Bangkok, 25th August 2009

FULL DEPTH RECLAMATION WITH STABICOL BINDER IN THAILAND A CASE STUDY

1. INTRODUCTION

1.1 Background

The cold in place recycling has become a common concept to rehabilitate and to upgrade distressed roads in Thailand for the last decade. The technique is so common that there are now, about 65 machines for this application. Treatment with cement is mainly used for economical reasons, availability all over the territory, easy use and mechanical performance. Nevertheless cracks rising appeared on many sites despite a very low gradient of temperature over the year and reasonable dosage of cement used affecting consequently the service life of the retreated pavement.

Between 19 to 24 million sq.m of cold in place rehabilitation is planned in 2009 in Thailand most of it treated with cement and a part recycled with foam bitumen and cement

With the experience of more than twenty years in composite binders TIPCO COLAS has proposed STABICOL as an alternative to the Department of Highways for the rehabilitation project of the road 347 in the PATHUN THANI Province (North Bangkok) over 36,700 sq.m (exit 346 to BANGSAI Royal Folk arts and Craft Center)

1.2 Objective

This paper intends to share our first experience of STABICOL in Thailand and to point out the specific advantages resulting in the combination of elastic and viscous binders in cold in place asphalt pavement recycling

2. STABICOL Characteristics

STABICOL is a composite mixture of two binders; Portland cement and Bitumen through a bitumen emulsion medium especially designed for this technique. Due to its components STABICOL combines the hydraulic binder structural resistance and the flexibility of bitumen.

It results from a throug dispersion of specific unit of cement particles into bitumen emulsion

Rheological behavior: This combination of elastic and viscous properties has been demonstrated by studying the rheological behavior with a visco-analyzer.

The phase angle indicates the elasticity or viscosity of the binder. The cement represents the perfect elastic solid with a phase angle close to zero which remains almost constant over the range of testing temperatures. At the opposite the viscous behavior of bitumen increases with the temperature to become almost liquid over 60-70oC. The behavior of B/C mixes is intermediate between the pure cement and pure bitumen and depends on the respective proportion of each component. It clearly exhibits a viscous component which makes it flexible enough to accept the constraint of shrinkage crack at service temperatures. If the fatigue resistance must be favored and the risk of crack rising reduced the bitumen ratio can be increased. At the opposite end, an increase of the cement ratio will improve the stiffness modulus to the detriment of the flexibility and resistance to the cracks formation

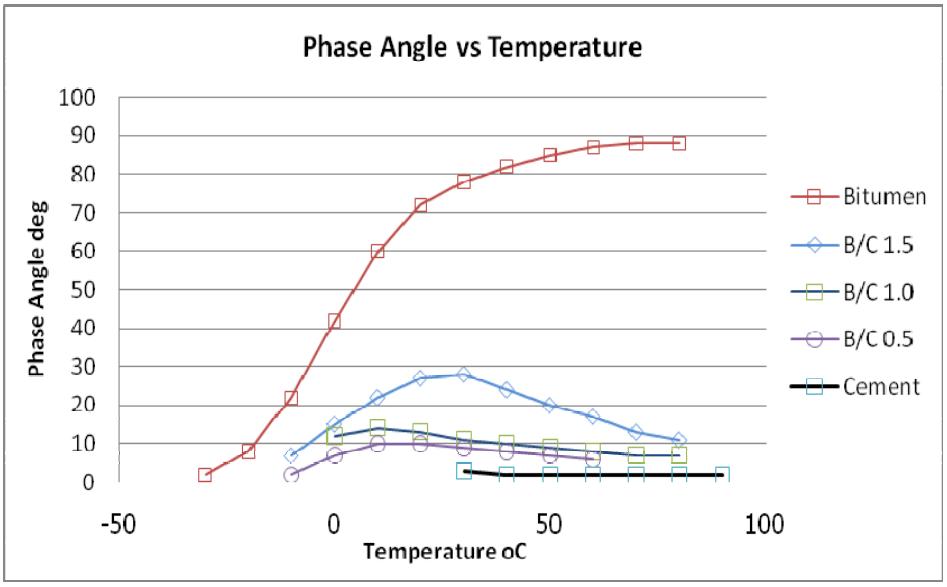


Fig 1

The master curve clearly shows that the behavior of the residual binder after setting switch gradually from the viscous to the elastic behavior. In the ratio used for the FDR the modulus remains at high level despite the interaction of the bitumen. The modulus increases slowly with the frequency of solicitation that we can assimilate to the traffic

