TC SIB – TG6 CR

University of Parma

CAPSA'11

Update from RILEM TG6 – Cold Recycling

Gabriele Tebaldi, Ph.D., P.E.

11th September 2011 - Drakensberg, South Africa

ISAP TC APE Asphalt Pavements & Environment

Technical Committee SIB

Testing and characterization of Sustainable Innovative Bituminous materials and systems

TC SIB – TG6 CR

University of Parma

Chairman: Manfred N. Partl
Secretary: Emmanuel Chailleux

TG 1 Binders (Dariusz Sybilski)

TG 2 Mixture Design and Compaction (Hussain Bahia)

TG 3 Mechanical testing of mixtures (Hervé Di Benedetto)

TG 4 Pavement Multilayer System Testing (Francesco Canestrari)

TG 5 Recycling (Chantal De La Roche)

TG 6 Cold Recycling (Gabriele Tebaldi)

TC SIB – TG6 CR

Members

University of Parma

Gabriele Tebaldi (*Chairman – University of Parma*)

Vincent Gaudefroy (*IFSTTAR*)

Martin Hugener (*EMPA*)

Patrick Muraya (*NTNU – Norwegian University of Science and Technology*)

Eshan Dave (University of Minnesota@Duluth)

Alessandro Marradi (University of Pisa/Dynatest)

Fabio Picariello (ELLETIPI)

Paul Marsac (*IFSTTAR*)

Marco Pasetto (University of Padova)

Kim Jenkins (University of Stellenbosch – SANRAL)

Andreas Loizos (NTUA)

Louisette Wendling (*IFSTTAR*)

Layella Ziyani (*IFSTTAR*)

Todd Thomas (*Road Science LLC*)

Bjørn Ove Lerfald (*Veidekke Asfalt*)

ISAP TC APE Asphalt Pavements & Environment

TC SIB – TG6 CR

Strategic Plan

University of Parma

Evaluate test and mix design methods for the use of materials with reclaimed bituminous materials from the road, focusing on cold mix recycling with emulsion and with foam bitumen.

The work will focus on **mixes with high % of RAP** proposing guidelines on how to characterize and define RAP in order to conduct comparable inter-laboratory tests on evaluation and test methods for cold recycling mixtures.
To make a link with ISAP APE WG2.

Warm and half-warm techniques use additives like zeolites, waxes, etc., in some case not well known due to patents and industrial secrets: so to avoid the risk of a large number of variables those techniques are **temporarily not considered**

