

# DATA CENTERS

Banes S. Lal

**XYPEX®**

CONCRETE WATERPROOFING  
BY CRYSTALLIZATION

# About Xypex



Over 55 years ago, the team at Xypex Chemical Corporation pioneered a transformative technology that revolutionized the protection of concrete against aggressive environments. Xypex Crystalline Technology operates from within the concrete, providing unparalleled waterproofing capabilities even under extreme hydrostatic pressure, while extending service life and facilitating self-healing in the presence of water.

For data center infrastructure, our integral waterproofing solutions offer measurable and verifiable advantages compared to traditional waterproofing membranes. Trusted in over 110 countries for almost six decades, Xypex safeguards concrete from the inside out, ensuring the protection of critical digital infrastructure from the very beginning.

The widespread adoption of Xypex Crystalline Technology in thousands of diverse waterproofing projects worldwide serves as a testament to its original brilliance. We proudly continue this legacy of excellence today, delivering outstanding results and fostering lasting relationships with our valued clients.

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# Introduction

## *The Hidden Risk Beneath Data Centers*

Data centers are engineered to minimize risk and maintain continuous operation. Yet one of the least visible threats to their long-term reliability may lie beneath the facility in the concrete exposed to surrounding soil, groundwater, sustained moisture, and hydrostatic pressure.

Foundations, below-grade walls, utility vaults, pump pits, cooling tower basins, equipment galleries, duct banks, and underground service corridors are expected to protect critical systems for decades. Although concrete appears solid, it contains pores and capillary pathways and is susceptible to cracking. When water penetrates the concrete through these pathways or through joints, penetrations, honeycombing, and other construction defects, it can expose reinforcing steel and embedded components to conditions that contribute to corrosion, leakage, and progressive deterioration.



What begins as a concrete durability issue can ultimately become an operational concern. Water intrusion may threaten sensitive equipment, increase maintenance requirements, compromise access to below-grade spaces, or require disruptive repairs after the facility has been commissioned. The risk is especially significant because many affected structures become difficult or impossible to access once they are buried or surrounded by operating equipment.

Cooling tower basins demonstrate how closely concrete performance is connected to data center

operations. These structures continuously collect and recirculate water used to reject heat from the facility. When located below grade, they face a two-sided waterproofing challenge: preventing groundwater from entering under hydrostatic pressure while also preventing treated cooling water from escaping into the surrounding soil.

Leakage can increase makeup-water demand, disrupt water chemistry, affect adjacent soils, and create environmental or operational concerns. The same underlying vulnerabilities can affect pump pits, valve vaults, below-grade equipment areas, foundations, and utility corridors throughout the site.

These risks become more significant when data centers are constructed on sites containing sulfates, chlorides, acidic groundwater, or other chemically aggressive conditions. Water can transport these substances through concrete, contributing to chemical attack, reinforcement corrosion, cracking, leakage, and premature deterioration.

***This makes permeability a central durability concern.***

Protecting data-center concrete requires more than responding to visible leakage after it occurs. Site conditions, water movement, chemical exposure, crack control, joint detailing, material selection, construction quality, and long-term accessibility must be considered from the earliest stages of design.

We will examine the risks facing data centers constructed in corrosive soil and aggressive groundwater environments. It explores the relationship between concrete performance and operational reliability, the vulnerabilities of cooling and below-grade infrastructure, the mechanisms of deterioration, the role of integral crystalline waterproofing, relevant performance evidence, and the lifecycle value of designing for durability from the outset.

***Because in a facility designed for uninterrupted operation, the concrete protecting critical infrastructure cannot be an afterthought.***

# Section 1

## *Uptime Depends on More Than Digital Systems*

The systems housed within a modern data center are designed with redundancy, monitoring, backup power, environmental controls, and multiple layers of protection. However, the performance of those systems still depends on the physical infrastructure surrounding them.

Concrete provides the structural and protective framework for much of the facility. Depending on the site and design, concrete may be used for:

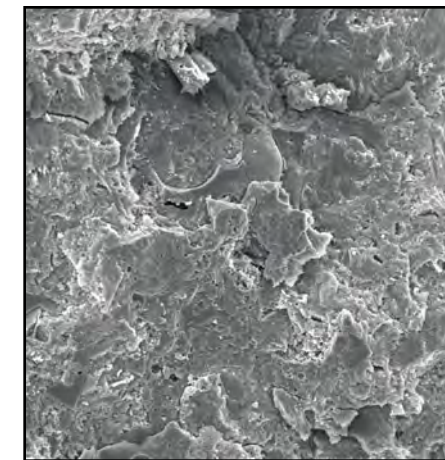
- Foundations, mat slabs, and below-grade perimeter walls
- Utility and electrical vaults
- Cooling tower basins
- Pump pits, valve chambers, and retaining structures
- Underground service corridors
- Stormwater and process-water structures
- Generator and mechanical equipment foundations.

Many of these elements are in direct contact with soil, groundwater, stored water, or moisture-laden environments. Some are exposed on one side, while water-retaining structures may be exposed on both sides.

