Warm Mix Asphalt Technology

Northeast Asphalt
User-Producer Group
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Wilkes-Barre, Pennsylvania

Advantages of Lower Temperatures

- Lower fumes
- Lower plant emissions
- Lower energy consumption
- Lower plant wear
- Decreased binder aging

Available Technologies

- Materials Processing
  - Foamed asphalt
- Additives
  - Mineral
  - Organic

Warm Asphalt Mix (WAM) Foam

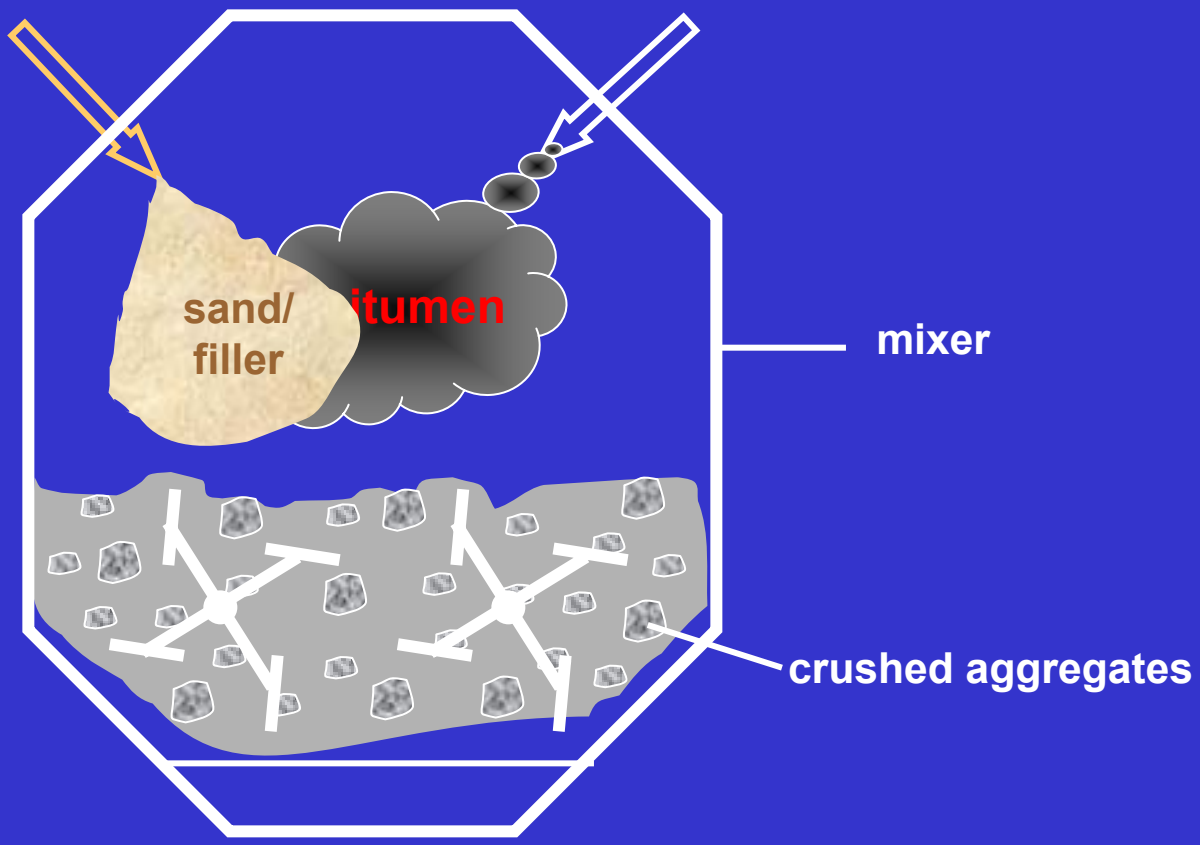
What WAM Foam is NOT

- **‘New’ asphalt cement**
- **‘Old’ foamed asphalt technology**
- **Emulsified asphalt cement system**
- **Base Layer Stabilization**
- **Miracle**

What WAM Foam Is

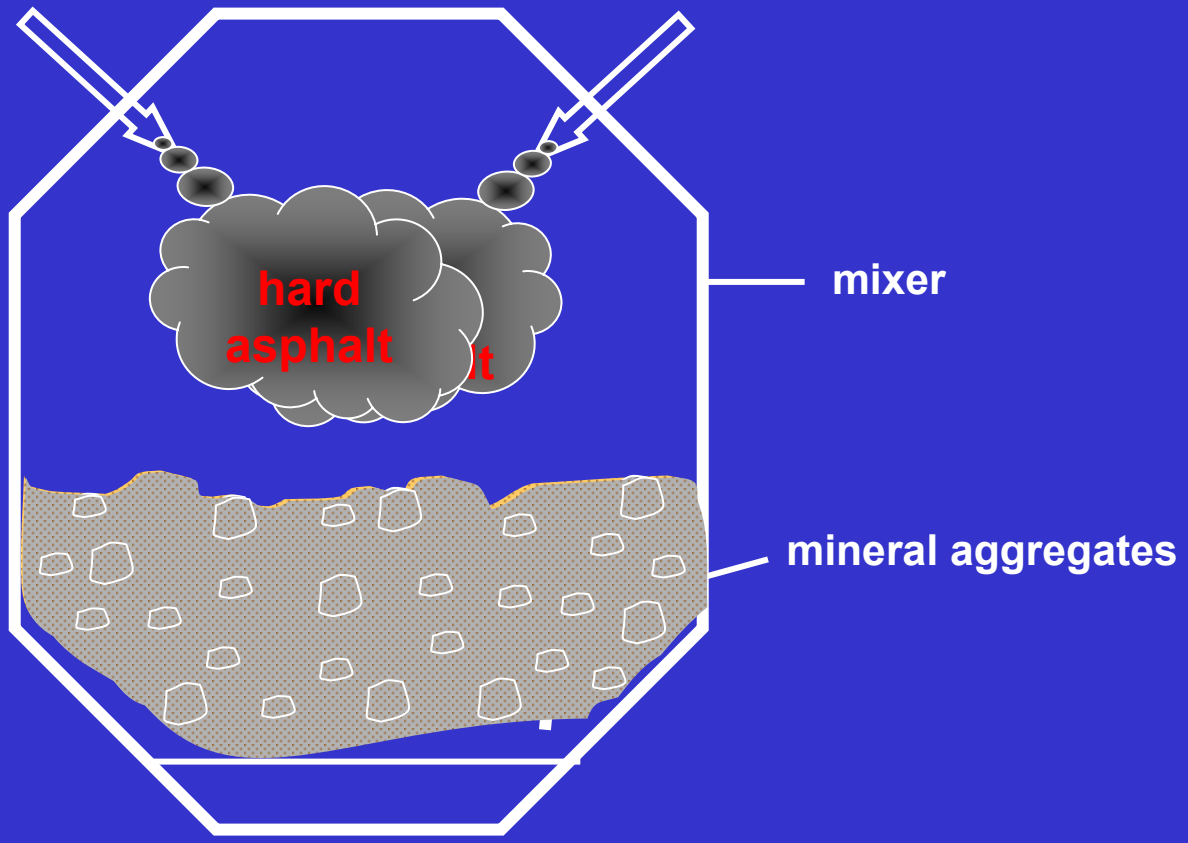
- **Joint Development between Shell and Kolo Veidekke a.s to produce asphalt pavements at lower operating temperature**

