Introduction to Bitumen Stabilised Materials BSMs

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SARF Course on BSMs

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14 and 15 July 2015

Stellenbosch

60th anniversary SARF Founded in 1950

THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD

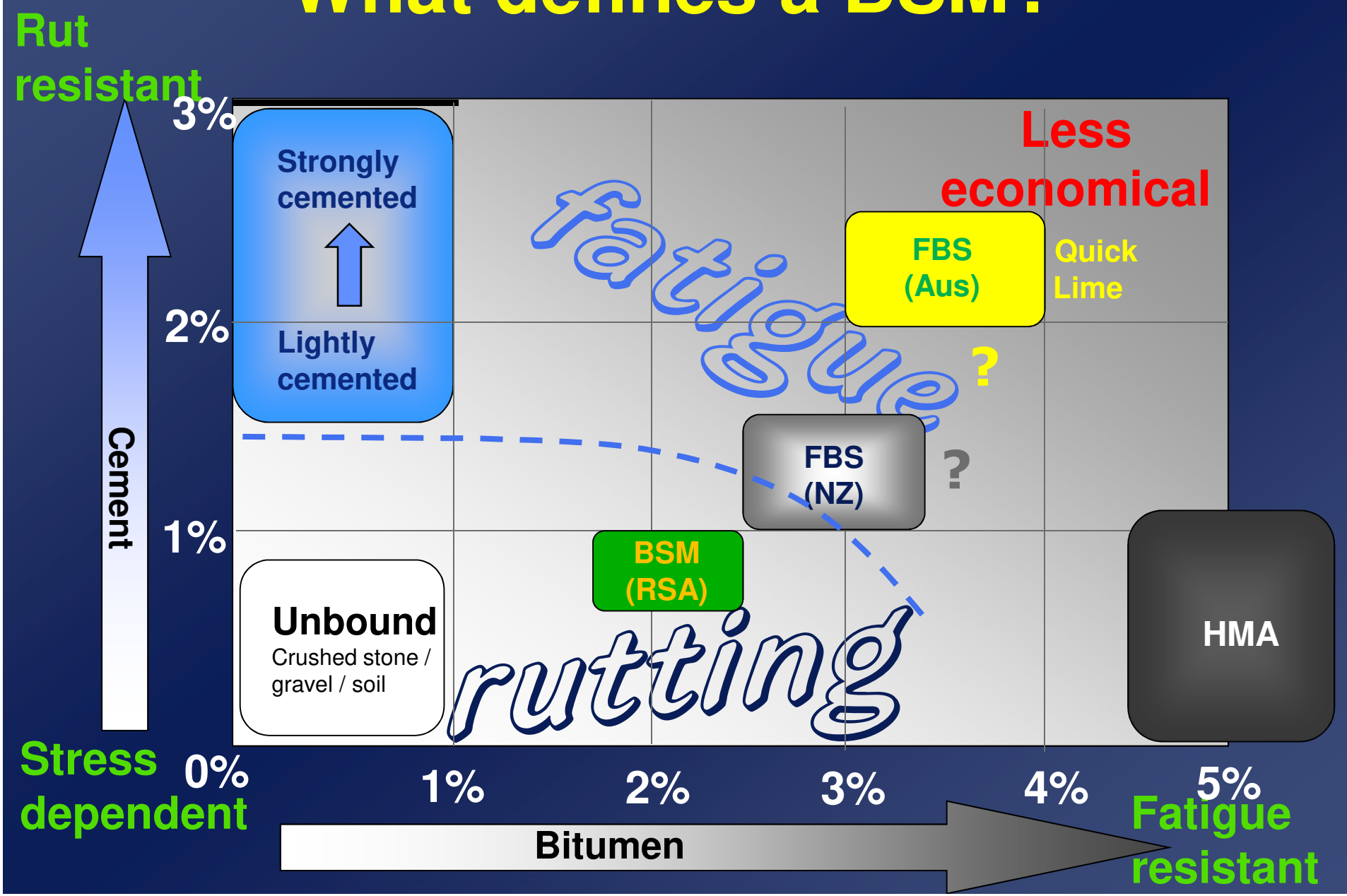
Reg. No.1998/009584/06

Hot

In Place **In Plant**

Cold

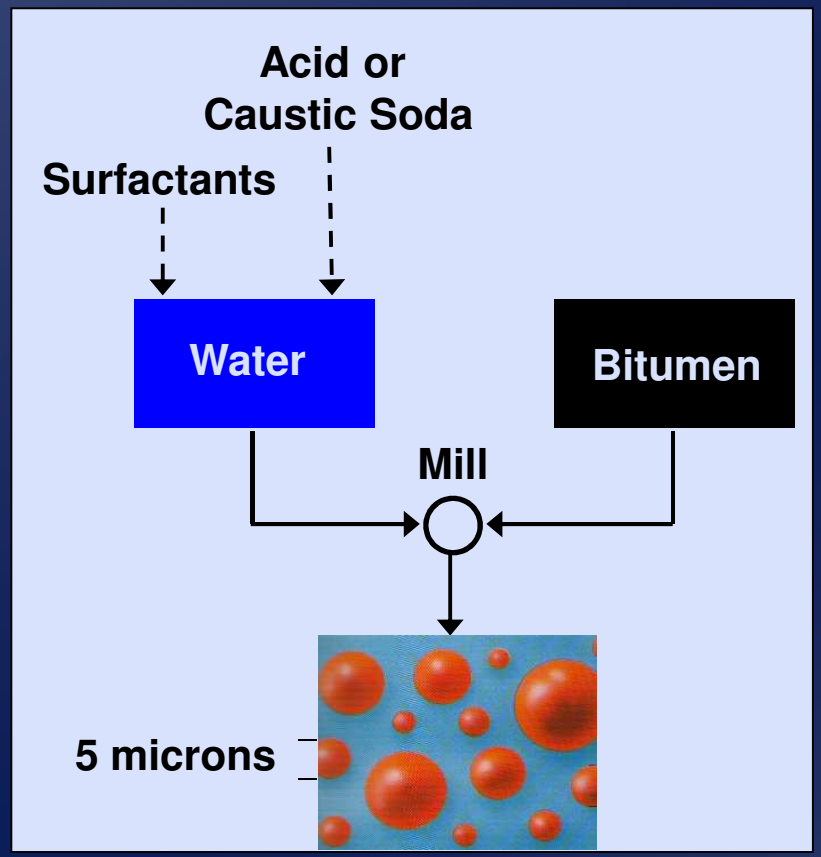
What defines a BSM?