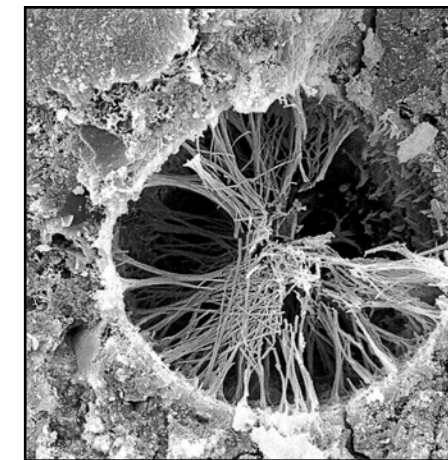
Concrete deterioration is often gradual and initially difficult to detect. Moisture may move through pores or small cracks without producing an obvious structural failure. Reinforcing steel can begin to corrode below the surface. Water may accumulate behind finishes or within inaccessible utility areas. A small leak may remain manageable until operating equipment, cabling,

or sensitive systems are installed nearby.

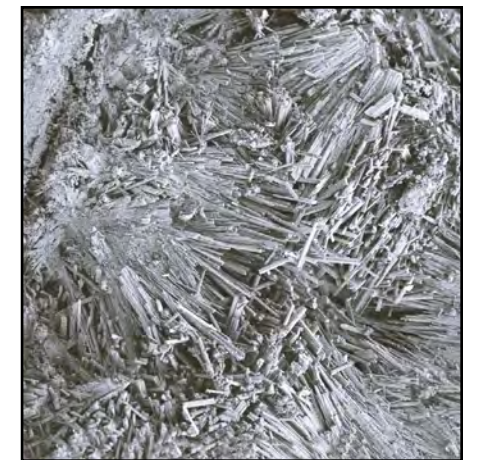
As reinforcement corrodes, the resulting corrosion products occupy more volume than the original steel. This expansion can create internal stresses, leading to cracking, delamination, and spalling of the surrounding concrete. At the same time, continuing water movement can transport additional chlorides, sulfates, and other aggressive substances deeper into the structure. For data-center owners, the concern is not limited to whether the concrete remains standing. It is whether the infrastructure remains dry, serviceable, accessible, and capable of protecting the systems around it.



*Untreated Concrete*



*Crystallization Initiated*



*Crystallization Mature*

A concrete defect that might be considered a maintenance issue in another building can carry more serious consequences in a mission-critical facility. Repair work may require shutdowns, restricted access, temporary water control, equipment protection, or complex coordination around systems that cannot easily be taken offline. The objective must therefore extend beyond meeting initial strength requirements. Concrete must be designed and constructed to resist the site's actual exposure conditions throughout the intended service life of the facility.

# Section 2

## Cooling Tower Basins

### A Two-Sided Waterproofing Challenge

Data centers generate substantial quantities of heat. Nearly all the electrical power used by servers and supporting equipment is ultimately converted into heat that must be removed from the building.

Many facilities use chilled-water or condenser-water systems connected to evaporative heat-rejection equipment. In a cooling tower, heat is removed from circulating water partly through evaporation. The cooled water is then collected in a basin and pumped back through the system. Because data centers often operate continuously and at high loads, cooling-water circulation, evaporation, blowdown, chemical treatment, and makeup-water demand can persist around the clock. Large volumes of water may be stored and circulated through concrete basins, pump pits, valve vaults, and associated mechanical infrastructure.

### The Two Directions of Water Movement

A below-grade cooling tower basin must manage water moving in two possible directions. From outside the structure, groundwater may be driven inward by hydrostatic pressure. If groundwater enters the basin, it can dilute the cooling water, interfere with chemistry control, and increase water-treatment requirements. From inside the structure, treated basin water may escape through cracks, joints, penetrations, honeycombing, misplaced waterstops, or other discontinuities. This can increase makeup-water consumption and potentially introduce treatment chemicals into surrounding soils.

Cooling-water systems may use corrosion inhibitors, biocides, scale-control products, and other treatment chemicals. The composition varies by facility, water source, equipment, and operating requirements, but the presence of treated water makes reliable containment a priority for operations and the environment.

### Where Leakage Commonly Develops

Concrete basins are particularly vulnerable at:

- Construction and cold joints
- Movement or expansion joints
- Wall-to-slab interfaces
- Pipe and conduit penetrations
- Waterstop locations
- Tie holes
- Areas of inadequate consolidation
- Honeycombed or segregated concrete
- Full-depth or static shrinkage cracks.

No waterproofing material can compensate for every design or construction deficiency. Watertight performance depends on the concrete mix, crack control, reinforcement, joint layout, waterstop selection, placement, consolidation, curing, penetration detailing, and quality assurance working together. However,

## OUTAGES

Leaks alone cause  
**~10% of outage.**



## COOLING LEAKS

Studies show cooling system leaks & moisture issues account for

**~15% of unplanned outages.**

## LOWER COSTS

Replacing membranes with Xypex in a major data center build avoided an estimated

**2 months of schedule and \$187K in costs.**



## Section 2

reducing permeability in concrete can provide an additional level of protection by limiting the pathways for water movement.

