FOAM vs EMULSION SELECTION FACTORS

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SARF Course on BSMs

Assegai, Shongweni

14 and 15 July 2015

Stellenbosch

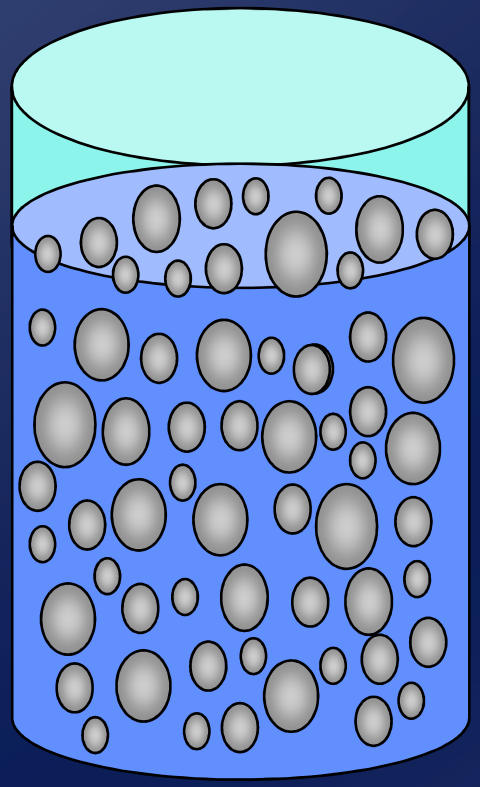
60th anniversary SARF Founded in 1950

THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD

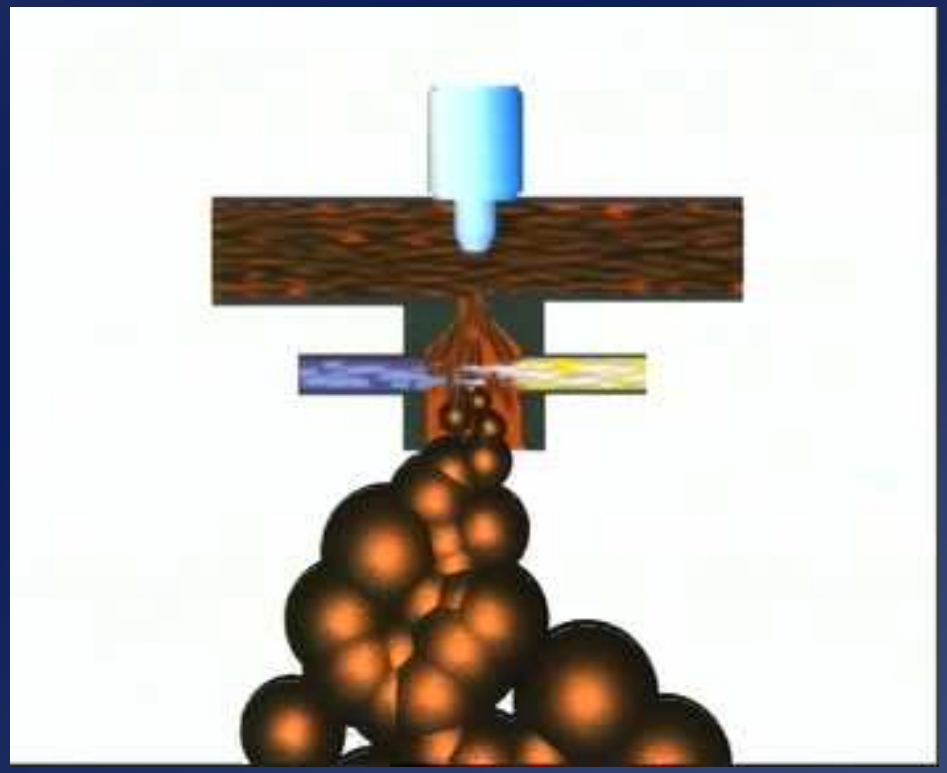
Reg. No.1998/009584/06

