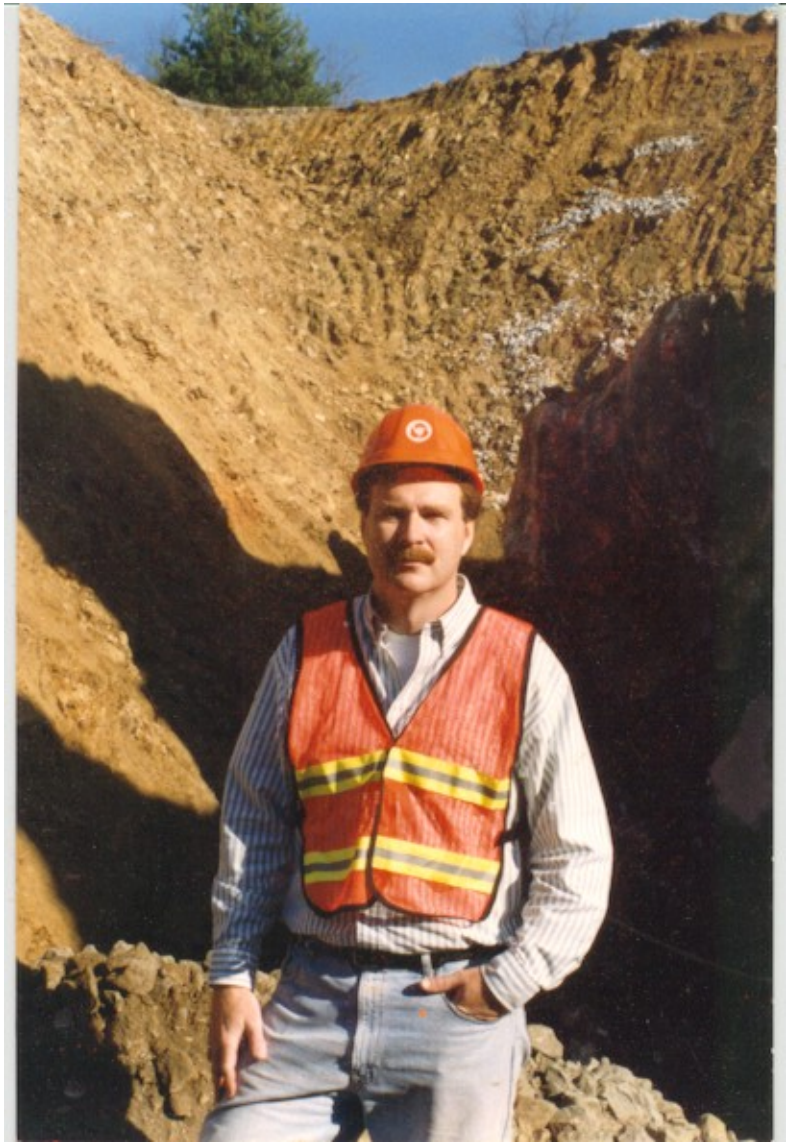
Sustainable Paving with Slag Cement

Henry B. Prenger, P.E.
Lafarge Cement

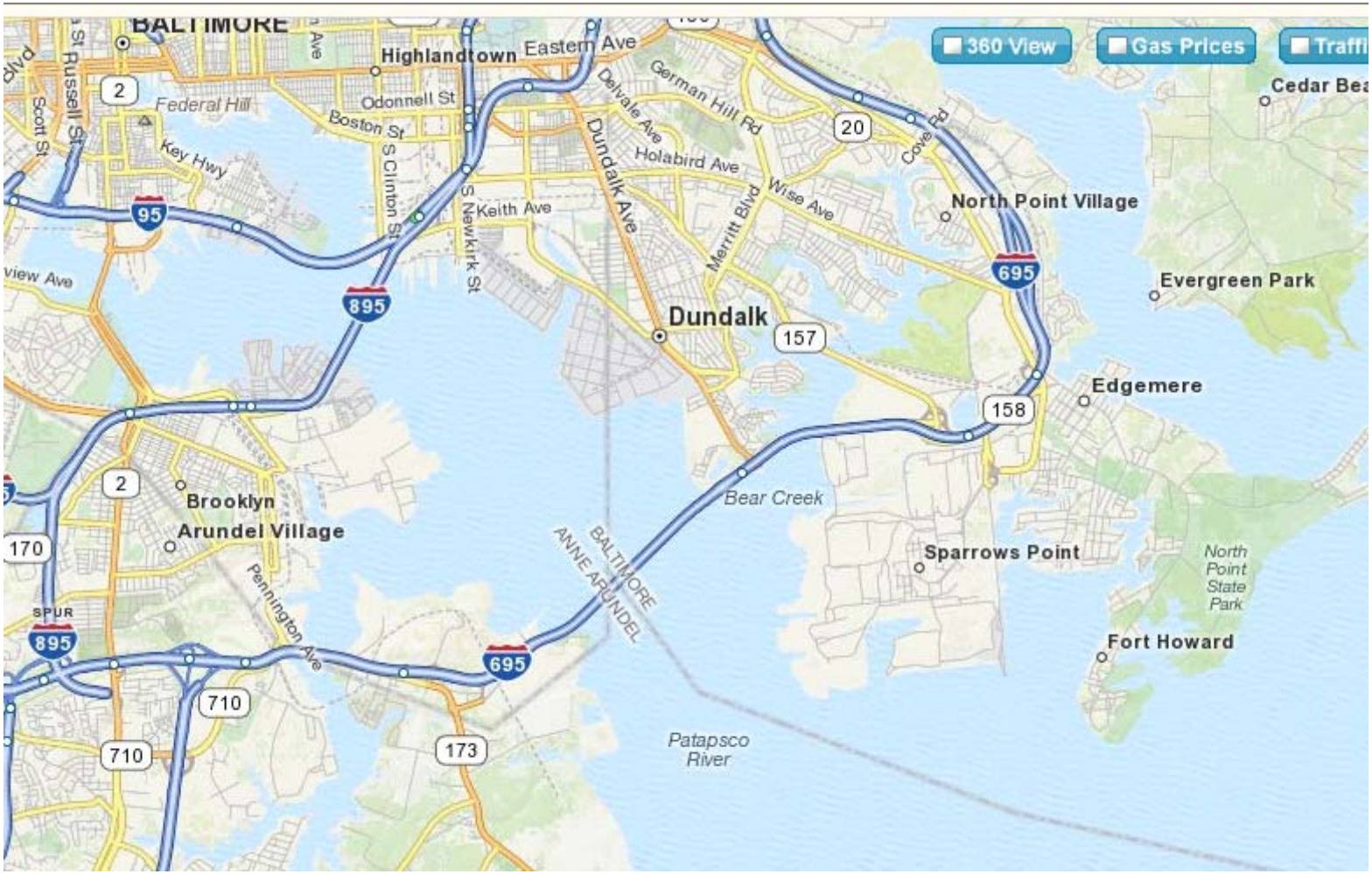
Back in the Day



CEMENT
CEMENT

Sparrows Point Plant

Bethlehem Steel Corporation
Sparrows Point Plant

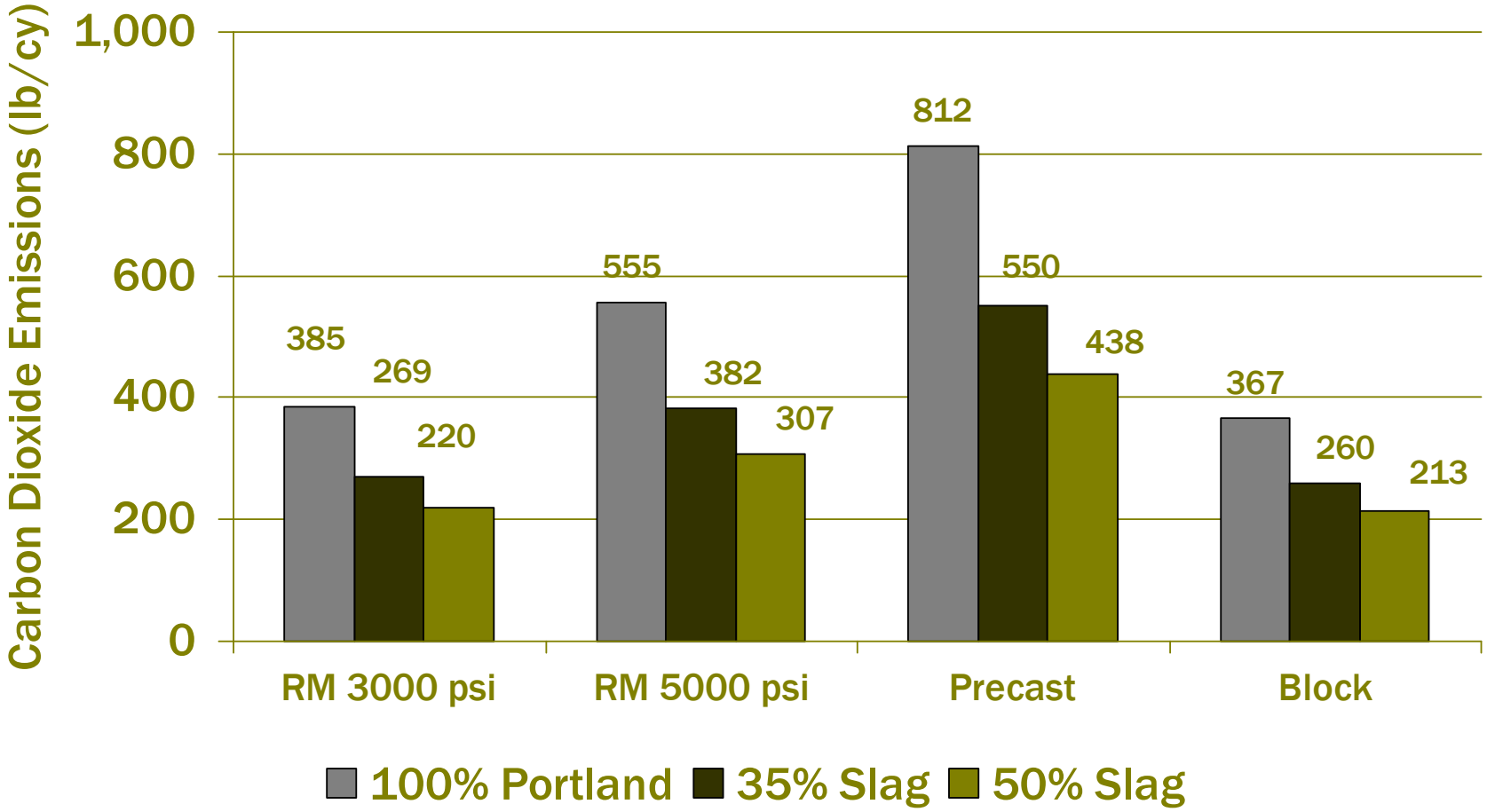

360 View
Gas Prices
Traffi
BALTIMORE
Highlandtown