### Operational Consequences

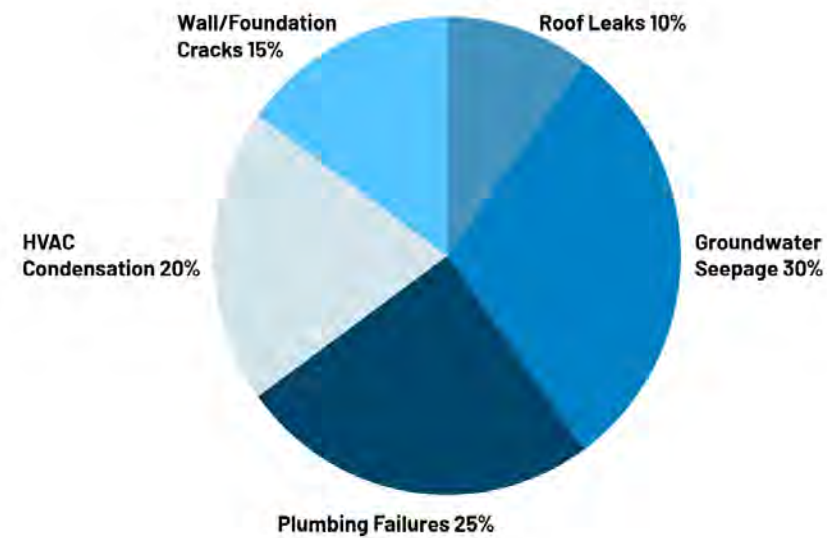
Cooling tower basin leakage is not simply a loss of water.

It may:

- Increase continuous makeup water requirements
- Affect cooling-water concentration and chemistry
- Increase chemical-treatment demand
- Allow groundwater contamination or dilution
- Expose embedded steel and mechanical components to moisture
- Affect adjacent soils or below-grade spaces
- Accelerate concrete deterioration
- Require difficult repairs around operating cooling infrastructure.

Cooling is essential to data center uptime. The durability and watertightness of the concrete supporting that system should therefore be treated as part of the facility's operational resilience strategy.

**Data Center Water-Related Downtime by Cause**



## Section 3

### *Why Corrosive Soils & Aggressive Groundwater Matter*

As data-center development expands into new markets, projects are increasingly being delivered across a wide range of geological and environmental conditions.

A site that is suitable from a location, power, network, or development perspective may still contain aggressive soil or groundwater conditions. These can include:

- Elevated sulfate concentrations;
- Chloride-bearing soils or groundwater;
- Low-pH or acidic conditions;
- High groundwater tables;
- Hydrostatic pressure;
- Variable or seasonal water levels;
- Repeated wetting and drying; and
- Combinations of chemical and moisture exposure.

The risk depends on the concentration of aggressive substances, the availability and movement of water, the characteristics of the concrete, the depth and quality of cover over reinforcing steel, and the duration of exposure.

### Sulfate Exposure

Sulfates present in soil or groundwater can enter permeable concrete and interact with components of the cementitious matrix.

# Section 3

Depending on the exposure and concrete composition, sulfate attack may contribute to expansion, cracking, softening, loss of cohesion, and deterioration of the concrete surface. As damage progresses, permeability can increase, allowing additional moisture and dissolved chemicals to enter. The presence of sulfate does not automatically mean deterioration will occur. Performance depends on exposure severity, cementitious materials, water to cementitious materials ratio, permeability, curing, drainage, and other design factors. Nevertheless, elevated sulfate conditions must be identified and addressed during design.

## Chloride Exposure

Chlorides can migrate through concrete toward embedded reinforcing steel. When sufficient chloride reaches the reinforcement, it can disrupt the protective passive layer that normally helps prevent corrosion in alkaline concrete.

If moisture and oxygen are available, corrosion may begin. The resulting expansion can cause cracking, delamination, staining, and spalling.

Chloride exposure is often associated with marine environments and deicing salts, but chlorides may also be present in soils, groundwater, industrial fill, or other site-specific sources.

Reducing the rate of chloride transport is therefore an important consideration for below-grade reinforced concrete exposed to chloride-bearing groundwater.

## Acidic Soil and Groundwater

Acidic exposure can affect the cement paste that binds concrete together. The severity depends heavily on pH, chemical composition, concentration, replenishment rate, temperature, and the duration of contact.

Concrete is not universally resistant to strong or continuously replenished acids. Highly acidic environments may require additional drainage, linings, coatings, specialized materials, or other protective measures beyond a permeability-reducing admixture.

However, reducing water movement through the concrete can still form part of a broader strategy by limiting the transport pathways available to aggressive solutions.

## Hydrostatic Pressure

Water under hydrostatic pressure can be driven into cracks, joints, capillary pores, and defects. The pressure may vary seasonally or rise after heavy rainfall, flooding, drainage failure, or changes to surrounding site conditions. Structures designed during a period of low groundwater may later experience greater pressure than anticipated if seasonal or long-term groundwater conditions were not adequately evaluated.

Below-grade waterproofing should therefore be based on credible maximum water levels and site-specific conditions rather than on conditions observed only during construction.

## Moisture Cycling

Alternating wet and dry conditions can intensify the movement and concentration of dissolved salts. Water entering concrete may carry aggressive ions inward. As the surface dries, salts can become concentrated or deposited within the pore structure.

Repeated moisture cycling can also contribute to dimensional changes and increase the significance of existing cracks and defects.

