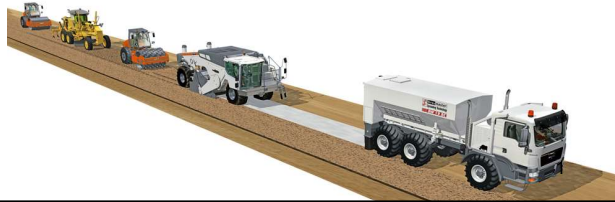


Introduction to Road Materials Engineering

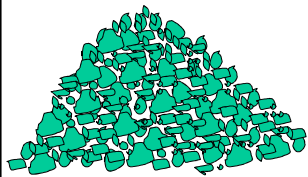
Part 2: Principles of Stabilisation

Presented by SARF

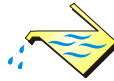
Presenter:
Ron Berkers



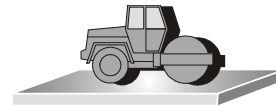
BASIC PRINCIPLES OF STABILISATION



Road building
materials



Stabilising Agent



Improves material's
properties, bonds
particles, and forms
a "beam" in the road

Most popular stabilizing agents:

cementitious



bituminous



3

SELECTING THE MOST APPROPRIATE STABILISING AGENT

- *Price*
- *Availability*
- *Materials characteristics*
- *Policy*

4

Using lime to modify or stabilise soils

Quicklime is made by heating limestone to a high temperature, forming Calcium Oxide

Toxic, burns skin and eyes

Roadlime or “slaked lime” is produced by saturating the quicklime with water, converting the Calcium Oxide to Calcium Hydrocarbonate

Reduced health problem – easier to handle

When roadlime is mixed with clayey materials the PI is reduced. There is usually a long-term gain in strength, depending on the minerals in the material

NOTE

Roadlime may not be effective in improving the strength of low-plasticity materials

5

Using lime to modify or stabilise soils

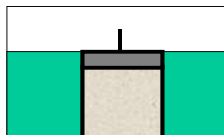
The term “modify” is used to define the process of adding lime mainly as a means of improving the material by **reducing** its **plasticity**, which will in turn improve its **strength**. Where there are strength gains **due to cementation**, the process is known as “**stabilisation**”

Besides the Indicator test, the **CBR** can be used as a means of determining the improvement to the material’s engineering properties after modification with lime. The CBR specimens should be **cured for a period of 7 days** before soaking

Cure CBR moulds for 7 days



Soak for 4 days



Penetrate



NOTE In cases where lime is used to **stabilise** materials, it is more appropriate to use UCS or ITS tests to evaluate the material’s properties

6

Testing of cementitiously stabilised materials

Strength

Unconfined compressive strength (UCS)

Specimens are compacted at OMC, cured, soaked and then crushed

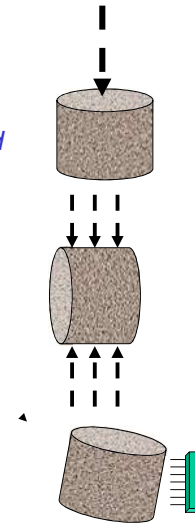
Indirect tensile strength (ITS)

Specimens are compacted at OMC, cured, and then crushed

Durability

Wet/dry durability (brush test)

Specimens are compacted at OMC and cured. They are then subjected to 12 wet and dry cycles, with brushing using a standard steel brush on each cycle