Eastern Ave
Federal Hill
Odonnell St
Boston St
Key Hwy
Scott St
Russell St
S Clinton St
S Newkirk St
Keith Ave
Delvale Ave
German Hill Rd
Holabird Ave
Dundalk Ave
Merritt Blvd
Wise Ave
Cove Rd
North Point Village
Evergreen Park
Cedar Bea
Dundalk
Edgemere
Brooklyn
Arundel Village
Bear Creek
Sparrows Point
North Point State Park
Fort Howard
Pennington Ave
BALTIMORE
ANNE ARUNDEL
Patapsco River
SPUR
95
895
695
2
20
157
158
170
710
173

Bethlehem’s ‘L’ Blast Furnace

Opening a Tap-Hole on ‘L’ Furnace

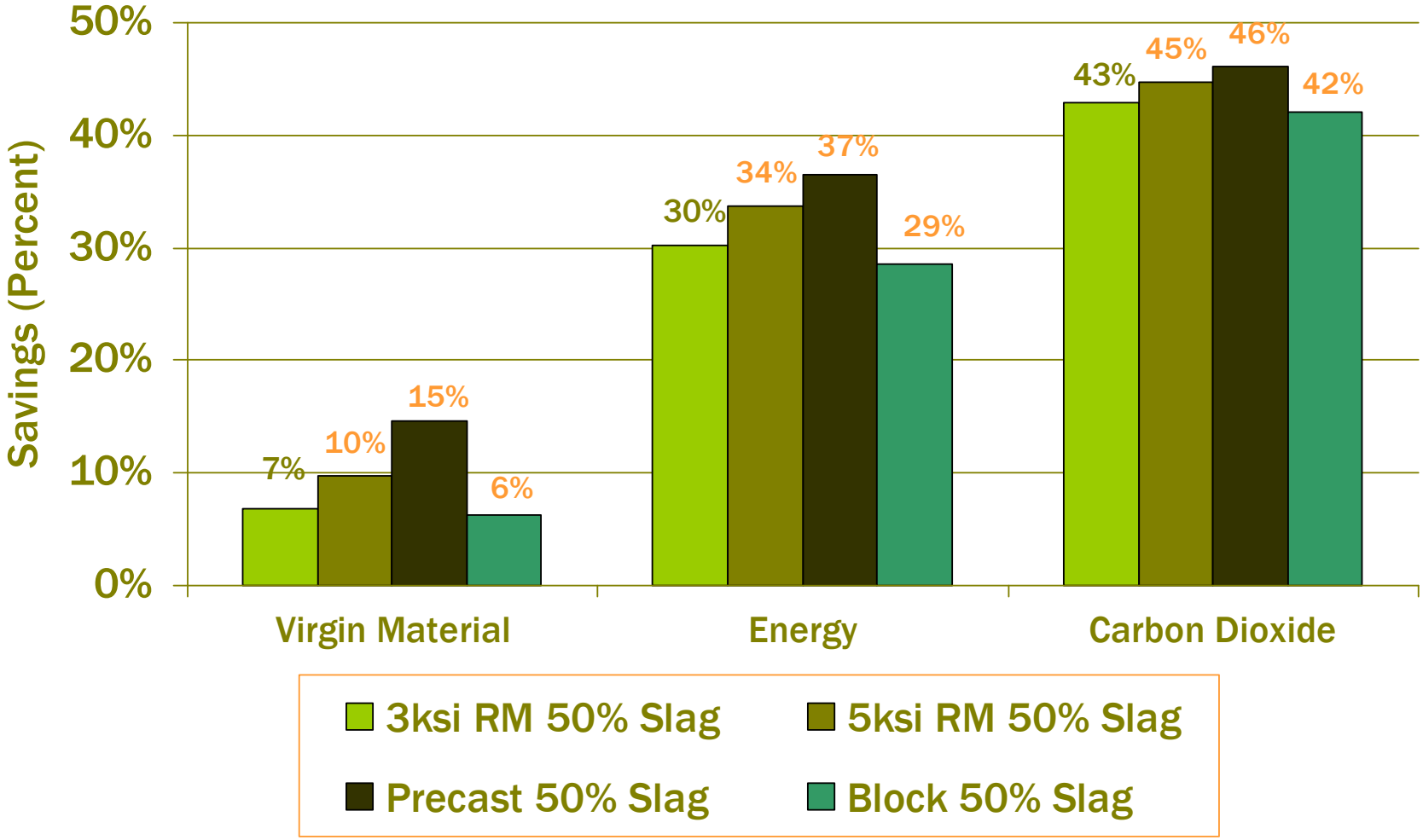
Grinding Mill

Reduced CO_2 to Produce Concrete and Concrete Products



Percentage Savings

Material, Energy and Greenhouse Gas



Blue Circle Cement Executive Team, U.K.