The concrete exposure should be evaluated as a complete environment. Sulfates, chlorides, acidity, groundwater pressure, temperature, and moisture cycling often occur together rather than as isolated conditions.

# Section 4

## Permeability

### The Common Pathway to Deterioration

Concrete durability in aggressive environments depends substantially on controlling the movement of water and dissolved substances.

Concrete contains a network of pores and capillary tracts created during mixing, placement, hydration, and curing. The continuity and size of these pathways are influenced by the water to cementitious materials ratio, cementitious materials, consolidation, curing, cracking, and workmanship.

Water can also move through larger discontinuities, including:

- Shrinkage and thermal cracks
- Construction joints
- Penetrations
- Poorly bonded interfaces
- Honeycombing
- Tie holes
- Unsealed formwork defects
- Damaged or improperly installed waterstops.

**Permeability connects the primary risks discussed throughout this ebook.**

It enables groundwater to enter below-grade spaces. It allows cooling water to escape from a basin. It carries sulfates, chlorides, acids, and other chemicals into the concrete. It brings moisture into contact with reinforcing steel. It turns small cracks into leakage pathways.

This is why durability cannot be addressed solely by increasing compressive strength. Two concrete mixtures with similar compressive strengths may have different permeability and transport characteristics depending on their proportions, cementitious materials, curing, air content, placement, and cracking.

**TABLE 1. Reduction of Permeability of Concrete Using PRAs**

| Admixture type           | Coefficient of permeability of reference concrete | Coefficient of permeability of test concrete | Percent reduction in permeability |
|--------------------------|---------------------------------------------------|----------------------------------------------|-----------------------------------|
| Crystalline              | $4.29 \times 10^{-14}$                            | $1.28 \times 10^{-14}$                       | 70                                |
| Colloidal silica         | $1.98 \times 10^{-13}$                            | $1.61 \times 10^{-13}$                       | 19                                |
| Hydrophobic pore blocker | $2.23 \times 10^{-12}$                            | $1.14 \times 10^{-12}$                       | 49                                |

*Source: ACI 212.3-R10, "Report on Chemical Admixtures for Concrete"*

A comprehensive durability approach should reduce the movement of water through both the concrete matrix and the structure's vulnerable details.

This requires several coordinated measures:

- Low-permeability concrete
- An appropriate water to cementitious materials ratio
- Suitable cementitious materials for the exposure
- Effective crack control
- Adequate reinforcement cover
- Proper joint and penetration detailing
- Reliable waterstops
- Thorough consolidation
- Effective curing
- Inspection and repair of defects.

Integral crystalline waterproofing can support this strategy by reducing water-transport pathways.

# Section 5

## Integral Crystalline Waterproofing

Traditional waterproofing frequently relies on membranes, coatings, or other barriers applied to the surface of hardened concrete.

These systems can perform effectively when they are properly designed, installed, protected, and compatible with the service conditions. However, their performance may be influenced by:

- Surface preparation
- Substrate moisture
- Weather conditions
- Installation workmanship
- Seam and termination detailing
- Penetrations
- Damage by other trades
- Protection during backfilling
- Future access for inspection or repair.

Once an external membrane is buried, locating and repairing a failure can be difficult. Excavation may be constrained by utilities, foundations, roads, equipment, or operating infrastructure.

### A Different Approach

Xypex Admix C-Series is added to the concrete during batching rather than applied only as a surface layer. Its active chemicals react with moisture and cement hydration by-products to



### XYPEX = UPTIME

By making concrete waterproof, and highly durable, Xypex safeguards data center uptime from day one.

**The risk of water-related outages or structural degradation is dramatically reduced.**

create a non-soluble crystalline formation within the concrete's pores and capillary tracts. The objective is to obstruct pathways through which water and other liquids can move.

Because the crystalline treatment becomes part of the concrete, it is not dependent solely on adhesion to an exposed surface. It cannot peel, tear, or be punctured in the same manner as an external membrane. Xypex also states that its Admix products can seal static hairline cracks up to 0.5 mm when moisture is present to activate the crystalline reaction.

### Water Movement from Either Direction

The integral nature of crystalline waterproofing is relevant where exposure can occur from either side.

For a below-grade wall or vault, groundwater may press inward from the surrounding soil. In a cooling tower basin, water may attempt to enter from outside or escape from inside.

An integral system is intended to reduce water movement through the concrete regardless of the direction from which pressure is applied. This makes it particularly suited to basins, foundations, below-grade walls, pits, tanks, and utility structures that may face changing or two-sided exposure.

### Constructability

Adding the waterproofing treatment at the batching stage may reduce dependence on a separate field-applied membrane installation.

Potential constructability advantages include:

- Fewer weather-sensitive application activities
- Reduced surface-preparation requirements associated with membranes
- Less risk of puncture during reinforcement, formwork, or backfill operations
- Fewer seams and terminations
- Reduced need for protection boards in applicable designs
- Simplified coordination among trades
- Greater flexibility in construction sequencing.

The specific effect on schedule and cost depends on the project design and whether external

## Section 5

membranes are eliminated, supplemented, or retained in selected locations. These decisions should be made by the design team based on site conditions, risk tolerance, code requirements, and the required level of redundancy.