CBR

California Bearing Ratio



UCS

Unconfined Compressive Strength



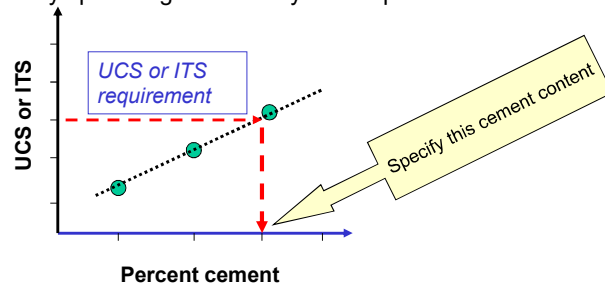
Using cement as a stabilizing agent

- different cement types available – use CEM III 32.5 for stabilisation where possible as working time should be slightly longer than other cement types
- consider blending with Ground Granulated Blast Furnace Slag (GGBS)
- reduce processing time – mixing, profiling & compaction – as far as possible
- sample and compact laboratory specimens within 3 hours from the time that the water was added during the mixing process
- use modern soil stabilizer/recycler to carry out the mixing and water addition whenever possible
- carry out the stabilization process at 1.5% below OMC to reduce shrinkage cracking

9

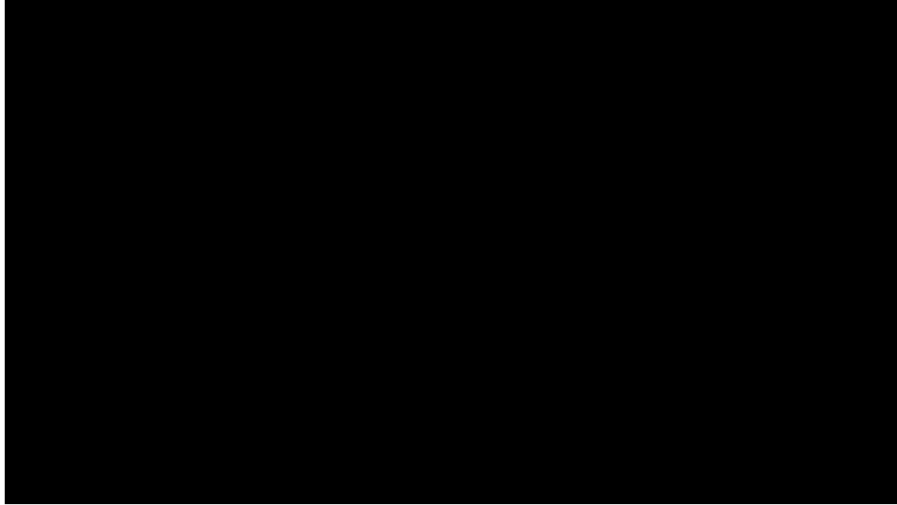
Properties of cement stabilised materials

- improves the tensile strength of granular materials by bonding the particles together
- the cement stabilised layer is relatively brittle
- the layer is prone to shrinkage cracking – the cement content should be limited to that required to obtain the necessary UCS or ITS, also take the Wet/dry durability into account
- the stabilised layer should be cured by keeping it constantly damp or by spreading the next layer on top



10

Stabilisation of soil



Click on picture

11

Stabilization



12

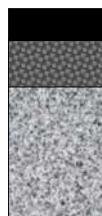


.... but bituminously stabilised materials form a **flexible** layer in the road, *like a pizza*

13

Comparison of equivalent pavement structures

STABILISED WITH CEMENT

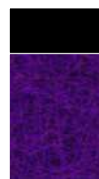


40mm AC
90mm BC
300mm cement treated material

Brittle cement treated layer requires an asphalt base

Biscuit

STABILISED WITH BITUMEN EMULSION OR FOAMED BITUMEN



50mm AC
200mm bitumen emulsion or foamed bitumen treated material

More flexible bituminously treated layer - thinner recycled layer and no asphalt base required

Pizza

Reference manuals

GEMS – the design and use of granular emulsion mixes SABITA Manual 14 October 1993 (out of circulation)

Technical Guideline: The design and use of foamed bitumen treated materials Asphalt Academy TG2 2020, 3rd edition

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Using bitumen emulsion as “modifying” or “stabilizing” agent

- “Modification” – low percentage of emulsion (residual bitumen content 2% or less.