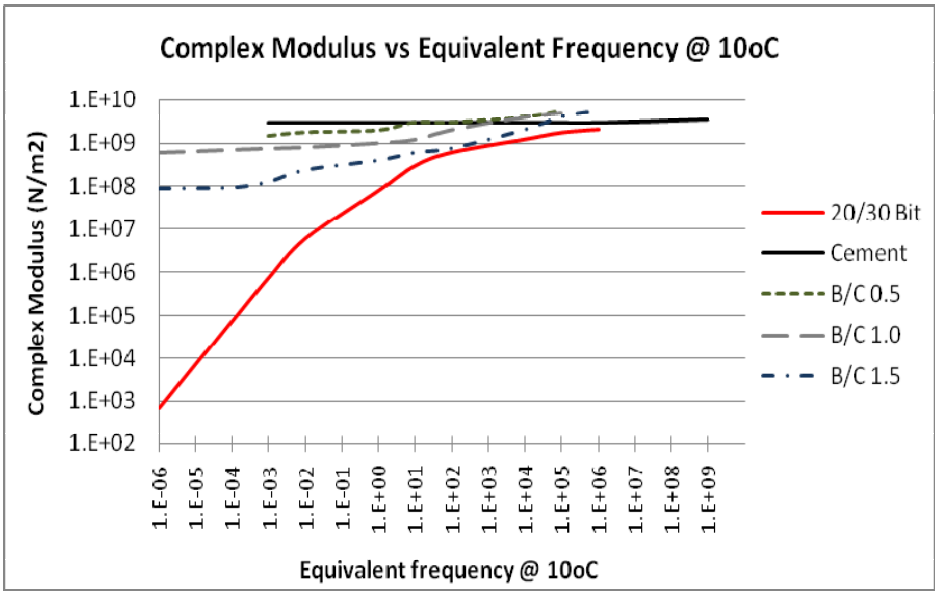


Fig 2

Resistance to cracking: The STABICOL binder retained for the job site is tested through the standard test method NF P15-434 – Ring cracking test

STABICOL must be designed to pass the test otherwise the formulation must be reconsidered using new source of cement and reconsidering the ratio of B/C if necessary

STABICOL is used cold and presents various advantages:

- The higher flexibility of STABICOL compare to cement treated material reduces the risk of reflective cracking
- Being liquid at the application it acts as a lubricant and thus improves the compactibility of the treated material and the resulting mechanical performances
- The high homogeneity of binder guarantee a better cohesion of the mineral skeleton

- As cold binder, STABICOL preserve the environment from green gashouse effect and reduces the energy cost

3 REHABILITATION of the ROAD 347

3.1 Description of the Project: The project consisted of upgrading the frontage road of the Highway 347 between the km 3.300 and km 8.500 nearby PATHUNI THANI (North BANGKOK). The project was split in several sections corresponding to the defective areas or spots

The original solution consisted in

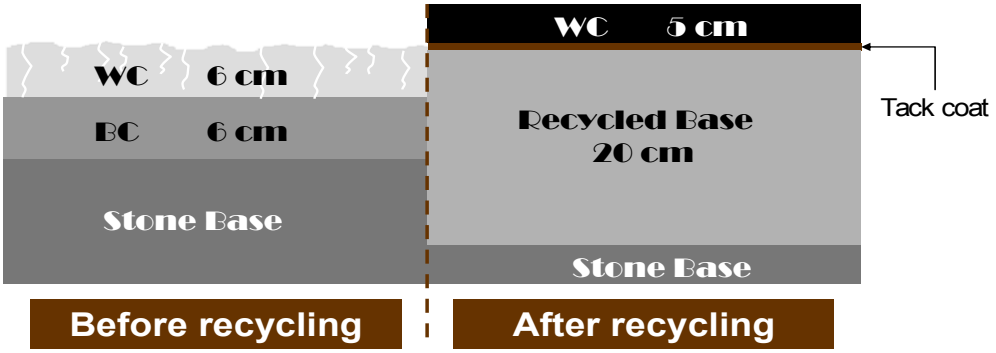
- Retreating in place with 3% Portland cement on 20cm deep
- Spraying seal coat emulsion
- Laying 5 cm asphalt pavement

The road was severely damaged with numerous spots of deep and wide cracks. The origin has to be found mainly in the under sizing of the asphalt pavement layers in regards to the increase of traffic.