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FLOODING IN NEWCASTLE, AUSTRALIA

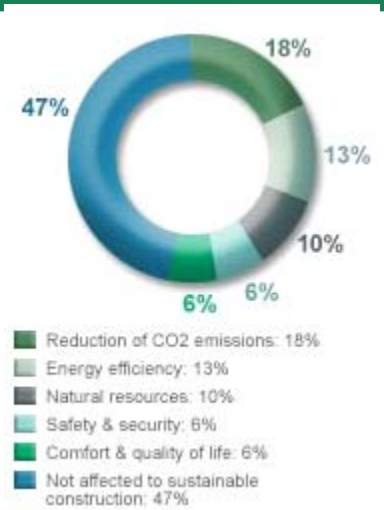
Glo Bull
Warming

LAFARGE NORTH AMERICA

WWF | LAFARGE Conservation Partner

Lafarge on Facebook

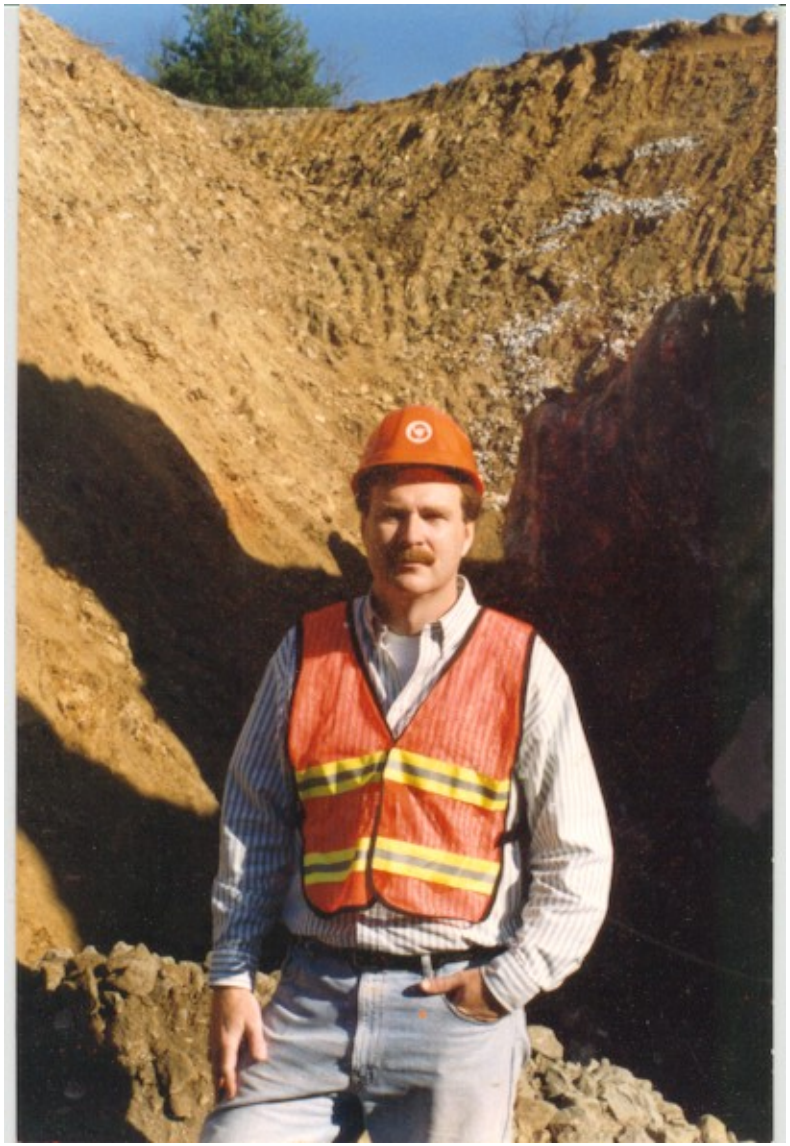
Become a fan



What's new Listen

Lafarge is looking back at the Copenhagen conference and reaffirming its commitment to the fight against climate change.

Copenhagen 2009 - time to take stock



Performance Benefits

- Improved strength
  - Increased psi per pound of cementitious material
- Improved durability
  - Reduced permeability
  - Increased resistance to ASR
  - Increased resistance to sulfate attack
- Increased life cycle

