15<sup>th</sup> SINGAPORE SYMPOSIUM ON PAVEMENT TECHNOLOGY (SPT 2010)



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# Important Factors on Chemilink Grouting Material of Semi-Rigid Pavement

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## 1. Introduction

- □ Semi rigid pavement is a kind of effective and durable pavement to cater for increasingly heavy wear and tear.
- Composition of semi rigid pavement: <u>open asphalt concrete</u> + <u>high strength polymer-cement grout.</u>
- □ The properties of semi rigid pavement are determined by that of <u>asphalt concrete</u> and <u>polymer-cement grout</u>.
- □ Semi rigid pavement has advantages of both <u>asphalt</u> <u>concrete</u> and <u>polymer-cement grout</u>.
  - > High skid resistance;
  - > Easy to maintain and repair;
  - > Jointless;
  - > Quick Installation and short curing time; etc.



## 2. Chemilink Grouting Material

The requirements for grouting materials:

- **Good flowability (Workability)**
- □ High strength
- **Balance of the above two**



## 2. Chemilink Grouting Material

□ High performance polymer modified cementitious material

- ➢ High flowability → Easy application
- ➢ High early strength → Early opening to traffic
- ➢ High long-term strength → Low maintenance
- Requires only the addition of water to produce a smooth and highly workable mixture.
- □ Result of extensive research work with the introduction of nano-technology.



## 2. Chemilink Grouting Material

Properties		Test Methods	Values of Chemilink Grout
Flowability (Workability)		ASTM C939	• 13 ~ 27 Seconds
		JASS 15 M103	• 27 ~ 31 cm
Compressive Strength	12 hrs	EN 12190	• 20 ~ 30 MPa
	1 day		• 55~ 85 MPa
	7 days		• 100 ~ 120 MPa
	28 days		<ul> <li>120~ 140 MPa</li> </ul>
Flexural Strength at 28 days		EN 196	• 7 ~ 15 MPa
Setting Time		EN 196 - 3	2~3h, 3~6h, 6~8h

**Instrument:** 

**Vicat Test Set** 



## **3.** Key Factors on Chemilink Grouting Material





#### **Setting Time**





#### 2) Flowability

Two Methods to Test Flowability of Cement Grout:

ASTM C939 Method (Flow Cone Method)

Material of Flow Cone:

- (1) Discharge tube: stainless steel
- (2) Body: stainless steel, cast aluminum, non-corroding metal high density polyethylene

Volume: 1725 ± 5 mL

Measure the time of efflux of about 1725mL cement grout from the flow cone.





#### Flowability

#### Two Methods to Test Flowability of Cement Grout:

#### > JASS 15 M103 Method





#### Flowability





Flowability

□ <u>As w/p ratio ≥ 0.25</u>, the flowability of Chemilink grout is:

- $\succ$  Flow cone method  $\leq$  27 seconds
- >JASS15 M103 method ≥ 27cm
- Chemilink grout can penetrate into the porous asphalt concrete 50~100mm deep and fill the voids very well

□ JASS method is highly recommended, because:

- Easy to use
- Save time



#### 3) Compressive Strength





**Compressive Strength** 





Compressive Strength and Optimum w/p ratio

- □ <u>As w/p ratio  $\leq$  0.30, compressive strength:</u>
  - ≻ 1-day > 55 MPa;
  - ≻ 7-day ≥100 MPa;
  - ➤ 11-day ≥110 MPa (meets LTA requirement for 28 days);
  - ➢ 28-day≥120 MPa

<u>0.25~0.30</u> is the optimum w/p ratio range for this specific formula as Chemilink grouting material obtains the balance of good flowability and high strength in this w/p ratio range.

**Optimum w/p ratio can be adjusted by adjusting formula.** 



#### 4. Semi-Rigid Pavement

Properties	Test Method	Semi-Rigid Pavement (Chemilink Grout as Topping)
Compressive strength at 12 hrs	EN 12190	• 3 ~ 5 MPa
Compressive strength at 1 day		• 6 ~ 8 MPa
Compressive strength at 8 days		• 9~12.5 MPa
Compressive strength at 28 days		• 10 ~ 15 MPa
Flexural strength at 28 days	EN 12190	• ≥3 MPa
Modulus	ASTM D4123	<ul> <li>≥ 6,500 MPa (at 25°C)</li> </ul>
Skid Resistance	ASTM E303	● ≥ 50 ~ 60 BPN
Impermeability	DIN 18130	impermeable
Curing time	-	<ul> <li>4 ~ 8 hours</li> </ul>

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#### 5. Application Procedure



Porous Asphalt Concrete



Mixing of Grouting Material



Flowability Checking Using ASTM Method



Flowability Checking Using JASS Method



Filling Grout into Porous Asphalt Concrete



Scraping



#### **5.** Application Procedure



**Right After Filling** 



Hardened Surface



**Cored Samples** 



Heavy Loading Yard at Sungei Kadut Street 4 (2005)





#### Singapore Changi Airport Apron 1 (2007)





Singapore Changi Airport Apron 2 (2007)





#### **Turning Area of Heavy Loading Yard at Sungei Kadut Street 1 (2010)**





Heavy Loading Yard at Abingdon Road (2010)





## 7. Conclusions

**Chemilink Grouting Material** 

- Compressive strength:
  - 1-day: 55~85MPa
  - 11-day: 110~125MPa (meets LTA latest requirement for 28 days)
  - 28-day: 120~140MPa.
- ➢ Flowability: when <u>flow cone method ≤ 27 seconds</u>, JASS15 M103 method ≥ 27cm, Chemilink grouting material can penetrate 50~100mm deep into porous AC.
- > Different version for different requirement.
- □ Chemilink can specially design the formula to meet customer's specific requirements.

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## 8. Acknowledgement

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# Thank You for Your Attention!