aggregate addition sequence method



Courtesy IFTA GmbH

Two phase bitumen mixing method



Courtesy IFTA GmbH

Goals for Warm Asphalt Mix WAM

- Lower production temperatures of Hot Mix Asphalt
- Use existing Hot Mix Asphalt plants
- To meet existing standards for Hot Mix Asphalt specifications
- Focus on dense graded mixes for wearing courses
- **WAM quality = Hot Mix Asphalt quality**

Towards lower temperatures -asphalt cement rheology-

Hot mixtures

ΔT = 30 - 50 °F workability - additives

colder Hot Mix

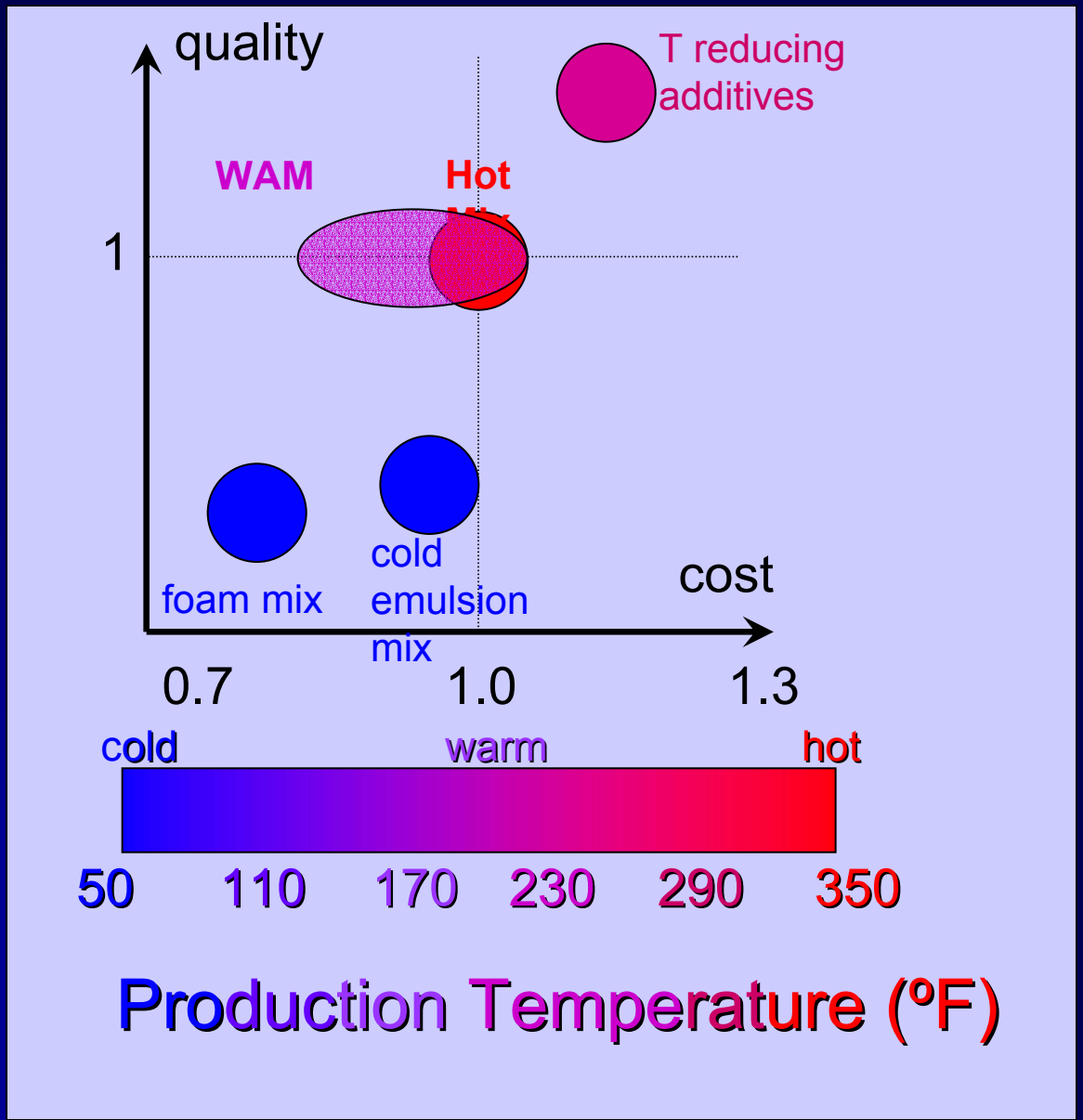
