

## Calendar restrictions on use of flyash mixes

Wally Rooke, P.Eng.  
Executive Director,  
Manitoba Ready Mix Concrete Association

## Concrete pavement market

- Some 80,000 to 100,000 cubic metres of concrete are placed in Winnipeg street pavements each year.



## Concrete pavement market

- Paving mixes meet CSA A23.1 C-2 Exposure:
  - 32 MPa @ 28 days
  - w/cm ratio: 0.45
  - air entrained
  - low slump
- Cementitious contents
- are typically 340 kg/m<sup>3</sup>
- Current City spec restricts flyash content to 15%



## Late season paving mixes

- Decades ago, it was common to restrict the use of flyash by the calendar for pavement mixes.
- North Dakota DOT's forbidding of flyash from paving mixes after September 15 each year was typical of specifications in the 1970 & 1980's.

## Late season paving mixes

- Winnipeg City Street spec, too, has had a similar calendar restraint on paving mixes since it added the 15% flyash option to its spec.

## 2005 Portland cement allocation

- This past autumn, by September 2005, cement supply was put on an allocation basis to concrete producers across the Prairies.

## 2005 Portland cement allocation

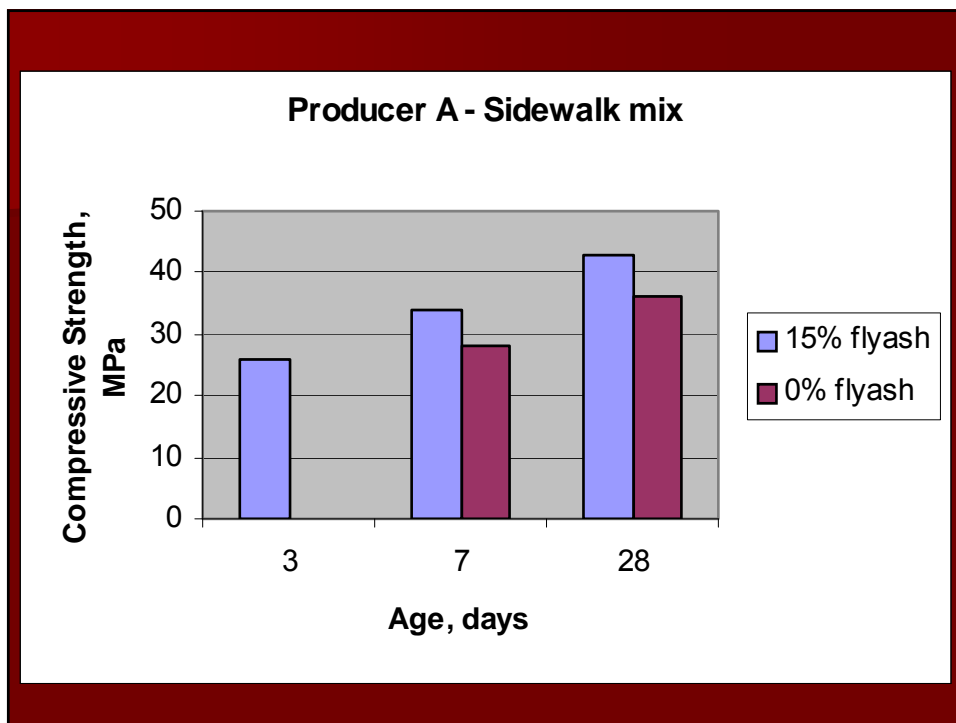
- Heavy demand for Portland cement in the autumn of 2005, combined with a late start to the paving season because of early summer rains, created a situation where many street projects in Winnipeg may not have been completed.