1. BSM Binder Type

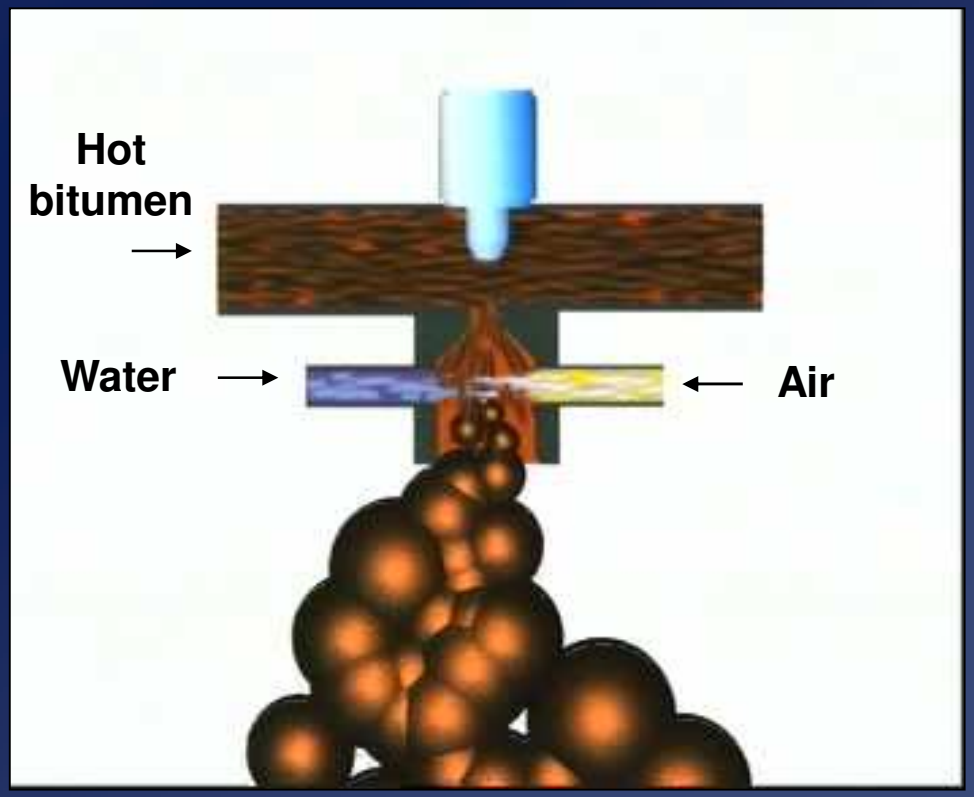
BITUMEN EMULSION

Colloidal Mill

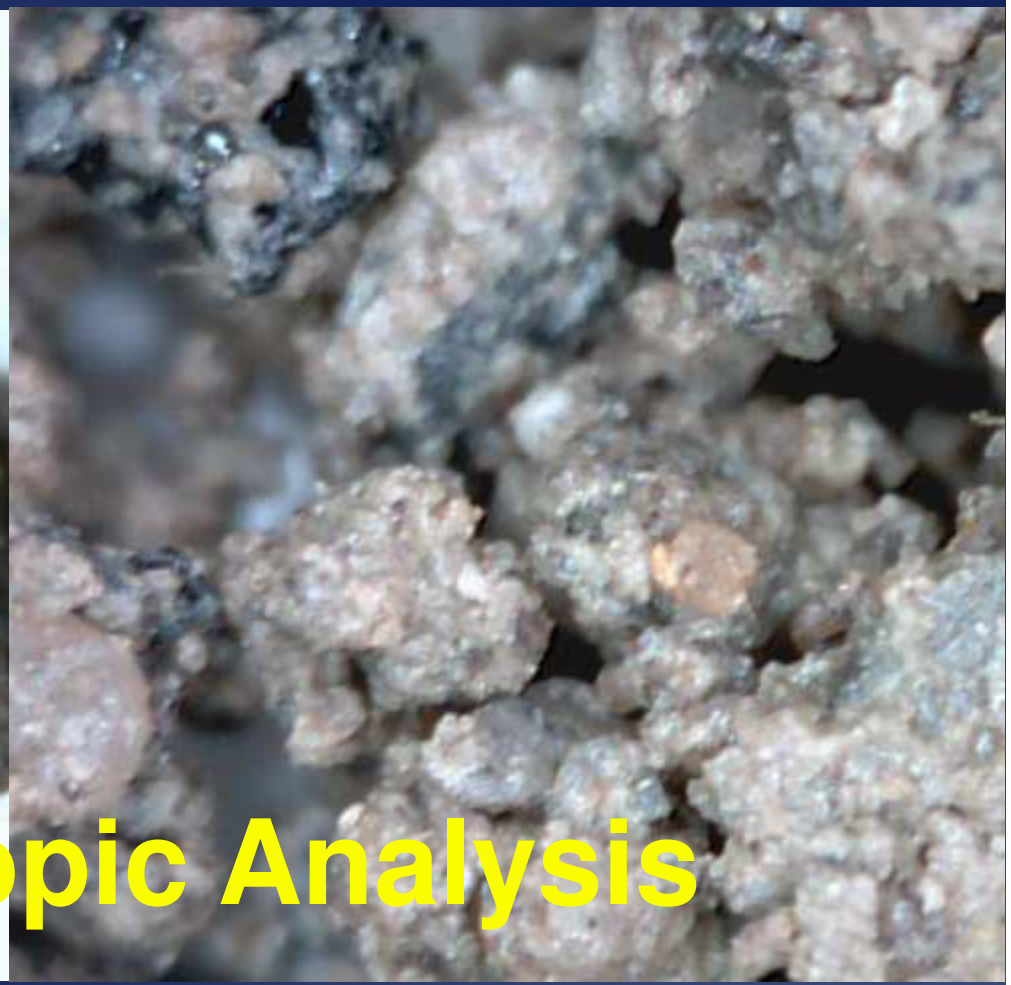


FOAMED BITUMEN

Expansion chamber



2. Bitumen Dispersion



Microscopic Analysis

BSM-emulsion

BSM-foam

Type of Dispersion

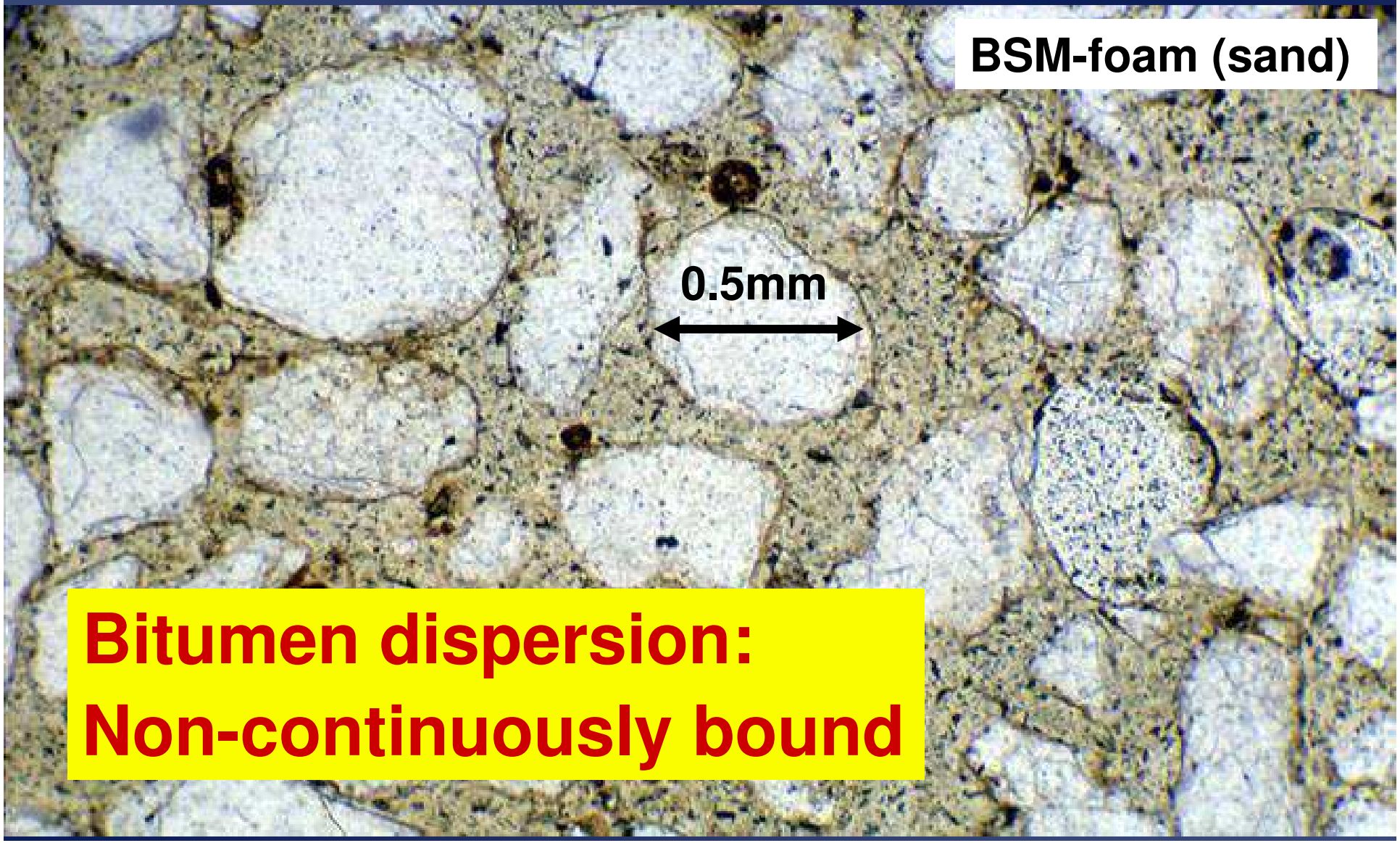
Painting

BSM-emulsion

Spot-welding

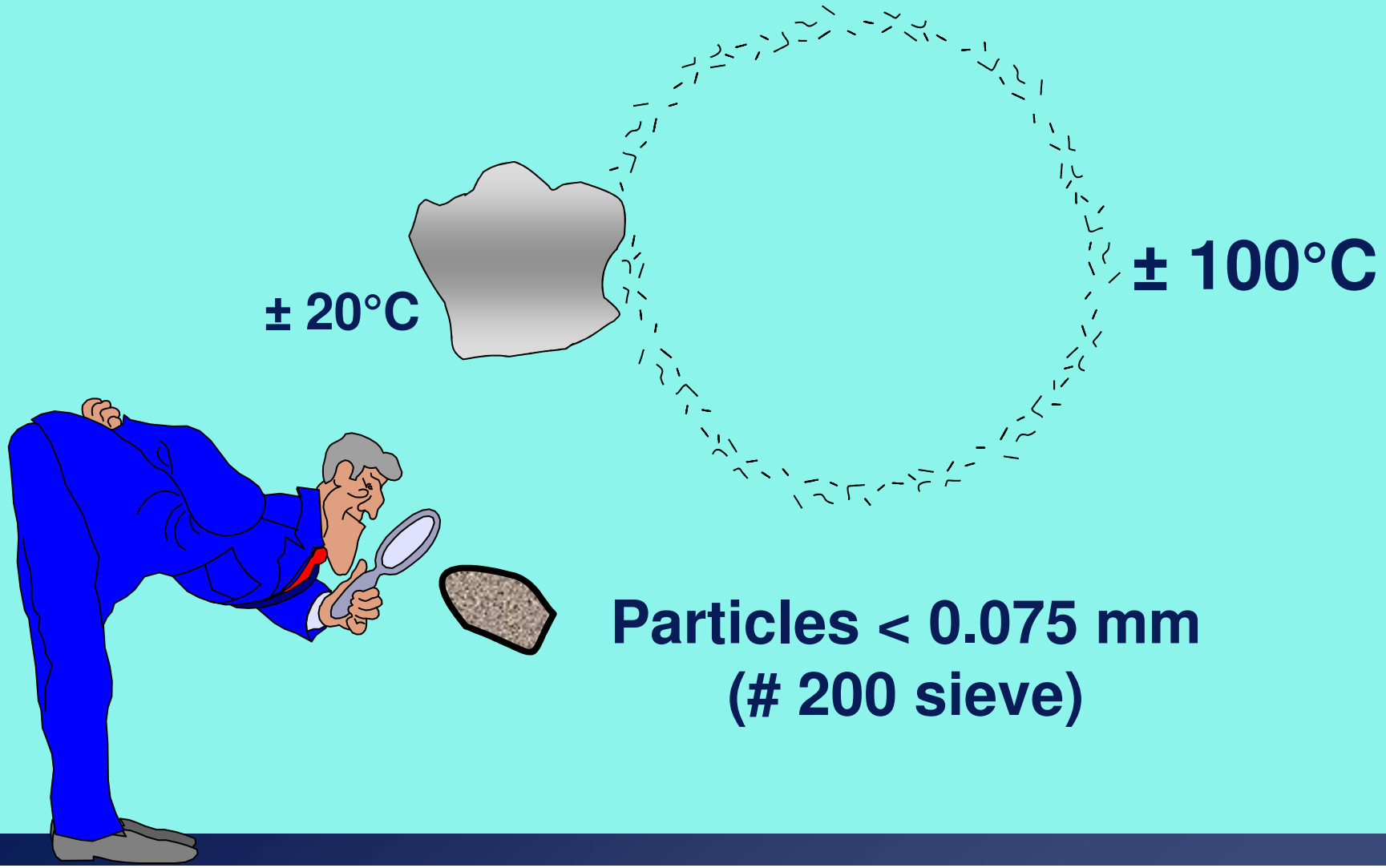
BSM-foam

Nature of BSMs (cold)