or

ΔT = 100 - 140 °F WAM-Foam process

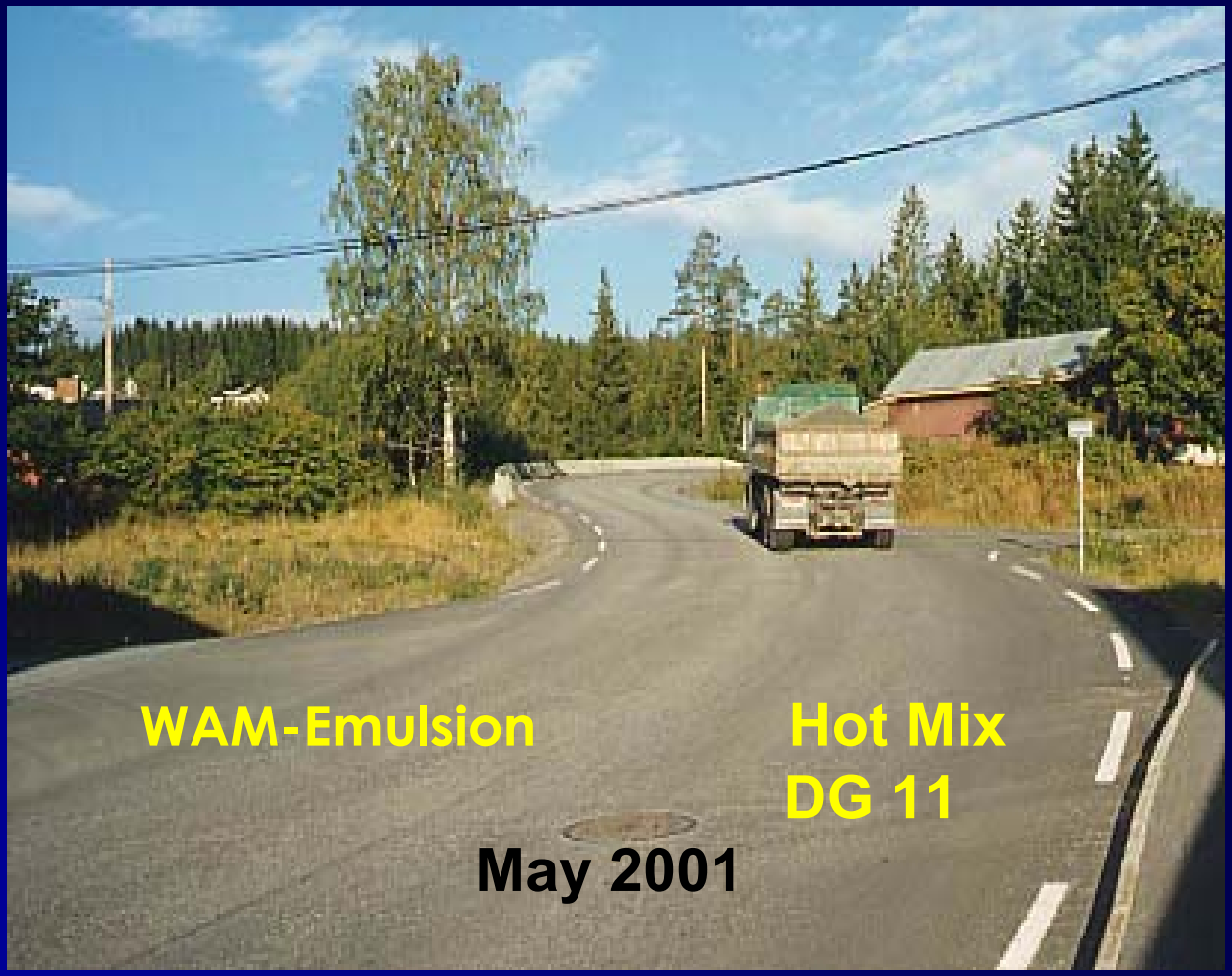
warmer Cold Mix

Cold mixtures - emulsions - foamed bitumen

WAM Positioning



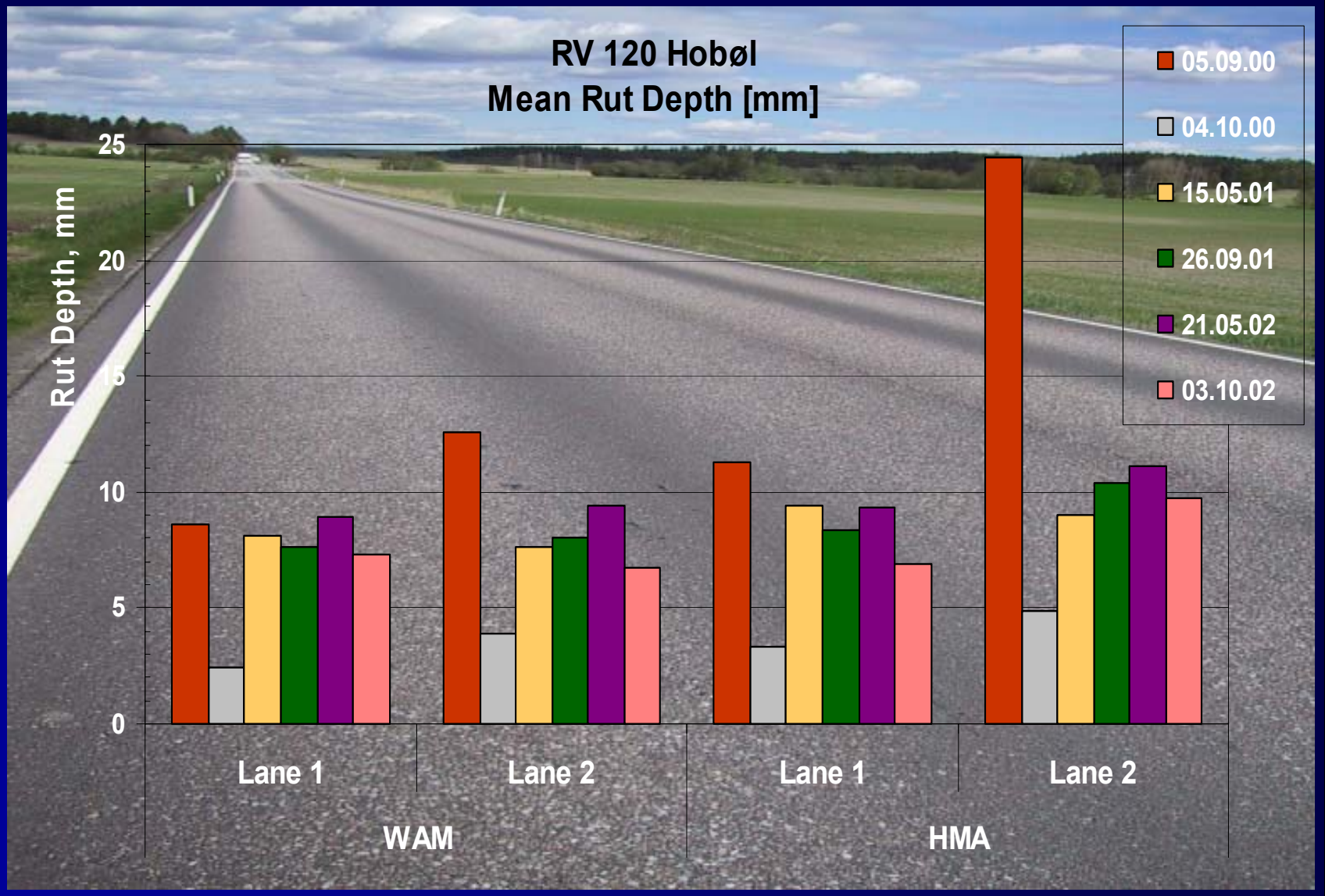
Field trials in Norway 1996



WAM Emulsion Hunndalen

WAM Foam installation in an Asphalt Batch-Plant

Road 120 Hobøl
Rut Depth




Hot Mix (155 °C)
311 °F
WAM (110 °C)
230 °F
LT5473
BC-81650

HMA vs. WAM-Foam

WAM Foam in Drum Mix Plants 2001

WAM Foam, FV 82 Frogn – Nesodden September 2001

What have we achieved with WAM Foam?