### A System, Not a Stand-Alone Detail

Integral crystalline waterproofing does not eliminate the need to address joints, penetrations, cracks, tie holes, honeycombing, and other discontinuities.

Cooling tower basins and below-grade data-center structures should be treated as systems. Integral protection within the concrete should be coordinated with:

- Properly selected waterstops
- Construction-joint treatment
- Expansion-joint assemblies
- Penetration seals
- Crack-control reinforcement
- Repair materials
- Inspection procedures
- Corrective measures for placement defects

Xypex offers admixture, surface-applied, and repair products that may be combined according to project requirements. Product selection and detailing should be reviewed with qualified design professionals and Xypex Technical Services.

### SELF-HEALING CONCRETE



Compared to traditional methods,  
Xypex-treated concrete:

- **Lowers risk**
- **Reduces maintenance**
- **Stands up against extreme hydrostatic pressure, freeze and thaw**

## Section 6

### Performance in Aggressive Environments

Product selection for mission-critical infrastructure should be supported by relevant test data, not solely by general claims. Xypex publishes summaries of laboratory testing covering permeability, hydrostatic pressure, sulfate exposure, chloride diffusion, acid resistance, crack sealing, and other performance characteristics.

Test results should always be interpreted in context. Laboratory conditions do not reproduce every field exposure, and performance depends on the concrete mixture, dosage, construction quality, curing, cracking, and service environment. Nevertheless, testing can provide evidence of how treated concrete performs relative to untreated controls under defined conditions.

### Resistance to Water Under Pressure

In testing summarized by Xypex, Admix-treated and untreated samples were subjected to increasing water pressure that was maintained at 7 bar for 10 days. Untreated reference samples began leaking during the test, while the treated samples reportedly showed no leakage.

In another reported test, concrete containing Xypex Admix NF was subjected to 10 bar of pressure for two weeks. The treated concrete showed a reduction in water-permeability coefficient of up to 93% at the tested 1.2% dosage rate.

A separate test described in the cooling tower basin article used a modified U.S. Army Corps of Engineers protocol. Admix-treated slabs subjected to 150 psi—approximately 1.04 MPa—showed no measurable leakage after five days, while water permeated the untreated specimens. These tests support the use of crystalline waterproofing where concrete is exposed to hydrostatic pressure, including below-grade foundations, utility vaults, pump pits, and water retaining basins.

# Section 6

## Sulfate Resistance

Xypex's published testing summary describes treated and untreated concrete specimens immersed in a concentrated sulfate solution for four months.

The treated samples reportedly experienced substantially lower mass loss and showed no visible surface deterioration, while untreated specimens recorded significantly greater mass loss and surface damage.

The results indicate improved resistance under the specified test conditions. They should not be interpreted as meaning that mix design, exposure classification, sulfate resistant cementitious materials, drainage, or other protective measures are unnecessary.

## Chloride Diffusion

Testing summarized by Xypex compared chloride diffusion coefficients in treated fly-ash and slag concrete mixtures with corresponding untreated controls.

The reported reductions varied according to the concrete mixture and Admix dosage. This is important because supplementary cementitious materials and crystalline admixtures affect concrete differently, and the overall performance must be evaluated as a complete mix rather than attributed to one component alone.

Reduced chloride transport can help delay the time required for chlorides to reach reinforcing steel, supporting extended corrosion protection in chloride-bearing environments.

## Acid Resistance

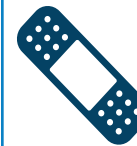
Xypex also reports testing of Admix treated samples exposed to sulfuric acid.

In one test, treated concrete demonstrated lower weight loss than untreated controls. In another test involving mortar exposed to a 5% sulfuric-acid solution, samples containing Xypex Admix C-1000 NF reportedly experienced 48% less weight loss than cement only controls and 53% less than the tested fly-ash controls after 12 weeks.

These findings indicate improved performance under the specific test conditions, but they should not be interpreted as universal resistance to all acidic environments. Highly acidic or continuously replenished chemical exposure may require specialized liners, coatings, drainage, or chemical resistant materials.



**Integral Waterproofing:** Xypex's crystalline admixture becomes part of the concrete matrix, blocking water and chemicals internally (the concrete itself becomes the barrier).



**Healing:** Xypex technology enables concrete to heal hairline cracks (up to 0.5 mm) by growing crystals, maintaining long term watertightness.



**Long term Durability:** Xypex treated concrete resists hydrostatic pressure, corrosion of rebar, sulfate attack, and abrasion, greatly extending service life.



**Low Maintenance:** No membranes to inspect, repair, or replace. The waterproofing is permanent for the structure's life.

## Static Hairline Crack Sealing

Cracks can form because of drying shrinkage, thermal changes, restrained movement, loading, and construction conditions.

Xypex states that its crystalline technology can seal static hairline cracks up to 0.5 mm. Moisture entering the crack activates the crystalline reaction, supporting the growth of additional crystalline material within the crack pathway.

This ability is particularly relevant below grade, where a minor crack may otherwise become a route for groundwater and dissolved chemicals. However, crystalline crack sealing is not intended to accommodate unrestricted structural movement, active expansion joints, unstable cracks, or significant defects. Structural cracks and moving joints must be evaluated and treated according to their cause and expected movement.