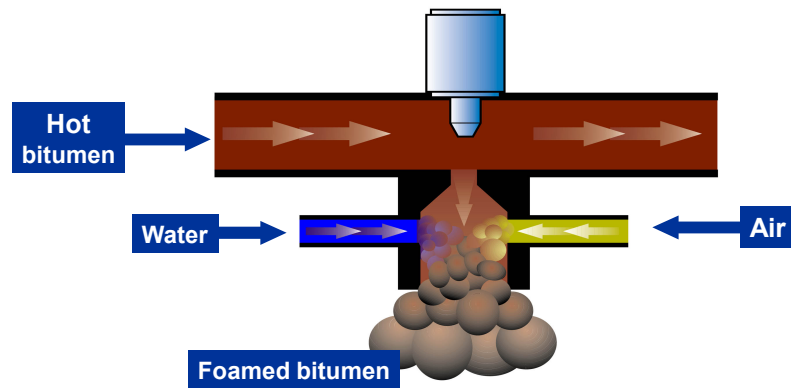
Acts as compaction aid and improves layer's resistance to ingress of water

- “Stabilisation” – higher percentages of emulsion (residual bitumen contents 2% to 5%).

Enhances the material's properties in a similar way to hot-mixed asphalt

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Principles of foamed bitumen



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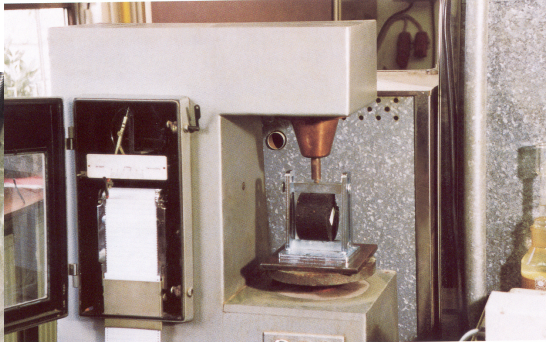
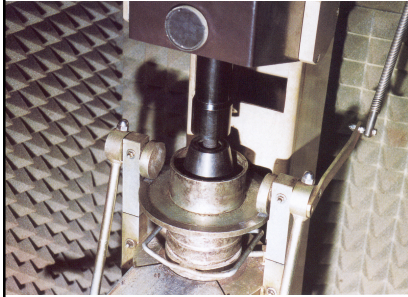
Mousse de bitume
Foam Bitumen
Espuma de betun

ARGUMAT



Click on picture

See how quickly the volume of the foamed bitumen reduced as the reduced

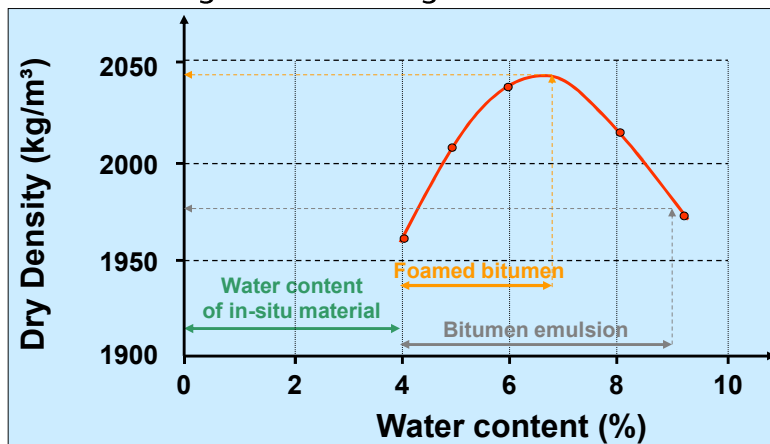


Laboratory testing -
Indirect tensile strength



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Challenges when using Bitumen Emulsion



Stabilisation with bitumen emulsion often results in the material being wetter than the OMC – the material has to be dried out to enable it to be properly compacted

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Using stabilisation in the rehabilitation of road pavements