COLD MIX BINDERS

Emulsion



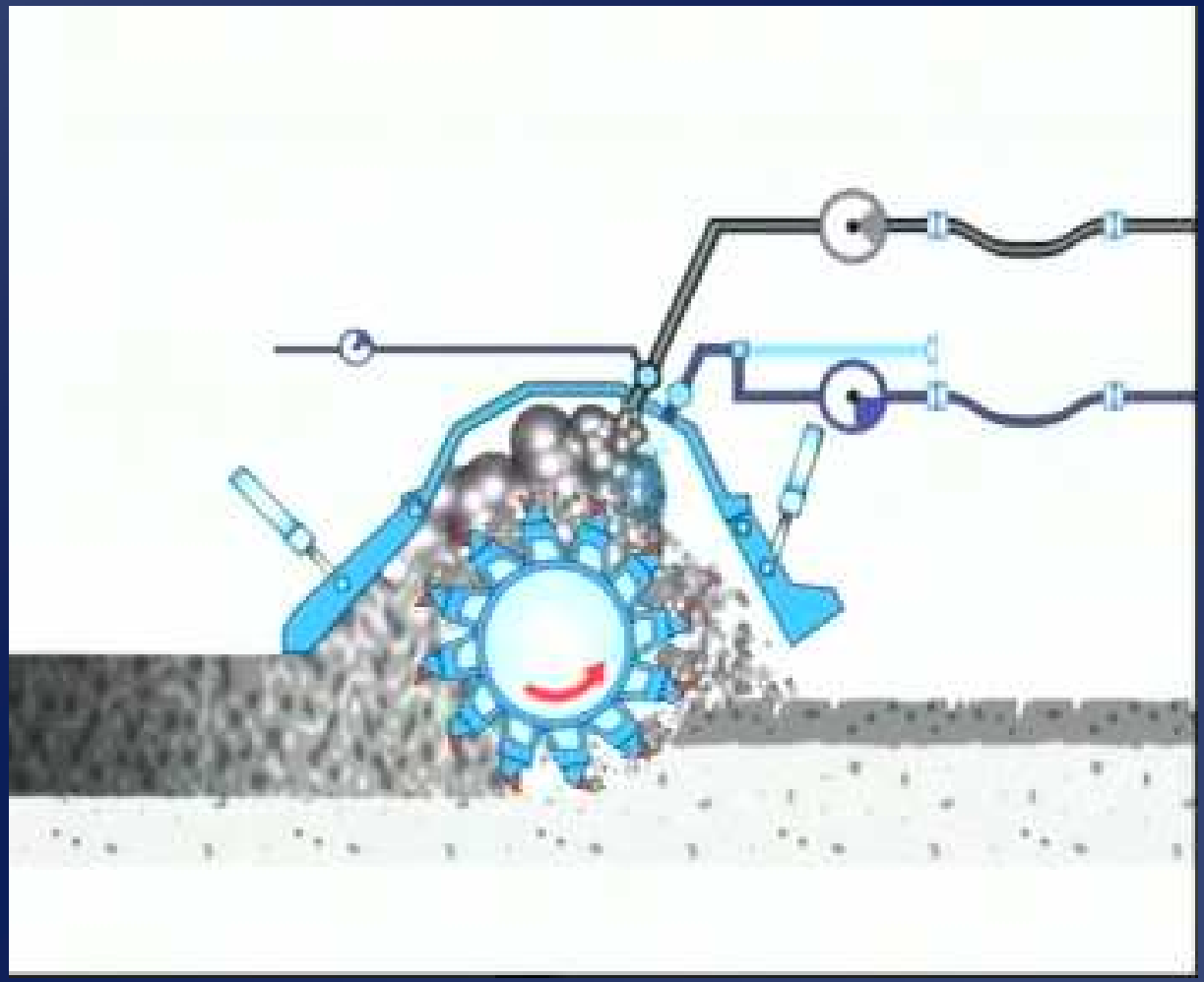
Foamed Bitumen



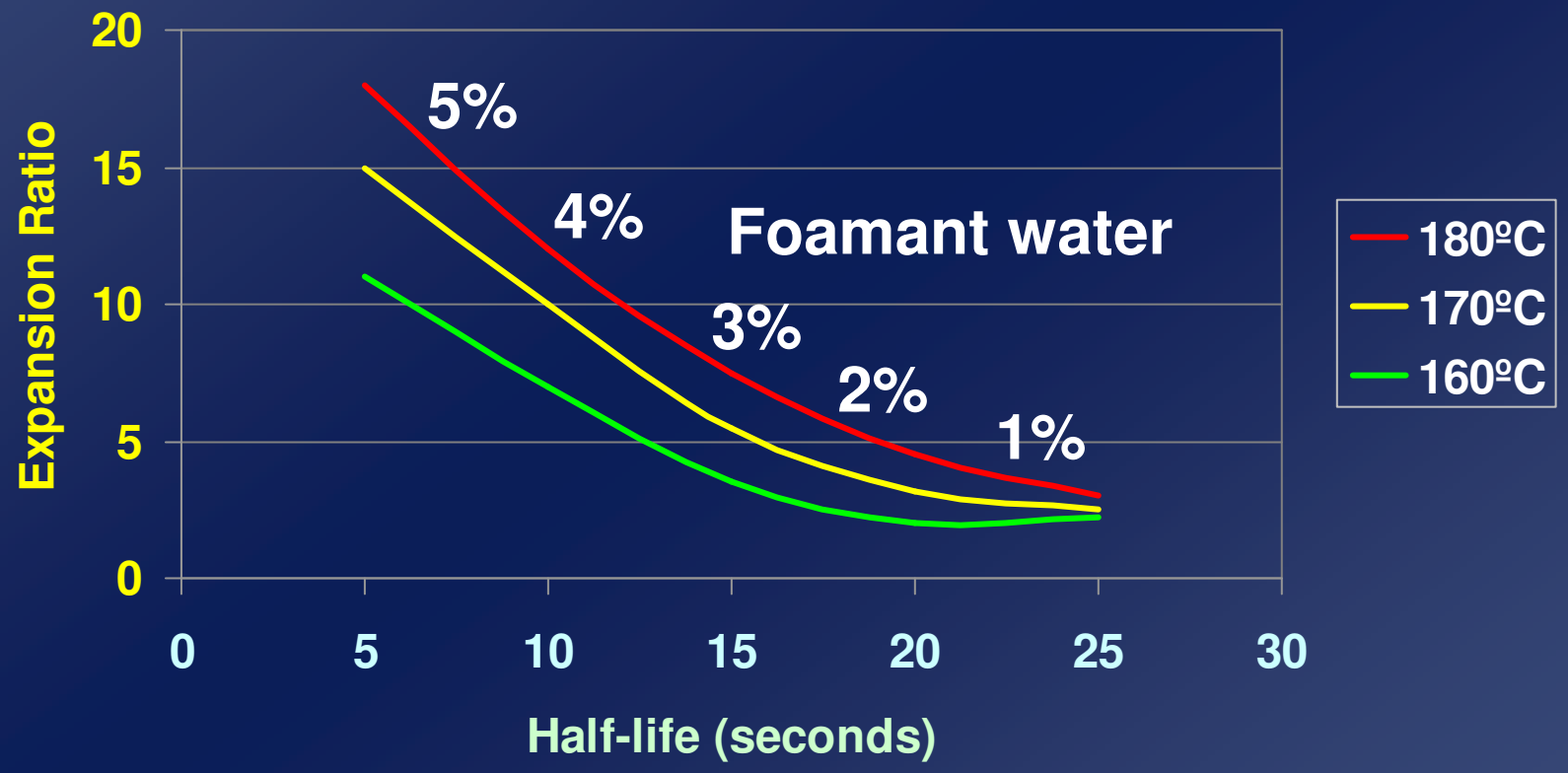
Emulsion
Plant

Foamed Bitumen CIPR
Prototype tested in South Africa - 1996

Production of alternative cold mix binders: foamed bitumen

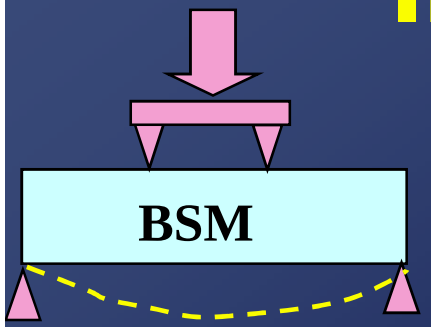


Temperature effects on foam

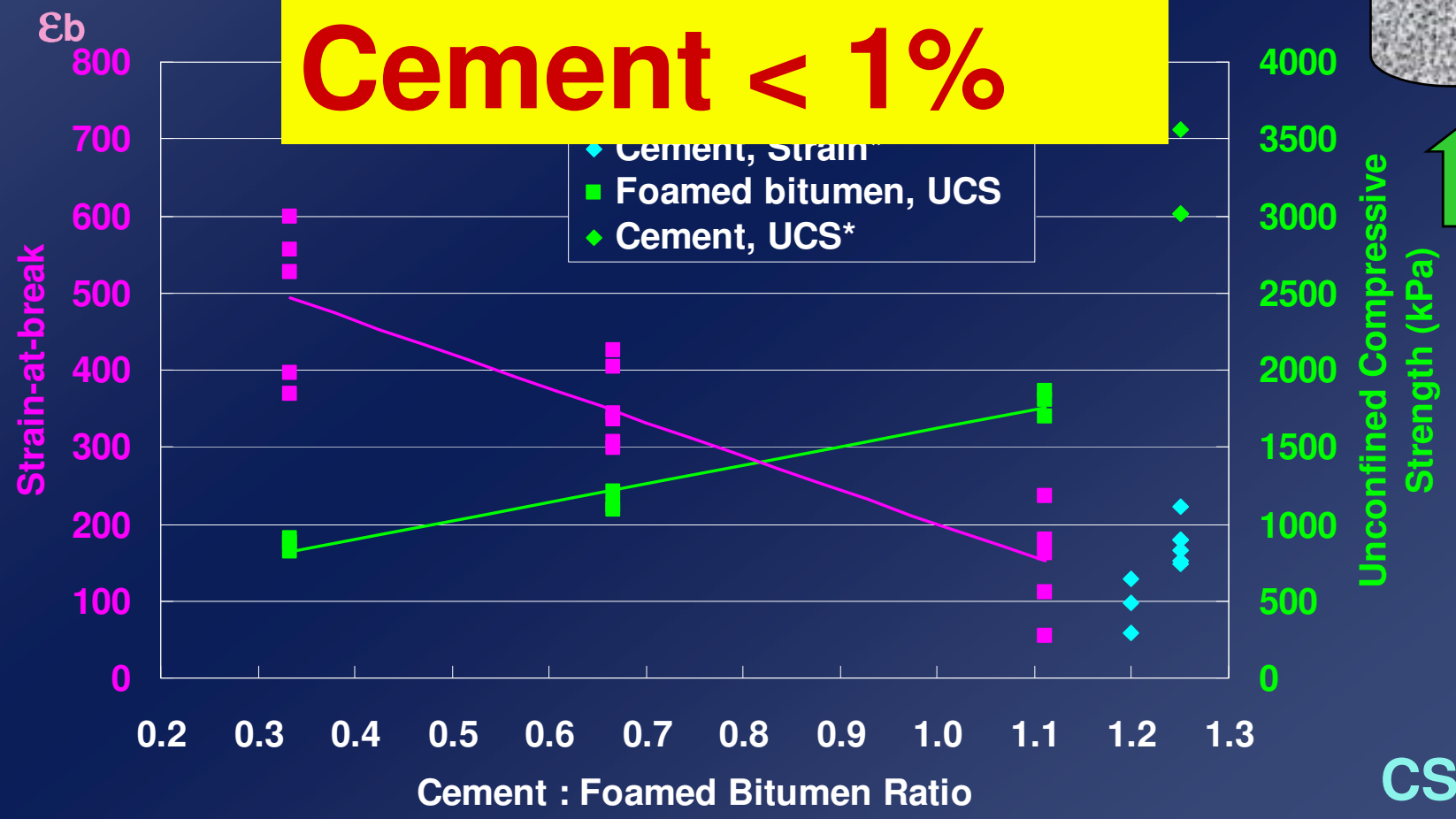


