



SCMs

(Supplementary Cementing Materials)

a producers perspective

Presented by:

*Phil Trunk, P.Eng.
Manager Technical Services
Dufferin Concrete – East District*



Producer's Thought's on SCMs

Although some caution must be exercised in their use:

- We like them !
 - They give us flexibility !
 - They enable us to produce some product that we could not realistically do otherwise
 - They helps us meet the needs of our customers



Producer's Limitations

- We have limited storage capacity
- Generally the producer has other ongoing projects which can be affected “non-Standard” products.



Producer's Concerns

What we don't like !

- Being forced outside of typical substitution levels:
 - Replacement levels **well** beyond our experience
 - Materials we are not familiar with
 - Different Type &/or Source
 - Not allowed to substitute one SCM with another
- Being held responsible for negative performance issues beyond our control



Producer Concerns

Curing

One of the most important and most abused aspect of Concrete Construction !



Curing

Hardening of Concrete is a Function of:

- Time
- Temperature
- Moisture

SCMs are more sensitive to these issues than standard concrete

Testing **MUST** be done as per CSA !



Mix Considerations



CSA recognized Cementing Materials

- **Portland Cement** (subject to exposure)
 - Type GU (10)
 - Type HE, high early strength (30)
 - Type MH (20) or LH (40) for low heat
 - Type MS (20) or HS (50) for sulphate resistance
- **Blended Cements**
- **SCMs**
 - Type S (GGBFS, slag)
 - Type F, CI, CH (Fly ash)
 - Type SF (Silica Fume)



Cement Availability

Not all Cements are readily available

- Type GU (formally Type 10)
 - Normal/standard cement Always available
- Type HE (formally Type 30)
 - Available from cement producer, but due silo restriction is often not available from R/M Producer
- Type GUb-SF (formally Type 10E-SF)
 - Blended Silica Fume cement ~7% – 12% silica fume content
- All other Types should be checked
 - SCMs and admixtures can give equiv. performance Type xxb (e.g. Type MSb-35S)

This includes **LOW ALKALI Cement**



Cement Availability

The use of SCMs allow for the production of concrete of

“Equivalent Performance”

OR superior performance

- Often with no negative impact on other ongoing projects.



CSA – A23.1

2004 addition

May change the way people think
about SCMs



Supplementary Cementing Materials (SCM)

They may no longer be
waste products, diluting the mix !
Rather they are:

Performance Enhancers !



CSA Exposure Classes

- **C - Chloride Exposure**

- C-XL Agriculture Higher Durability Performance
 - C-1 - **A-1** Structural
 - C-2 - **A-2** Non-structural
 - C-3 - **A-3** Submerged
 - C-4 - **A-4** No freezing & thawing
- CSA A23.1 - 04
changes
"indirectly"
require SCMs

- **F - Freeze Thaw Exposure**

- F-1 Saturated
- F-2 Unsaturated

- **S - Sulphate Exposure**

- S-1 Very Severe
- S-2 Severe
- S-3 Moderate

- **N - Non-classified**



SCM Drivers

	High	<u>Strength</u> (MPa)	<u>RCP</u> Low (Coulombs)	Permeability
C-XL		50 @ 56d	1000 @ 56days	
C-1 (A-1)	strength		1500 @ 56days	

Sulphate Resistance

- S-1
- S-2
- S-3

N

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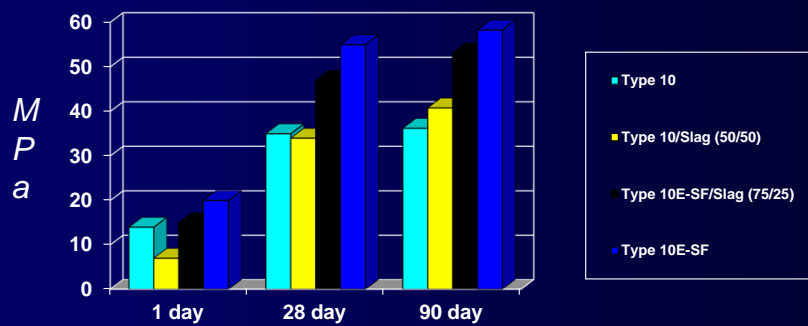