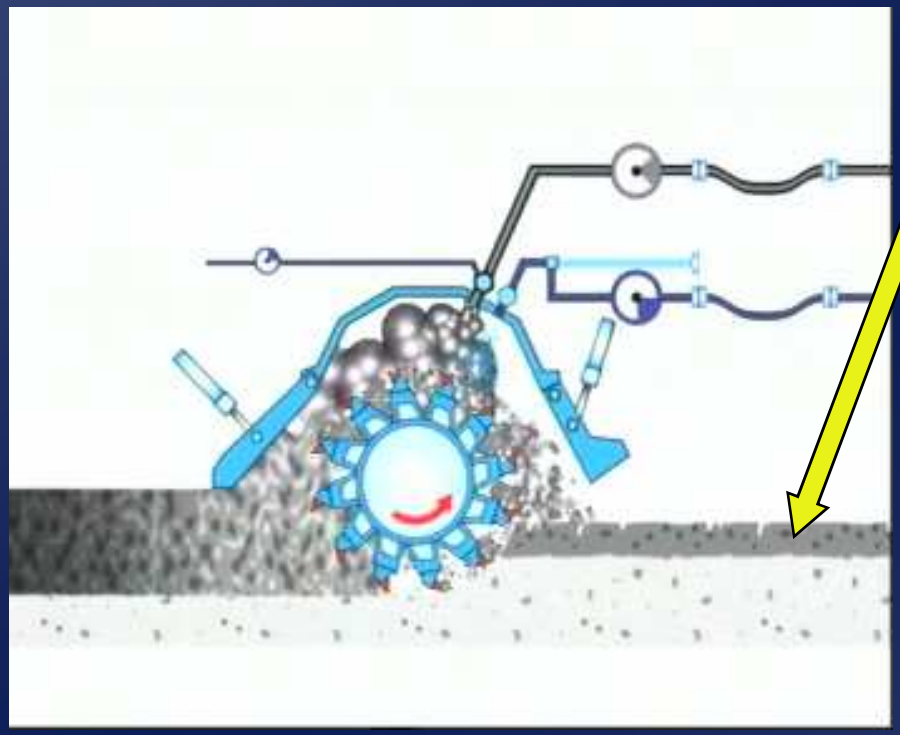


Bitumen dispersion:
Non-continuously bound

BITUMEN DISPERSION



3. Aggregate Types



Recycled Materials

100% RAP

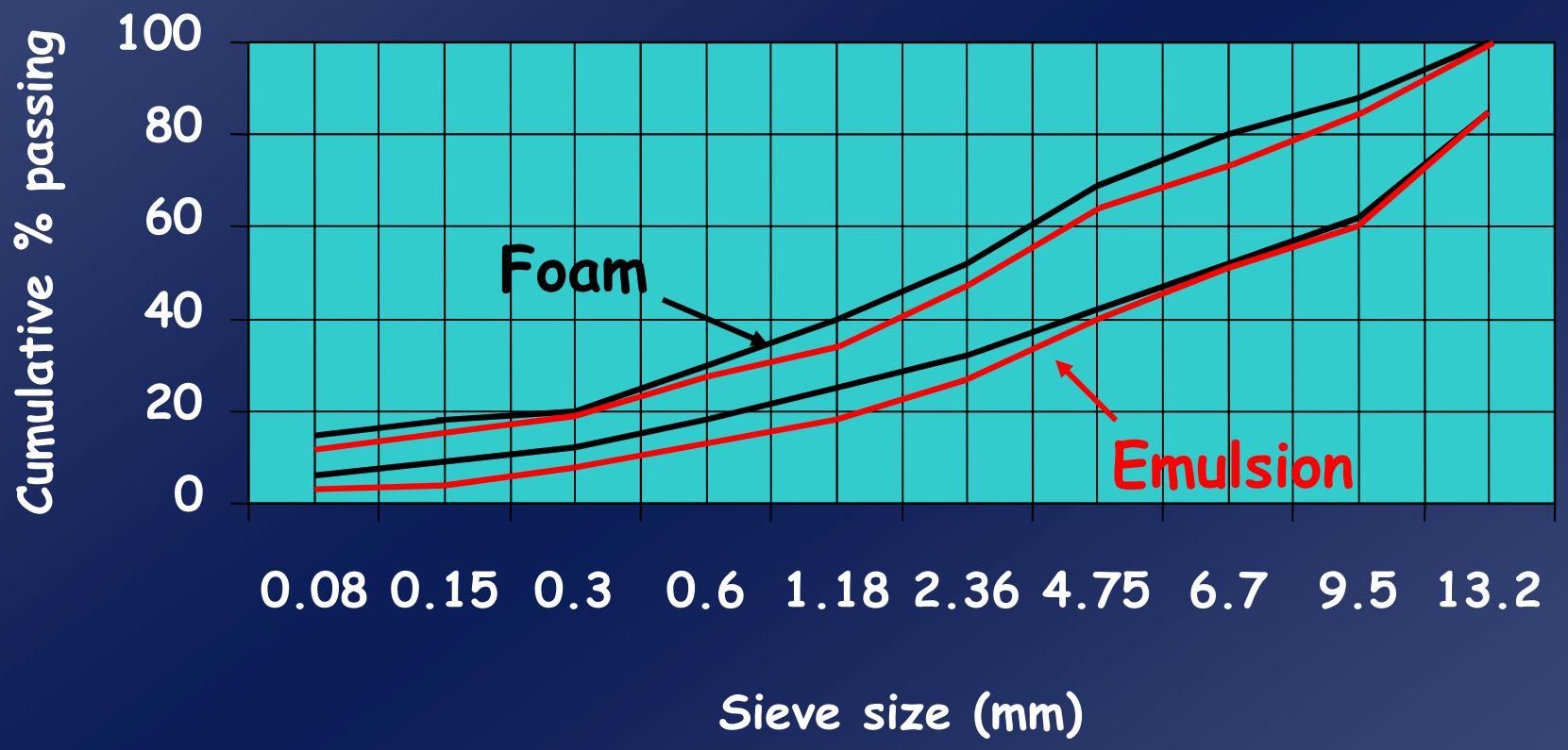
Natural Gravel CBR>25%

Crushed Gravel CBR>45%

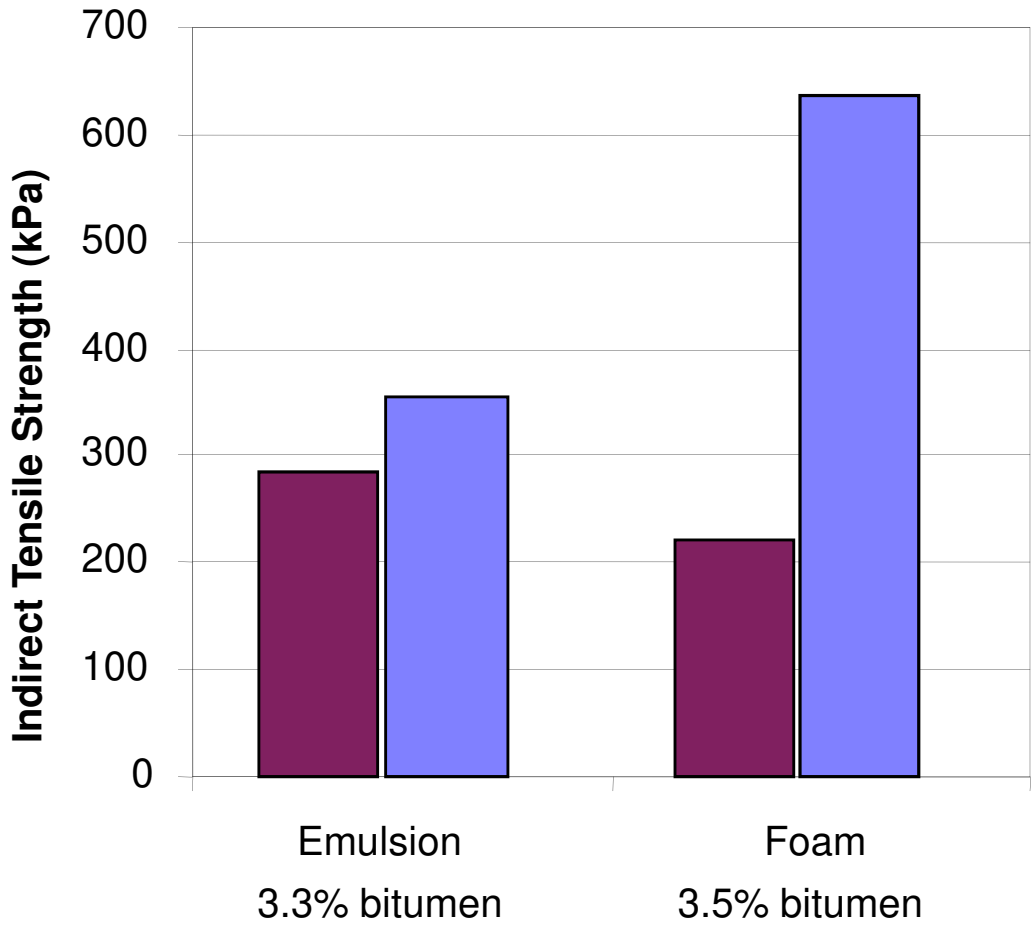
Graded Crushed Stone

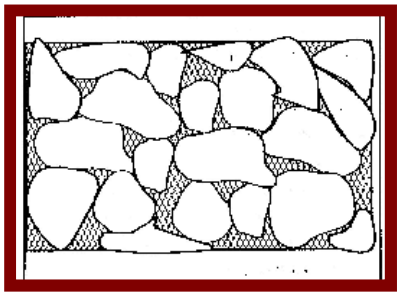
50% RAP + GCS

4. Grading requirements



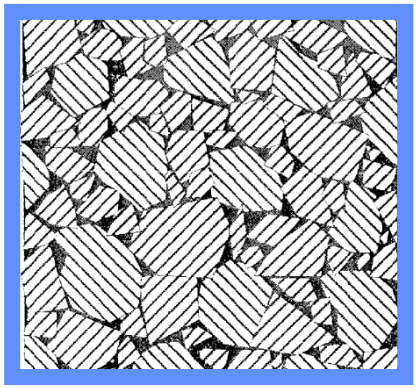
Optimisation of grading curve





Without blending

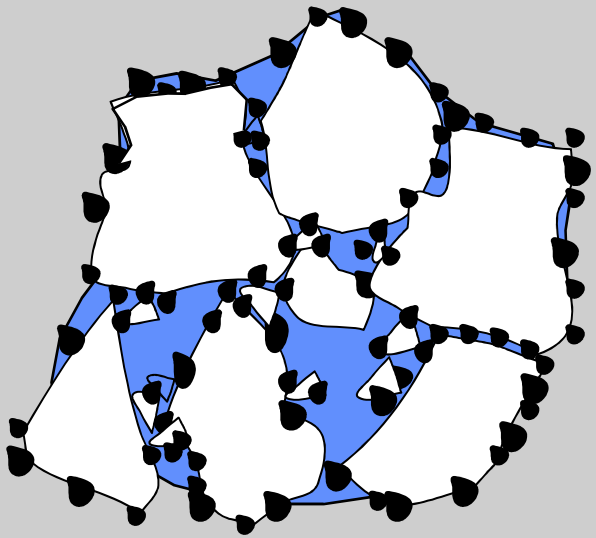
With 10% fines blend

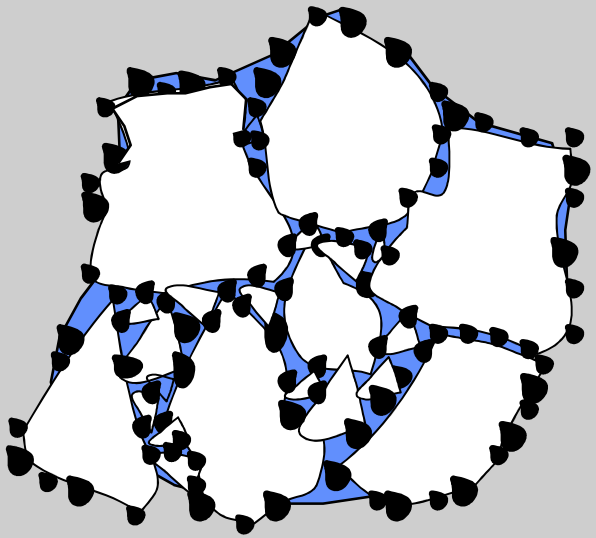


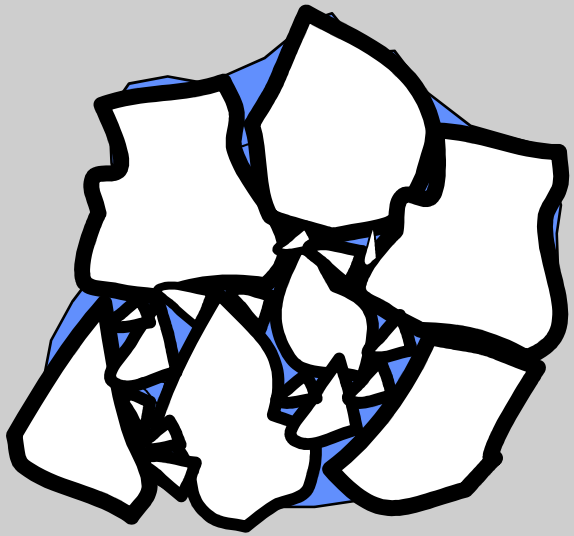
Moisture: Durability

FOAMED BITUMEN

EMULSION







Poorly graded

Well graded

Well graded

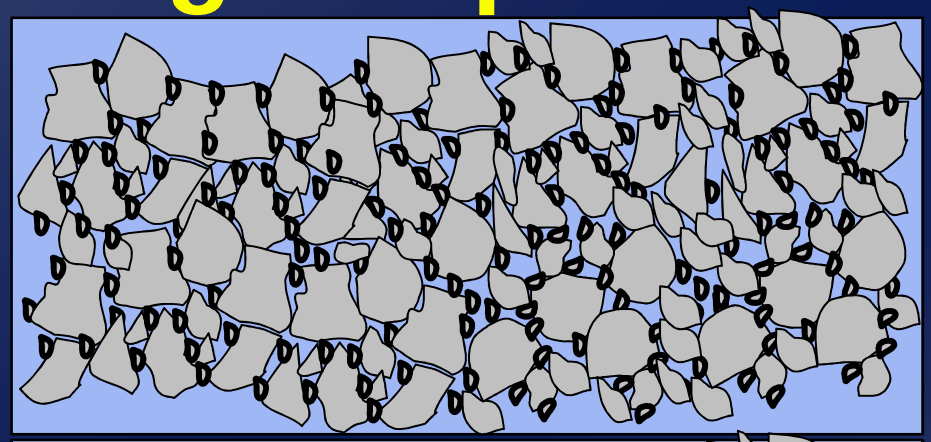
5. Bitumen content

BSM Class	Aggregate	Bitumen (%)
BSM 1	>75% RAP + Crush agg	1.6 – 2.1
BSM 1	>25% RAP + Crush agg	1.8 – 2.5
BSM 1	<25% RAP + Crush agg	2.0 – 3.0
BSM2	Natural Gravel (CBR>45%)	2.2 – 3.5
BSM 3	Natural Gravel (CBR>25%)	2.5 – 4.0

(Wirtgen Recycling Manual, 2012)