- 30 % reduction in energy consumption,
- 30 % reduction in CO_2-emissions,
- 50 – 60 % reduction in dust emission,
- Fume from WAM Foam is below detection limits

Additional Benefits

- Reduced energy consumption
- Reduced temperature => reduced binder oxidation
- Production rate is maintained
- No problems with humidity observed in drum mixer
  – some humidity in the stack of batch plant
- Reduced production temperature => reduced wear

EUROVIA

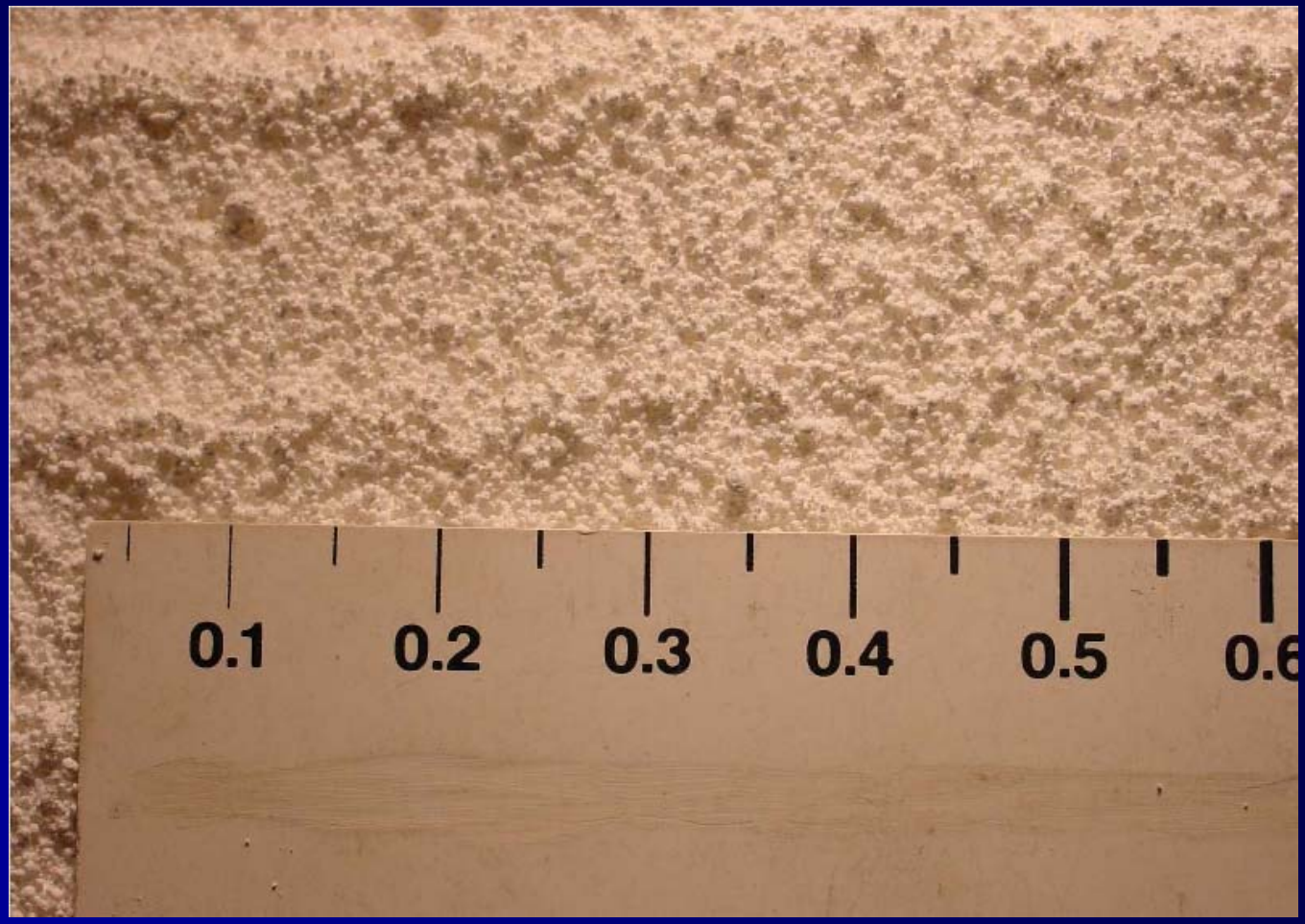
Warm Asphalt Mixes by adding aspha-min®, a synthetic zeolite