SCMs can Benefit Concrete

- Increased ultimate strength



COMPRESSIVE STRENGTH CURVE

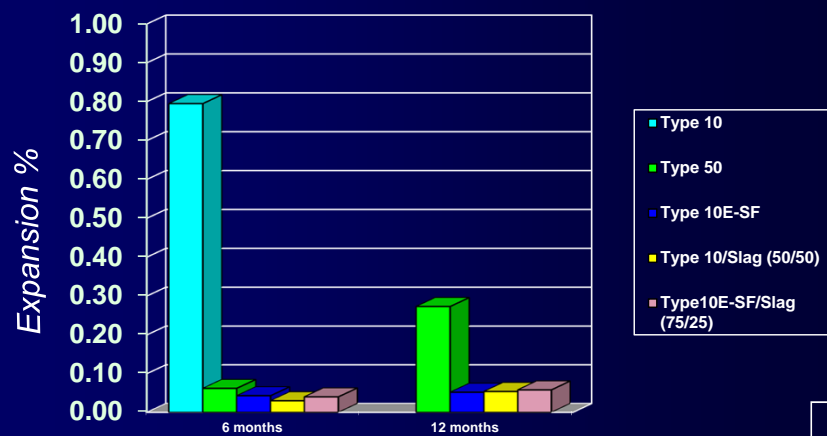


SCMs can Benefit Concrete

- Increased ultimate strength
- Superior Sulfate resistant



SULFATE RESISTANCE

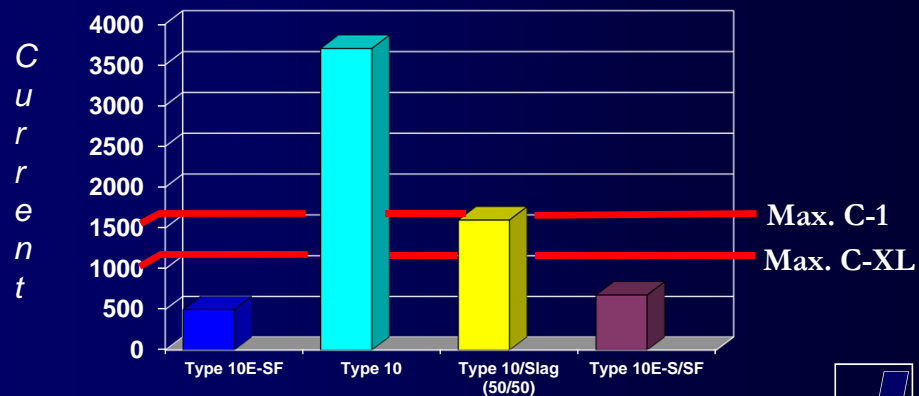


SCMs can Benefit Concrete

- Increased ultimate strength
- Superior Sulfate resistant
- Decreased Permeability

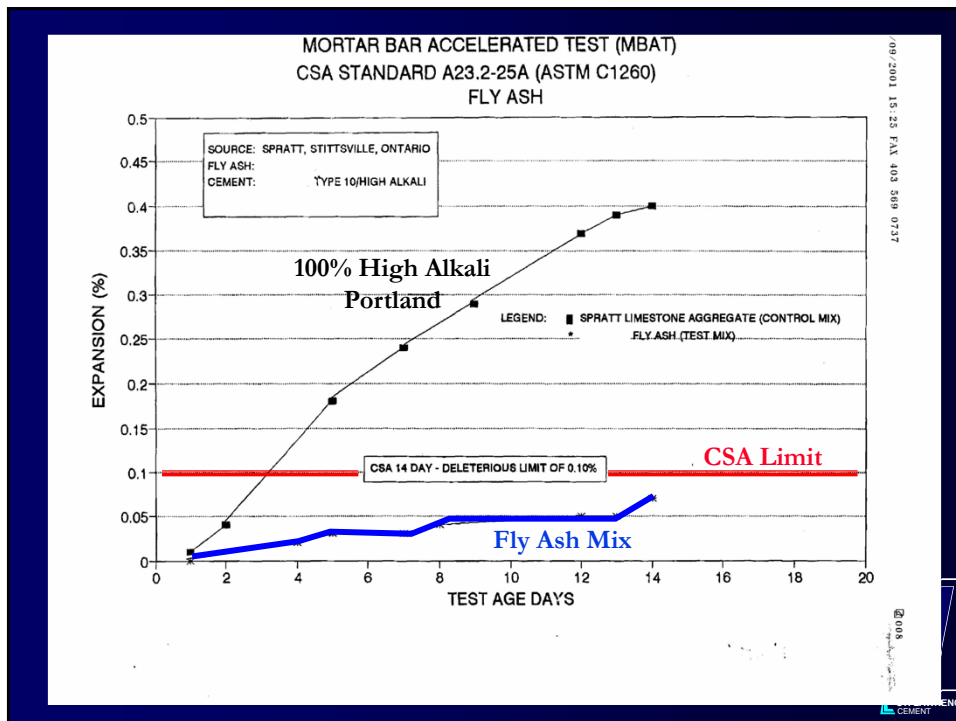


PERMEABILITY as measured by RCP test



SCMs can Benefit Concrete

- Increased ultimate strength
- Superior Sulfate resistant
- Decreased Permeability
- Mitigate Alkali Aggregate Reaction