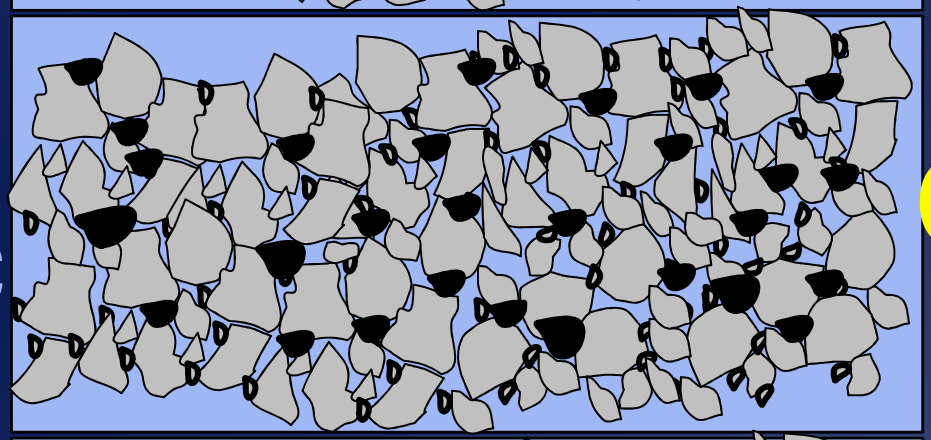
Aggregate Mixing Temperature

Foam > 25ºC



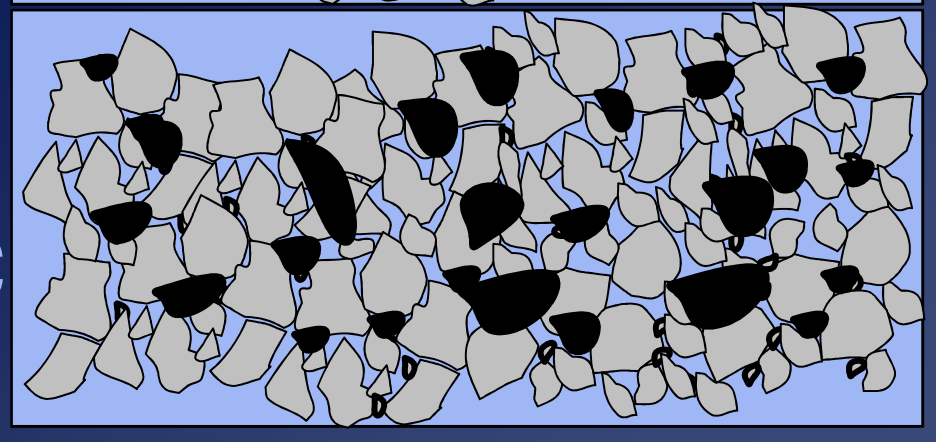
√

Foam 15ºC
Emulsion 10ºC



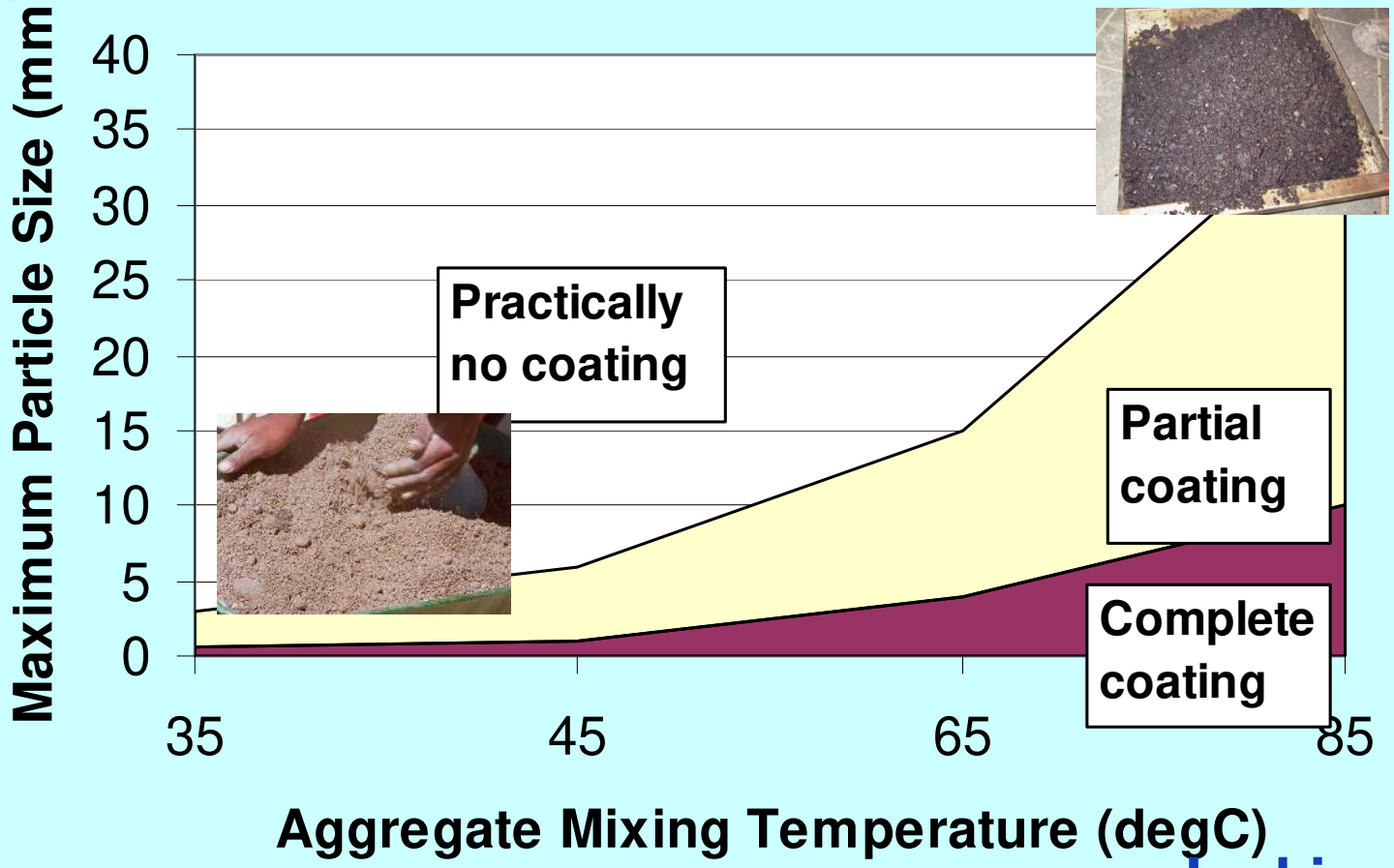
OK

Foam <15ºC
Emulsion<10ºC



X

Aggregate Temperature vs Particle coating (BSM-foam)



Jenkins, 2000

7. Moisture Regime (mix & compact)

EMULSION

Bitumen coating (thin films)