In-place recycling

Comparing old and new processes



The old process using motor graders



The old process using motor graders



23

Modern specialized recyclers

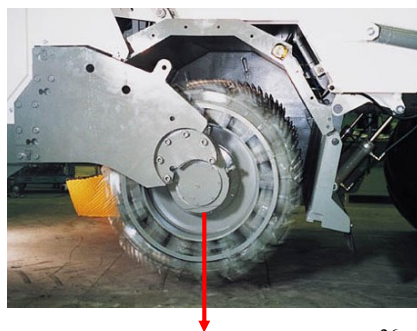


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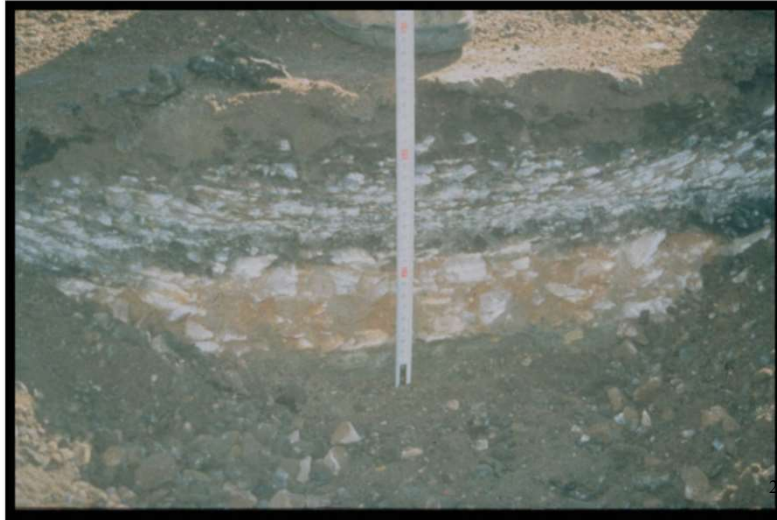
The milling drum



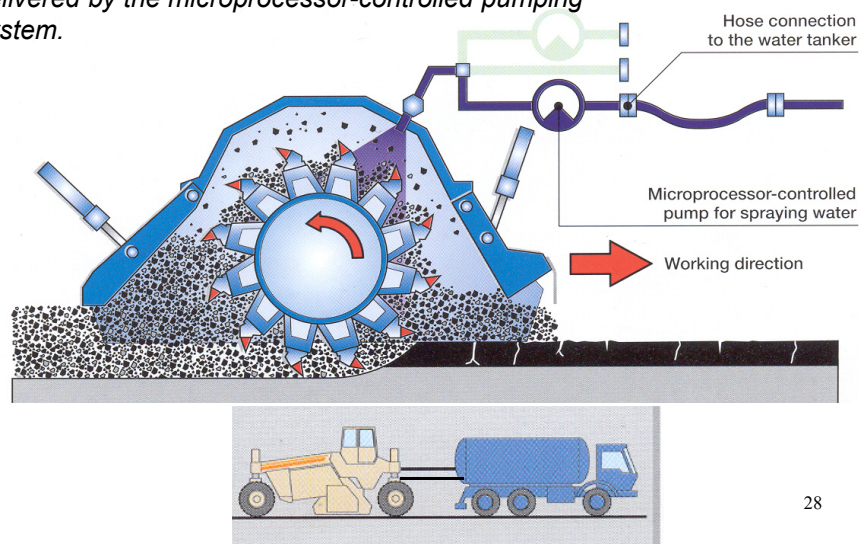
The milling drum is lowered, milling the material in the old pavement