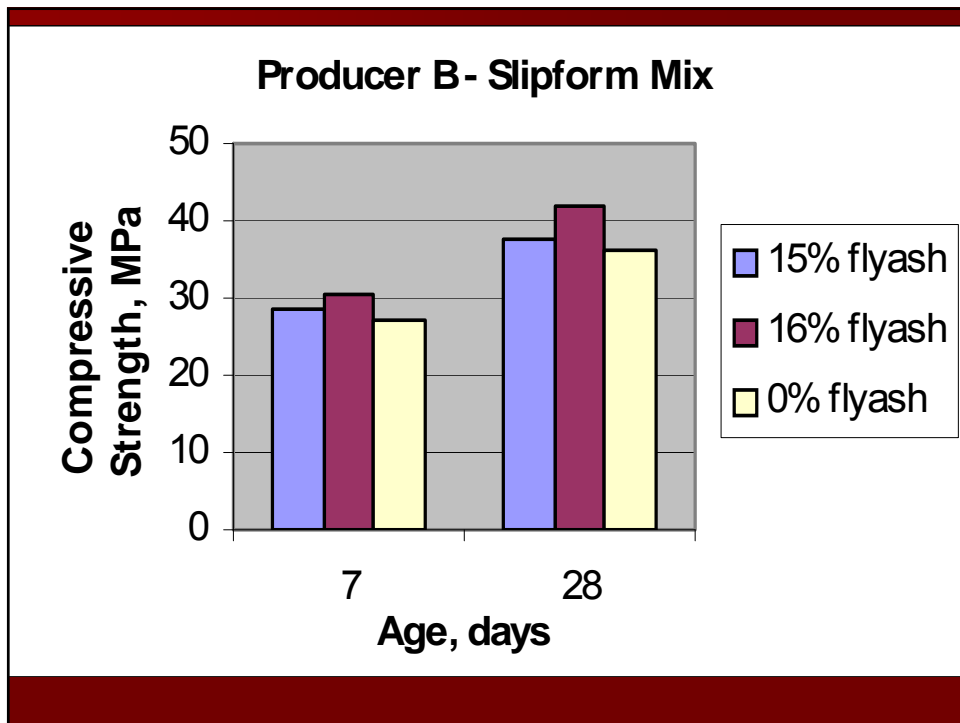
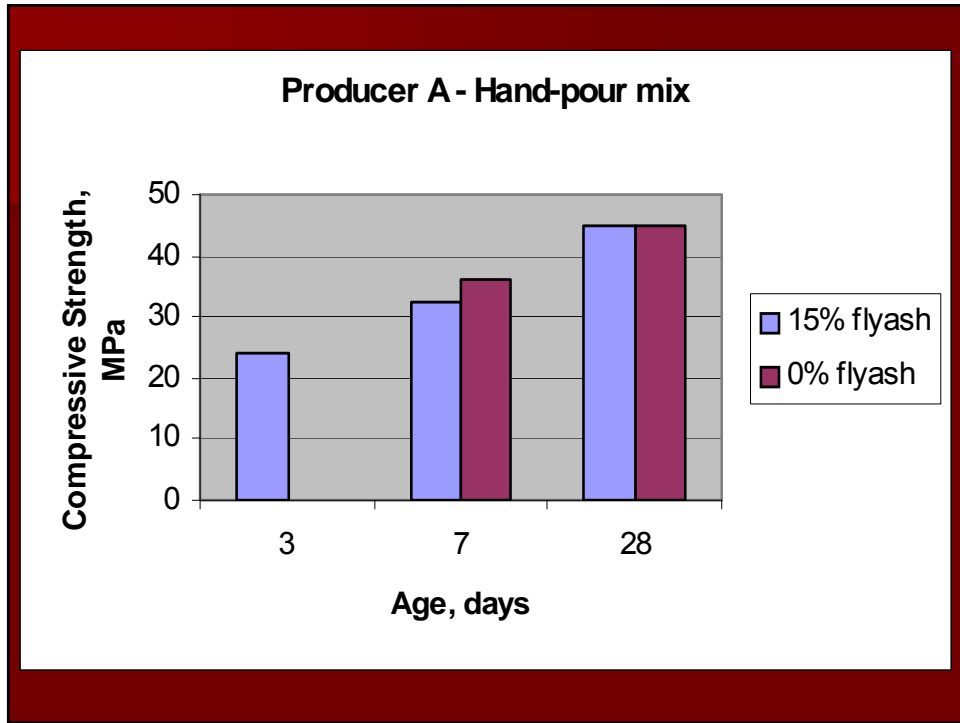
## Removal of flyash restriction considered by City