ISAP TC APE Asphalt Pavements & Environment

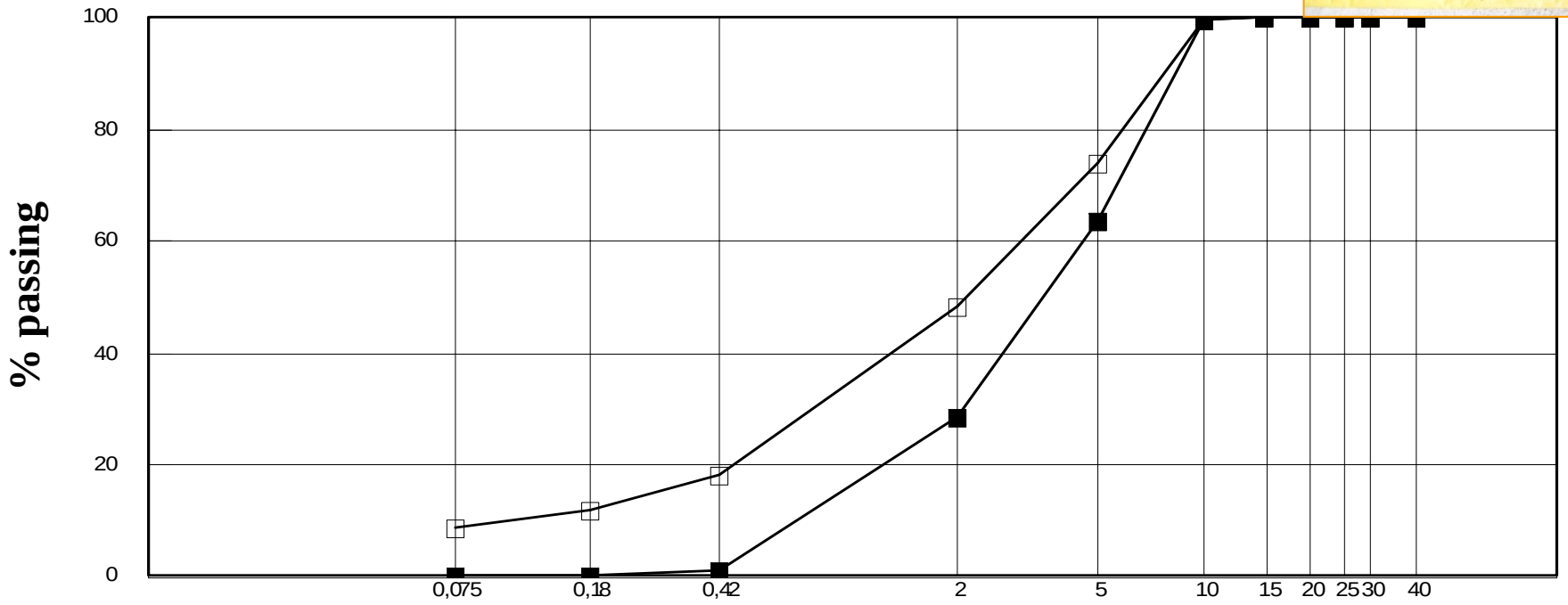
TC SIB – TG6 CR

RAP Grading Curve

University of Parma

Italian experience

8mm maximum size



■ Black grading curve □ White grading curve

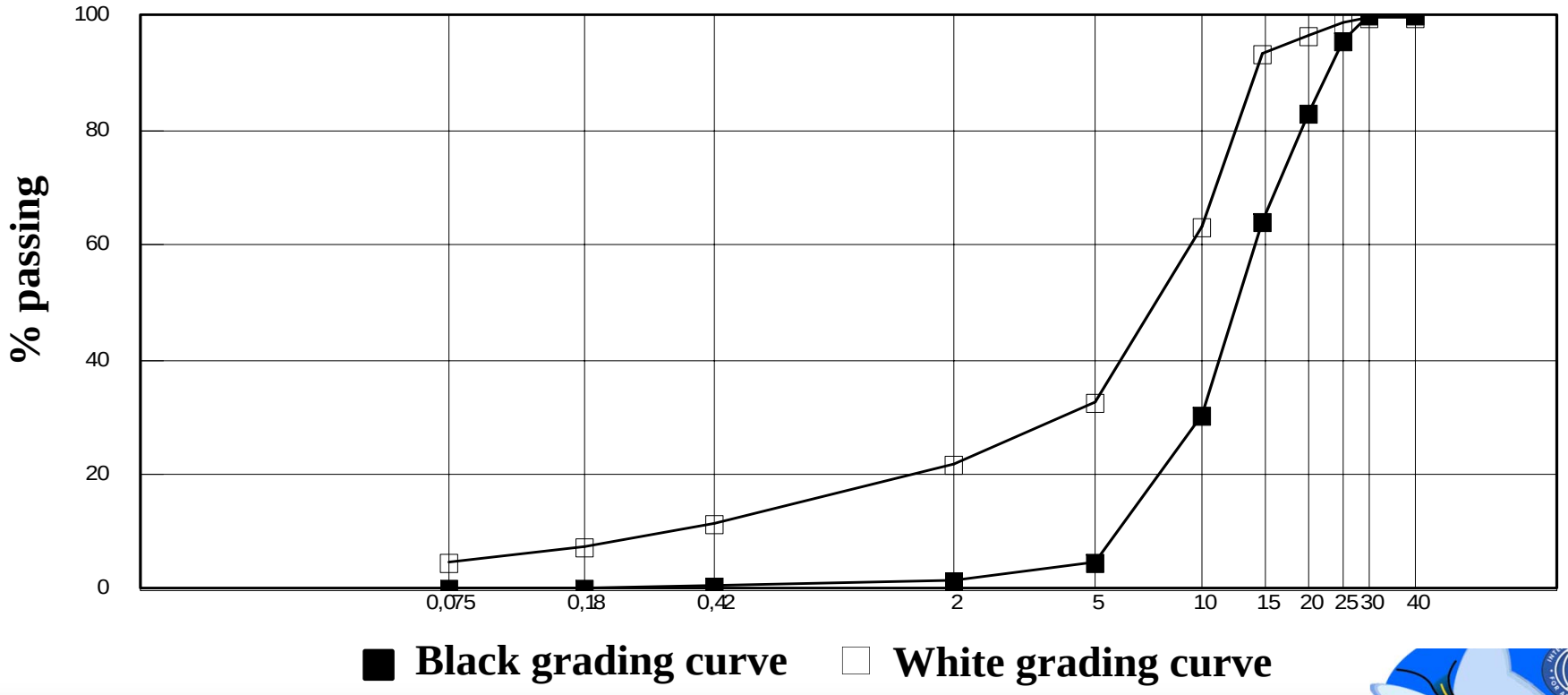
TC SIB – TG6 CR

RAP Grading Curve

University of Parma

Italian experience

8mm minimum size – 30mm max size



TC SIB – TG6 CR

RAP bitumen's characteristics

University of Parma

Pen@25°C

R&B

Asphalten contents
(ASTM D 3279-97)

DSR

….and/or..??

TC APE Asphalt Pavements & Environment

TC SIB – TG6 CR

Work Plan

University of Parma

I. RAP Classification

1) Literature review
   - *Rap production methods, definition of Rap, industrial operations*
2) Cleanliness/foreign matter
3) Grading evaluation “black-white”(ASTM/EU)
4) Bitumen content
5) Bitumen characteristics
   - *R&B, Pen@25, viscosity at list at 2 temperature, BBR*
6) Aggregates characteristics
   - *Mineralogy and petrography, shape, reactivity*
7) Moisture continent
8) Accuracy and representatively

TC SIB – TG6 CR

Curing

University of Parma

Role of fluids in BSM		
Component	BSM-emulsion	BSM-foam
Bitumen	Contributes to fluids for compaction	Negligible contribution to fluids for compaction