# Section 7

## Real-World Project Relevance

Data-center projects are often confidential, and public details about the materials used in hyperscale, financial, telecommunications, and security facilities may be limited. However, several public Xypex project references illustrate how crystalline technology has been used in applications with risk profiles relevant to data-center infrastructure.



Vancouver Art Gallery



Bank of Tanzania

## Global Footprint

Xypex has been used in mission-critical facilities (e.g. bank data centers, telecom hubs, hyperscale cloud campuses) around the world. Many hyperscale operators specify crystalline admixtures to protect their investments in **high value infrastructure**. Projects in high water table or floodprone areas have successfully relied on Xypex to **prevent water ingress** over decades of operation, while eliminating unplanned maintenance from fountain leaks.

## Data Security Site – Colorado Springs, Colorado

A cellular security facility located against a damp hillside from recent rain of mist required protection from water intrusion. Xypex Concentrate, Modified, and Patch'n Plug were used to treat approximately 10,000 square feet of concrete. Although this project used surface-applied and repair products rather than Admix alone, it illustrates the importance of combining waterproofing and detailing products according to the structure's condition and exposure.



The project is relevant to data centers and telecommunications facilities constructed against slopes, near elevated groundwater, or in locations where water can accumulate against below-grade concrete.

## What These Projects Demonstrate

The project examples involve different structures, products, climates, and exposure conditions. They should not be treated as direct predictions of performance for another facility.

Together, however, they reinforce several principles:

- Water exposure should be addressed before critical equipment is installed
- Below grade access becomes more difficult after construction
- Integral and surface applied crystalline products can be combined as a system
- Reducing permeability can support protection in hydrostatic and chloride bearing environment
- Durability decisions made during design and construction can influence long term maintenance and serviceability

# Section 8

## *Design & Specification Considerations*

Xypex should be specified as part of a complete durability and waterproofing strategy, not as a substitute for geotechnical evaluation, structural engineering, appropriate mix design, or proper construction practices.

### Begin with the Site Investigation

The geotechnical and environmental investigation should identify the exposure conditions that may affect concrete.

Depending on the project, relevant information may include:

- Sulfate concentrations in soil and groundwater
- Chloride content
- Soil and groundwater pH
- Electrical resistivity
- Groundwater elevation
- Seasonal high water levels
- Potential for perched water
- Soil permeability and drainage
- Industrial or historical site contamination
- Fill composition
- Expected changes to groundwater after development.

Samples should be representative of the locations and depths where concrete will be constructed.

Conditions can vary across large data-center campuses, especially where grading, imported fill, previous land uses, or multiple building phases are involved.

### Assign Exposure Requirements by Structure

Not every concrete element faces the same exposure.

A cooling tower basin must retain treated water and may also resist external groundwater pressure. A mat foundation may experience one-sided groundwater exposure. A utility vault may require both watertightness and protection of electrical systems. An exterior equipment pad may face atmospheric exposure but not hydrostatic pressure.

The design team should assign durability and waterproofing requirements to each relevant element rather than applying a single generic solution to the entire site.

### Coordinate the Concrete Mix

The concrete mix should be designed for the specified exposure and required performance.

Considerations may include:

- Maximum water to cementitious materials ratio
- Minimum strength
- Cement type
- Supplementary cementitious materials
- Sulfate resistance
- Chloride diffusion resistance
- Compatibility with Xypex Admix
- Workability
- Air entrainment where required
- Setting characteristics
- Heat generation in mass placements
- Shrinkage potential
- Curing requirements.

# Section 8

Trial batches and preconstruction testing may be appropriate for major placements or where several admixtures and supplementary materials are used together.

## Design for Crack Control

Crack control must be addressed structurally.

The design should consider:

- Reinforcement ratios and spacing
- Concrete temperature at placement
- Thermal gradients
- Drying shrinkage
- Restraint
- Placement size and sequence
- Joint location
- Curing
- Loading
- Anticipated movement

Crystalline technology may seal qualifying static hairline cracks, but it does not replace reinforcement, movement joints, structural design, or appropriate repair of significant cracking.

## Detail Joints and Penetrations

Construction joints, expansion joints, pipe penetrations, conduit entries, tie holes, and wall-to-slab interfaces require specific detailing.

A complete specification should identify:

- Waterstop type and location
- Joint preparation
- Surface-applied crystalline treatment where required

- Sealants or movement-joint systems
- Penetration seals
- Repair procedures
- Treatment of honeycombing
- Tie-hole filling
- Inspection requirements
- Responsibility for corrective work

## Establish Quality Assurance



### Confirm Presence of Xypex in Hardened Concrete

Xypex Admix products include the proprietary Visual Detection System (VDS) tracer, allowing engineers and inspectors to verify the presence of Xypex in hardened concrete. This unique feature allows for independent confirmation of crystalline in the concrete.



Integral waterproofing simplifies some field activities but still requires quality control.

The project team should confirm:

- Approved product and dosage
- Batching sequence
- Mixing time
- Delivery documentation
- Placement and consolidation
- Curing

## Section 8

- Presence of the specified Visual Detection System (VDS) where applicable
- Joint and waterstop installation
- Repair of defects
- Completion of required testing and inspections.

Coordination among the concrete producer, contractor, waterproofing specialist, testing agency, design team, and Xypex representative is especially important on fast-track projects.