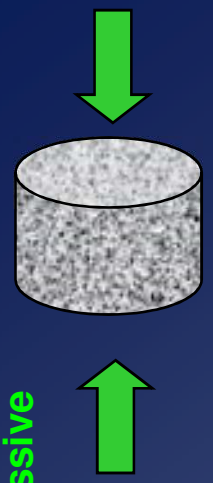
Influence of Active Filler BSM-foam

Strength and flexibility



Cement < 1%

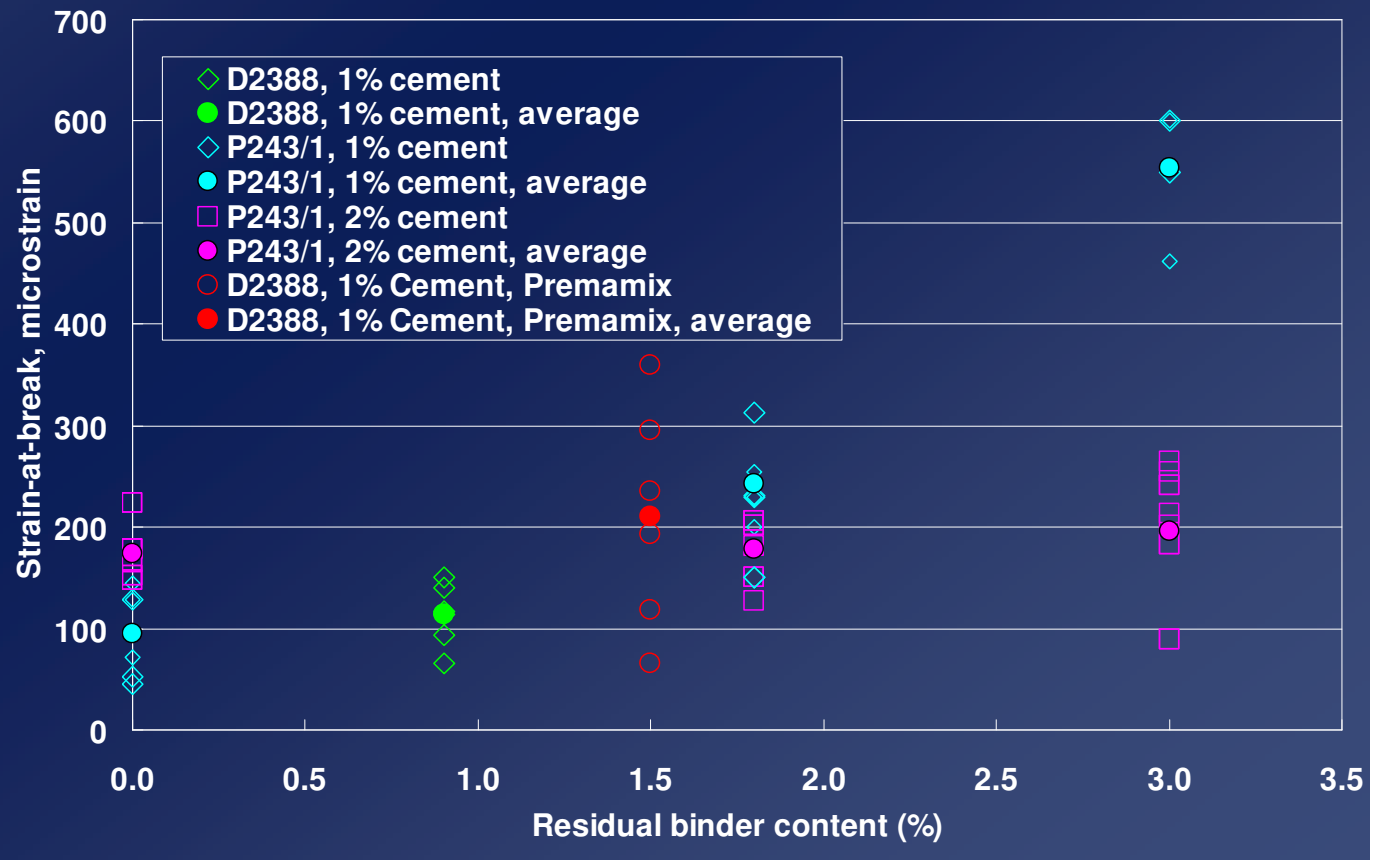




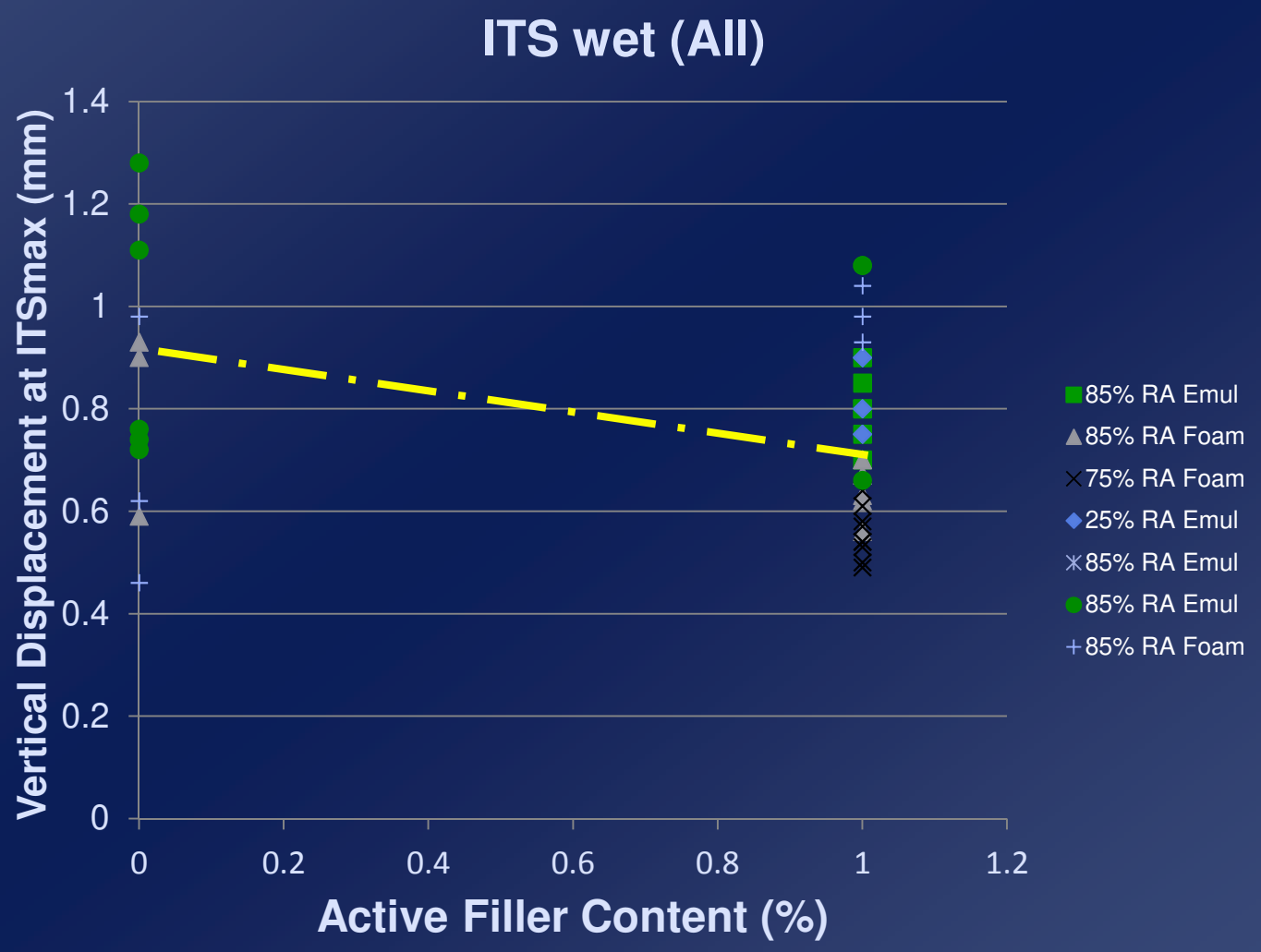
CSIR

Influence of Active Filler BSM-emulsion

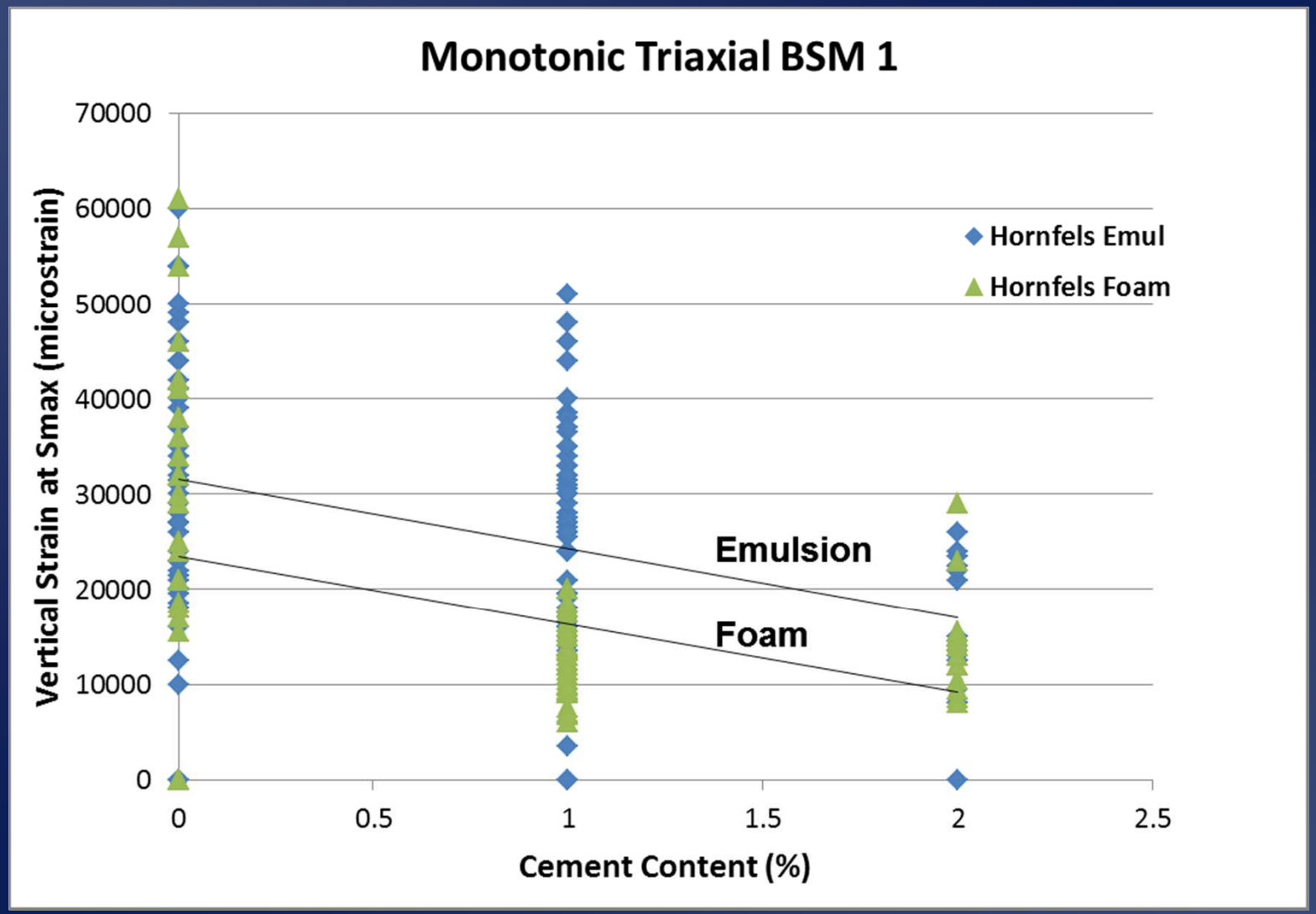
- Increasing ε_b with increasing bitumen %
  - If cement content not too high (CSIR)



