UK experience of in situ recycling with cement for the structural maintenance of pavements

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UK EXPERIENCE OF IN SITU RECYCLING WITH CEMENT

Introduction

Background to current guidance

Current guidance

SMART
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INTRODUCTION

COLD IN SITU RECYCLING

‘… the procedures using specialist plant to pulverise and stabilise existing road materials, in-place, at ambient temperature with the addition of hydraulic and/or bitumen binder…’

LINEAR QUARRY PROJECT

‘Every deteriorated road is a source of aggregate for its own structural maintenance by cold in situ recycling.’

TRL 386 (1999)
### UK EXPERIENCE OF IN SITU RECYCLING WITH CEMENT

#### INTRODUCTION

#### Pavement thickness design

<table>
<thead>
<tr>
<th>Original pavement</th>
<th>Recycled pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original surfacing</td>
<td>New surfacing</td>
</tr>
<tr>
<td>Original roadbase</td>
<td>Recycled structural course</td>
</tr>
<tr>
<td>Original subbase</td>
<td>Remaining subbase as foundation platform</td>
</tr>
<tr>
<td>Sub-grade</td>
<td>Sub-grade</td>
</tr>
</tbody>
</table>
UK EXPERIENCE OF IN SITU RECYCLING WITH CEMENT
BACKGROUND TO CURRENT GUIDANCE

THE LINEAR QUARRY PROJECT
RESEARCH METHODOLOGY

Examination of nine in-service roads maintained by cold in situ recycling

- 7 foamed bitumen
- 2 cement

Construction and monitoring of two full-scale road trials on A3008 Cartgate Road in Somerset
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BACKGROUND TO CURRENT GUIDANCE

CARTGATE ROAD TRIAL PHASE 1

- 2.5 lane kilometres
- 8 trial sections
  - 4 cement
  - 4 foamed bitumen
- 2 control sections

CARTGATE ROAD TRIAL PHASE 2

- 2.4 lane kilometres
- 2 trial sections
  - 1 cement
  - 1 foamed bitumen
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DATA COLLECTION FROM ROAD TRIALS

- Extraction of cores
- Falling Weight Deflectometer
- Visual inspection
- Particle size distribution
- Moisture content
- Cube refusal density
- As placed density by NDM
- Thickness of recycled layer
- Cube compressive strength
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CURRENT GUIDANCE

Design guide and specification for structural maintenance of highway pavements by cold in-situ recycling

by L J Milton and M G Earland

TRL Report 386 (1999)
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CURRENT GUIDANCE

PART ONE
• Environmental considerations
• Cold in situ recycling
• Site evaluation
• Design of recycled material
• Pavement design
• Specification
• Construction

PART TWO
• Specification
• Notes for Guidance
FLOW CHART A: SITE EVALUATION

Is site of sufficient area?
- Yes
- No
  
  Is depth sufficient?
  - Yes
  - No
    
    Can levels be raised?
    - Yes
    - No
      
      Can subgrade be included?
      - Yes
      - No
        
        Import supplementary aggregate
        
        Is material OK for pulverisation?
        - Yes
        - No
          
          Central plant recycling
          
          Is aggregate consistent?
          - Yes
          - No
            
            Recycle as alternative material
            
            Are services deep enough?
            - Yes
            - No
              
              Cold in-situ recycling
              
              Is strength/stiffness OK?
              - Yes
              - No
                
                Conventional reconstruction
FLOW CHART B: PRIMARY BINDER SELECTION

- Structural maintenance by cold in-situ recycling

  - Is the pulverised aggregate too fine and plastic?
    - Yes: Pre-treat with hydrated lime or cement to produce non-plastic aggregate
    - No:

  - Is there any doubt about the binder to use?
    - Yes:
    - Is groundwater a problem?
      - Yes:
      - Is subgrade free from seasonal ground movement?
        - Yes: Overriding preference of engineer
        - No: Foamed bitumen
      - No: Portland cement
    - No:

- Portland cement
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LIMITATIONS

- Limited to in situ recycling
  - restricts depth of recycled layer
- Generally limited to cement and foamed bitumen binders used separately
- Prescriptive in nature
SMART PROJECT

Sustainable MAintenance of roads using cold Recycling Techniques
MATERIAL ‘FAMILIES’

FAMILY 1
‘HYDRAULIC’ BINDERS

FAMILY 2
‘VISCO-ELASTIC’ BINDERS

Family 2(a)
Foamix only mixtures

Family 2(b)
Emulsion only mixtures

FAMILY 3
‘VISCO-ELASTIC / HYDRAULIC’ BINDERS

Family 3(a)
Foamix + cementitious/pozzolanic mixtures

Family 3(b)
Emulsion + cementitious/pozzolanic mixtures
TEST METHODS TO BE CARRIED FORWARD

- PRIMA
- Norwegian Torsion Meter
- Geogauge

Controls:
- German Dynamic Plate
- FWD
- Nuclear Density Gauges
NTM: SPIKED BASE
PRIMA TESTING
COMPARISON OF IN SITU TEST EQUIPMENT

Stiffness, Mpa

Torque, N.m

Locations

PRIMA 29/11
PRIMA 30/11
GDP 29/11
torsion meter 29/11
CONCLUSIONS

- The development of a performance based specification should broaden the use of cold recycling

- Recycled cold mix material can be cored during early life

- After achieving its design life, the recycled material is in place to be recycled again