Standard Cement Materials, Inc.

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GEOPOLYMER CEMENTS ELIMINATE RISKY TRENCHING ALTERNATIVES FOR MANHOLES & SEWERS…

QUESTION…

IF THERE WAS A WAY TO

REPAIR A SEWER MANHOLE [PIPE]

WITHOUT-DIGGING

THEREBY ELIMINATE RISKY TRENCHING REPLACEMENT

GEOPOLYMER CEMENT MORTAR…

CO HOUSTON FACES TEXAS SIZE MANHOLE & SEWER PROBLEMS -1991

TNRCC/ USEPA Mandate Orders 4th Largest City to Fix Sanitary Sewer Overflows

- No Money!
- Managers Report - Lack of Federal & State Funding
- Facing Operating Budget Shortfalls, Cancelation of Capital and Spending Cuts Take Effect
- MH Failing Faster than Resources(Man Power) Could Be Found To Fix Them!
- Failing MH Problem Prove to be an Even Greater National Problem!

GHWP–WATER OPERATIONS CHARTS A NEW COURSE…

WASTEWATER & STORMWATER COLLECTION SYSTEM

- Collection System Includes:
  - 6,250 Miles of Sewer Pipe Upgrades
  - Construction of Relief Sewers
  - +1000 LS Restorations
  - Expansion of WTP
  - Target - +100,000 Sewer Manholes
- Rehabilitation Method Requirements Include:
  - General maintenance for stopping water (I/I)
  - Corrosion resistant barrier for wall corrosion
  - Renew manhole structural integrity

USEPA MANDATE DRIVES CHANGE…

GHWP ADJUSTS TO THE NEW NORMAL

Management Sets New Project Construction Methods

- WOE – Assessed the Trenchless Technology Alternatives
  – Evaluated the Many Rehabilitation Methods for Gravity Sewers Pipes
  – Specified Microsilica Geopolymer Cement Mortar
- Eliminates Risky Trenching Replacement Alternatives for Manholes & Sewers
- MS Geopolymer Cement - Sets New Specification Criteria for MH Rehabilitation
  - Specification - Implements Structural No Digging Rehabilitation Method Instead Risky Trenching Replacement Alternatives for MH & Sewers
  - Provides Best Balance of Easy Installation, Performance and Cost!

BALANCING EASY INSTALLATION, PERFORMANCE & COST!

NEW MANHOLE REHABILITATION GUIDELINES

3 Manhole Rehabilitation Conditions:

- Condition 1 –Signs of Structural Fatigue, Restore Structural Integrity, Stop Water Infiltration/ inflow Apply MS Cementitious Coating
- Condition 2 – Cracks, Loss of Bricks, Concrete Corr¯< 0.5 in., Cross-sectional distortion Apply Partial Structural Coating & Corr¯ Barrier Coating
- Condition 3 – Severe Distress, Collapse is Imminent, Cross-sectional Distortion> 10% Exposed Reinforcement Steel Apply full Structural Rehabilitation/ Renewal

EPA

United States Environmental Protection Agency

Office Of Water (WH-547)

430/09-91-009
September 1991

Hydrogen Sulfide Corrosion In Wastewater Collection And Treatment Systems

Report To Congress

ENVIRONMENTAL PROTECTION AGENCY
DALLAS, TEXAS
LIBRARY

USEPA Names Specialty Concrete as Suitable Repair Material…

Printed on Recycled Paper

MICROSILICA PATENT FACTS…

"Dry Castable Concrete Compositions
and Methods of Preparing and Casting the Same" 1993

- Centrifugal/ Spin Casting
- Dry Pack
- Cast in Place
- Tamp

WHAT IS MICROSILICA GEOPOLYMER?

POWERFUL SILICA RICH MATERIAL…

Geopolymer Cement Mortar Characteristics:

- Adds High Early Strength
- Enhances Shear & Bond Strength
- Permeability Reduction
- Set Control – No Unwanted Flash Setting Surprises (+100°)
- Excellent Resistance to Chemical Attack in Aggressive Environments, Marine Environments, Environments with High Carbonation, and Is Suitable for Applications Such As Mining, Specialty Manufacturing and Sewers

- Super Performing Pozzolan
- Effective Pozzolan - every pound of microsilica added to dry packaged cement mixes increases strength, abrasion resistance and chemical resistance.