Zeolite

Zeolites: crystalline hydrated aluminium silicates.

aspha-min®, is added (0.3%) to the HMA in the 100 to 200 °C (212 to 392 °F) temperature range

Granulated aspha-min®



Production of warm asphalt mix

No modifications to mix design are required.

Aspha-min® is considered as an additive to increase workability at low temperatures.

Mixing temperature of between 130 and 145°C (266 to 293°F) possible.

How zeolite works

Vapor is created by adding aspha-min® to pre-heated mixture of sand and stone at the same time as apshalt is being introduced.

Adding aspha-min®

Manual Feed

Reduction of Emissions

Reduction of 30 – 35 °C (about 55 °F) the energy consumption was reduced by 30 %.

In Germany, 65 million tons of HMA are produced annually results in a reduction of 400,000 tons of CO_2.

CO_2 Measurement at the plant

Reduction of Emissions

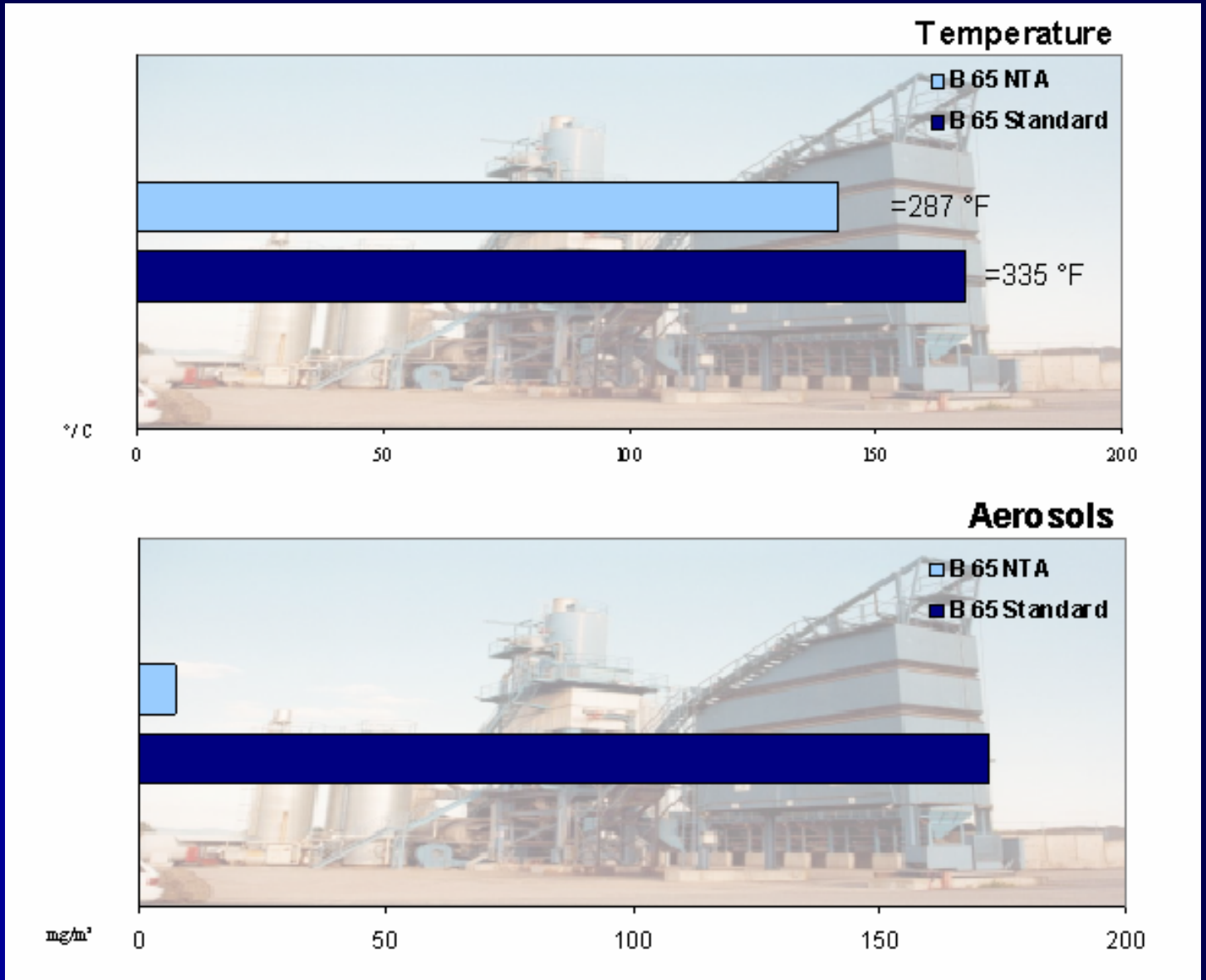
Using a 65 pen binder in the mix at a temperature of 168 °C (340 °F) an emission of 350 mg/ m^3 fumes and aerosols was determined.