Portland Cement Reaction

Portland Cement
+
Water

→

Calcium-Silicate Hydrate
+
Calcium Hydroxide

Slag Cement Reaction

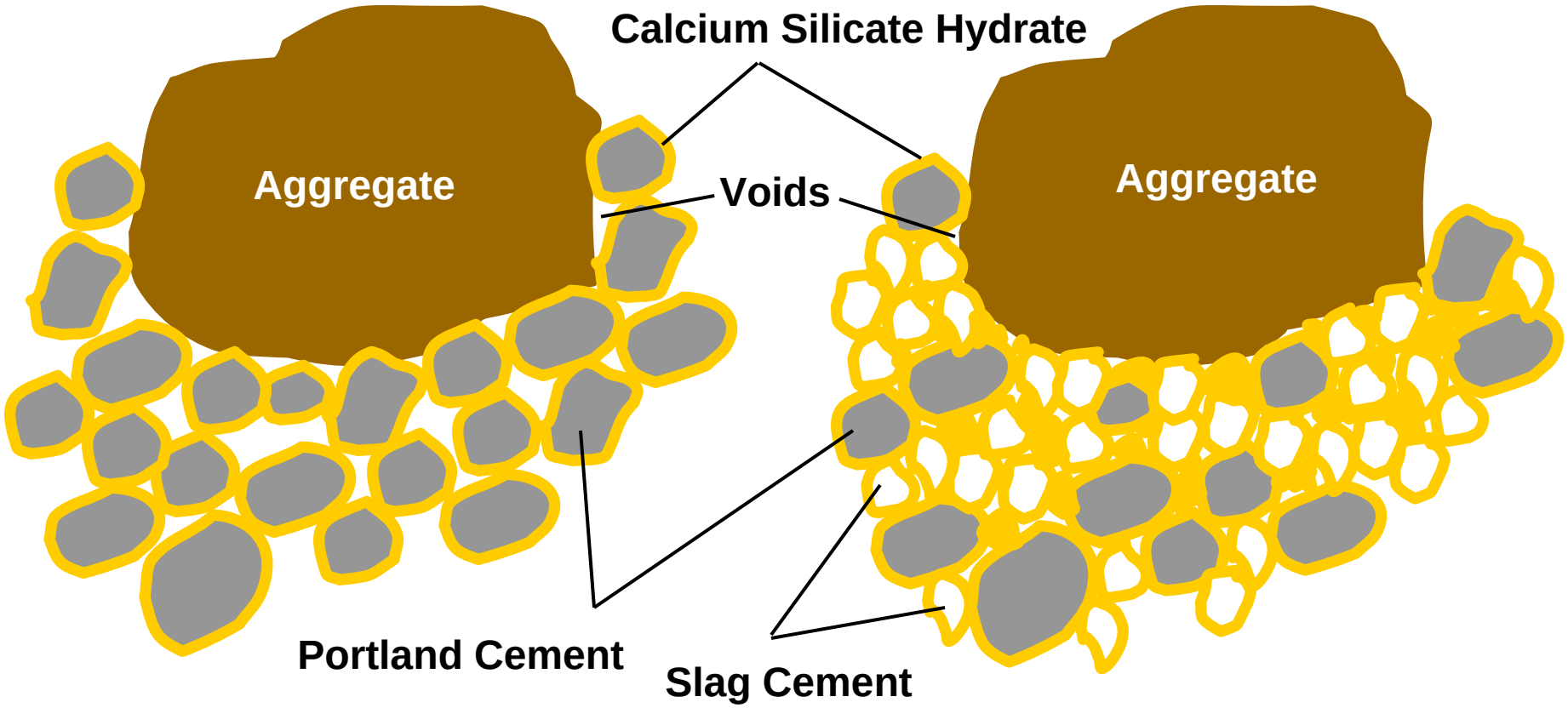
Slag Cement + Water → **Calcium-Silicate Hydrate**