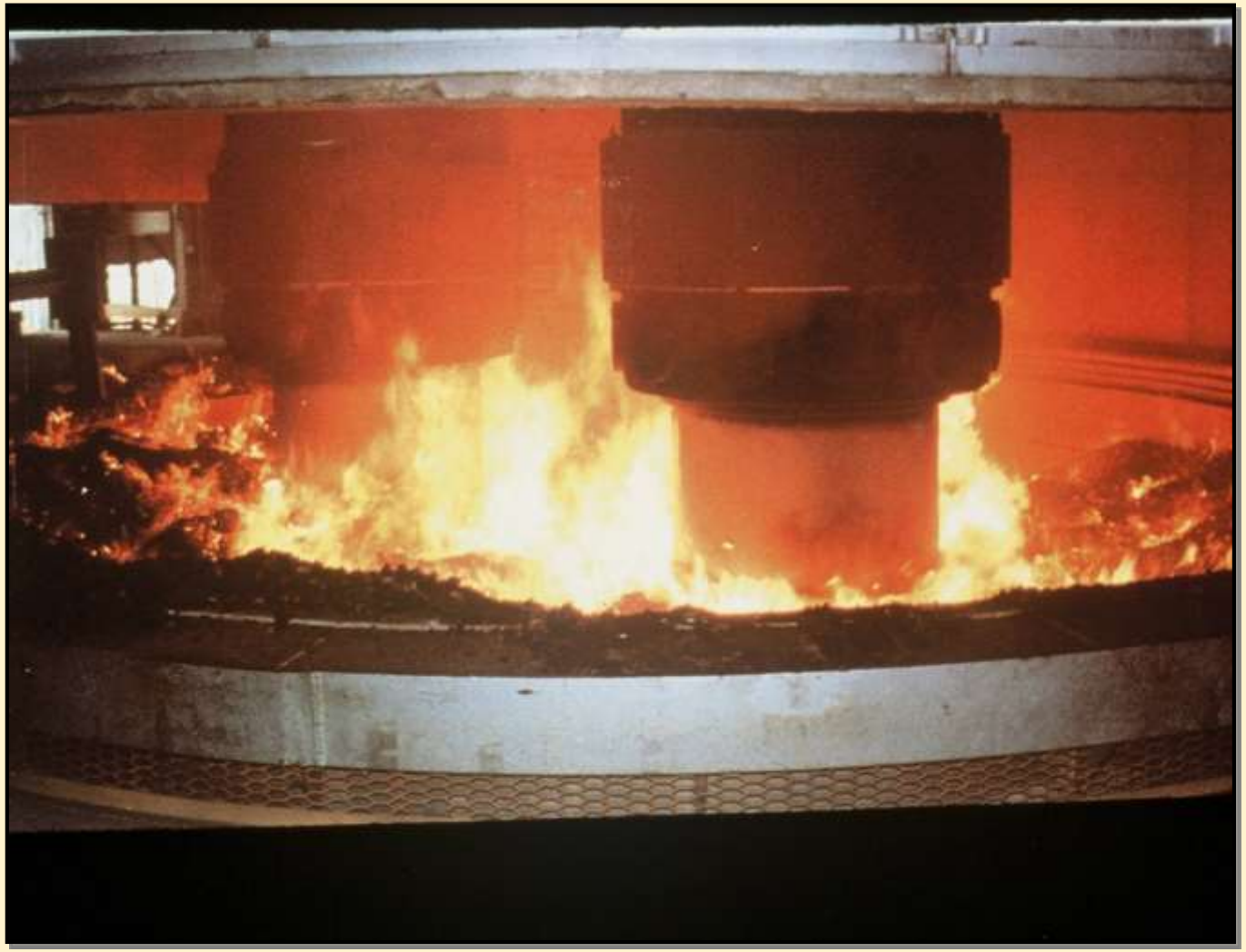
GEOPOLYMER CHEMICAL ANALYSIS…

SILICON DIOXIDE CONTENT

MICROSILICA IS NOT SAND…

ORIGIN:

- Silica rich “by-product” from Ferro-silicon alloys [metallic silicon] manufacturing industry.
- Microsilica Geopolymer is an aluminum-silicate and silicon source material-amorphous.
- Condensed silicon dioxide (SiO_2) gas particles produced in submerged electric-arc furnaces:
  - Raw materials include quartz, coal, steel fibers, rock and wood chips.
- Glass-like particles formed by the oxidation and condensation of the released silicon sub-oxide gas (smoke).



