

2008 Annual Virginia Concrete Conference  
 Count on Concrete for Long Life and Value  
 Sheraton Park South Hotel, Richmond, VA  
 March 6 - 7, 2008



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## Current Admixture Technology

- Background
- Chemical Admixtures
  - NextGen High-Range Water Reducers (Superplasticizers, aka Super P)
  - Viscosity Modifying Admixtures
  - Rheology-Controling Admixtures
  - Air Detrainer Admixture
  - Compatibility of Admixture Systems
- Conclusions

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## Background

### ACI 116R-00 definition

- A material **other than**
  - water,
  - aggregates,
  - hydraulic cement, and
  - fiber reinforcement,
- used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during the mixing.



Admixture

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Scanning electron microscope (SEM) micrograph of fly ash particles. Although most fly ash spheres are solid, some spheres are hollow cenospheres (as shown).

Fly Ash Particles

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### V.S. Ramachandran:

- ... important group of admixtures used in small amounts...
- Water soluble or emulsified systems
- Accelerators, retarders, water reducers, superplasticizers, etc.
- Air entraining, pumping aids, coloring, alkali-aggregate expansion-reducing, and others...

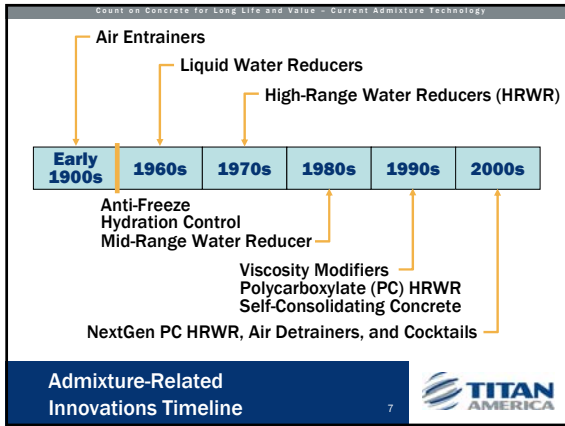


Liquid Admixtures

Chemical Admixtures

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**Standard Specifications**

- Air Entraining Admixtures
- Water-Reducing
- Retarding
- Accelerating
- Water-Reducing and Retarding
- Water-Reducing and Accelerating
- High Range Water-Reducing
- High Range Water-Reducing and Retarding

**Specifications for others?**

Designation: C 260 - 06  
Standard Specification for Air-Entraining Admixtures for Concrete<sup>1</sup>

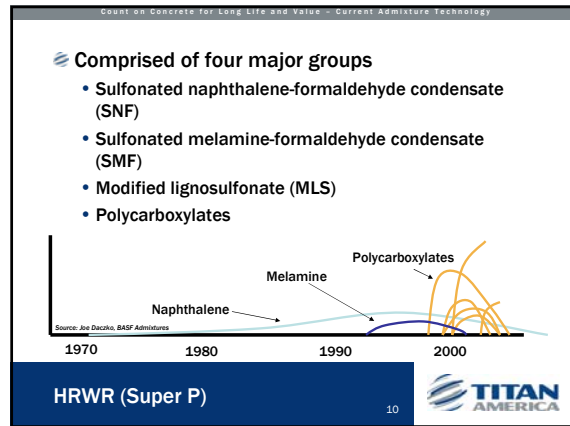
Designation: C 494C 494M - 05a  
Standard Specification for Chemical Admixtures for Concrete<sup>1</sup>

Designation: C 1017C 1017M - 07  
Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete<sup>1</sup>

**Chemical Admixtures**

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# Chemical Admixtures HRWR (Super P)



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**Design molecules for specific performance and specific cement chemistries**

Molecular attributes can be altered to affect performance (via synthetic chemistry)

- Density of side chain grafts
- Density of charge on backbone
- Molecular weight of side chain
- Molecular weight of backbone

Backbone and side chain chemistry are by design

Source: Joe Dacko, BASF Admixtures

**NextGen PC HRWR**

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**Results of PC HRWR molecular design**

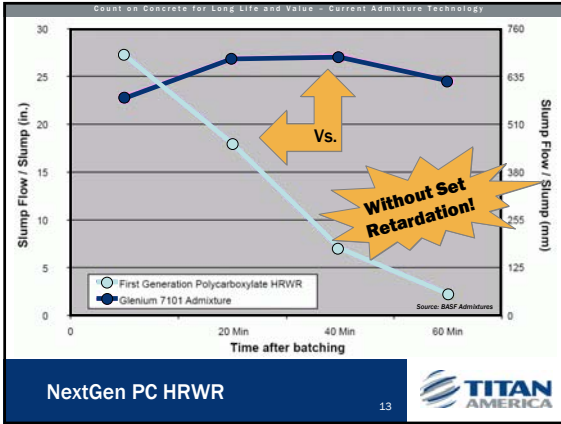
- Dispersion efficiency
  - Electrostatic repulsion
  - Steric repulsion
- Slump retention
- Control over setting time
- Early-age strength

Atomic Force Microscope (AFM) picture  
PC HRWR Molecule In Concrete

Source: Joe Dacko, BASF Admixtures

**NextGen PC HRWR**

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## Viscosity Modifying Admixtures