Slag Cement + Water + Calcium Hydroxide → **More Calcium-Silicate Hydrate**

↑

From Portland Cement

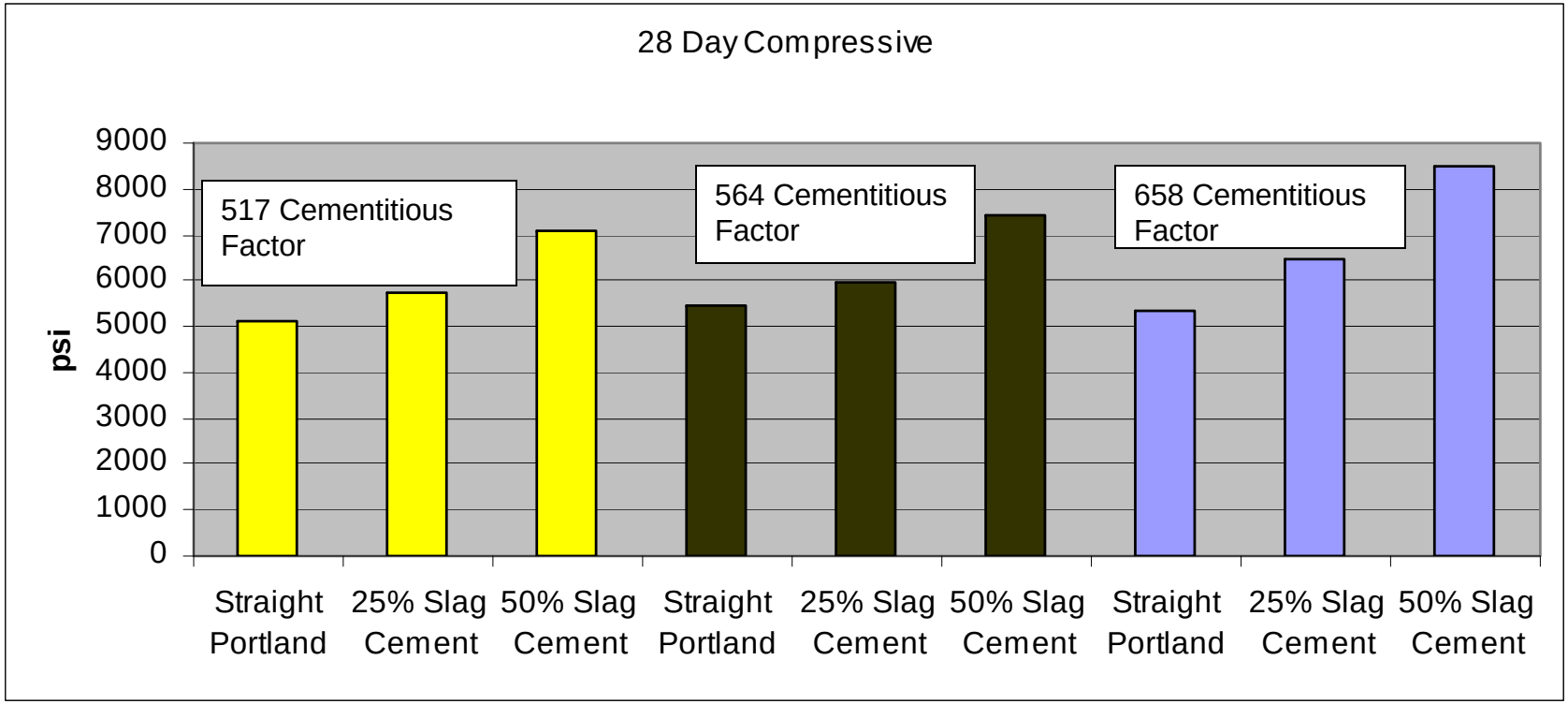
Slag Cement Reaction



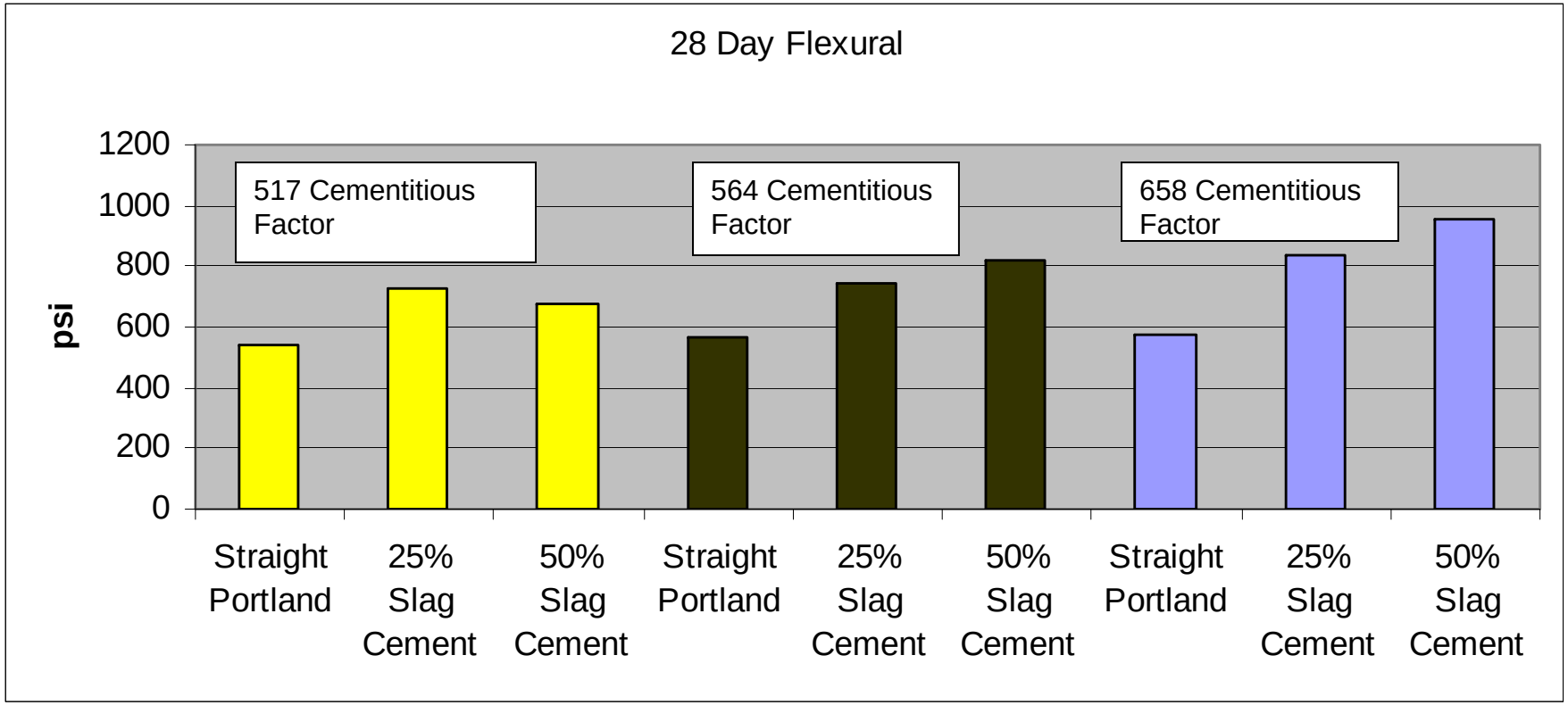
Portland Cement Concrete System

Portland-Slag Cement Concrete System

Compressive Strength

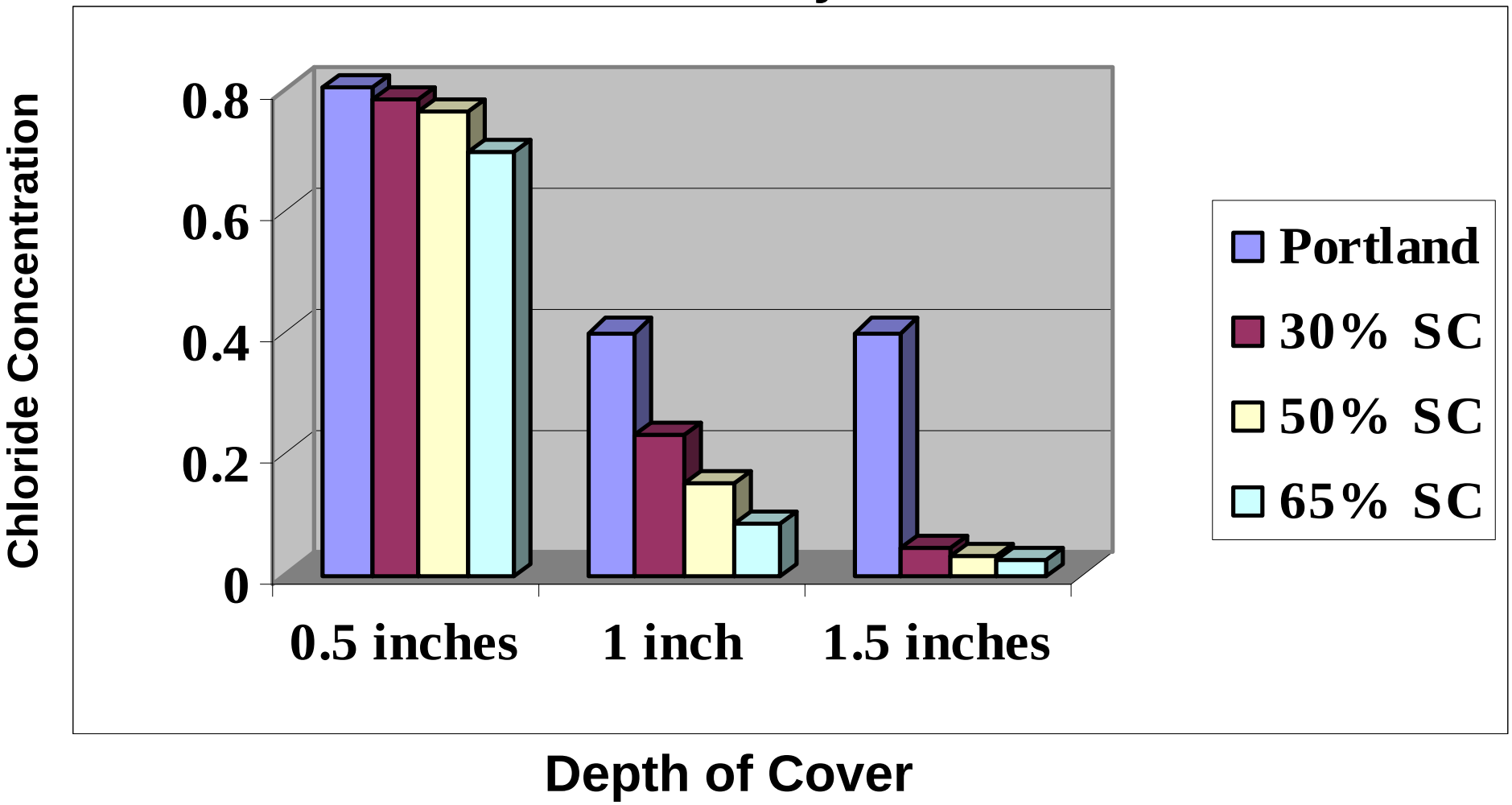


Flexural Strength



Chloride Penetration

365 Days



Time of Set Characteristics

George Bush Intercontinental Airport

George Bush Intercontinental Airport

- 83,300 cubic yards mainline a runway
- Approximate Savings
  - Material saved 10,200 metric tns
  - Energy saved 29,155 $mbtu_s$
  - Reduced carbon footprint 9,400 metric tons of CO_2
- Life Cycle 365
  - 120 years service life

Florida I-95

- 120,000 cubic yards of mainline paving
- 60% slag cement replacement
  - 11.1 m lbs. not extracted from the earth
  - 44.0 mbtu power saved
  - Carbon footprint lowered by 33m lbs. of CO_2