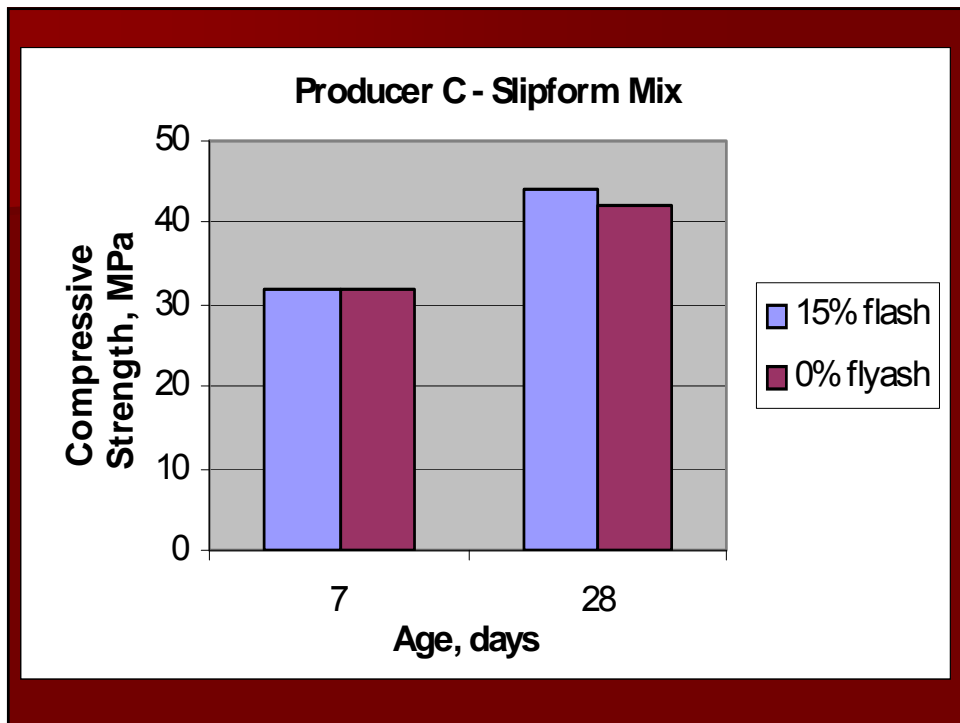
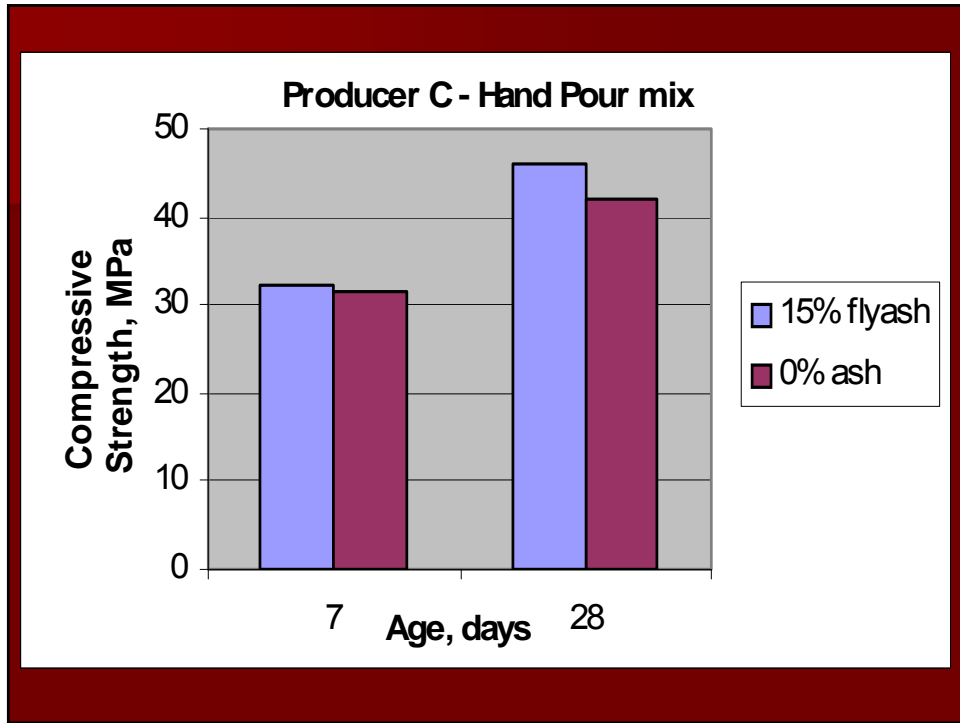
- The cement shortage prompted City and industry in October to address the situation with the view to freeing up 15% of the cement in street projects by dropping, at least temporarily, the restriction on late season use of flyash.