Moisture in aggregate	Reduces absorption of bitumen emulsion water into aggregate	Separates and suspends fines making them available to bitumen during mixing
	Prevents premature breaking	Acts as carrier for bitumen splinters during mixing
	Extends curing time and reduces early strength	Reduces early strength
	Provides workability of BSM at ambient temperatures	
	Reduces friction angle and lubricates for compaction	
	Provides shelf-life for the mix	

BSM-emulsion

Changes in moisture content occur in two distinct phases, namely:

- **Breaking** is the separation of the bitumen from the water phase through flocculation and the coalescence of the bitumen droplets to produce films of bitumen on the individual particles of the material. The rate at which the bitumen droplets separate from the water phase is referred to as the breaking time (Also known as the setting or settling time.)

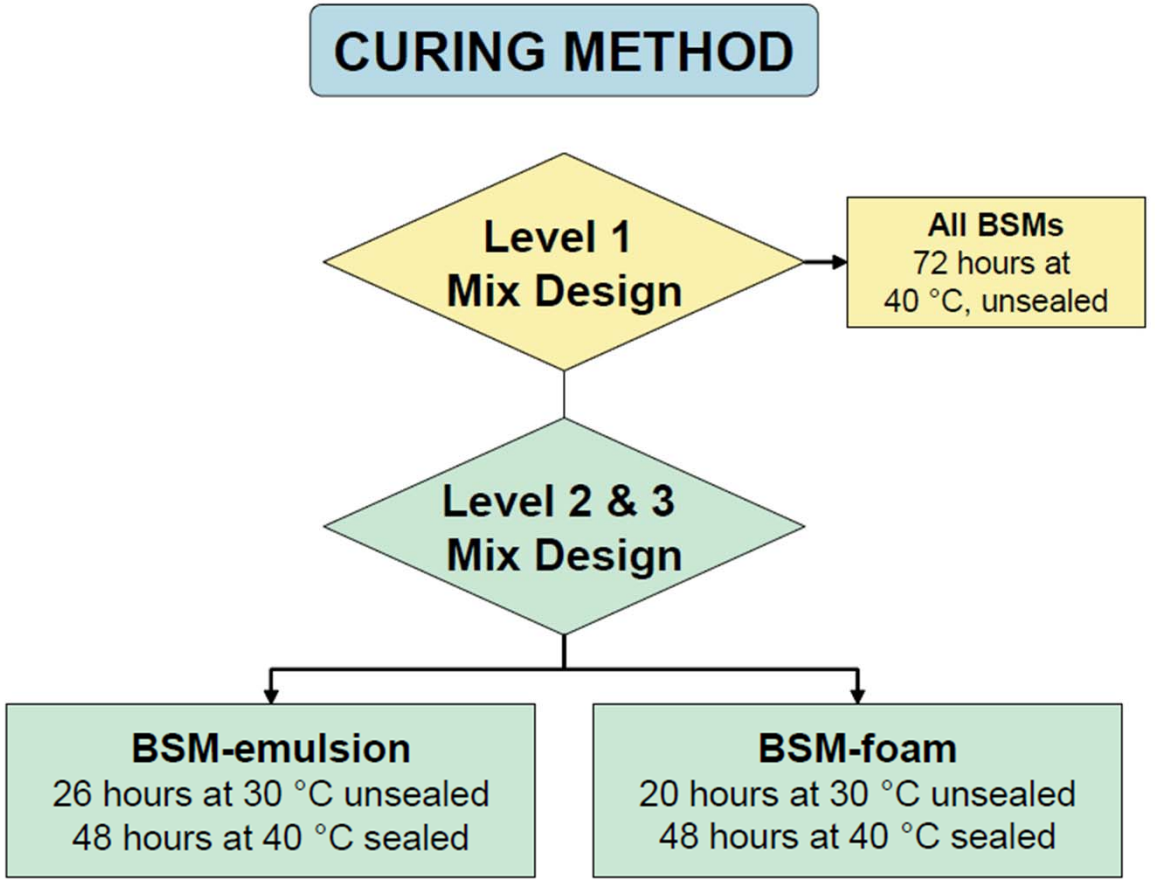
  The breaking process with anionic bitumen emulsions is a mechanical process (evaporation), whereas cationic bitumen emulsions produce a chemical break. For dense mixtures, more time is needed to allow for mixing and placement and slower breaking times are required. As the bitumen emulsion breaks, the colour changes from dirty brown to black. Although this can be observed with the naked eye, it is recommended that a magnifying glass is used.