At a productions temperature of 142 °C (285 °F) where zeolite had been added, 90 mg/m^3

Reducing temp by 26 °C (47 °F) created a reduction in fume emissions of 75 %.

At the application site a 35 °C reduction resulted in as low as 1/10 of the equivalent fume level.

Testing at Mixing Plant (1)
65 pen vs. 65 pen with aspha-min®



Workability

All mixes produced at lower temperatures handled the same way as traditional mixes and obtained comparable density.

Organic Additives Sasobit

Two classes:

- synthetic Fischer-Tropsch paraffin waxes
- low molecular weight ester compounds

Fischer-Tropsch paraffins are

- long-chained aliphatic hydrocarbons
- from coal gasification
- with the Fischer-Tropsch process

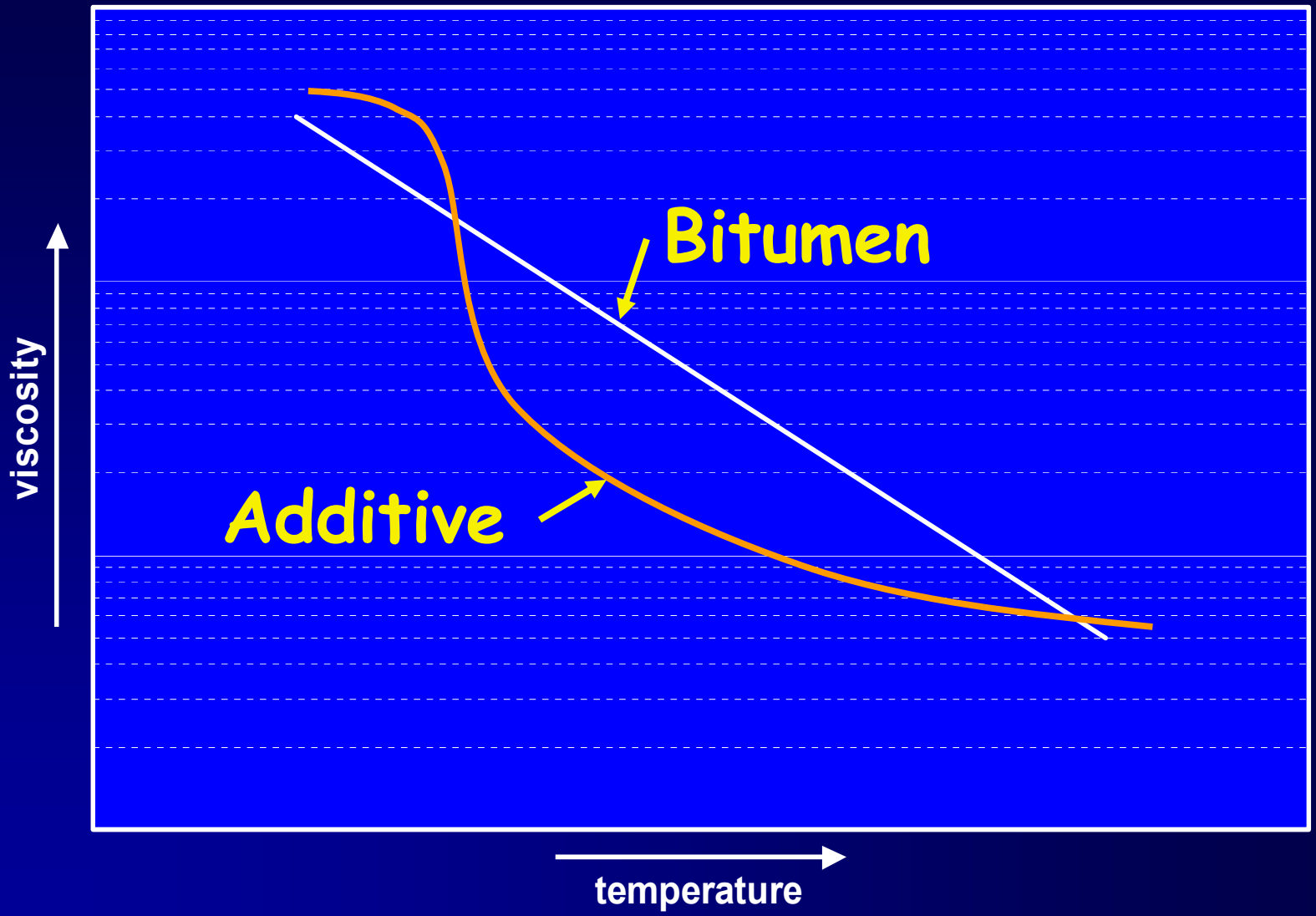
	Bitumen wax	*Synthetic wax*
Melting point, ° C	70	100
Penetration at 25 °C, 0,1 mm	120	< 1
Viscosity at 135 °C mm^2 /s	8	15
Average molecular weight, g / mol	800	1600
n-paraffins, %	14	73

Ester additives are:

- Coal wax
- consists mainly of esters from fat acids and wax alcohols
- produced by toluene extraction of brown coal