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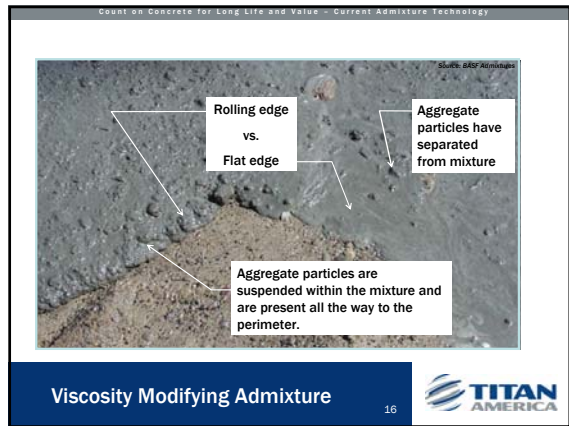
☞ A material added to concrete that changes its viscosity and improves the stability of the mixture

- Cellulose
- PEG - Glycol derivative
- Natural Gums (Welan, Diutan, Guar)

Viscosity Modifying Admixture

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Pervious No VMA

Pervious VMA

☞ VMAs

- Provide cushion to aggregate particles
- Add more "body" or "cream" to concrete
- Keep particles suspended, reduced segregation

Viscosity Modifying Admixture

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TITAN AMERICA

## Rheology-Controlling Admixture


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**Rheology** http://www.wikipedia.com

- The study of the deformation and flow of matter under the influence of an applied stress, which might be shear stress or extensional stress.

**Rheometer**

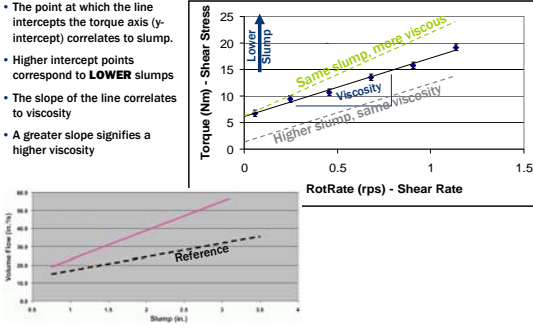
- An H-shaped impeller spins in a bucket of concrete
- Data is converted to torque
- Torque data is then collected for various impeller rotation rates




Rheology-Controlling Admixture 19 

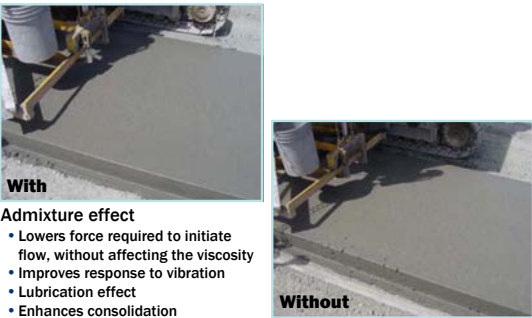
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- The point at which the line intercepts the torque axis (y-intercept) correlates to slump.
- Higher intercept points correspond to **LOWER** slumps
- The slope of the line correlates to viscosity
- A greater slope signifies a higher viscosity



Rheology-Controlling Admixture 20 

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**With**

Admixture effect

- Lowers force required to initiate flow, without affecting the viscosity
- Improves response to vibration
- Lubrication effect
- Enhances consolidation


**Without**

Rheology-Controlling Admixture 21 

Air Detrainer Admixture

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- Not recommended for use in air-entrained concrete...
- Reduces the air content of concrete mixtures
- Helps to maintain design strengths of concrete mixtures
- May reduce rejected load potential
- Other benefits?
  - Interior flatwork

Air Detrainer Admixture 23 


Compatibility of Admixture Systems

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**Combination of Water Reducer and HRWR**

- Low water content concrete, i.e. zero slump (initial water content is critical)
- Add Type A (2.0 oz/cwt) to increase to 2 in slump
- Add type F (9.0 oz/cwt) to increase to 11 in slump
- Higher strengths, lower shrinkage
- High slump retention
- Good pumpability

Source: Richard Seccy, Lattimore Materials Company, LP.


Admixture Cocktails 25 

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**Combination of Mid-Range and Retarder**

- High temperatures, low humidity
- Longer working time
- Better control over set time
- Typically 8.0 oz/cwt and 2.0 oz/cwt, respectively

Source: Richard Seccy, Lattimore Materials Company, LP.


Admixture Cocktails 26 

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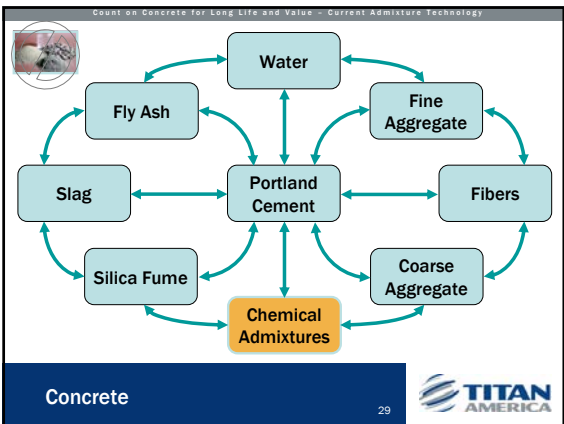
**Combination of hydration stabilization admixture (HAS) and accelerator and HRWR**

- Job Constraints/Specifications
  - 3000 psi in 6 hrs, Type I/II cement
  - 2 yd<sup>3</sup> bucket placement, 8 yd<sup>3</sup> per truck
  - 45 min haul to job
  - No staging of trucks, tight jobsite
- Admixture Sequencing
  - Type F added to truck
  - Type C added after Type F
  - Type B added after Type F and C

Source: Richard Seccy, Lattimore Materials Company, LP.

Admixture Cocktails 27 


Conclusions



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**Chemical Admixtures**

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- Compatibility of Admixture Systems

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# Thank You

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