- **Curing** is the displacement of water and the resultant increase in stiffness and tensile strength of the BSM. This is important as a mix needs to acquire sufficient stiffness and cohesion between particles before carrying traffic.

TC APE Asphalt Pavements & Environment

Curing


ASPHALT
ACADEMY


CURING METHOD
Level 1
Mix Design
All BSMs
72 hours at
40 °C, unsealed
Level 2 & 3
Mix Design
BSM-emulsion
26 hours at 30 °C unsealed
48 hours at 40 °C sealed
BSM-foam
20 hours at 30 °C unsealed
48 hours at 40 °C sealed

TC SIB – TG6 CR

Curing

University of Parma

UCPRC UNIVERSITY of CALIFORNIA Davis • Berkeley | PAVEMENT RESEARCH CENTER

Caltrans

Extrude the specimens from the mold immediately after compaction and cure in a forced draft oven at 105°F (40ºC) for 72 hours.

After curing, remove the specimens from the oven and place in a water bath for 24 hours. Water temperature should be between 68°F and 77°F (20ºC and 25ºC). Water depth should be 4.0 in. (100 mm) above the specimen surface. Specimens must not be stacked.

After soaking, remove the specimens from the water and allow them to drain for 60 minutes and equilibrate to the room temperature. Ambient temperature should be 77°F ± 4°F (25°C±2ºC).

Specimens should be covered with a damp cloth to prevent excess evaporation. Care should be taken at all times to prevent damage to the specimens.

ISAP TC APE Asphalt Pavements & Environment

Work Plan

II. Specimen preparation/curing

1) Literature review Liverpool meeting (paper for APE ISAP 2012)
2) Rap preparation
   - *Dry process*
   - *Homogenization process*
3) Emulsion/bitumen preparation
4) Virgin aggregates preparation
5) Mixing process (all the details)
6) Pre-compaction curing- temperature treatment
7) Compaction (all the details)
8) Post-compaction curing
9) Test procedure to evaluate the curing (IDT and uniaxial compression, moisture continent,..)

TC SIB – TG6 CR

Outcome

University of Parma

- Journal papers
  - *Classification of Reclaimed Asphalt Pavement (RAP) Material 2nd*
    Abstract submitted to 2nd ISAP International Symposium on Asphalt Pavements & Environment
  - *Synthesis of Specimen Preparation and Curing Processes for Cold Recycled Asphalt Mixes*
    Abstract submitted to 2nd ISAP International Symposium on Asphalt Pavements & Environment
  - *Paper on specimen preparation/curing*
    Submission to "Materials and Structures" planned for December 2013
- Report
- Workshop and Seminar in Cooperation with ISAP TC APE – WG 2

TC SIB – TG6 CR

University of Parma

CAPSA'11

TC APE Asphalt Pavements & Environment