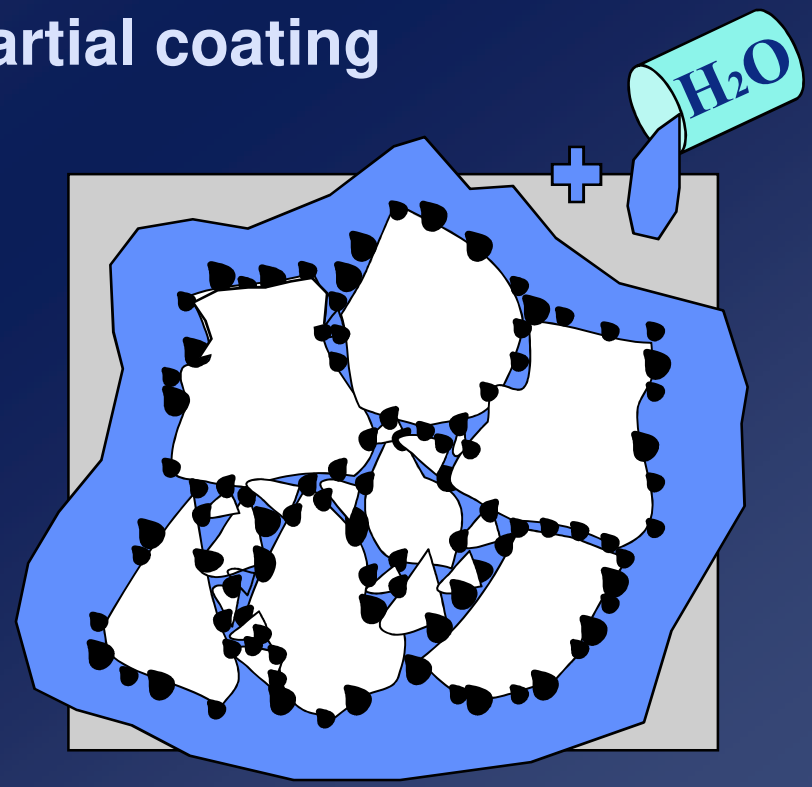
Some partial coating

Optimum Fluids Content

FOAMED BITUMEN

Bitumen dispersion selective

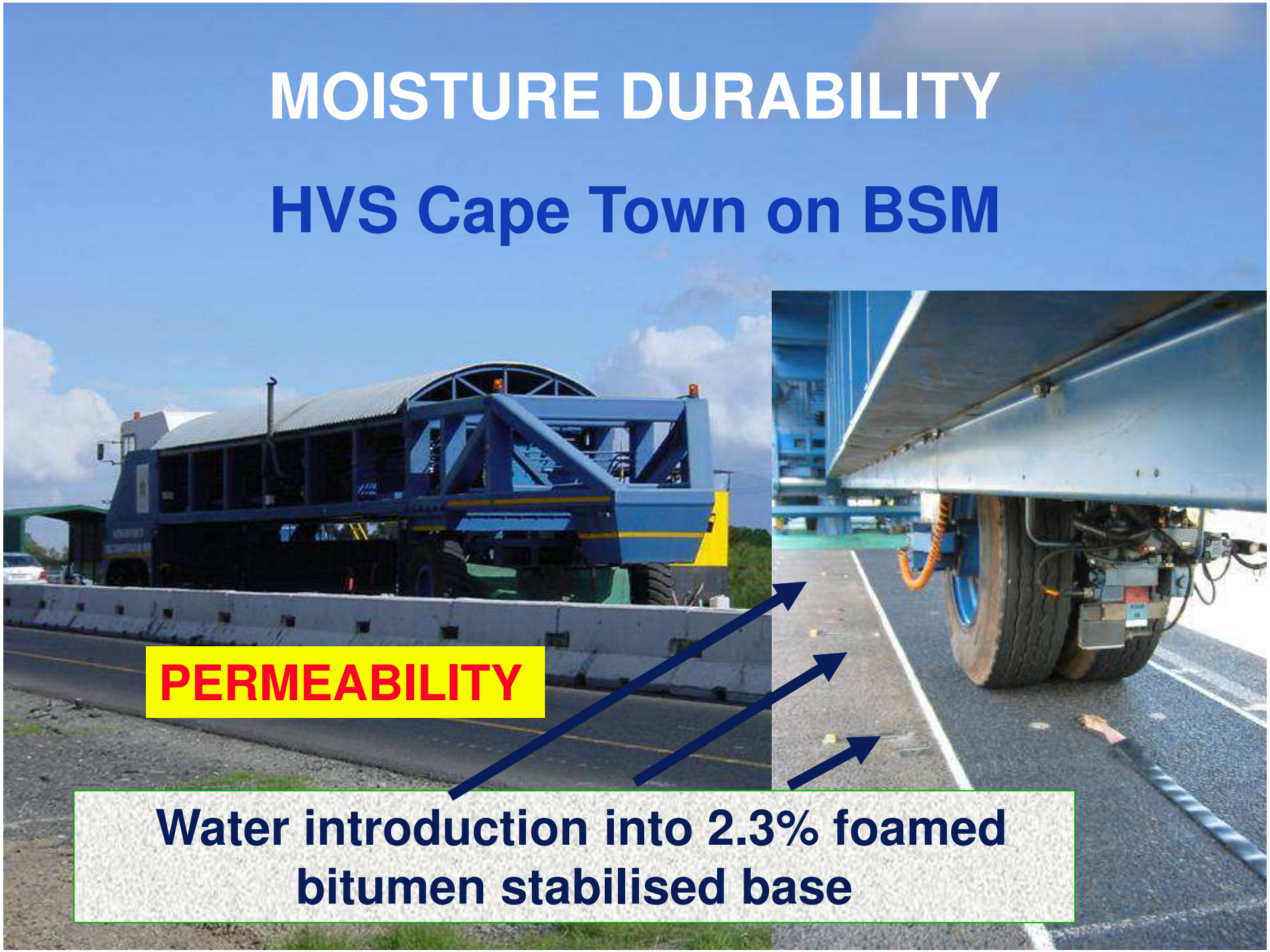
Partial coating



70% to 90% of OMC

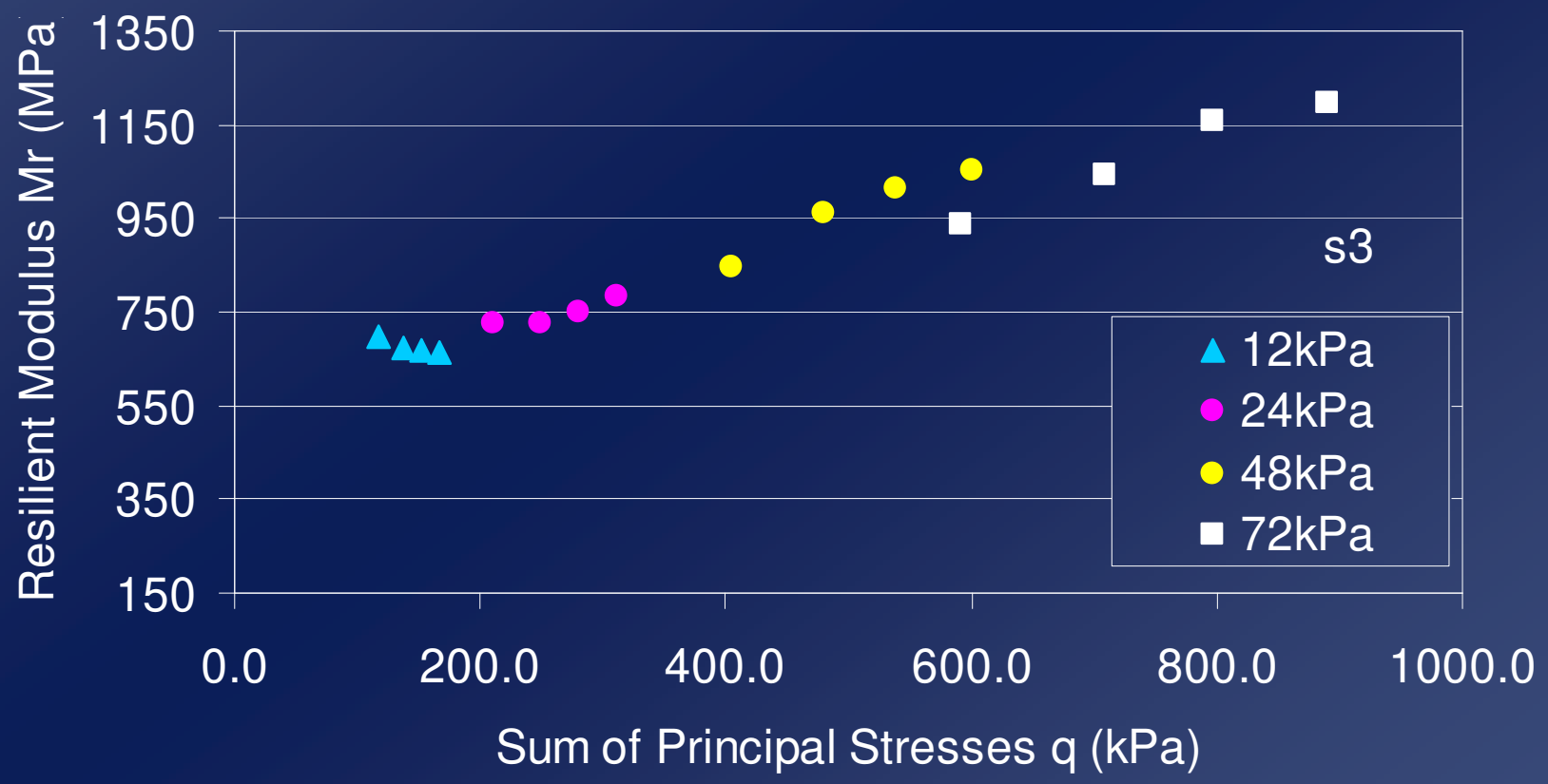