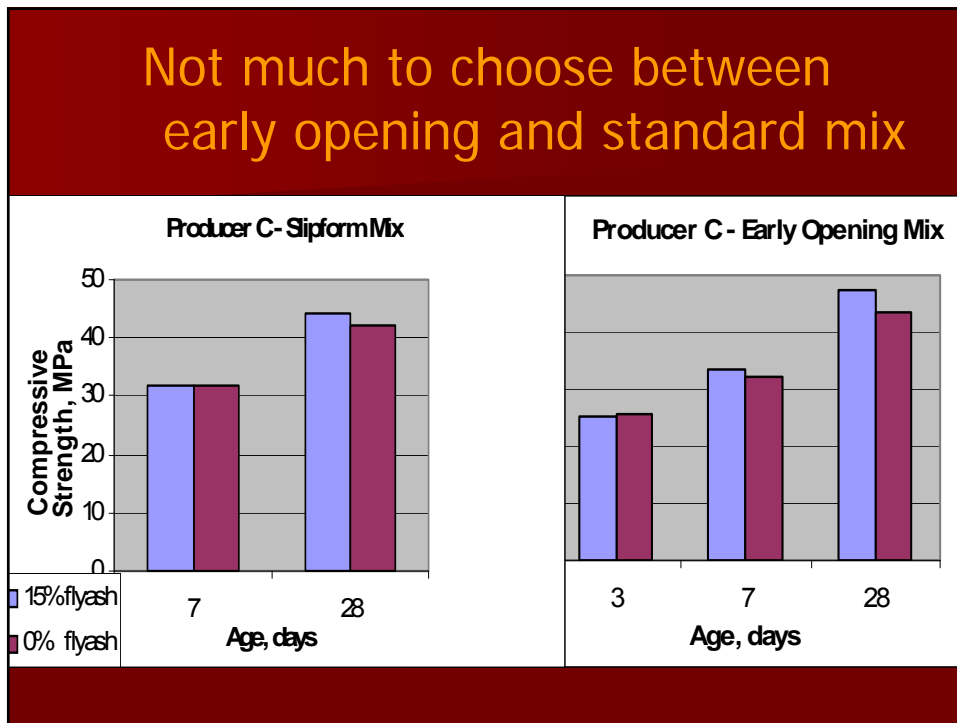
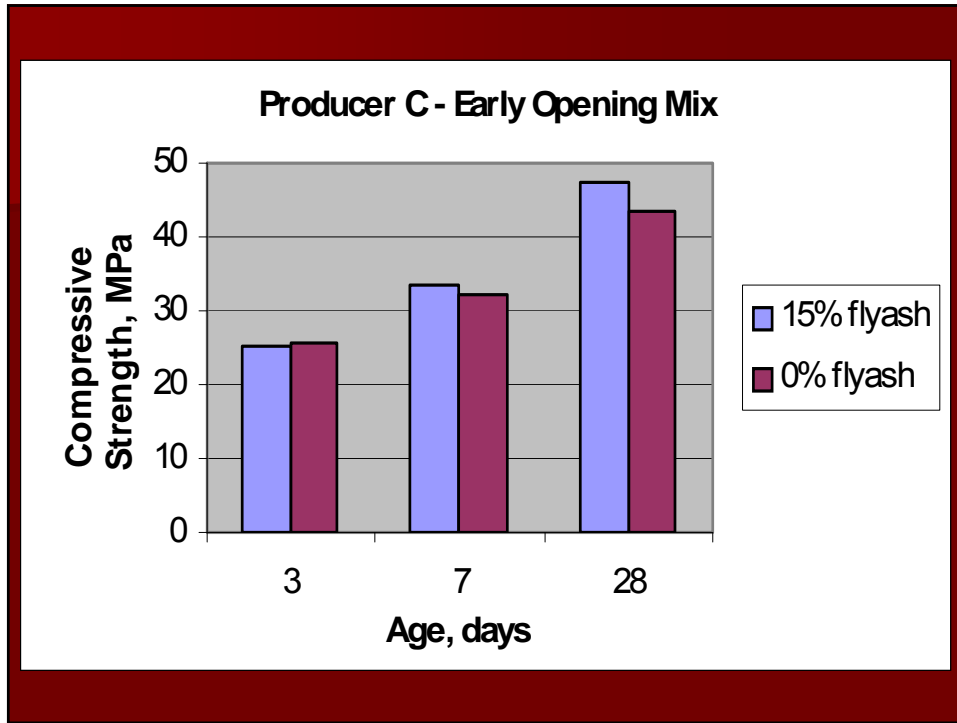
## City / industry discussion