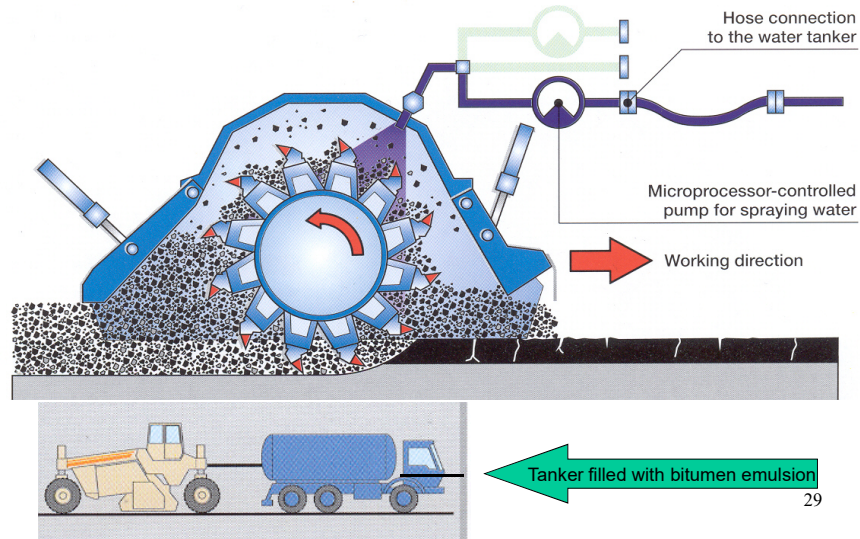
The recycler is capable of milling into tough pavements with thick layers of asphalt



The recycler pushes a tanker filled with water. The water is injected through a spray system into the mixing chamber. A precise quantity of water is delivered by the microprocessor-controlled pumping system.



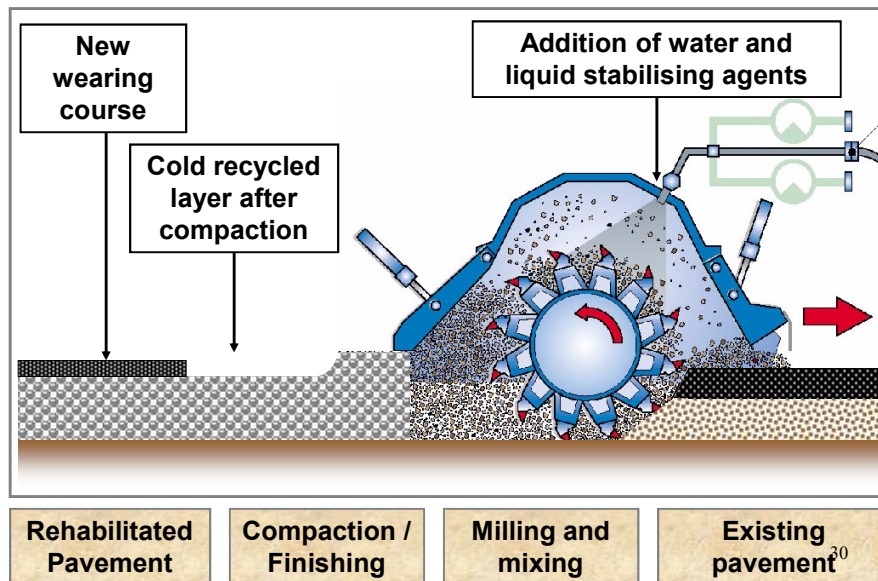
The recycler pushes a tanker filled with bitumen emulsion. The bitumen emulsion is injected through a spray system into the mixing chamber. A precise quantity of bitumen emulsion is delivered by the microprocessor-controlled pumping system. Usually water is also added during the process – this is delivered from a second tanker which is also pushed by the recycler



