℃)	Limits in the norm
PCG	**% Voids** after **60** gyrations NF P 98-252	8.6	8.1	5< %< 10
Duriez	**Moisture** damage (r/R) NF P 98-251-1	0.87	0.87	>0.75
Rutting	(%) after 30,000 cycles NF P 98-253-1	4.11	4.19	<5

- **No significant differences** in mechanical performance were observed between a **HMA** and a **WMA** with the chemical additive.

Example Field Jobs

✓ BBSG 0/10 **rolling surface**, (Béton Bitumineux Semi-Grenu) with **10% or RAP.** Compacted at **125℃** . 2 years of service → **OK**.

✓ EME (Enrobé a Module Eléve) for a **high traffic road** with a **10/20 [1/10mm] bitumen.** Produced at **130℃** (regularly 170°C).

✓ BBTM (Béton Bitumineux Trés Mince) for a **highway rolling surface** with a **polymer-modified bitumen**. Produced at **130℃** (regularly 170℃).

- **Robust technology** –different kind of bitumens, aggregates, formulas and conditions are **ok**

Emissions reduction

- Measurements were taken during the production of a thin wearing course with Polymer Modified Bitumen

	Fumes T (℃)	Dust (g/ton)	CO (g/ton)	CO_2 (g/ton)	VOC (g/ton)	NO_2 (g/ton)
WMA (125℃)	97	5.4	69.8	13.4	8.5	21.4
HMA (170℃)	125	7.4	109.6	15.6	10.7	31.2
Difference	**-28℃**	**-27%**	**-36%**	**-14%**	**-21%**	**-31%**

Energy savings

Base Layer 0/20

Bitumen content: 4.7%

Additive: 0,5%

	HMA 150℃	WMA 125℃	Savings
Gas consumption (m^3/ton)	6.4	5.1	**20%**

Foundation Layer 0/25

Bitumen content: 4.1%

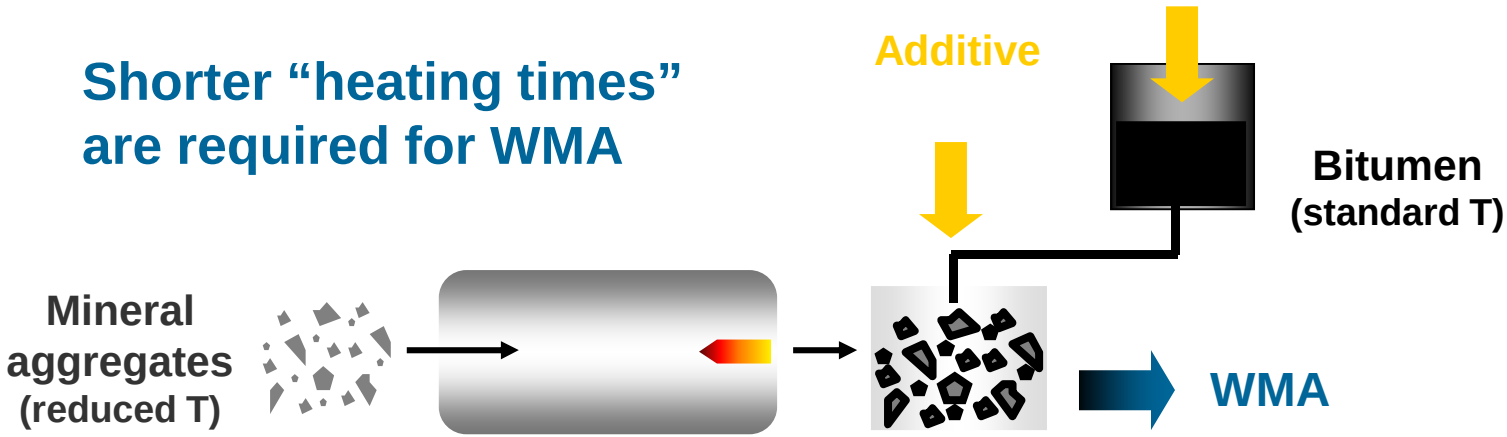
Additive: 0,5%

	HMA 145°C	WMA 125°C	Savings
Gas consumption (m^3/ton)	7.9	6.0	**24%**

"By **reducing 40℃** the temperature needed to produce the 350 million tons of asphalt mix produced in Europe every year, WMA would enable the road industry to generate energy savings equivalent to the annual fuel consumption of **55 New York –Paris daily flights."**