The retreated base course was composed of 60% RAP and 40% unbound granular material. The milled in place materials were of good quality and did not require addition of corrective aggregates

3.2 Road Structure: STABICOL had been proposed as an alternative to the cement recycling based on the same structure:

- Cold in place Recycling with STABICOL on 20 cm deep
- Seal coat with asphalt emulsion
- Laying 5 cm of conventional asphalt pavement



Project monitoring

- Laboratory study:
  - Stabicol design: The mix was been designed in the R&D laboratory of TIPCO, checked and approved by the central laboratory of the Department of Highways on our basis
- Calibration of metering devices
- Feasibility: The manufacturing of STABICOL was done by WIRTGEN 2200 slightly modified for this purpose and the feasibility of the recycling based on this binder had been tested with success through a trial section of 3000m2 in June 2008
  - Approval by the DOH
- Job site: The technique has been applied over 36,700 sq.m
- 6 months follow up was put in place by the DOH focusing mainly on the cracks formation

1.3 Laboratory Investigations: The laboratory study aimed to determine the most appropriate asphalt/cement proportion adapted to the present case, to fix the dosage of binder and conditions of application and to measure the resulting mechanical performances

It included:

- Sieve Analysis of the milled material
- The compaction Test
- Mixing test with STABICOL to determine the best coating conditions and Bitumen/Cement proportion
- Determination of the bitumen demand
- Testing mechanical performances (Modified Marshall test, Indirect Tensile Strength and the Resilient Modulus after Curing)

Finally the STABICOL 75 was found to give the best compromise on the basis of quality, performance and cost

3 CONSTRUCTION

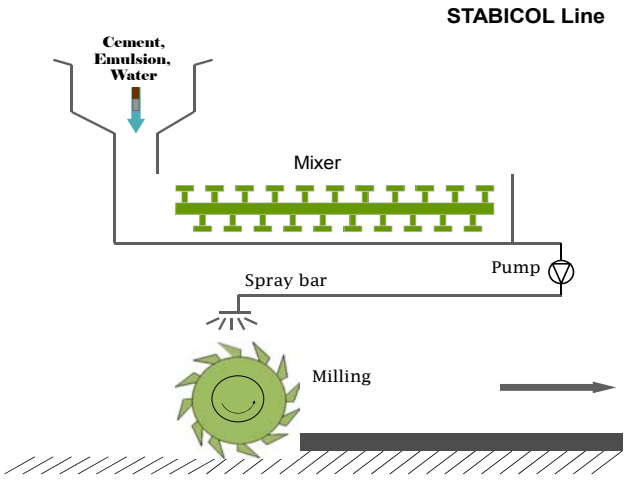
3.1 STABICOL binder manufacturing:

The construction involved the use of WIRTGEN 2200 reclaimer pushing a cement silo which is equipped with a cement slurry mixer. The cement, water and emulsion are introduced together into the slurry mixer to form an homogeneous slurry that is then injected into the mixing chamber. The weight of cement was controlled by load cells while water and emulsion were controlled by volumetric flowmeters. This ensured accurate application rates

The resulting STABICOL was a perfect homogenous blend of asphalt droplets, cement particles and water. The binder was liquid and could be injected easily into the milling chamber and it was dispersed during the milling operation by the rotor. The advantage resulted from efficient blending and the shorter time during the manufacturing and spraying which avoided the risk of settlement

STABICOL 90 was dosed at 5.0% binder by weight of milled material

Principle



In practice

3.2 Milling, Laying, Compaction, Curing

The treated material was laid by the screed set on the WIRTGEN and compacted by double steel roller compactors and rubber tire rollers. Profiling was ensured by motor grader

Once placing was completed the surface was protected from desiccation with tack coat emulsion dosed at 0.8L/m2

The traffic was re-opened immediately after compaction and the asphalt pavement was applied after the total recycling was achieved. This can be done up to one or two weeks later

3.3 Quality Control

The quality of the recycled layer not only depends on the design but also on the respect of the dosage, the homogeneity of dispersion of the binder into the retreated material and the conditions of application and compaction.

In this respect control tests were performed regularly all along the job site. They included:

- Field compaction tests
- Control of the thickness of the compacted material
- Measurement of the Indirect tensile Strength and Resilient Modulus at 30oC on fresh samples taken during the process and on cores drilled after 3 days in situ curing only at ambient ground temperature (between 35-40oC)

3.4 Performances

Tests	Conditions	Job Site Controls	Core Drills	Recommendations
ITS @ 30oC (kPa)	Soaked	573.9	558.7	> 350
	Unsoaked	692.6	702	
Resilient Modulus @ 30oC (MPa)	Soaked	11450	8193	
	Unsoaked	13450	10970.6	
Compaction (%)	Average Max Min	103 107 98.2		>97

4 CONCLUSIONS

This project was meant to prove that this technique (cement/asphalt emulsion) can be an effective alternative to the cement treatment

The use of a WIRTGEN 2200 makes this technique very easy to use by manufacturing in place and thus reducing all risk of settlement of cement in the blend. It can be extended to the 100% RAP material.

The interest from the DOH is real and the CIR based on cement/asphalt emulsion binder could be specified soon. In regards to the satisfaction of the customer for solving his problem we can be reasonably optimistic for the development of this cold technique in Thailand

This application in South East Asia confirms the past success obtained in Canada, Central Europe, Denmark, Caribbean and Australia

M.LENFANT