ITS displacement measures
(from Mix Design)

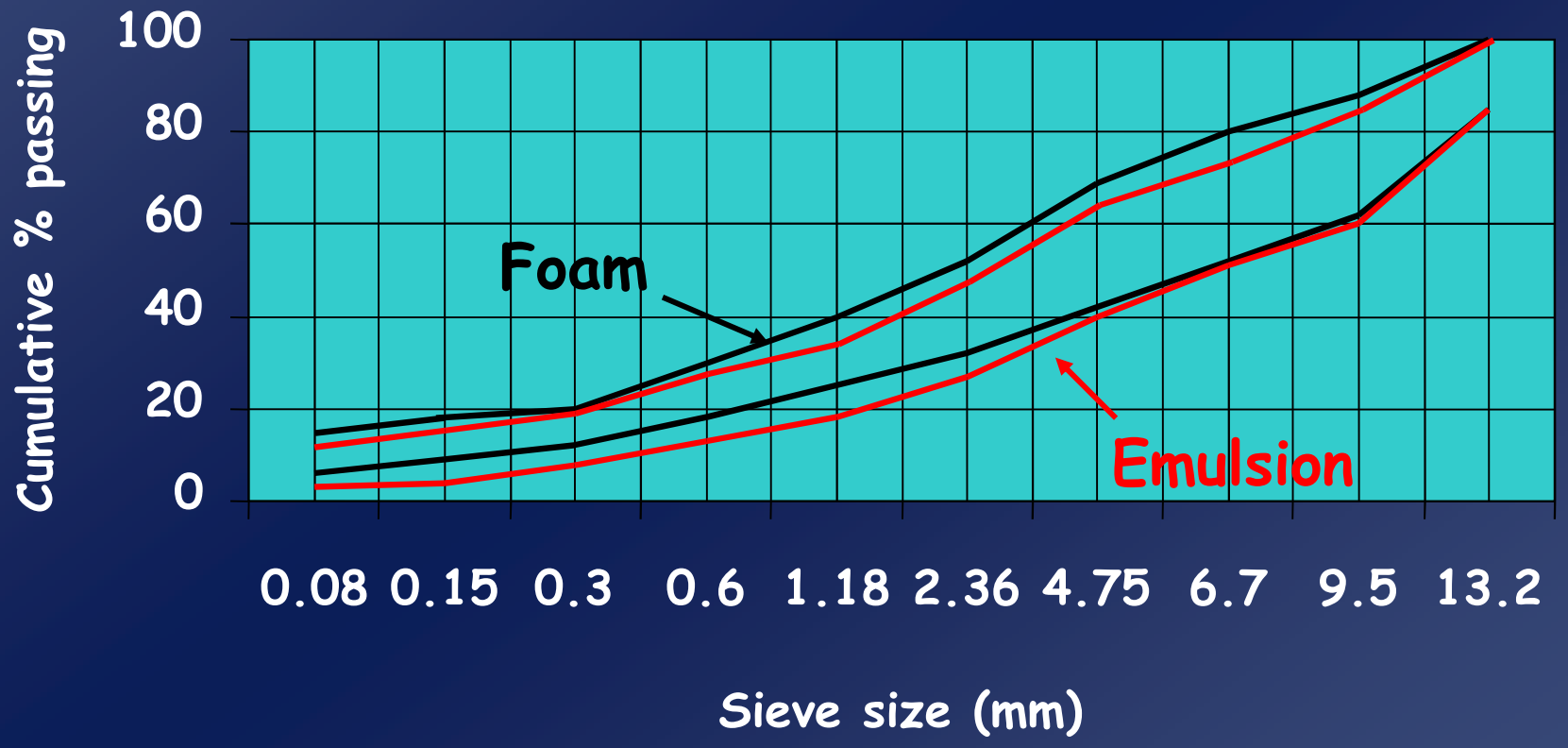


Triaxial data from Mix Design



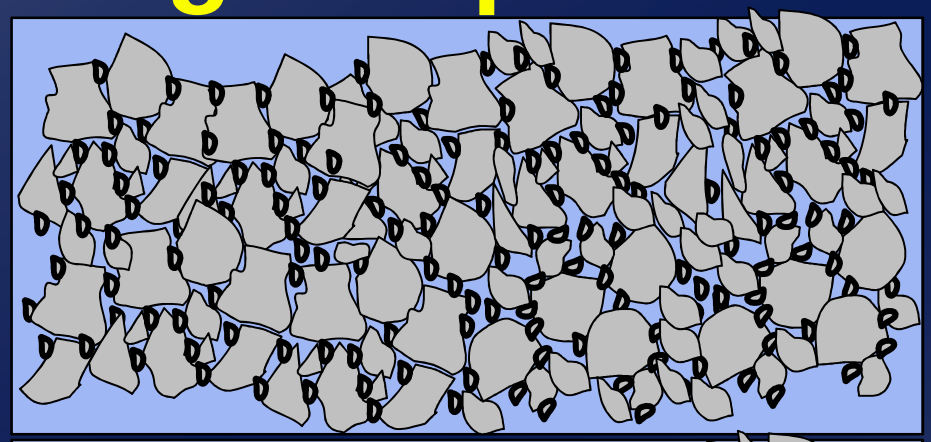
Can refine by separating data based on σ_3, but COV still high