150X MICROFILLER…

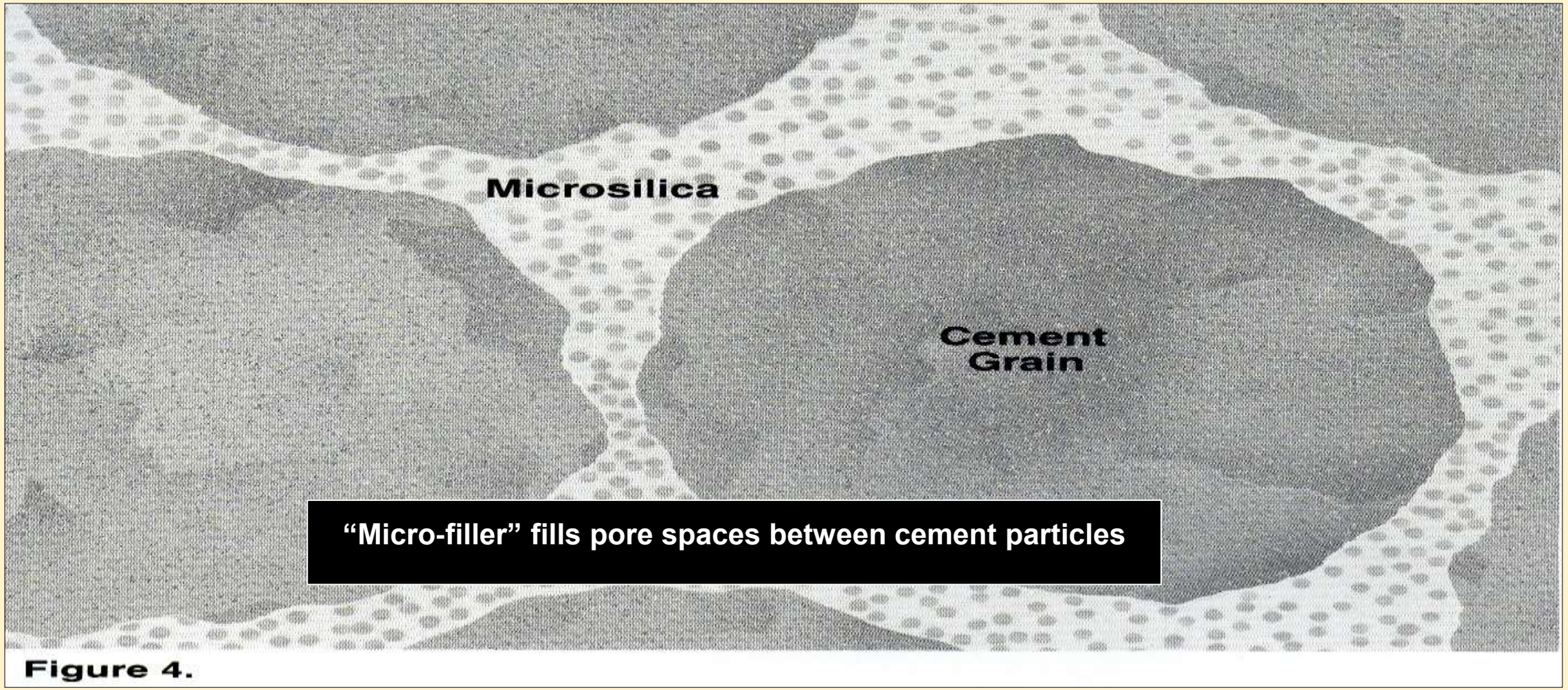