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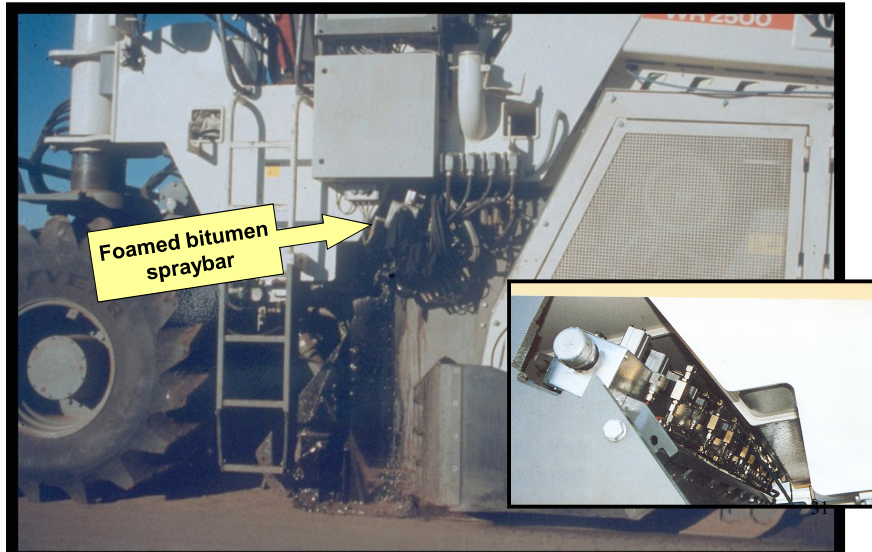
Stabilization

The recycling process using a modern recycler



Stabilization

Recycling using foamed bitumen. The foamed bitumen is injected into the recycler's mixing chamber through the spray bar.



Stabilization

Asphalt Recycling



Click on picture

32

Cold in place recycling with foamed bitumen



Click on picture

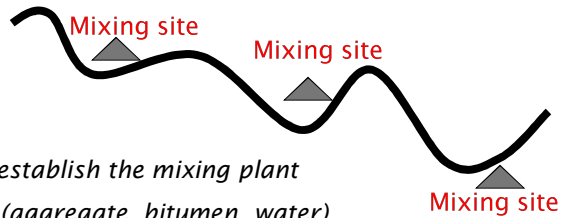
33

Cold in plant recycling



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Stabilization



*Choose the best locations to establish the mixing plant
in terms of materials supply (aggregate, bitumen, water)*

*Set up the mixing plant and carry out the mixing, place the foamed
bitumen treated material in stockpile*

The stockpiled material can be used over a period of several weeks

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Stabilization

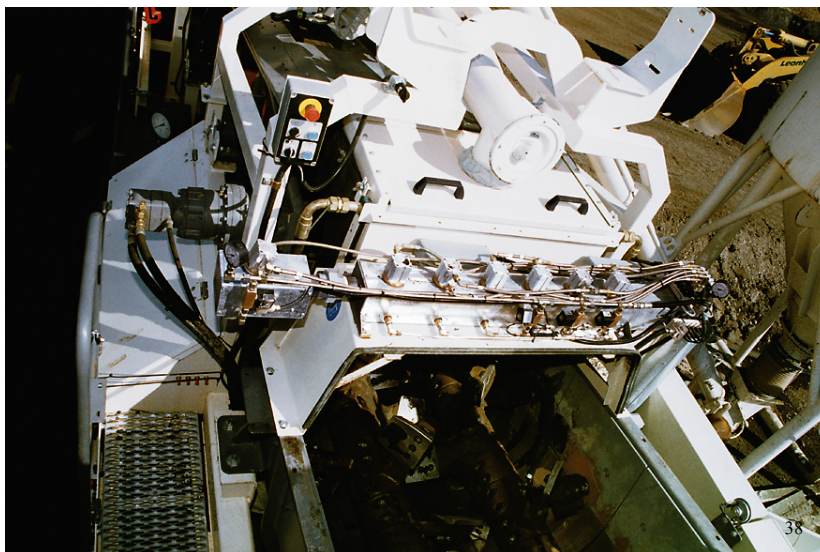


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Stabilization



Stabilization



Stabilization



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Stabilization



Click on picture

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