Aggregate requirements Gradation



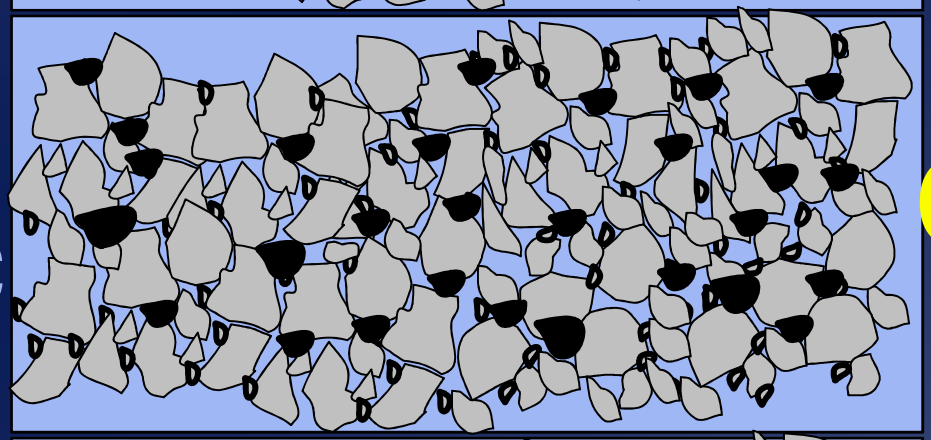
Aggregate Mixing Temperature

Foam > 25ºC



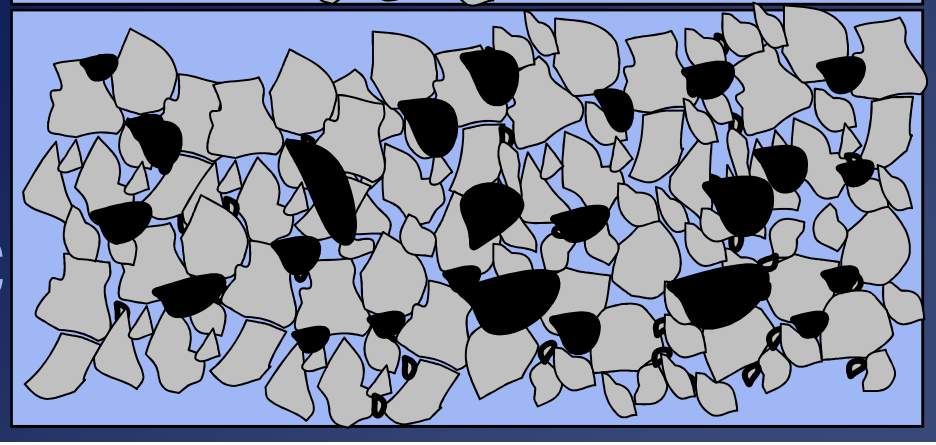
√

Foam 15ºC
Emulsion 10ºC



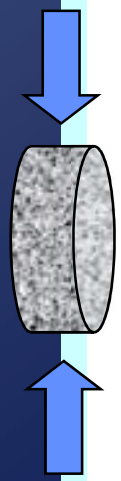
OK

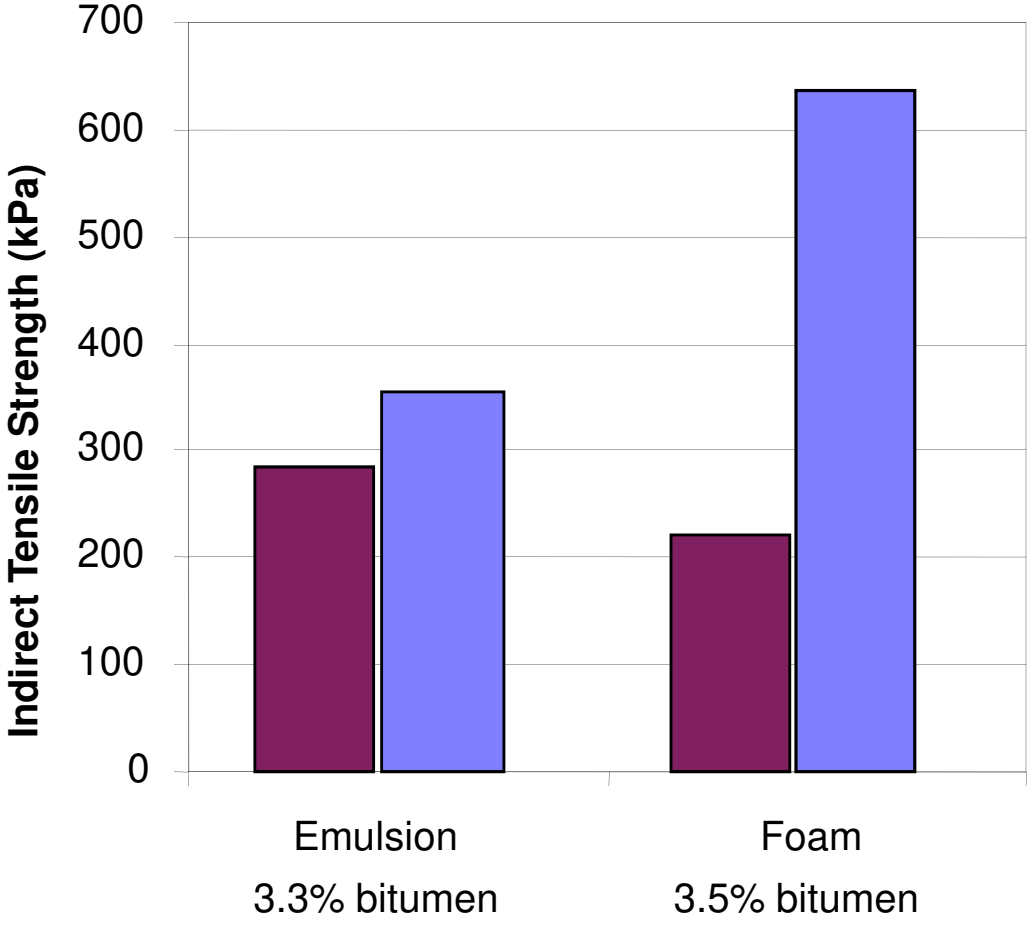
Foam <15ºC
Emulsion<10ºC

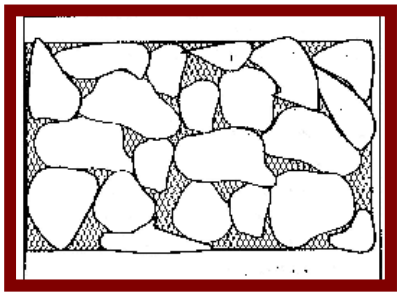


X

Optimisation of grading curve

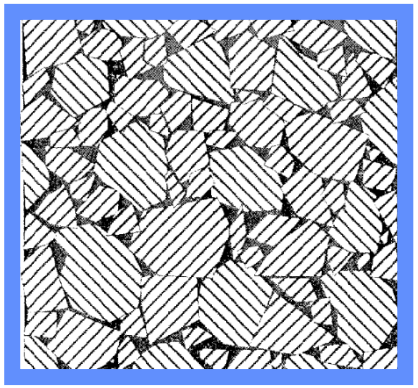






Without blending

With 10% fines blend



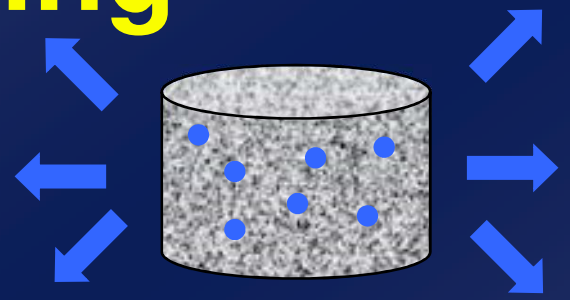
Role of Active Filler

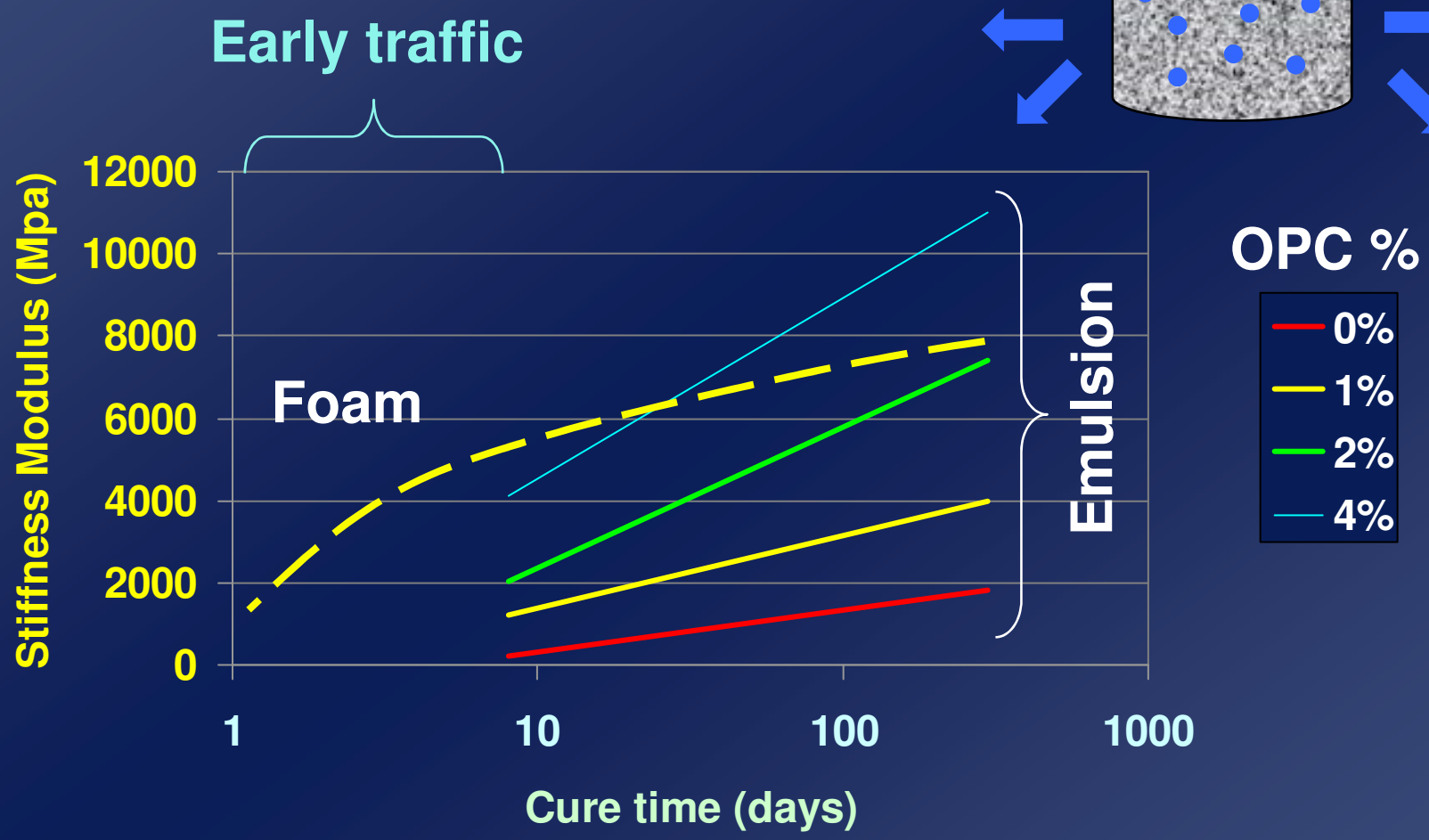
- Improve adhesion
- Improve dispersion
- Modify plasticity
- Increase stiffness & strength
- Accelerate curing