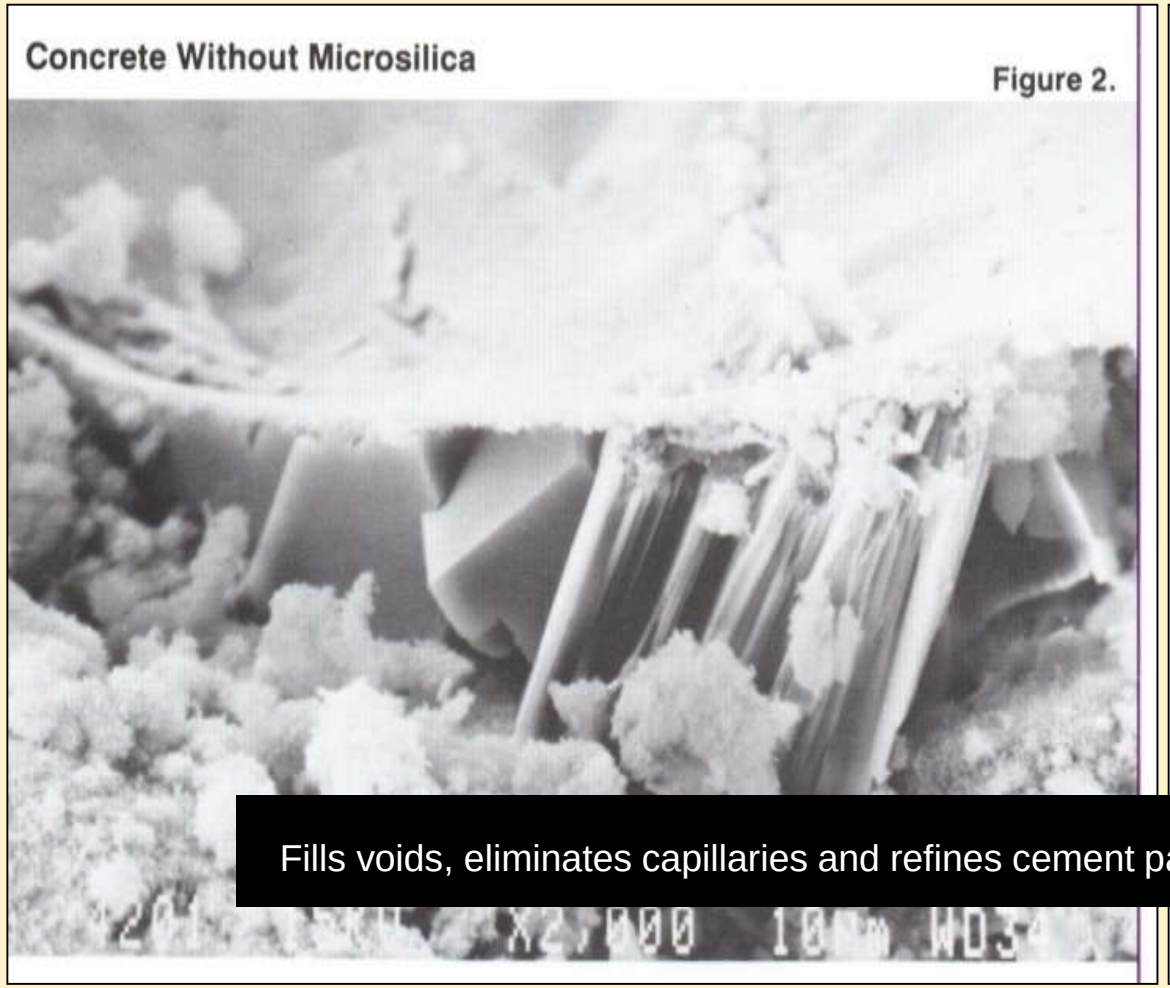