MOISTURE DURABILITY

HVS Cape Town on BSM



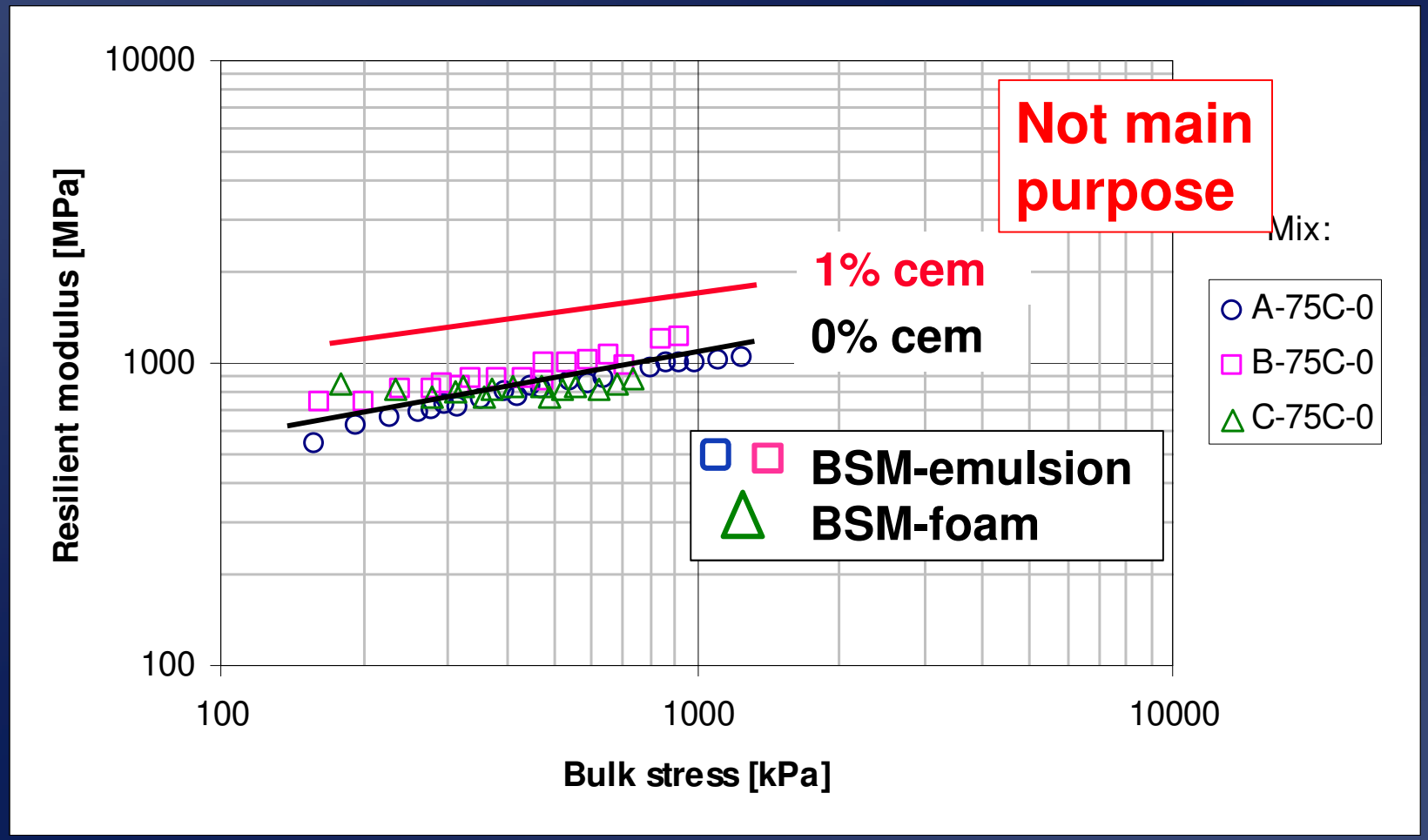
8. Behaviour = Granular type

Resilient Modulus of BSM-foam (BC = 2%)

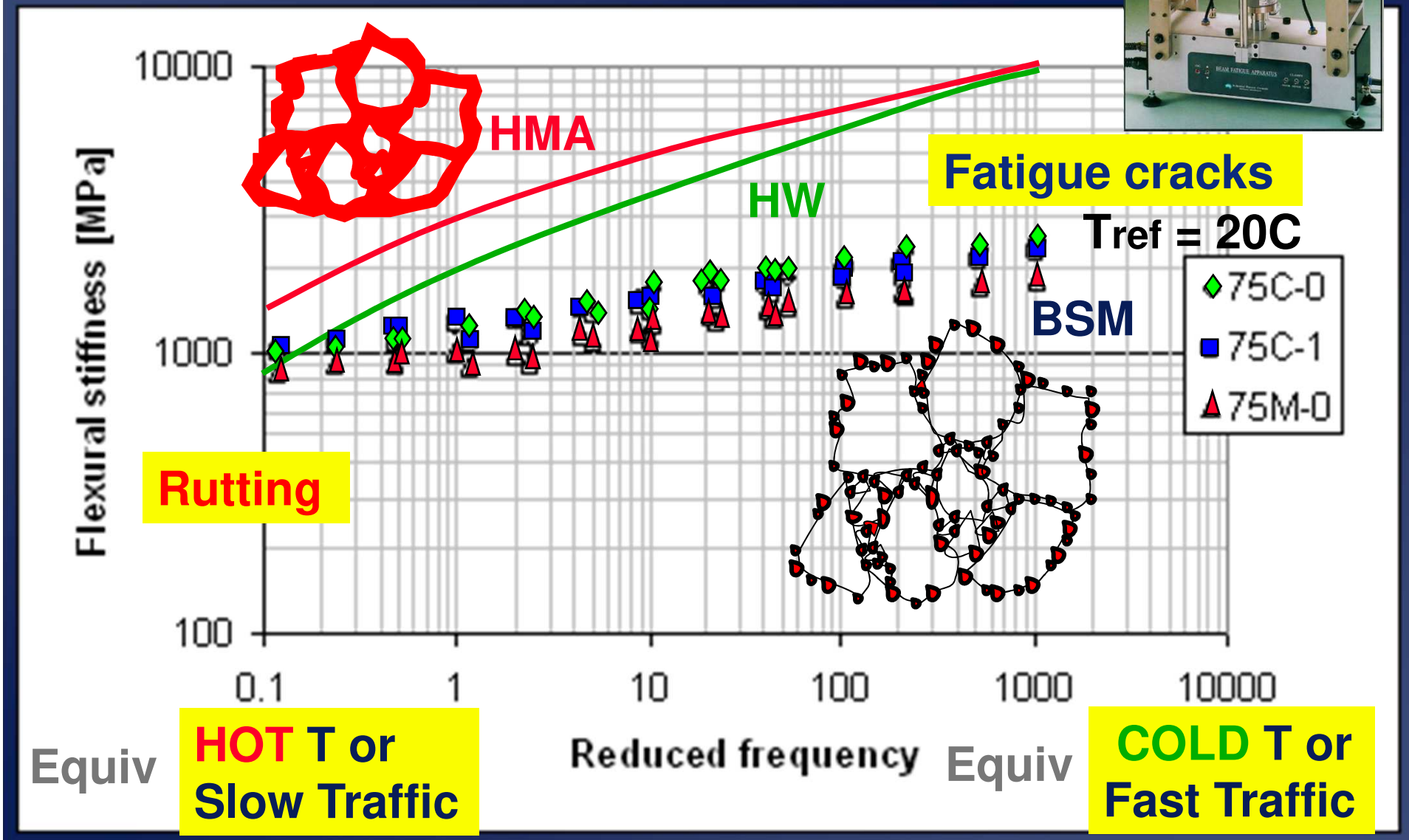


Stress dependency (triaxial)