### Address Severe Chemical Exposure Separately

Where soils or groundwater are highly acidic, contaminated, or otherwise unusually aggressive, the engineer should determine whether integral crystalline waterproofing provides sufficient protection as part of the concrete system.

Additional measures may include:

- Drainage and groundwater control
- Chemical resistant liners
- Protective coating
- Specialized cementitious systems;
- Increased concrete cover
- Corrosion resistant reinforcement
- Sacrificial concrete thickness
- Cathodic protection
- Redundant waterproofing.

No single waterproofing product should be expected to resolve every chemical exposure condition.

## Section 9

### *Lifecycle Value & Risk Mitigation*

Waterproofing decisions are often evaluated during design as construction cost items. For a mission critical facility, the more meaningful comparison is the total lifecycle risk.

The cost of enhancing concrete durability during construction may be small relative to the potential cost of:

- Excavating a buried foundation wall
- Repairing a cooling tower basin
- Protecting or relocating operating equipment
- Controlling active groundwater
- Replacing corroded reinforcement
- Restoring damaged concrete
- Managing contaminated leakage
- Interrupting cooling water operation
- Increasing ongoing makeup water use
- Coordinating repairs around a live data center.

### Reducing Dependence on Accessible Surfaces

External membranes can be effective, but access to them may be lost permanently after backfilling. An integral crystalline system remains within the concrete. This can reduce the risk associated with damage to an inaccessible exterior surface and provide protection throughout the treated concrete matrix.

Supporting Construction Sequencing

Fast-track data-center projects involve intense trade coordination and strict milestone requirements.

Where integral waterproofing allows a project to reduce or eliminate selected membrane activities, potential benefits may include:

- Fewer installation stages
- Less weather dependent work
- Reduced protection requirements
- Fewer interfaces between trades
- Less risk of membrane damage during backfill
- Earlier progression to subsequent construction activities.

These benefits should be evaluated against project specific costs, design requirements, and the need for redundancy.

Reducing Water and Maintenance Risk

Reliable cooling water containment can support water conservation objectives by reducing leakage and unnecessary makeup water demand.

Reducing water ingress can also help protect reinforcing steel, embedded items, utilities, and below grade equipment areas. This can lower the likelihood of future inspection, repair, dewatering, and maintenance activities.

Supporting Resilience

Data-center resilience is commonly discussed in terms of electrical redundancy, cooling capacity, connectivity, security, and disaster recovery. Concrete durability belongs within the same conversation. A structure that is difficult to inspect, repair, or take out of service must be designed with a long term view. Waterproofing and durability decisions should account for:

- The required operating life
- The consequences of leakage
- Future accessibility
- Repair complexity
- Environmental exposure
- Water availability
- Operational redundancy
- The owner’s tolerance for unplanned intervention.

The objective is not merely to avoid visible water during construction. It is to preserve the reliability, serviceability, and maintainability of the facility for decades.

Significantly Reduces Corrosion Rate

An independent long term study confirms that Xypex treated concrete reduces rebar corrosion rates by 40% in uncracked concrete and by up to 50% in cracked concrete. Corrosion loss was reduced by up to 67% in cracked specimens, attributed to Xypex’s crack-healing capability.

| Steel Heat | Concrete   | 1st Repair | 2nd  | 3rd  | 4th  | 5th  | Repair / 100 yrs |
|------------|------------|------------|------|------|------|------|------------------|
| Heat A     | Untreated  | 22.0       | 44.1 | 66.1 | 88.2 | —    | 4                |
|            | With Xypex | 32.4       | 64.7 | 97.1 | —    | —    | 3                |
| Heat B     | Untreated  | 19.2       | 38.4 | 57.7 | 76.9 | 96.1 | 5                |
|            | With Xypex | 27.6       | 55.1 | 82.7 | —    | —    | 3                |
| Heat C     | Untreated  | 26.1       | 52.1 | 78.2 | —    | —    | 3                |
|            | With Xypex | 39.8       | 79.6 | —    | —    | —    | 2                |

Predicted time to repair (years) per steel heat, untreated vs. Xypex-treated concrete

# Conclusion

## Designing Durability from the Ground Up

Data centers are built to house some of the world’s most advanced technology, but their long term reliability still depends on fundamental decisions about concrete, water, soil, and construction quality.

Cooling tower basins reveal the operational importance of watertight concrete. They must contain large volumes of treated water while resisting groundwater pressure from outside. Leakage can affect water consumption, chemistry control, surrounding soils, maintenance requirements, and the cooling infrastructure upon which continuous operation depends.

**The challenge extends beyond the cooling system.**

Foundations, utility vaults, pump pits, below grade walls, equipment galleries, and underground service corridors may be exposed to sulfates, chlorides, acidic groundwater, hydrostatic pressure, and moisture cycling. These conditions can transport aggressive substances through concrete and contribute to chemical attack, reinforcement corrosion, cracking, leakage, and premature deterioration.

**Permeability is the common pathway linking these risks.**

Xypex crystalline admixtures provide an integral approach to reducing water movement through concrete. Added during batching, the active chemistry forms a non-soluble crystalline structure within pores and capillary tracts. Published testing and project references indicate improved performance under water pressure and in selected sulfate, chloride, acidic, and crack-sealing evaluations.