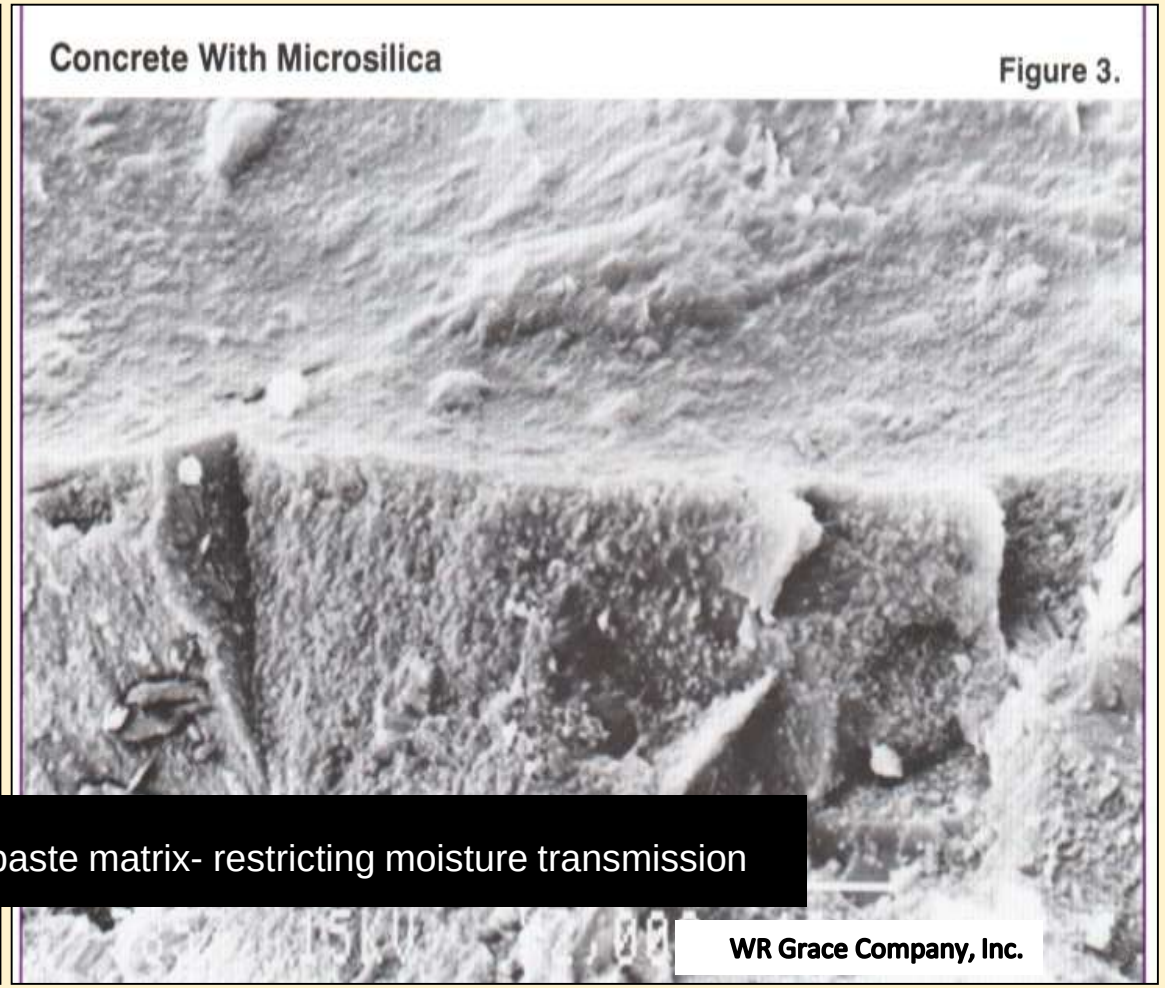