- To assure the City that 15% flyash mixes commonly used throughout the summer months would have strength development characteristics similar to 100% Portland cement mixes, MRMCA members companies provided detailed QC statistics of strength tests for both types of mixes.





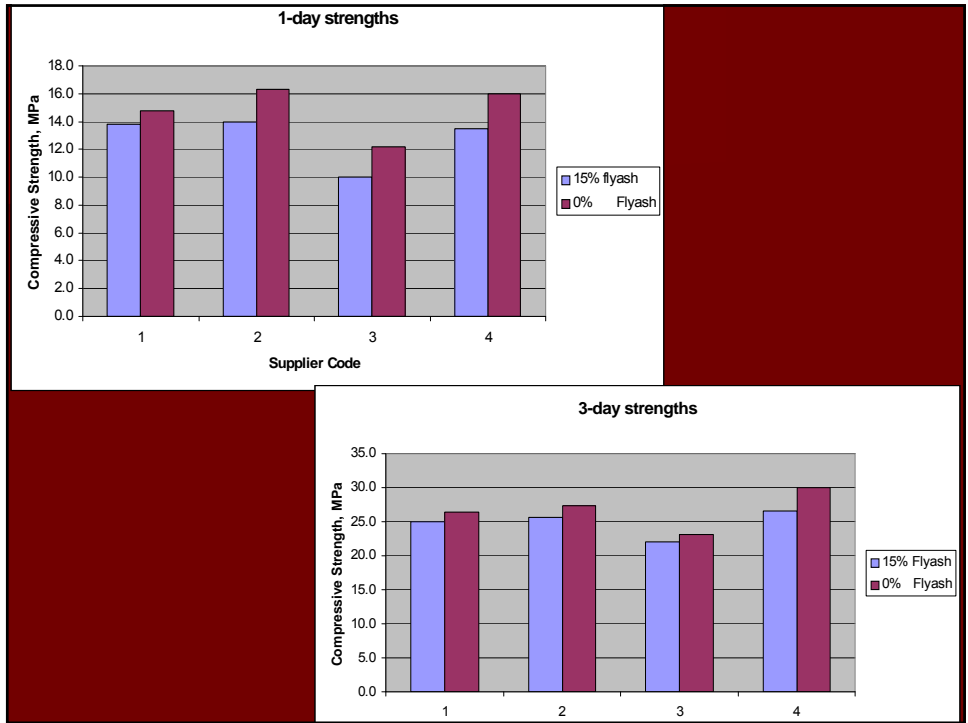




- The data from 691 Winnipeg tests demonstrated that mixes with 15% ash replacement outperform those with 100% Portland cement for all pavement mix types.
- In only one instance, with a data population of only 2 tests, was the contrary shown.