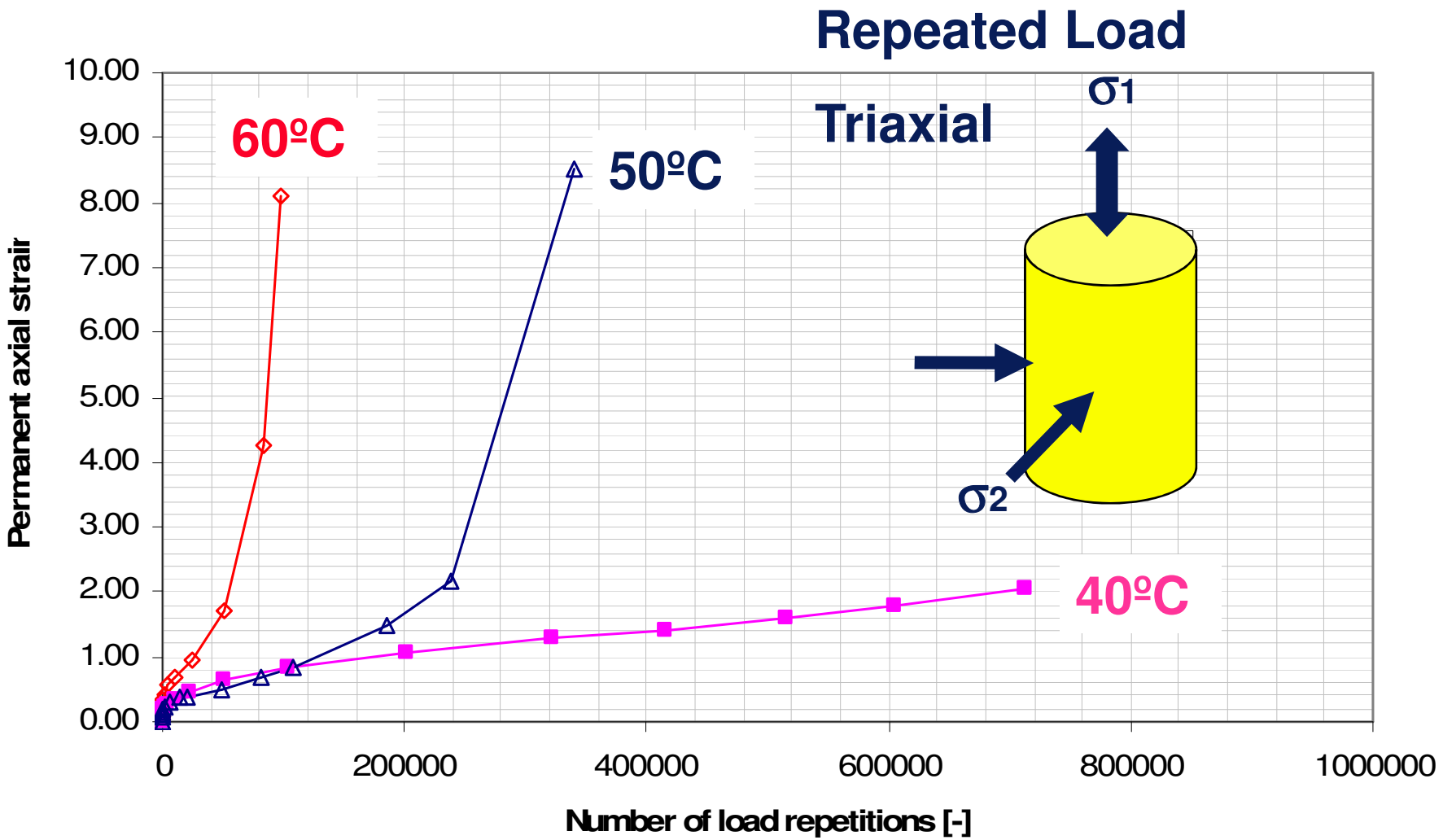
Resilient moduli 75C-0 blend



Visco-elastic properties of BSM-foam



Validation (100% RAP Foamed Mix)



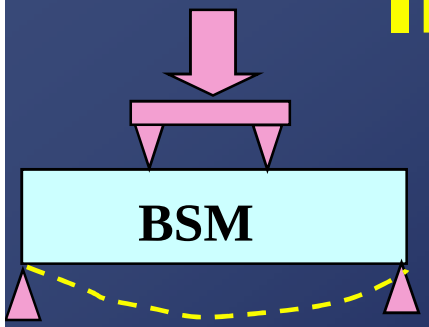
10. Active Filler: Purpose?

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

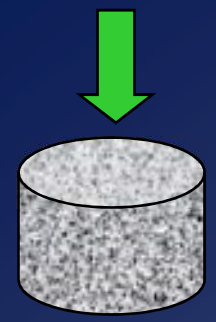
PRIMARY REASONS

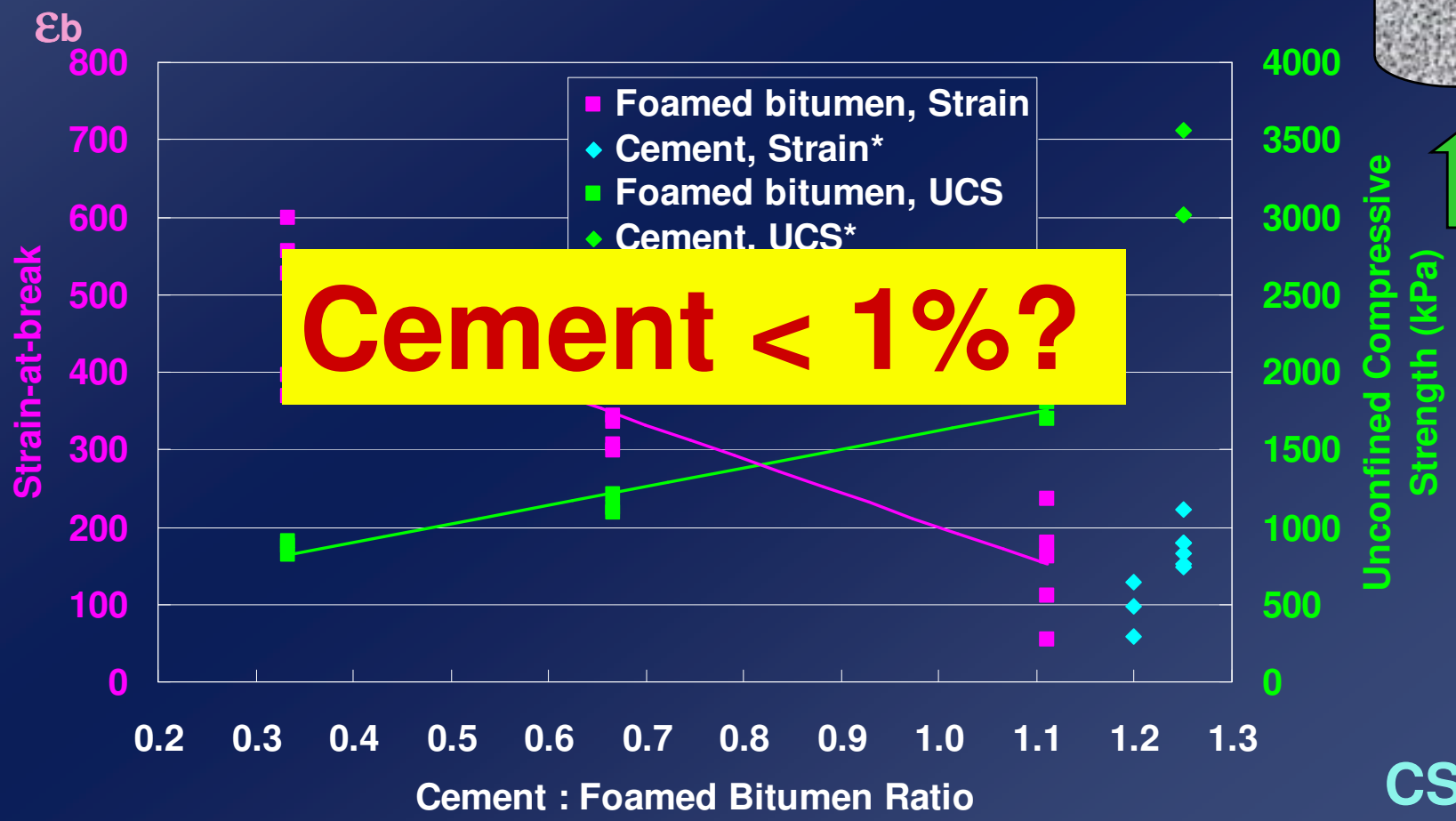
Emulsion	Foam
	Dispersion!

Influence of Active Filler



Strength and flexibility





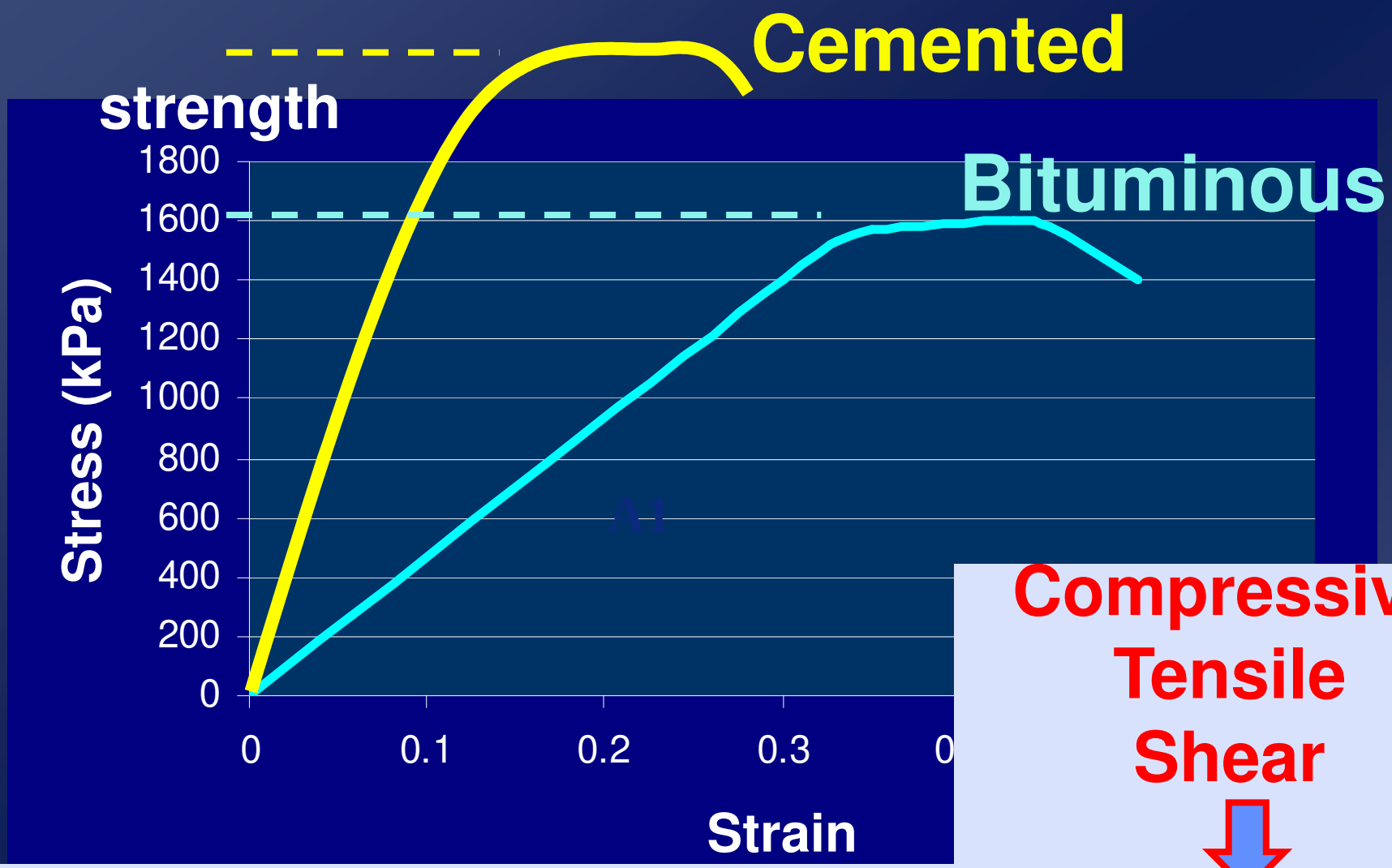
Cement < 1%?