Figure 4.

HOW MS GEOPOLYMER WORKS IN CONCRETE?

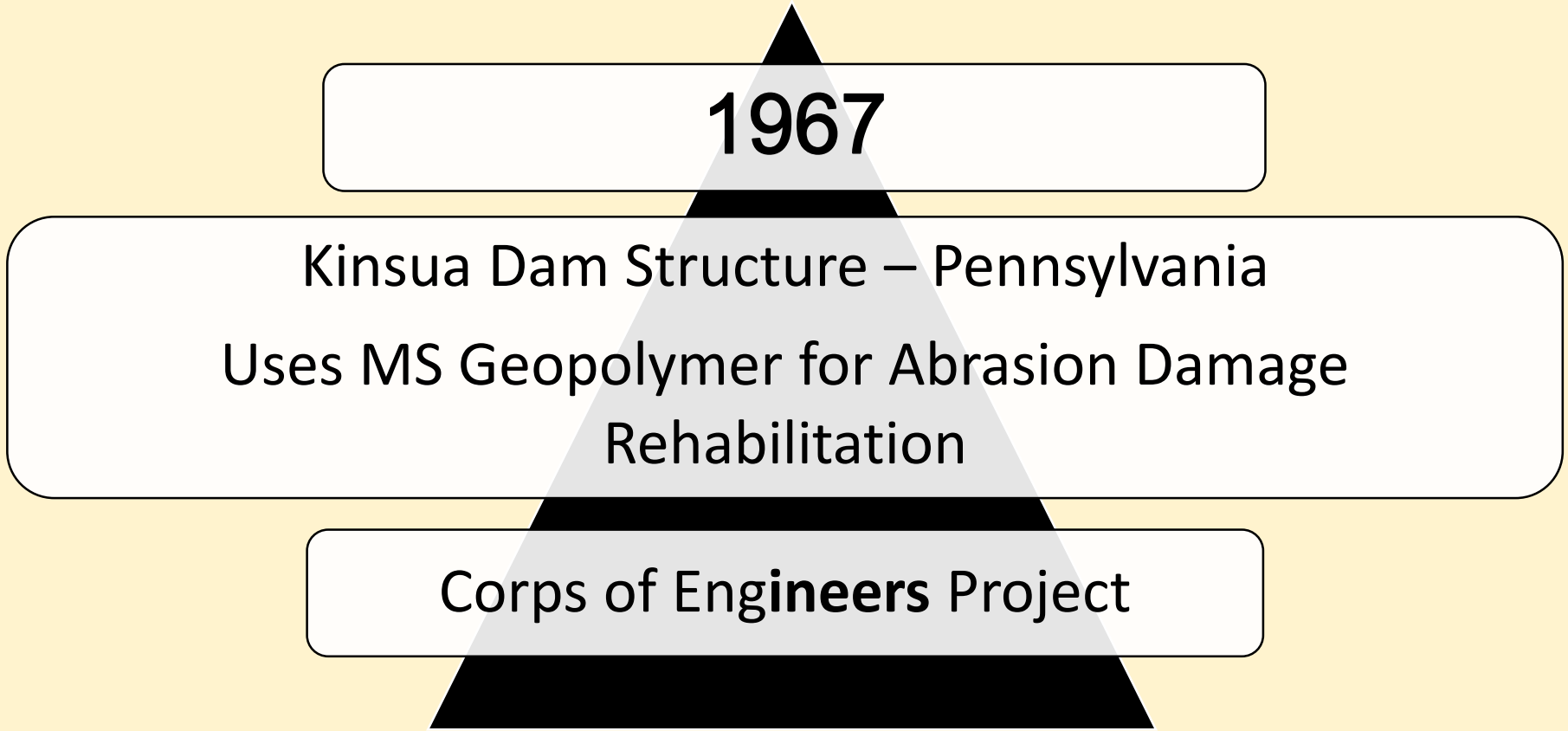




Fills voids, eliminates capillaries and refines cement paste matrix- restricting moisture transmission

WR Grace Company, Inc.

FIRST MICROSILICA CEMENT APPLICATION IN US…



STRENGTH ENHANCEMENT…

Microsilica Cement

Compressive Strength	+8,000 psi
Structural Increase	68%
Stress reduction	7.1%
Absorption	<2.3%
Dry unit weight , pcf	135 ± 2

HOW LONG DOES MICROSILICA CEMENT LAST?