Emulsion **Foam**

- Breaking time **Dispersion!**
- Improve workability

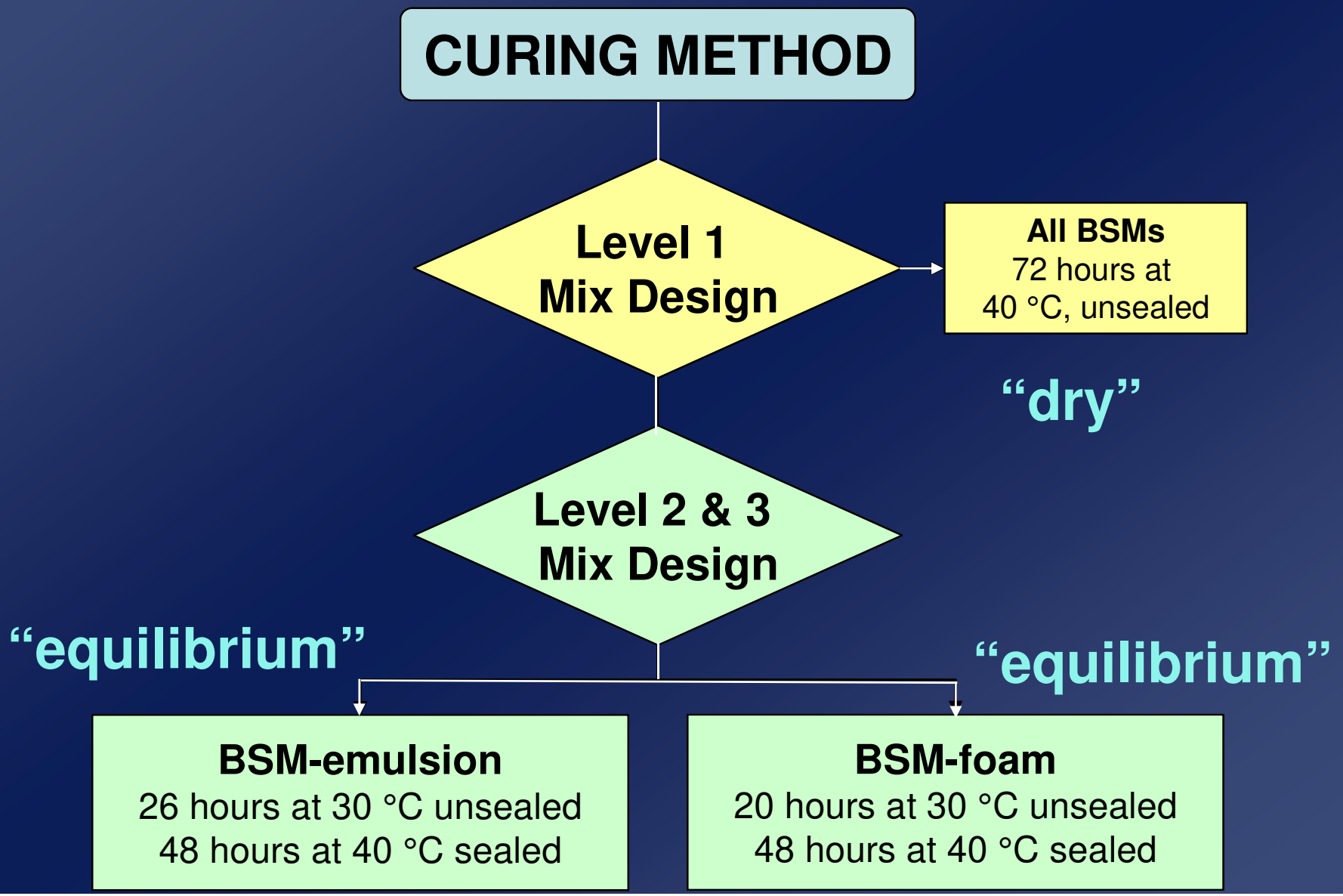
Moisture: Curing





Nottingham (AAPT, 2000) + Loizos (2006)

Final Curing Protocol



Moisture: Durability

EMULSION

Bitumen coating (thin films)

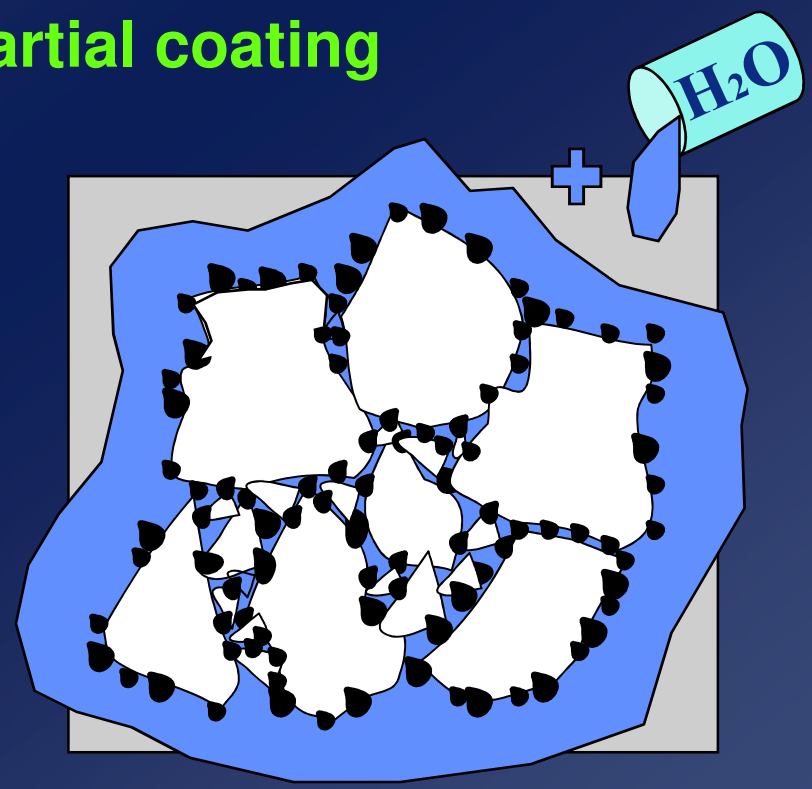
Some partial coating

?