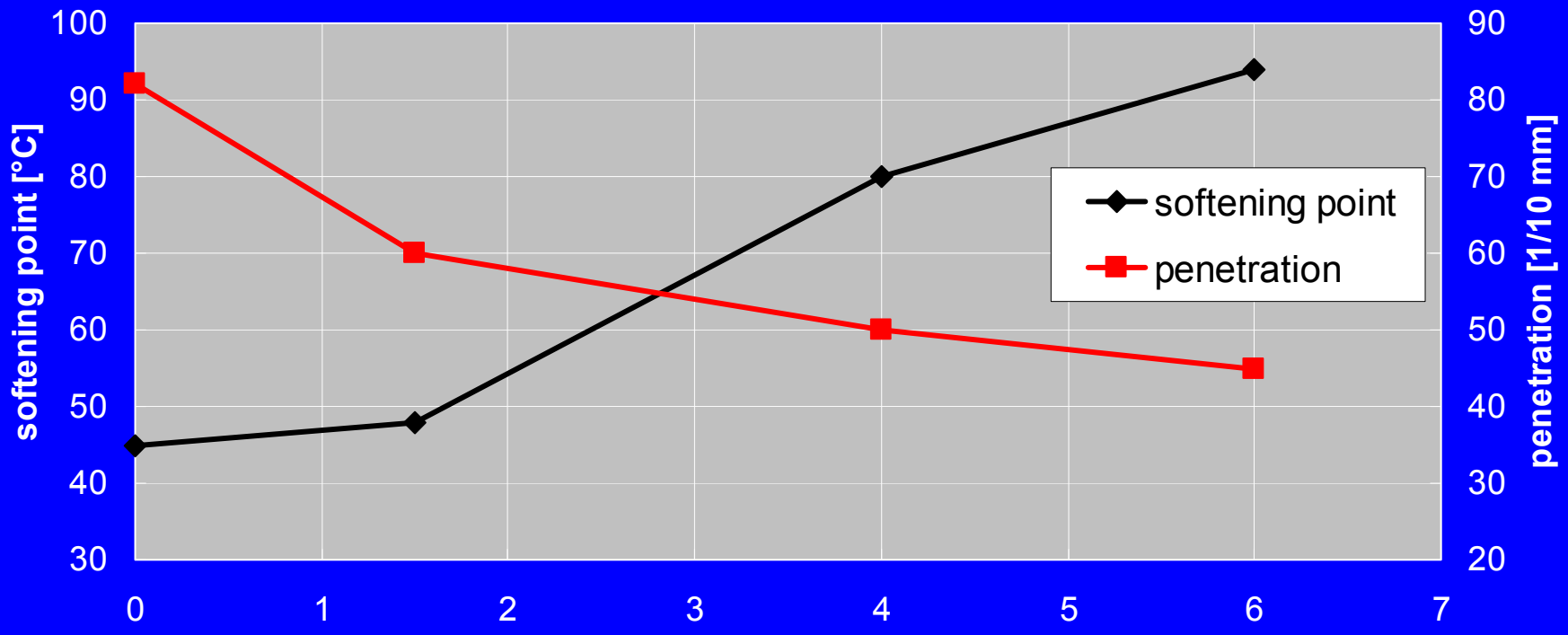
Average molecular weight: 510 g /mol

How organic additives work



Organic additives

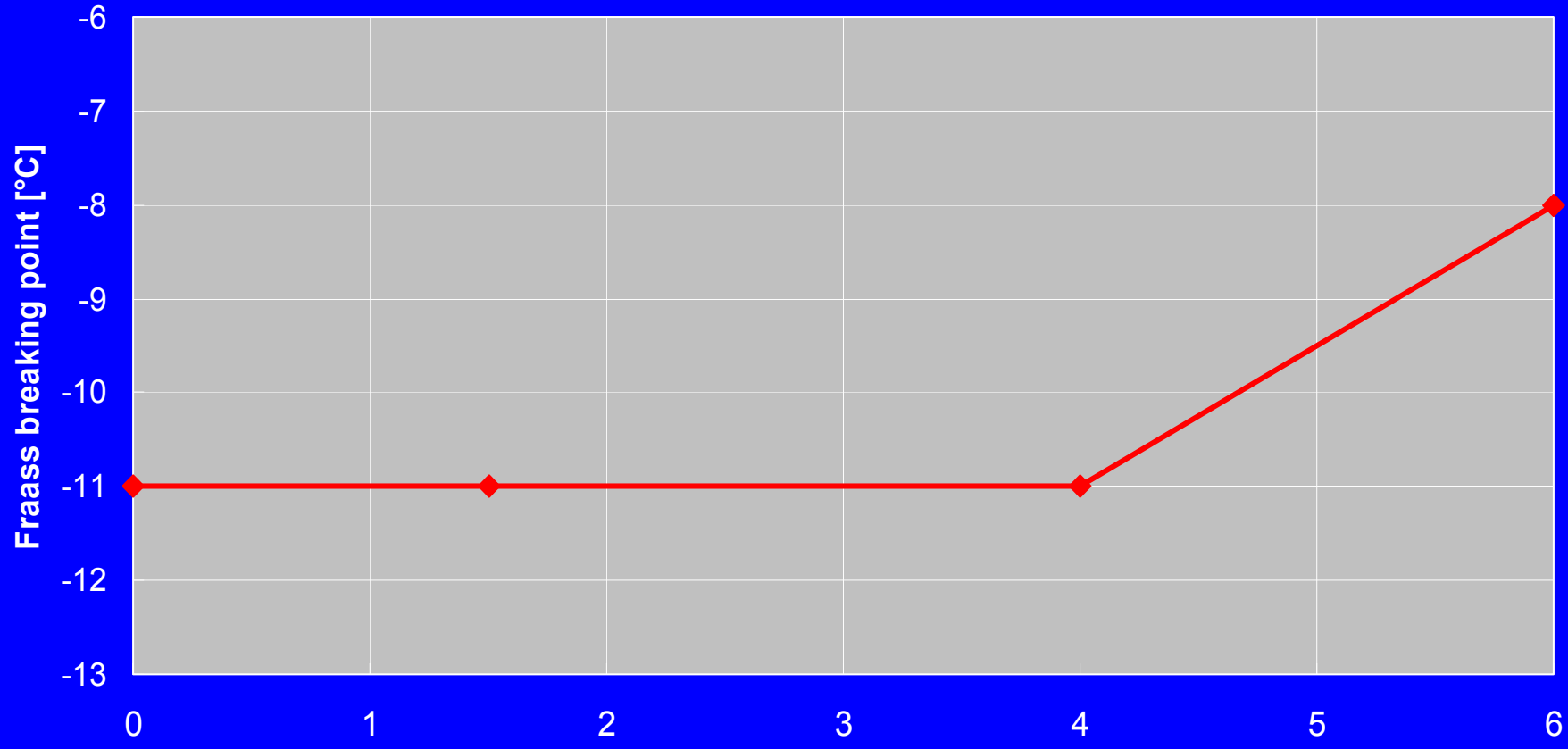
Influence of organic additives (FT)