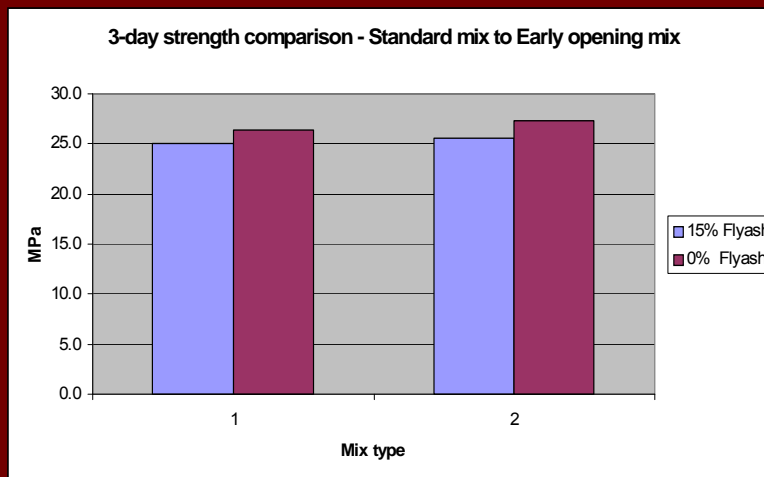
## Short term tests

- To demonstrate early strengths at 1, 2 & 3 days, additional tests were performed in early October.
- A slight delay in strength development at early ages was shown @ 1 day with a maximum difference of 2.5 MPa.



## Short term tests

- Even special Early-opening mix @ 3 days showed only marginal difference from standard mix.



- As a result of this review of data, the City issued official permission to contractors and consultants to continue to use flyash in the paving mix.
- Circumstances were reviewed weekly; this permission extended to the end of October.

### Future developments

- In view of this, MRMCA members will be approaching the City to alter its specification to eliminate all calendar restrictions on the use of flyash.
- Further tests are being considered to demonstrate that higher flyash contents up to 30% will show similar performance.

- Highways departments in both North Dakota and Minnesota specify from 15% to 30% flyash in paving mixes from pre-qualified plants.
- Both states previously had mid-September calendar restrictions on the use of flyash; these were dropped in the past 10 years.
- No reduction in pavement performance reported by either state.

## Other jurisdictions

- 2004 statistics from the US show only Nevada does not use flyash in its pavement mixes.
- Permissible range of flyash use is 15% to 30% depending on Class of flyash and use.