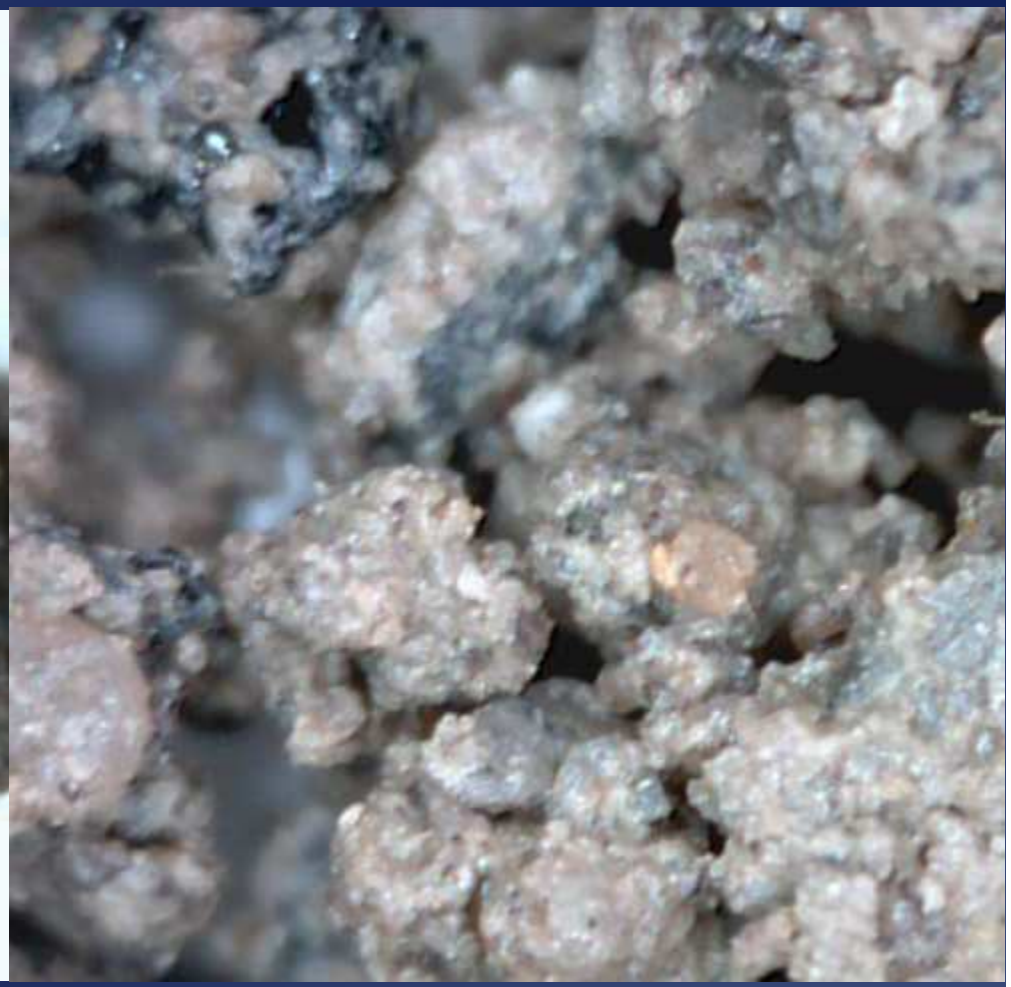
FOAMED BITUMEN

Bitumen dispersion selective

Partial coating



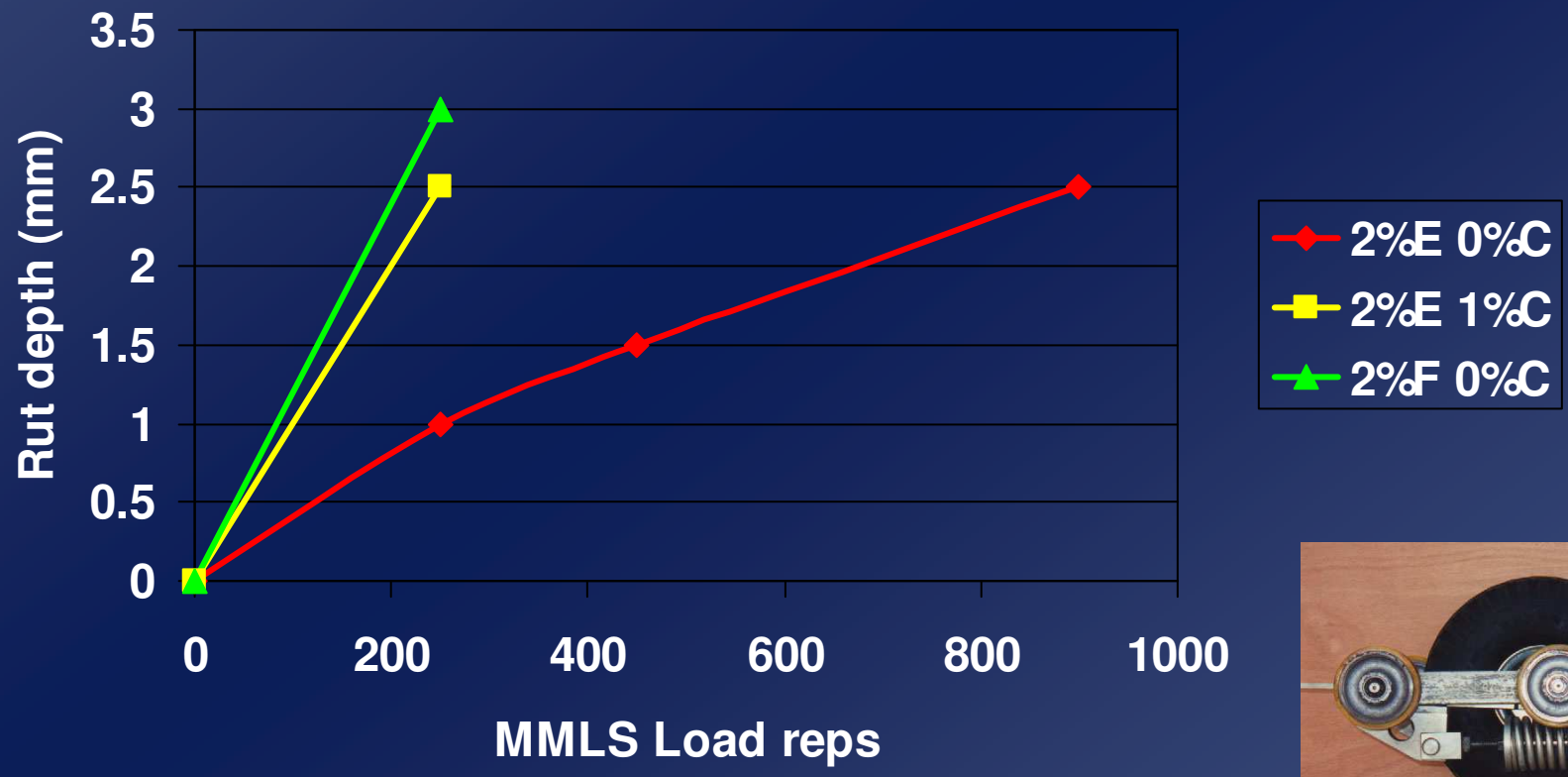
Microscopic Analysis

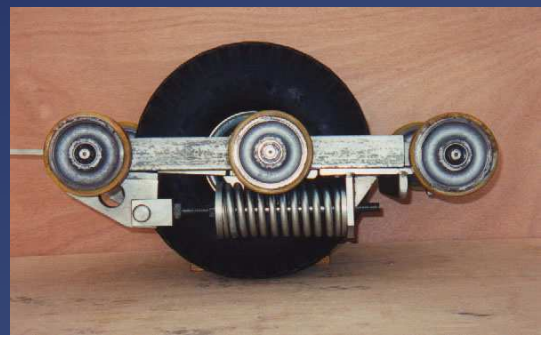


BSM-emulsion

BSM-foam

Lab APT


Rut depth (mm)
3.5
3
2.5
2
1.5
1
0.5
0
0
200
400
600
800
1000
MMLS Load reps
2%E 0%C
2%E 1%C
2%F 0%C