Integral crystalline waterproofing is not a replacement for proper engineering or workmanship.

Long term performance still depends on site investigation, exposure classification, concrete mix design, crack control, joint detailing, waterstops, penetrations, placement, consolidation, curing, inspection, and repair.

When these measures are coordinated, crystalline technology can form an important part of a comprehensive durability strategy—one that addresses water and chemical exposure before critical equipment is installed and before below grade structures become inaccessible.

For owners and developers, this approach supports lifecycle value and risk reduction. For engineers, it provides another tool for designing concrete capable of resisting aggressive environments. For contractors, it may simplify waterproofing coordination and reduce dependence on vulnerable external applications. For operators, it helps protect the physical infrastructure supporting continuous operation. For data centers where structural integrity and uptime are inseparable, this translates directly to reduced risk and lower lifecycle maintenance costs.

|                                             | Time Until Repair (Years) |      |      |      |      |
|---------------------------------------------|---------------------------|------|------|------|------|
|                                             | 1                         | 2    | 3    | 4    | 5    |
| Epoxy-coated reinforcement                  | 22.0                      | 44.1 | 66.1 | 88.2 |      |
| Conventional galvanized reinforcement       | 19.2                      | 38.4 | 57.7 | 76.9 | 96.1 |
| Continuous hot-dip galvanized reinforcement | 26.1                      | 52.1 | 78.2 |      |      |
|                                             |                           |      |      |      |      |
| Epoxy-coated reinforcement                  | 32.4                      | 64.7 | 97.1 |      |      |
| Conventional galvanized reinforcement       | 27.6                      | 55.1 | 82.7 |      |      |
| Continuous hot-dip galvanized reinforcement | 39.8                      | 79.6 |      |      |      |

The question is not only whether the concrete will meet its requirements when the data center opens. The more important question is whether it will continue protecting the facility throughout its intended service life.

**In a mission critical environment, durability must begin below the surface—and it must begin at the design stage.**

# Product Showcase

## XYPEX ADMIX C-500NF

Xypex Admix C-500 NF is added directly to the concrete mix at the time of batching, becoming a permanent part of the concrete matrix. Formulated without fine sand, it delivers a more concentrated and pure crystalline compound, ideal for high-performance applications where smaller volumes and precise dosing are required.

### ADMIX ADVANTAGES

- Suitable for cast-in-place and precast concrete elements
- Permanent integral protection
- Self-heals cracks over time and withstands extreme hydrostatic pressure
- Cannot be punctured or peeled off
- NSF certified, non-toxic, and no VOCs
- Contains VDS tracer for independent verification in hardened concrete



**VDS** Visual  
Detection  
System

## XYPEX VDS

Xypex proudly introduces a Visual Detection System (VDS) - a unique state-of-the-art technology designed to confirm that presence of Xypex Admix in hardened concrete visually. The VDS is a testament to our commitment to innovation, quality, and the environment.



## XYPEX Surface Applied

Xypex Surface Applied products can be used to increase the durability of existing data centers structures through the use of Xypex Concentrate, Modified, and repair materials, applicable to any concrete element regardless of age.

### SURFACE APPLIED ADVANTAGES

- Compatible with all concrete data center elements: walls, floors, vaults, pits
- Applicable to existing structures requiring enhanced durability
- Applied to save the element before full replacement
- Structural rehabilitation of localized areas subject to water ingress or cracking



## XYPEX REACT FOR TIME-SENSITIVE REPAIR & NEW CONSTRUCTION

Xypex React is a surface-applied crystalline crack-healing accelerator, designed for use with Xypex Admix. It reacts with the existing Admix crystalline system, triggering accelerated crystal growth that permanently blocks water pathways, even under high hydrostatic pressure. React speeds up the healing of static cracks up to 0.5 mm, ideal when data center schedules don't allow for standard healing timelines.



# Technical Note

This ebook is intended for general educational purposes. It does not replace project-specific geotechnical, structural, environmental, concrete materials, or waterproofing design. Product selection, dosage, detailing, and compatibility should be confirmed for each project with the engineer of record and Xypex Technical Services.

## Source Notes

1. **Trusted for Data Center Construction**, Xypex Content Hub. Discussion of concrete degradation, water ingress, reinforcement corrosion, uptime risk, integral waterproofing, and constructability. ([Xypex Global](#))
2. **Data Centers: Why Cooling Tower Basin Waterproofing Cannot Be an Afterthought**, Xypex Content Hub. Discussion of cooling water systems, below grade basin exposure, two-sided leakage, hydrostatic pressure, water chemistry, and design considerations. ([Xypex Global](#))
3. **Protecting Data Center Concrete in Corrosive Soil Environments**, supplied draft. Discussion of sulfate, chloride, acidic groundwater, permeability, project applications, lifecycle value, and specification considerations.
4. **Concrete Waterproofing Testing**, Xypex. Published summaries of permeability, sulfate, acid, chloride, crack-sealing, and other testing. (Xypex global)
5. **Data Security Site**, Xypex project profile. ([Xypex USA](#))
6. **Xypex Crystalline Technology**, Xypex. Description of crystalline formation and static hair-line crack sealing.



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