Production rate increase

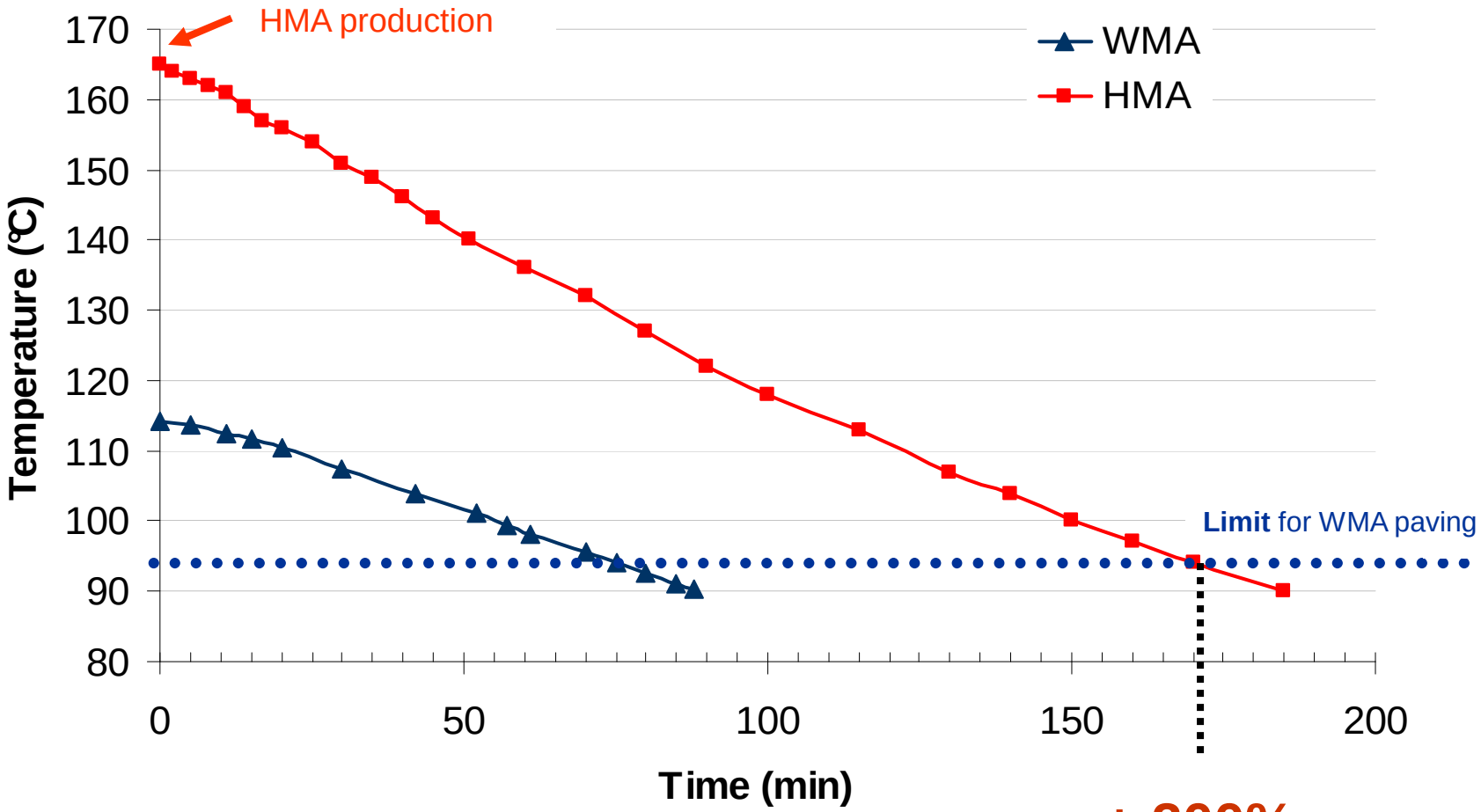
Shorter "heating times" are required for WMA



- An **increase** from 210 to 280 tons of mix /h (~ **30% increase**) was observed when changing from HMA to WMA

- **Flexible technology** - Easy to change from HMA to WMA and back

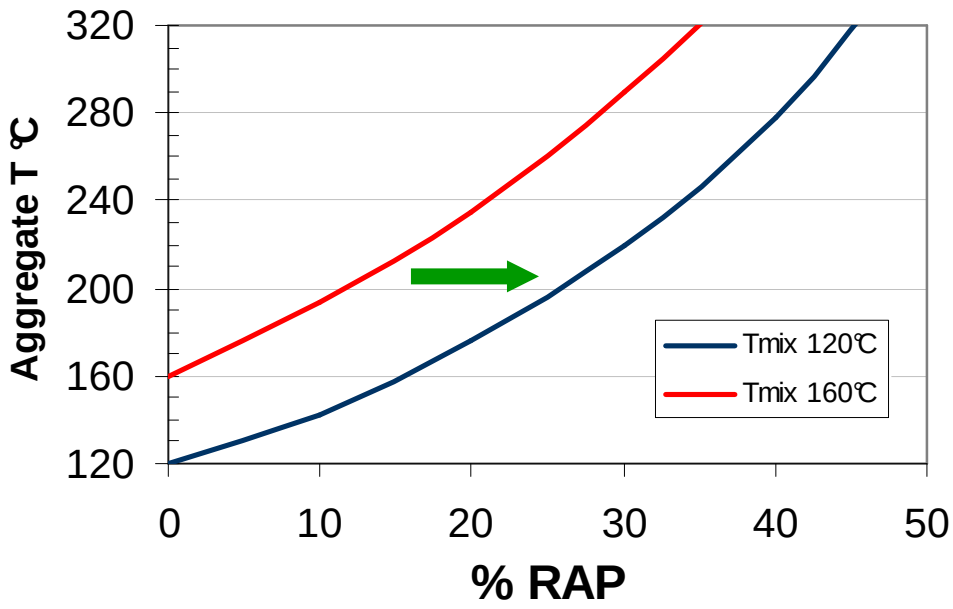
Longer Hauling



- A **HMA with chemical additives** may be paved after a hauling time **~3 times** longer

RAP

Required aggregate temperatures for a given % of RAP (Calculated)



	T aggregates (℃)	T bitumen (℃)	T RAP (℃)	T compaction (℃)	ITS (MPA)
Mix **20%** RAP	200	160	25	150	**1.28**
Mix **40%** RAP	200	160	25	130	**0.98**
Mix **40%** RAP + **0.4%** Cecabase RT	200	160	25	130	**1.32**

- Larger amounts of **RAP** may be used

Conclusions

- Adding 0.2 to 0.6% of **Cecabase RT additives®** in the bitumen improves the workability of an asphalt mix without changing the binder characteristics.

- These technology is **easy** to use and applicable to different kinds of asphalt mixtures

- Several **advantages** by the use of these additives were discussed:

  - **Longer hauling**
  - **Energy savings**
  - **Higher production rate**
  - **Less emissions**
  - **Higher RAP content**