% of FT-paraffin in Bitumen 70/100

Penetration: „Viscosity at room temperature"
Softening point: „Melting point"

Influence of organic additives (FT)

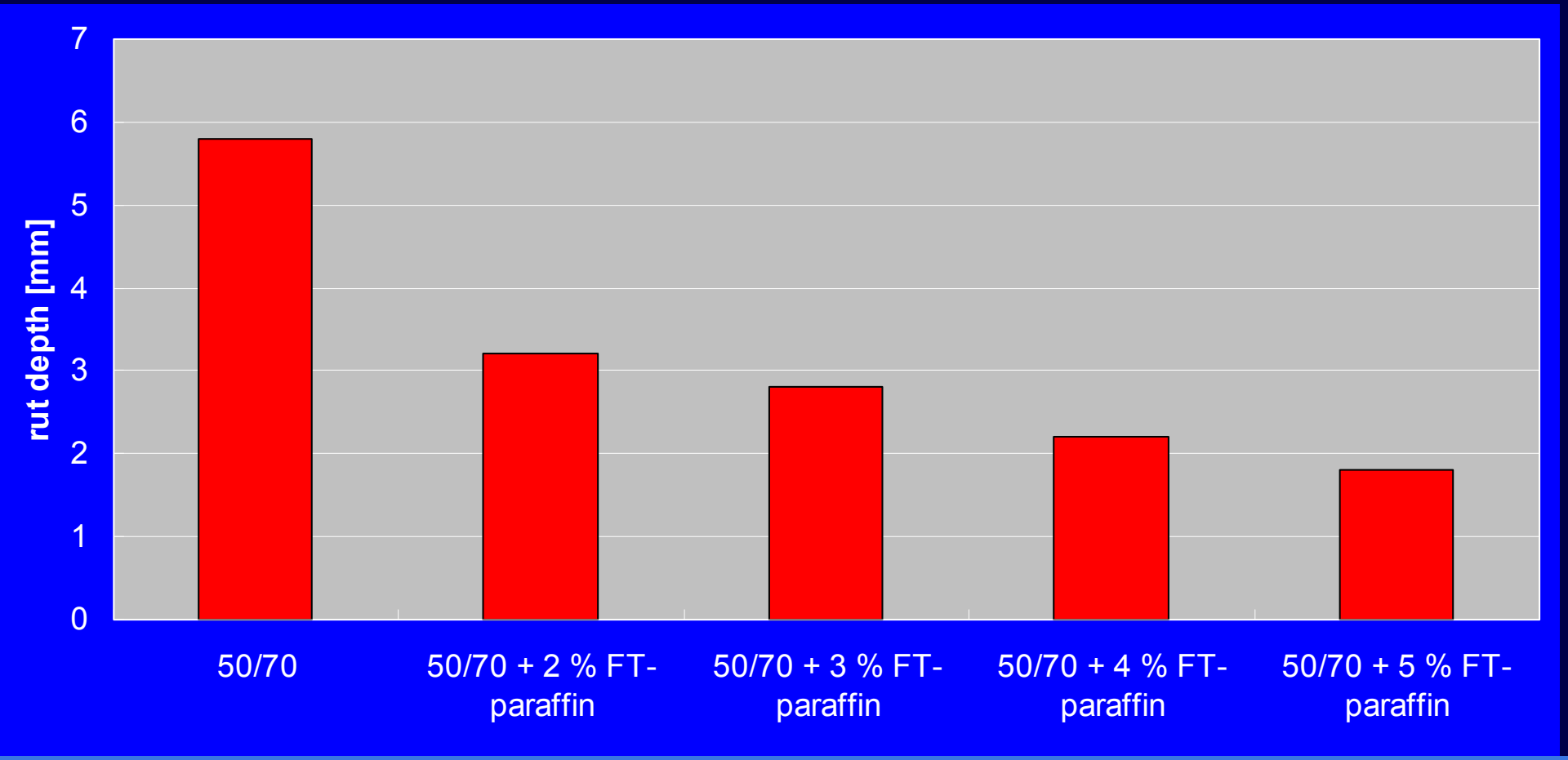


% of FT-paraffin in Bitumen 70/100

Fraas Breaking Point: Low temperature behaviour

Organic additives

Influence of organic additives (FT)



Wheel tracking test (Hamburg device) with growing %-FT-paraffin

Organic additives

Experiences with organic additives

Experiences with organic additives

Conclusions

- Success in Europe = Success in U.S.?
- Long-Term Performance?
- Cost Benefit?
- Definite Reduction in Emissions
- Definite Reduction in Fumes
- Definite Reduction in Energy Consumption

Activities

- World of Asphalt Demo – Mar 2004
- NCAT Study