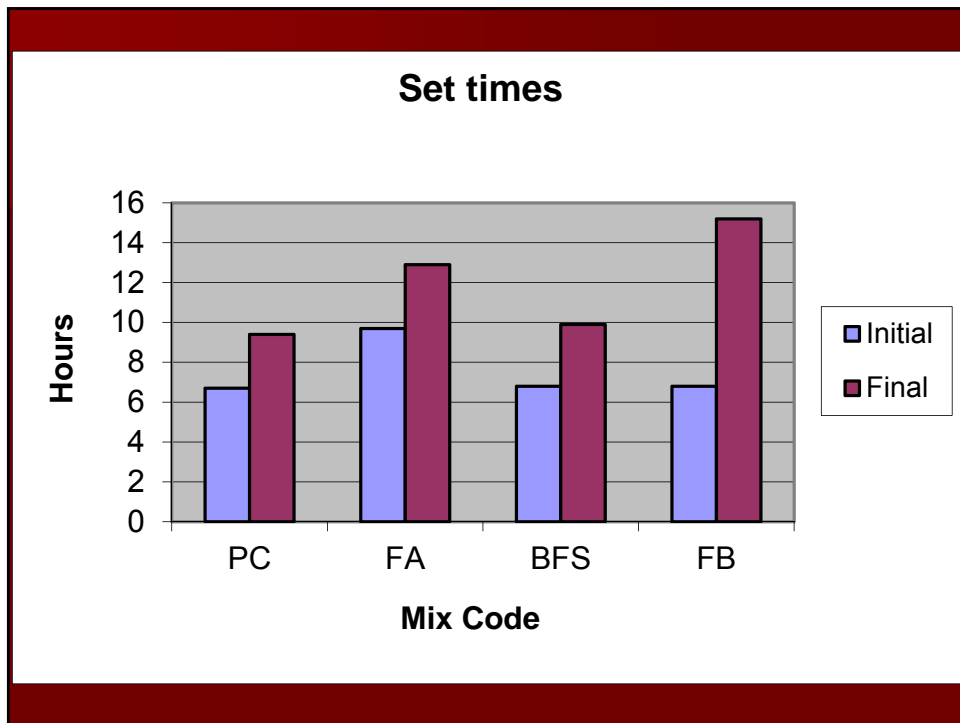
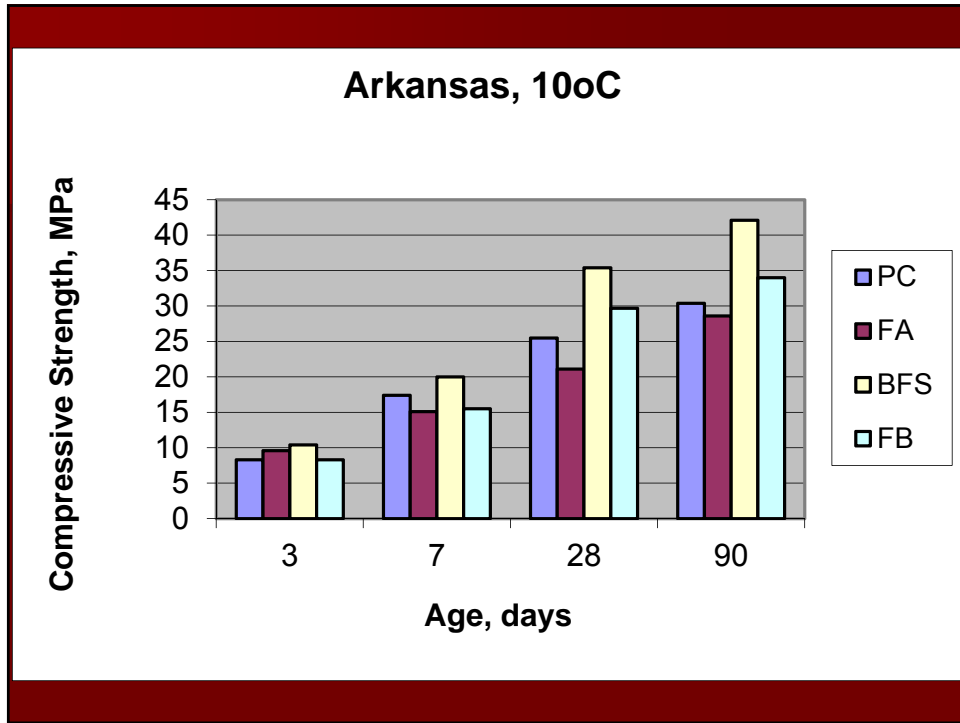
## Paving in other jurisdictions

