Chemilink In-Situ Rehabilitations for Various Pavements in Malaysia

Tan, Yih Fun, Wu, Dong Qing, Lim, Cheng Hui & E. Arasu
Chemilink Technologies Group, Singapore
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1. Introduction

• Rapid development
• Increase in traffic volume and loading
• Tropical region with rich rainfall, marine clay, peat and swampy soils, other soil improvement methods limited effectiveness
• Maintenance and upgrading work is tough
• Super-fast and Super strong technology introduced by Chemilink
• Significant improvement of CBR within short period without surface cracking like cement stabilization
1. Introduction

- Singapore Changi Airport project featured on Discovery Channel since 2008
- 1st Soil Stabilization Product approved by Federal JKR together with Malaysia Highway Authority
Federal JKR Approval Letter
2. In-Situ Rehabilitation and “Floating” Semi-Rigid Platform Effects

Advantages:

• Reuse existing unsuitable soil or damaged crusher run
• Promote Green Technology
• Early strength
• Faster construction
• Less traffic disturbance, immediate open traffic
• Semi-rigid floating platform, water impermeable
• minimize differential settlement
• Short and long term cost saving
2. In-Situ Rehabilitation and “Floating” Semi-Rigid Platform Effects

Project Examples

a) Public road over swampy area (1996, Brunei)
b) Road with higher water table (2002, Brunei)
2. In-Situ Rehabilitation and “Floating” Semi-Rigid Platform Effects

Project Examples

c) Oil Field Road over Swampy Region (2003, Indonesia)
d) New Well Road Functioning as Stock Yard (2003, Indonesia)
2. In-Situ Rehabilitation and “Floating” Semi-Rigid Platform Effects

**Project Examples**

e) Public road over paddy field (2012--, Malaysia)

f) Road with higher water table (2012--, Malaysia)
3. Design Criteria and Construction

- CBR ≥ 120% within 24-hour
- Chemical Binder Dosage: 1.50-3.00%
- Achievable Stiffness Modulus (28-day): 2,000-8,000 MPa
- UCS: 3.0-6.0 MPa
3. Design Criteria and Construction

Manual Spreading

Mechanical Spreading

Dry Mixing

Wet Mixing
3. Design Criteria and Construction

Compaction

Finished Layer of Stabilized Base.

In-Situ CBR Test

Laying of Asphalt Concrete

Immediate Opening
Construction Procedure

video
Project Case Studies

• Base strengthening of City Road
• Various Public Roads
• Heavy Duty City Road Junction
• Various Testing Result
• Senai Airport Runway and Taxiway Widening
• Penang Airport Taxiways Rehabilitation
• Strengthening of Port Klang Container Yards
Base Strengthening of City Road (Brunei, 2000)

- Rehabilitated thickness: 300mm
- Working time: 10:00pm – 6:00am
- Rehabilitation sequence: lane by lane and night by night
- A purpose: to make road more even and prevent differential settlements

a) Rehabilitation in process  
b) Immediate opening to traffic  
c) Cored samples at site
Project Case Studies

**Various Public Roads** (2012--, Malaysia)

- Road before and after ISR (300mm, Base)

![Road before ISR](image1.jpg)

![Road after ISR](image2.jpg)
Project Case Studies

**Various Public Roads** (2012--, Malaysia)
- Road before and after rehabilitation (300mm, base)
- Rehabilitation in process
Various Public Roads (2012--, Malaysia)

• Road before and after ISR (300mm, Base)
Project Case Studies

Heavy-Duty City Road Junction (2017, Malaysia)

• 300mm ISR for base course

• 50-75mm Semi-Rigid Pavement (SRP) as surface wearing course

a) ISR for base course

b) SRP as AC wearing course
Perak JKR Test Data

1-d ~ 930-d CBR (%) Values for JKR Perak Projects (SS-108 + CrushRun)
2012-2015

* Time (d) are in Log scale
Selangor Test Data

In-Situ CBR Test Data for Chemilink Rehabilitated CR Base
(Malaysia Selangor JKR & Town Council Projects, 2016-2018)

New QC criteria: CBR ≥120% within 24 hours
Skid Resistance

- Average: 82.5 (BPN) at dry condition
- Average: 73.1 (BPN) at wet condition

Airport Specs: ≥ 55BPN

- At Dry Condition
- At Wet Condition

Skid Resistance (BPN)

Road Sections
Chemical-Clay Stabilization for Runway/Taxiway Widening at Sultan Ismail International Airport, Malaysia

Senai International Airport Runway & Taxiways Widening (2007-2008)

Technical Challenges
• Higher clay/silt content (> 80%)
• Higher LL (up to 88%) & PI (up to 46%)
• Higher in-situ moisture content (up to 2 x OMC)

SENAI AIRPORT RUNWAY SHOULDER WIDENING
Soil Investigation Summary

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<th>LOCATION</th>
<th>DEPTH (mm)</th>
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<th>OMC (%)</th>
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<th>LL (%)</th>
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Chemical-Clay Stabilization for Runway/Taxiway Widening at Sultan Ismail International Airport, Malaysia

Average UCS: 2.063 MPa
Average CBR: 123.6%
Penang Airport Taxiways Rehabilitation

ACWC, 75 mm

ACBC, 75 mm

Base - 1, 300 mm
(Chemilink SS-108 Stabilized Crusher Run)

Base - 2, 300 mm (Optional)
(Chemilink SS-108 Rehabilitated In-Situ Crusher Run)

Existing Ground

A-A (mm)
Penang Airport Taxiways Rehabilitation

• Visual investigations were conducted immediately before the strengthening project started.

• The observations tally with the full investigation report and thus the strengthening designs were quickly adjusted and **ISR Solution** were engaged.

![Selected Damaged Sections of Taxiways](image-url)

a) Section 1  
b) Section 2  
c) Section 3
Penang Airport Taxiways Rehabilitation

All CBR Data Library

- Ave CBR at 95.4hrs = 247.5%
- Ave CBR at 47-52hrs = 199.8%
- Ave CBR at 18-30hrs = 172.8%
Penang Airport Taxiways Rehabilitation

After Chemilink Rehabilitation

Airport Spec: CBR ≥ 120% within 24 hours

Before Chemilink Rehabilitation

Construction Phases

CBR (%)
Project Case Studies

Port Klang’s Container Yard (2010-2013, Malaysia)

• Before and after ISR, phase by phase
Strengthening of Port Klang Container Yards
Conclusion

• Proven technology, especially over swampy and soft ground areas, in South East Asia for the past 20 over years.

• Significantly promoted the re-use and recycle of the in-situ materials

• First approved rehabilitation/stabilization solution in Malaysia under JMAL.

• The rehabilitated base/sub-base courses are satisfactory, and no defects or failures have been found during the long-term operations.
Reference

10. Wu, D.Q, Dato’ Hamid MA and Dato’ Aminnudin BY (2017). In-Situ Rehabilitation for Taxiway Strengthening in Operational Airport, the 10th International Conference on Road and Airfield Pavement Technology, August 08-10, 2017, Hong Kong, China.
Thank You for Your Attention!

Q&A