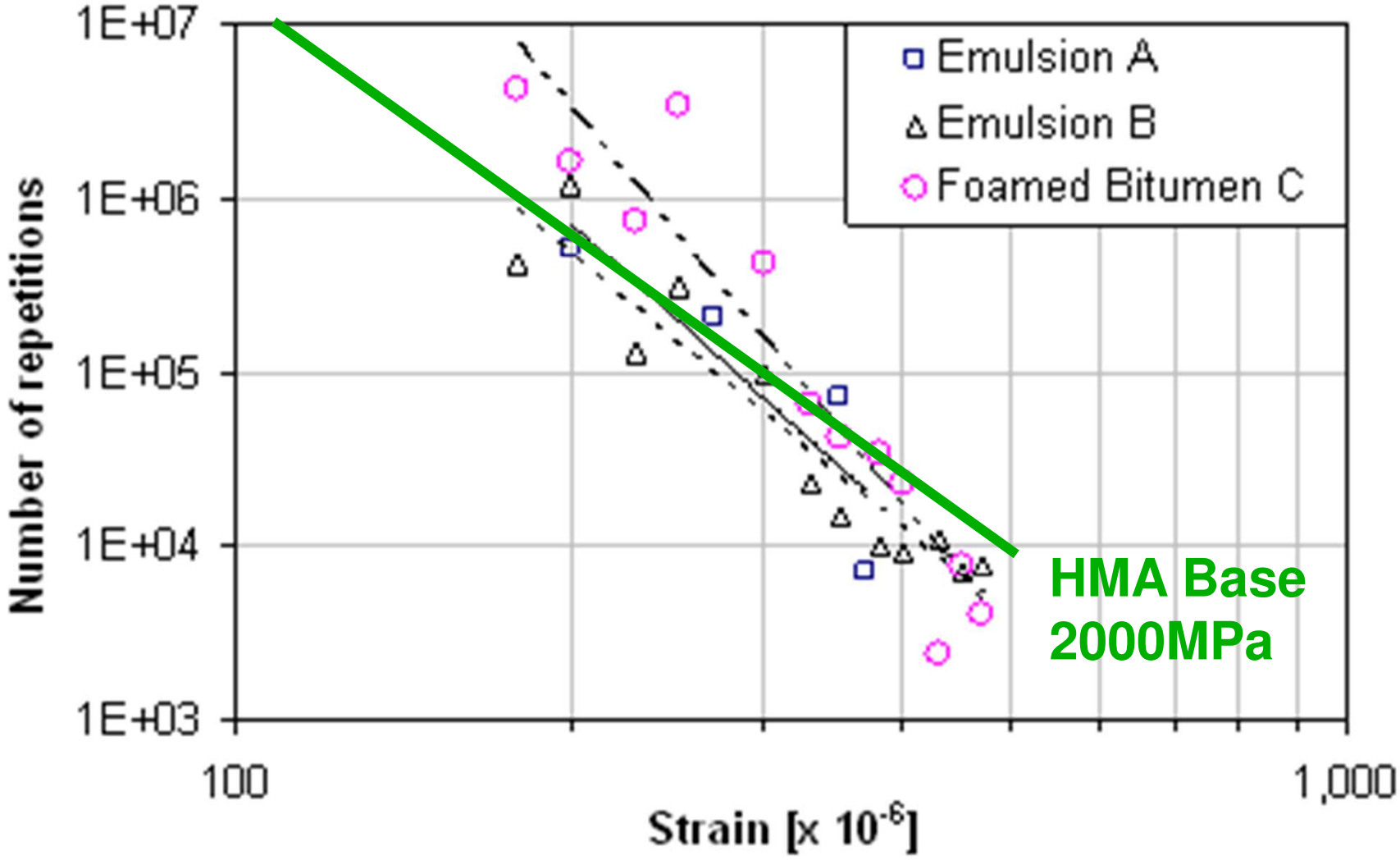
TASK 9 : Durability: Improved Tests

- Untreated Material Properties
- Moisture sensitivity tests

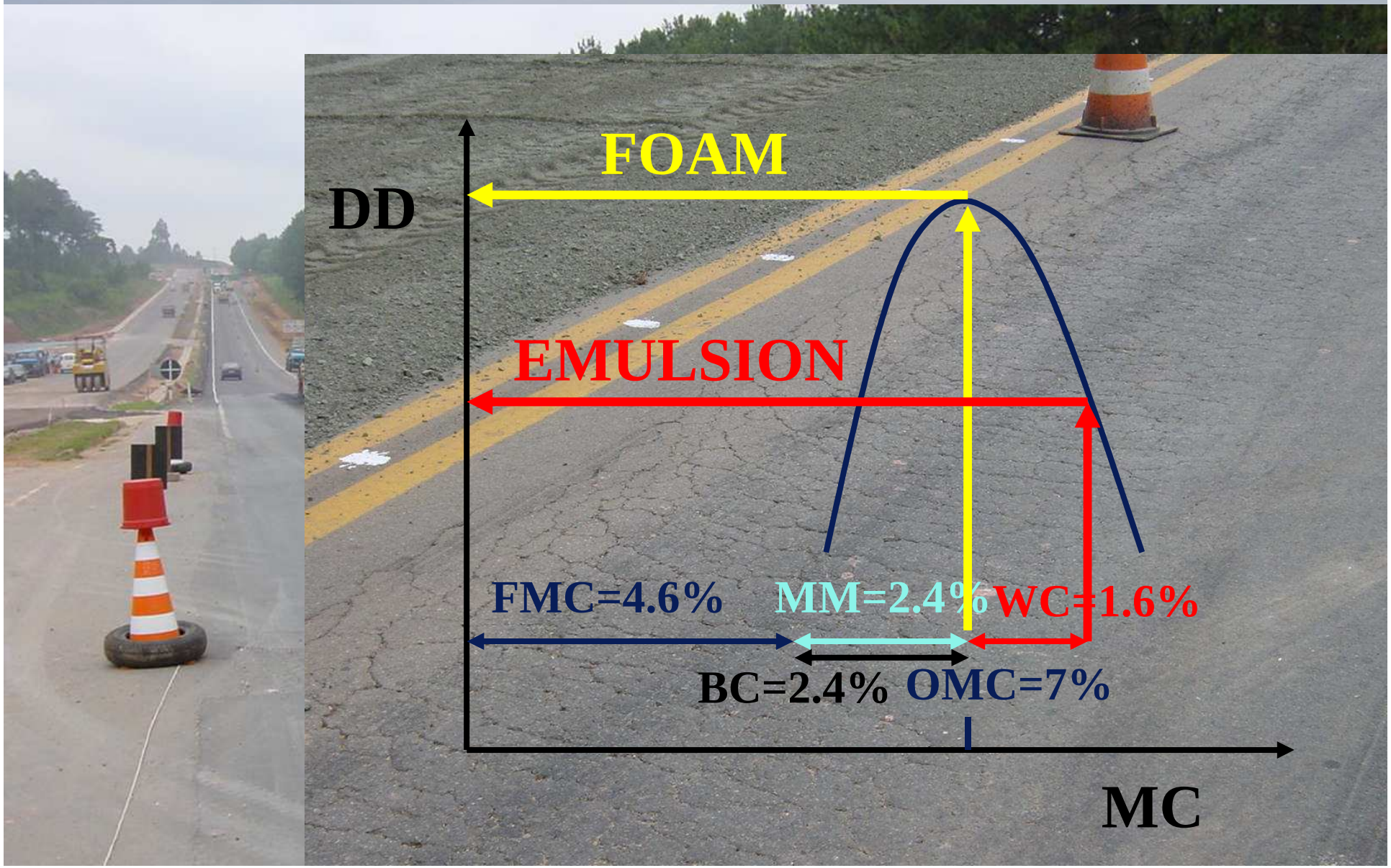
Moisture Induction Sensitivity Test MIST

(Twagira)

Fatigue: Mix 75C-0

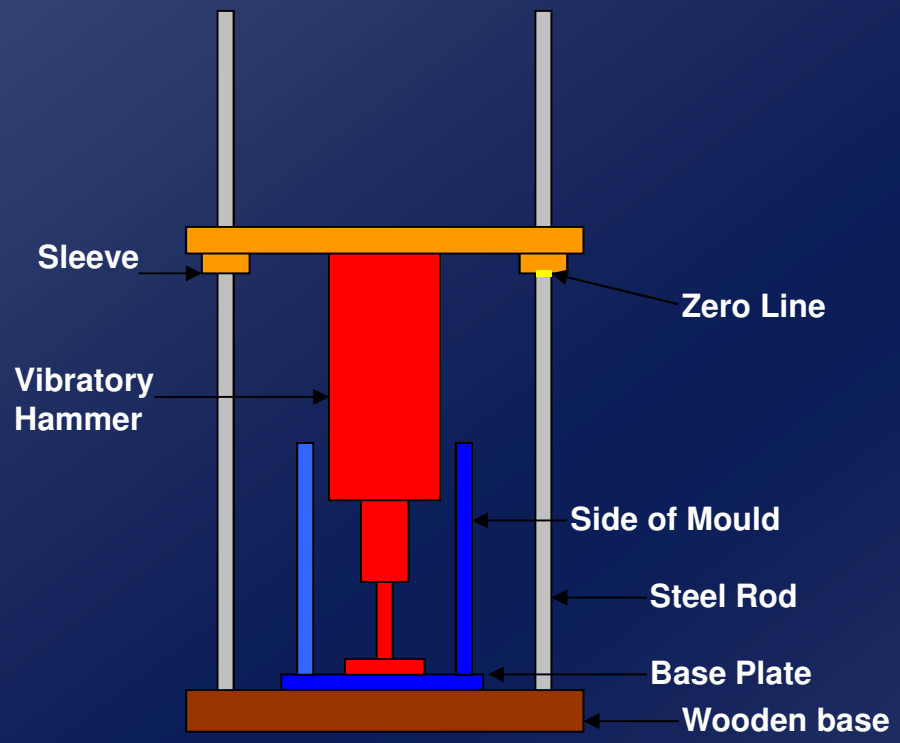


Moisture Content



Vibratory Compaction Hammer

To prepare specimens



Rear View of Frame

Kelfkens

Compaction time (vibratory)

Comp Time

Phase	Level 1	Level 2		Level 3
Test	ITS	ITS	UCS	Triaxial
Foot ϕ	100mm	150mm	150mm	150mm
Height	65mm	95mm	125	mm
Layers	1	2		5
Surchg	5 kg	10	kg	10 kg
Foam	10 sec	25 sec	25 sec	25 sec
Emuls	10 sec	15 sec	15 sec	15 sec

Under review
Only ϕ=100 OK