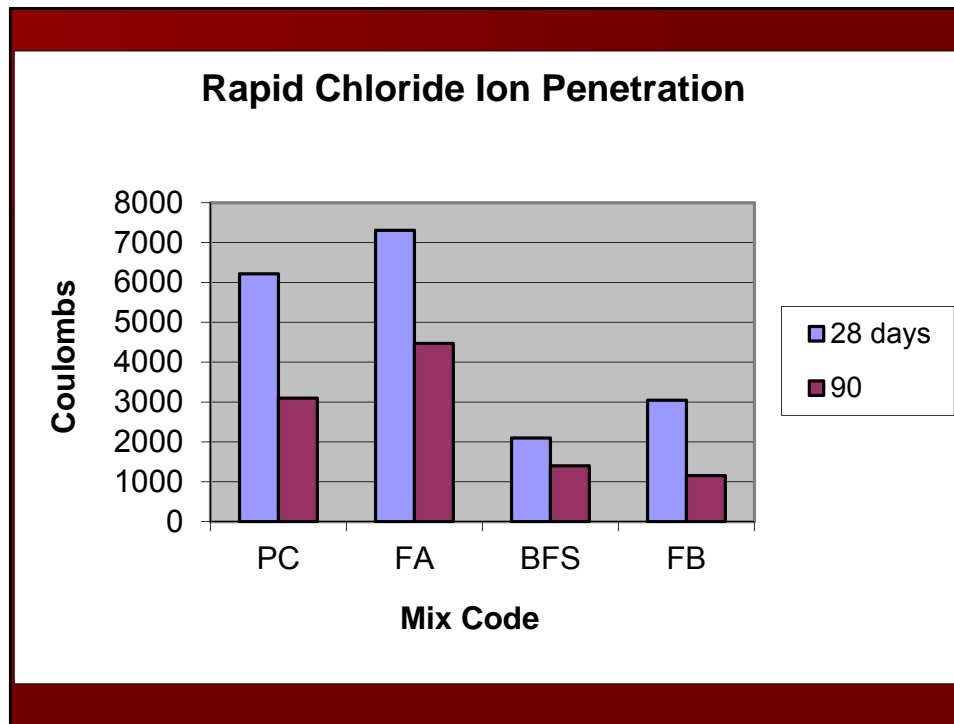
- Ternary mixes with flyash and slag reported by six states
- Blended cements specified in 41 states.
- Other applications for flyash:
  - ▶ Stabilized subbases with lime
  - ▶ Flowable or controlled density fill
  - ▶ Mineral filler in asphalt

## Recent research

- Control specimens, 392 kg/m<sup>3</sup>, with only Portland cement, were compared @ three batch & cure temperatures (10°C, 23°C & 38°C) to:
  - ▶ 20% Class C flyash replacement
  - ▶ 25% slag replacement
  - ▶ Blend of 20% flyash + 25% slag
- Set times, compressive strength @ 3, 7 & 28 days, Rapid chloride ion permeability, splitting tensile strength

TRB, Jan. 2005 Hale, Bush, Russell & Freyne, U of Arkansas





## Recent research

- *Under the conditions tested, results show that the addition of GGBFS (slag) at a relatively low replacement rate [25%] can improve the hardened properties for each curing regimen. This improvement was noticeable not only at later ages, but at early ages too. Mixtures containing both materials (25 %GGBFS plus 20% fly ash ) performed as well and in most cases better than mixtures containing only Portland cement at all curing regimens.*
- TRB, Jan. 2005 Hale, Bush, Russell & Freyne U of Arkansas

## Current research

- Studies (TRC 0604) currently underway in Arkansas with FHWA funding are testing ternary mixes with both slag and flyash.

*"The research results are promising. Mixtures containing both materials at cement replacement rates of 20 % (for each material) perform as well as mixtures containing only Portland cement (even at early ages)."*

Tests continue to determine strength development at temperatures below 70°F.

## SCMs in Performance Specs

- COW, provincial and state specs currently do not yet specify the Performance format.
- Over time, as the situation develops towards such specs, the Producers will be required to provide statistical data to assure any Owner that mix design being used – at whatever level or blends of SCMs they may choose – meets the strength and exposure criteria stipulated in CSA A23.1.

## Other applications

- If proper winter protection is provided to the works, the calendar is not a reason to limit the use of any % of any SCM in a concrete mix design.