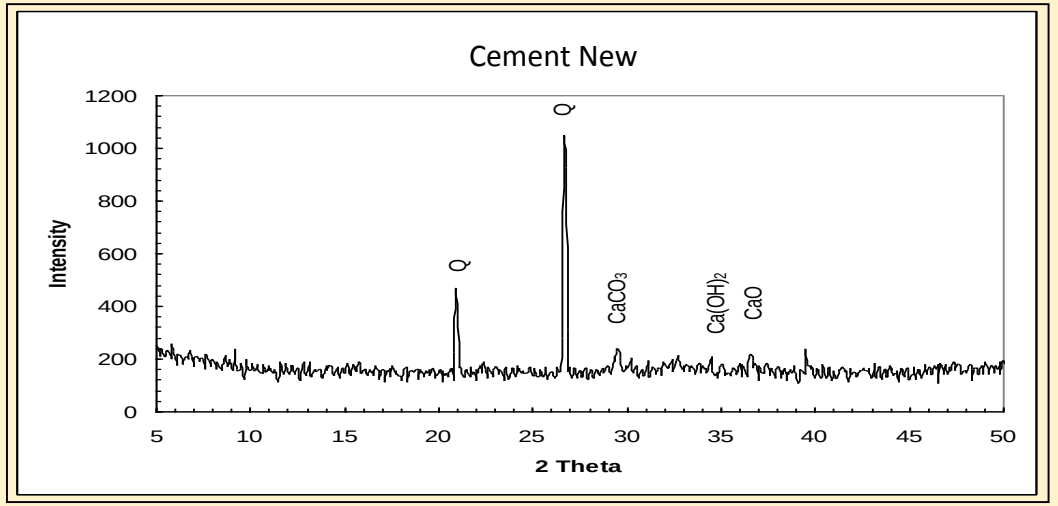
RECENT TEST…

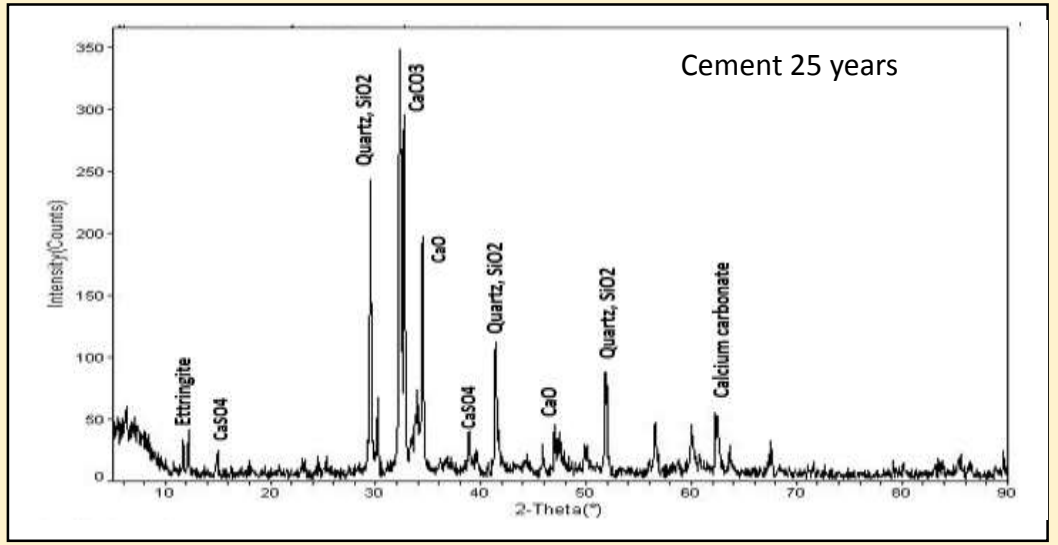
Examine

- Aging on Microsilica Geopolymer Cement Mortar
  - Objectives – examine the quality of core specimens obtained from MH wastewater environment.
  - Quantify the water uptake by the core specimens.
  - Determine the constituents of the core specimens using XRD and Thermogravimetric analysis.
  - Relate the age of specimens to quality of the samples.

Long Term Durability…

- No change after 25-years:
- No change in cement composition- stable.
- TGA/XRD Analysis – validate the cements high usage, specimens in good condition after active service.





MSC TEST SUMMARY…

Table 1. Summary of Test Results on the Liner Materials

Age of Liner	Visual Inspection	Dry Unit Weight (pcf)	Maximum Water Absorption (%)
New Liner	No discoloration. No fragments or loose material on the cored samples.	95	2.9
5 Years Old Liner	Slight discoloration. No fragments or loose material on the cored samples.	91	3.61
10 Years Old Liner	Some discoloration. No fragments or loose material on the cored samples.	87	5.32
15 Yeasr Old Liner	Some discoloration. No fragments or loose material on the cored samples.	82	7.32
25 Years Old Liner	Some discoloration. No fragments or loose material on the cored samples.	80	7.48

Durability and Chemical Resistance Since 1940…

- SUSTAINABLE GREEN TECHNOLOGY…
  - Bernhardt - concludes after 20-years of exposure the most resistance OPC are made when OPC is replaced with microsilica
  - Fiskka (and Sellvoid) - reduces permeability and increases OPC resistance to (H_2S) gas by anaerobic sulfur-reducing bacteria which oxidizes to sulfuric acid that attacks the cement paste.
  - Center for Innovative Gout Materials (CIGMAT) – various test indicated relative changes in the Reliner MSP® Cement over the years in service, but, the changes noted did not affect the quality or integrity of the liner material.

WRAPPING UP…

USEPA/ NSF International Verification

2016 – Long Term Performance of a Microsilica Based Cement Liner in Sewer Manhole Service from Two Major Cities Wastewater Environments, CIGMAT University of Houston

2010 - Long Term Performance Study of a Microsilica Cement Liner in Aggressive Sewer Manhole Wastewater Environments, CIGMAT University of Houston

2006 - USEPA ETV Joint Verification Statement – Infrastructure Rehabilitation Technologies Epoxy Coating for Control of Concrete Deterioration in Wastewater Facilities, CIGMAT University of Houston

1993 – Patent, Castable Concrete Compositions and Methods of Preparing and Casting the Same, No. 5,250,113 (Co-inventor)