SCMs can Benefit Concrete

- Increased ultimate strength
- Superior Sulfate resistant
- Decreased Permeability
- Mitigate Alkali Aggregate Reaction
- Increased resistance to chemical corrosives
- Increased abrasion resistance
- Improve finish ability
- Improve pump ability



Environmentally Friendly Materials

- Increased use of industrial by products.
- Reduced CO₂ emissions and lower energy consumption

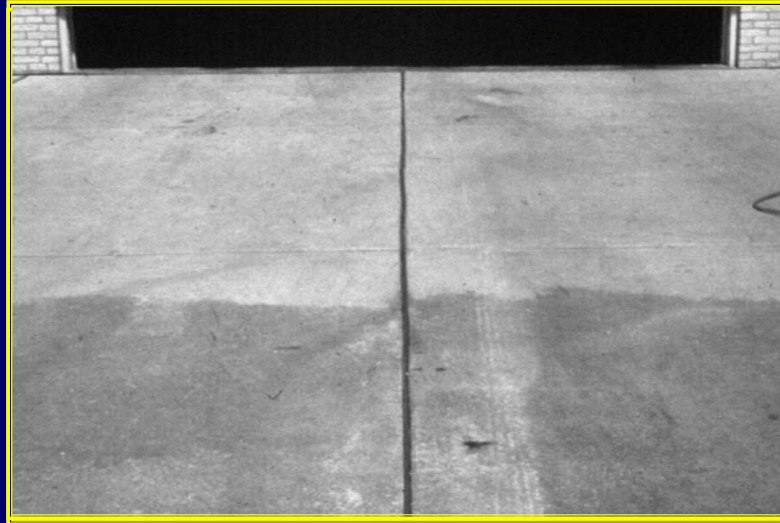


SCMs - Negative Impact

- **Delay Finishing**
 - Increased manpower costs
 - could be an advantage in hot weather, increased working time
- **Low Early Strength**
 - Delayed form turn over
 - extended construction schedule
- **SCMs “can” increase product variability**
 - Higher targets required to compensate (\$)
 - Greater risk of failure &/or customer complaints



Colour can be an issue



SCM Differences

● Slag

- Higher replacement levels
 - 1:1 substitution
- Little affect on Air Entrainment Dosage
- Can lower Heat of Hydration
 - Changes when the heat occurs
- Consistent product:
 - Performance
 - Colour



SCM Differences

● Fly Ash

- Lower Replacement Levels
 - 1:1+ substitution
- Good Water reduction
- Significantly lowers Heat of Hydration
- More variable than Slag
 - Performance
 - Air
 - Colour



SCM Differences

● Silica Fume

- Low replacement levels
- High Water Demand
 - Requires use Super P
- Significant Performance Improvements
 - Strength Enhancer
 - Permeability reduction
- Little to no bleeding
 - Plastic Shrinkage cracking & finishing concerns
- High Price / Limited Supply



Constructability Issues

e.g. “Green” Building with 30 MPa
50+% SCM specified

- Contractor has scheduling issues
 - Cannot deal with the required delay in stripping time.
- Concrete Suppliers accelerates the mix by increasing the “Total Cementitious” content.

QUESTION:

Are we ahead on the owners desire to reduce Green House Gas ?



Constructability Issues

e.g. “Green” Building with 35 MPa @50+% SCM

- **Standard 30MPa**, 360 kg/m³ total CM (30% replacement)
 - 250 kg/m³ Type GU / 110 kg/m³ Fly Ash or Slag
- **Green 30MPa**, 360 kg/m³ total CM (50% replacement)
 - 180 kg/m³ Type GU / 180 kg/m³ Fly Ash or Slag
- **Accel. 30MPa**, inc. to 430 kg/m³ total CM (50% replacement)
 - 215 kg/m³ Type GU / 215 kg/m³ Fly Ash or Slag
 - 45 kg/m³ less Portland / 105 kg/m³ more Slag >> 60 kg more CM

Are we ahead on Green House Gas ?



Producer's Wish List

- Give us as much flexibility as possible.
- Work with us in meeting your needs
- Do not forget about constructability issues



Thank you