Andrews Air Force Base

I 97 Baltimore - Annapolis

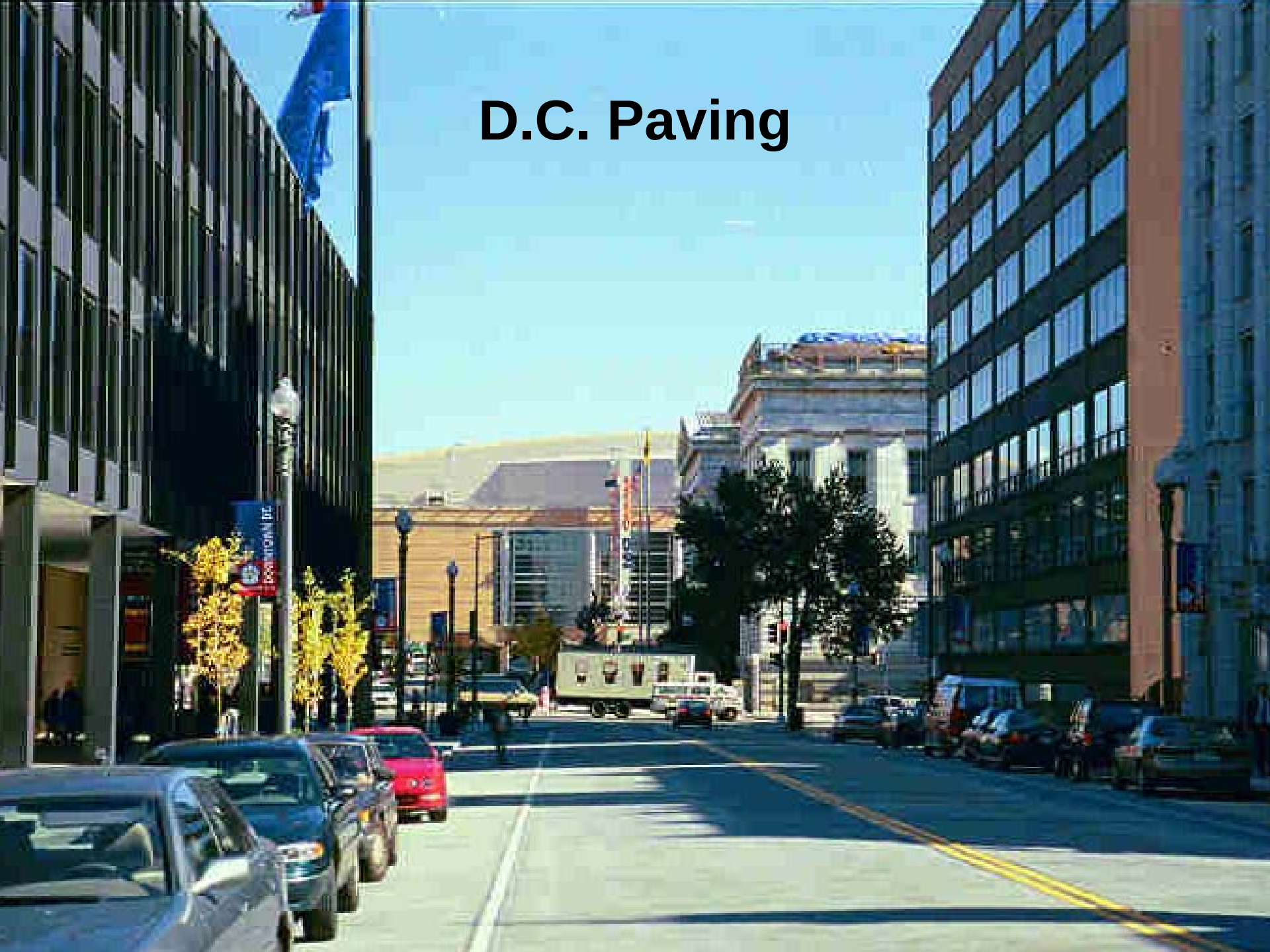
Dulles Airport

US Route 1 - Delaware

Salisbury By Pass

D.C. Metro Yard

D.C. Paving



CONCRETE PAVING PROJECTS USING SLAG CEMENT

Runways and Taxiways, Atlanta Hartsfield, Atlanta, GA
Apron and Taxiways, Baltimore-Washington International, Baltimore, MD
Aircraft Parking Apron, Myrtle Beach, SC
Apron Parking, Oceanna, Naval Base, Norfolk, VA
Apron Paving, Langley AFB, VA
Airport Taxiways, Norfolk, VA
Apron and Taxiways, Charlottesville, VA
Terminal Paving and Taxiway, Richmond, VA
Runway Paving, Salisbury, MD
Second Runway and Taxiways, Raleigh-Durham, NC
Runway and Taxiway, Seamour Johnston AFB, NC
Runway and Taxiways, Savannah, GA
Apron and Taxiways, Reagan National, Washington, DC
Apron and Taxiways, Dulles International, Chantilly, VA
Taxiways, Newark, NJ
Apron and Taxiways, Andrews AFB, MD
Apron and Taxiways, Patuxent Naval Air Station, MD
Taxiways, Hunter Field, GA
Air Cargo Apron Paving, Norfolk, VA
Apron and Taxiways, Manchester, NH
Apron Paving, Boston, MA
Apron and Taxiways, Martin State Airport, Essex, MD
Runway and Taxiways, Dover AFB, DE
I-684, Hampton, VA
State Route 128, DE
I-95, Fredericksburg, VA
State Route 1, DE
I-97, Baltimore, MD
US 113, Sussex County, DE
I-64, Hampton, VA
Route 23 @ Route 30, Lancaster, PA
I-295, Jacksonville, FL
State Route 300, GA
I-80, Columbia and Luzerne Counties, PA
I-895, Richmond, VA
I-95, SC
I-66, VA
I-495, DE

Conclusions

Slag cement makes concrete more sustainable

- Improved project life cycle
- Lower mined material use
- Lower embodied energy and emissions
- Lower urban heat island impact