MANHOLE REHABILITATION IN 60 MINUTES…

- Structural repair
- Stops water infiltration
- Protection against (H_2S) Corr⁻

SURFACE PREPARATION …

- Cleaning:
  - Mechanical
  - Abrasive sand blast
  - Chemical

High Pressure Wash

STOPPING I&I…

NO NEED TO FILL MISSING BRICK HOLES…

SEVERE DETERIORATION…

PREVENTS TOTAL DESTRUCTION…

CULVERT REPAIR in SOUTH COLLEGE PARK GA…

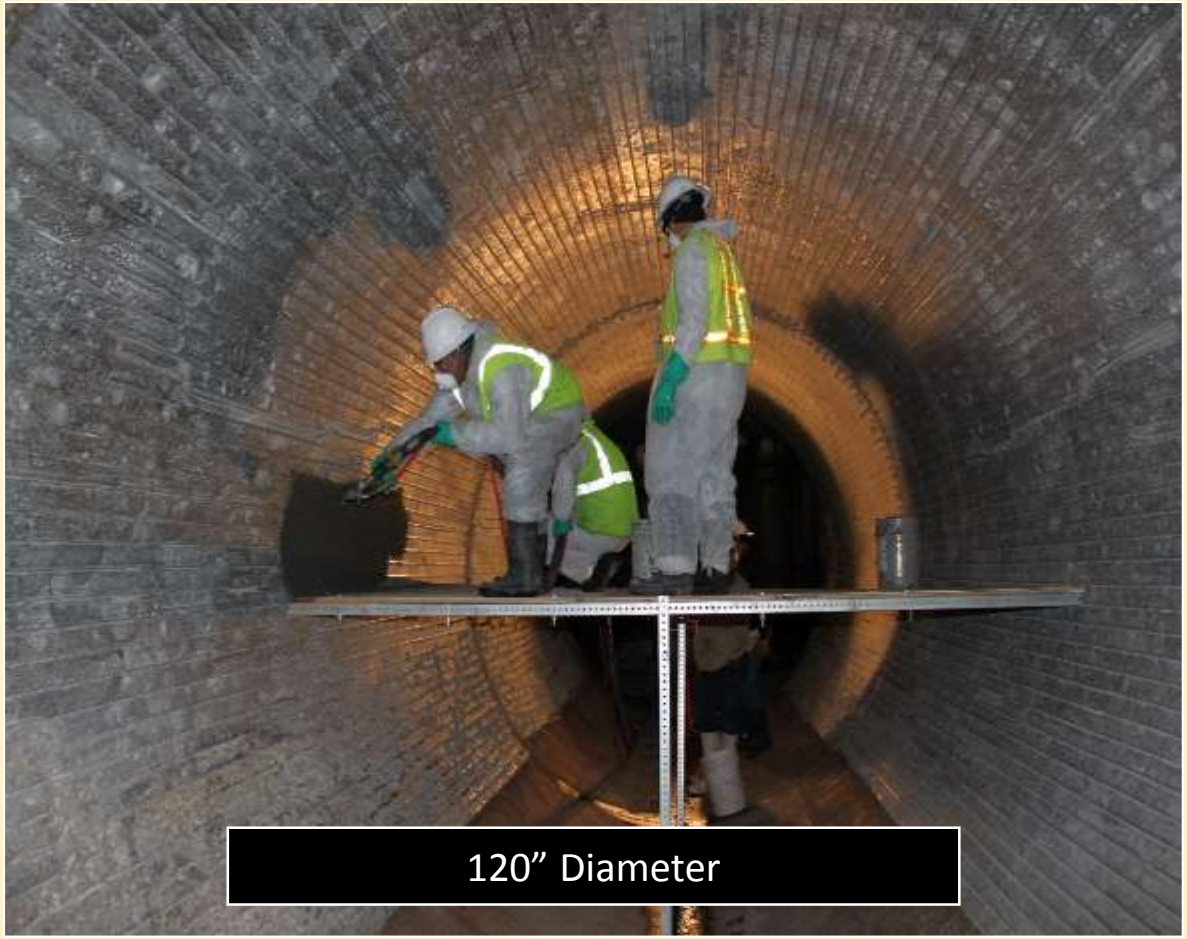
SAVE FAILED CMP INVERT…

SPIN CASTING STOPS HERE…

SPIN CAST APPLICATION SAVES TXDOT FM 361…

CMP Arch Pipe out-of- round

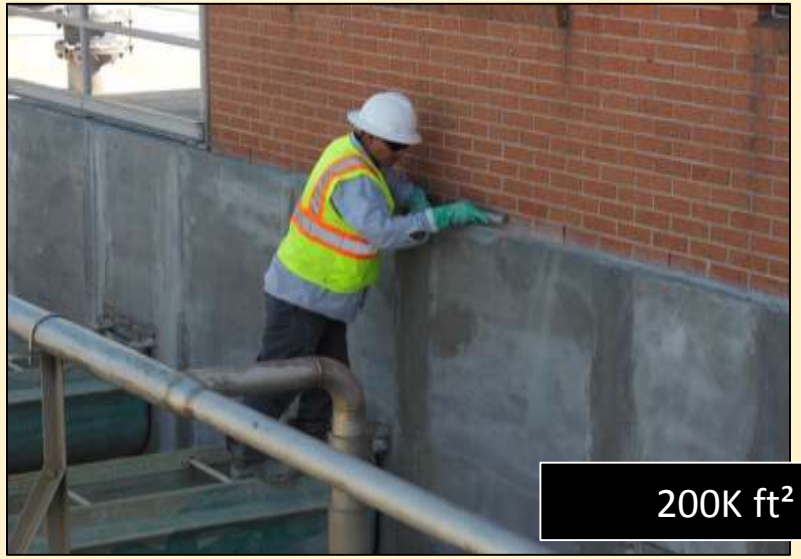
CONNECT TUNNELS TO MANHOLES…



120” Diameter

Lift Station – 40 ft. deep

RESTORE CONCRETE FILTRATION WALLS…



200K ft² Repair- Water Filtration Basin

CONCRETE CLARIFIER REHAB WITH EC...

THIS CONCLUDES THE SESSION…

Microsilica Geopolymer Increases Ambition
to Rehabilitate Manholes and Sewers
Reduces Motivation to Replace
by Trenching!