CSIR


Can 1.5% cement work?
BSM-foam + 1.5% cem
using cracked CTB
2 years of traffic
JIACTONG


江西省农
全面开通
农村信用合作联社
上海 广州 东莞
物流
610

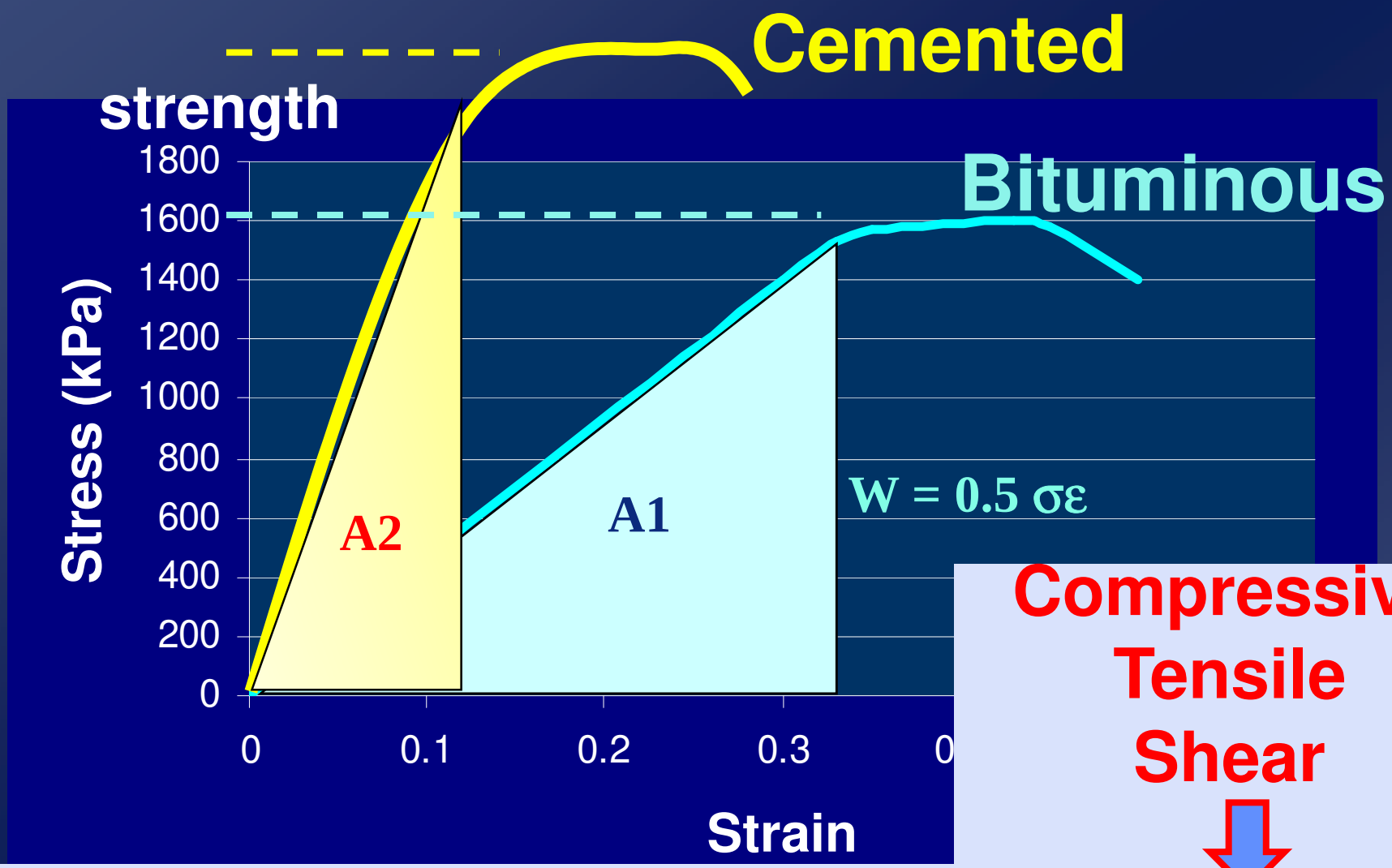
Mix Design Testing



Compressive
Tensile
Shear

It's undeniable: More cement = more strength!

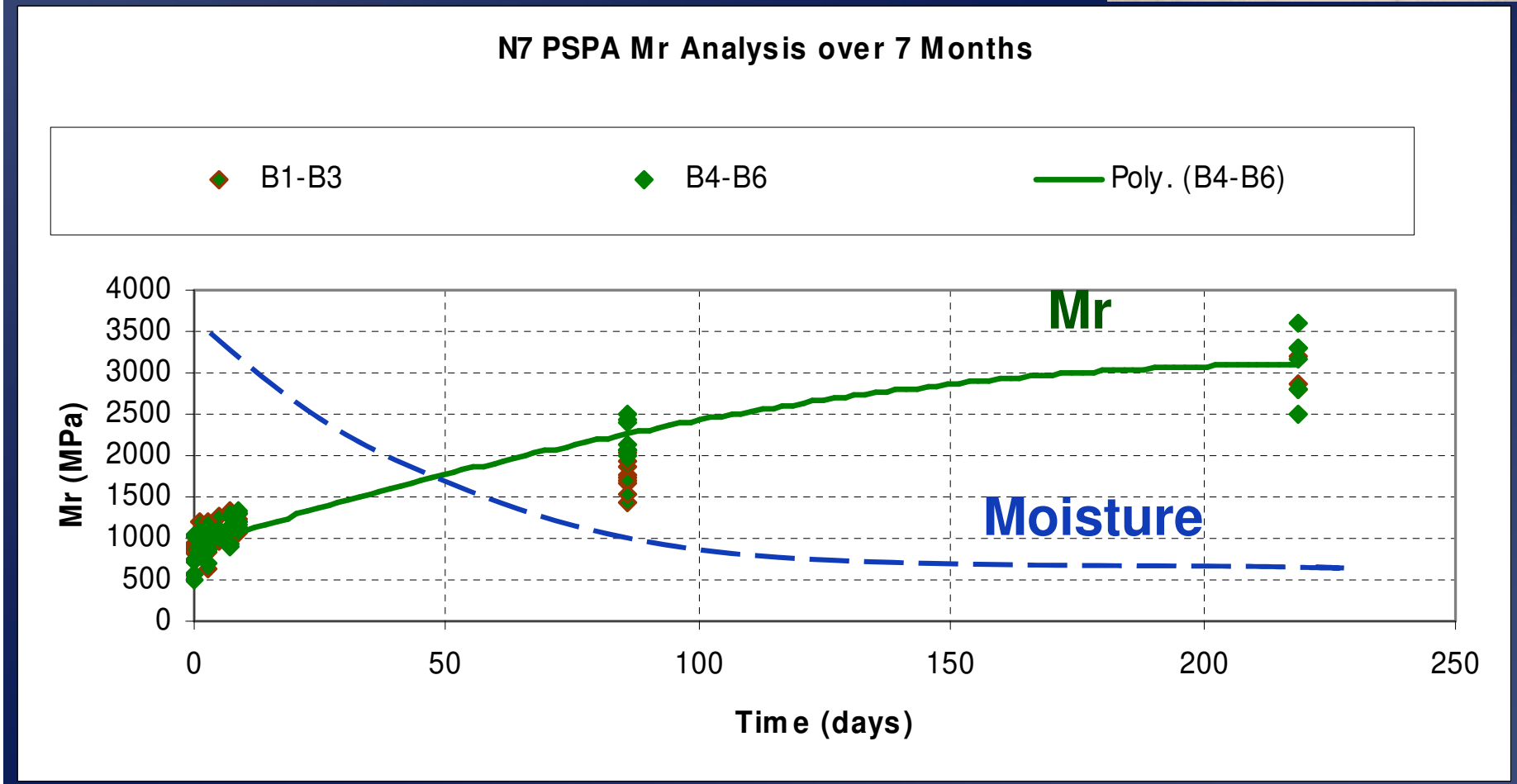
Dissipated Energy



Compressive
Tensile
Shear

It's undeniable: More cement = more strength!

11. Time Dependency Mr (field) versus cure



BITUMEN STABILISED MATERIALS

TG2 : 2nd EDITION

Published in
South Africa
by
Asphalt Academy
(CSIR / SABITA)

May 2009

Technical Guideline:

Bitumen Stabilised Materials

A Guideline for the Design and Construction of Bitumen Emulsion and Foamed Bitumen Stabilised Materials

TG 2
Second edition
May 2009

ASPHALT ACADEMY

Conclusions

- Many combinations of aggregates can be used (continuous grading)
- BSMs ≠ asphalt
- BSM is granular with higher cohesion and shear strength
- Flexibility is NB! Active filler content needs to be restricted

Thank you