2020
BEST
INTERNATIONAL
PROJECTS

EUROPE
AFRICA
MIDDLE EAST
ASIA
LATIN AMERICA
About the Xypex International Project Awards

Xypex’s international network of distributors brings our unique Crystalline Technology to our customers around the world and provides first-class technical service to the global construction industry. Xypex Best Project Awards recognize the efforts and dedication of our global team by showcasing their exceptional projects. The Best International Project of the Year winner is chosen from amongst the five Regional Winners from Latin America, Europe, Africa, Middle East and Asia.

About Xypex

Xypex Chemical Corporation is a world leader in waterproofing, protection, and repair of concrete structures with over 50 years of extensive experience and backed by a distribution network in more than 90 countries.

Xypex Crystalline Technology outperforms other methods because of its unique ability to become a truly integral and permanent part of the concrete matrix.

Xypex is proud to have served the construction needs of over thousands of global customers including Fortune 500 construction and engineering firms across a variety of projects in general construction, water resources, wastewater, tunneling, bridges, ports, industry, power and utilities.
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INTERNATIONAL WINNER

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In the Northeast Region of Brazil, there is a central area referred to as the Sertão Nordestino. This remote area is known to be very dry, receiving only 12% of Brazil’s annual rainfall and having a long history of water shortages. The region is home to over 2.2 million inhabitants with a per capita income 88% lower than the Brazilian average.

The Federal Government’s goal was to construct a 1,000 km water channel to bring water from Brazil’s 5th largest river, the São Francisco, to the Sertão Nordestino region. Before the Canal do Sertão water project was started, water was brought in by truck; approximately 2,400 truckloads of water per day (31 million litres).

The project team for the Canal do Sertão scheduled construction in three stages, beginning in 2010. The objective was to capture 26 m³/s of water from the São Francisco River to supply the rivers and reservoirs for the 390 cities of the Sertão Nordestino. Several construction companies, design teams and applicators were involved in the different stages to construct an ambitious 1,000 km water channel. This consisted primarily of trapezoidal concrete sections that utilized a HDPE membrane under the concrete elements as the sole waterproofing system. Additionally, 20 km of elevated aqueducts, pump stations, flood gates and small hydroelectric plants were to be built where no waterproofing system had been specified at the design stage.

**Fast, Permanent Repairs**

In Stage I, the contractor Quieros Galvão experienced problems with the elevated aqueducts resulting in thermal/dry shrinkage cracks every 2 meters — more than 2,000 linear meters of leaking cracks. Quieros Galvão engineers recalled a presentation given by Xypex distributor, MC Bauchemie, several months earlier and contacted them for assistance in how best to address the leaks. Due to the extent of the shrinkage cracking, resin injection was discounted as a repair solution. Other technologies were considered but, as they required significant and time-consuming
surface preparation, would not fulfill the requirement to keep the project on schedule. Additionally, as the continuous supply of water was essential to the region, future shutdowns for maintenance would not be possible and so a highly durable solution was required.

Xypex Crystalline Technology, as it requires minimal surface preparation and permanently waterproofs concrete, was considered as a potential solution for the problem. Xypex Concentrate and Modified were applied to a 0.5 km test section of the 3.5 km aqueduct to confirm waterproofing effectiveness. The application was a resounding success and the remaining 3.0 km of elevated aqueduct were also treated, stopping all leaks within 30 days. The use of Xypex saved significant time and costs in addressing the issues and enabled the contractor to proceed without having to resort to injecting the 2,000 linear metres of cracks. In Stage I, 38 tonnes of Xypex Concentrate and 38 tonnes of Xypex Modified were used to treat elevated aqueducts, pump stations, flood gates and hydroelectric plants.

Integral Waterproofing
The project progressed from Stage I to Stage II (constructed between 2013-2016) and new construction companies became involved (Serveng & SA Paulista). As a result of the lessons learned from Stage I and the success of Xypex crystalline waterproofing, the design team incorporated Xypex Admix C-500 NF into the concrete for 4.0 km of elevated aqueducts as well as pump stations, flood gates and hydroelectric plants. This stage of the project utilized on-site concrete batch plants. The utilization of Xypex Admix C-500 NF in the concrete mix facilitated project scheduling and provided the owner with waterproof, durable structures that were maintenance free. Stage II used 80 tonnes of Admix C-500 NF and, when put into service, no leaking was observed in any of the Xypex treated structures.

Stage III (constructed between 2017-2020) - the final stage of this ambitious project - presented the contractor (Odebrecht), the owner and design team with further challenges. As Stage III was located in the remotest regions, the ability to control concrete mix designs and batching processes was complicated so the design team of Petra opted to use a combined approach incorporating both Xypex Admix C-500 NF and the Xypex Concentrate/Modified
coating system on the elevated aqueducts, pump stations, flood gates and hydroelectric plants. Stage III presented other challenges as the concrete design had higher compressive strengths than the previous stages thus needing more rigorous surface preparation than before. Additionally, the extreme heat during application required strict compliance to the Xypex coatings curing procedure. Stage III used 17 tonnes of Xypex Admix C-500 NF, 45 tonnes of Xypex Concentrate and 15 tonnes of Xypex Modified.

Xypex Crystalline Technology was introduced to the project as a means to solve a specific problem in the early stages of construction. As a result of its performance it became an important component of the whole project to solve the waterproofing challenges. The combined efforts of the federal government, the design team and the contractors together with technical assistance from Xypex distributor MC Bauchemie, enabled the timely delivery of these stages of this highly important project for the Sertão Nordestino region of Brazil.
INTERNATIONAL RUNNER-UP

2020 BEST INTERNATIONAL PROJECT AWARDS
### The Rihand Dam
*Sonebhadra, Uttar Pradesh, India*

<table>
<thead>
<tr>
<th>Completion Date</th>
<th>JULY 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractor</td>
<td>APAAR INFRATECH PVT. LTD.</td>
</tr>
<tr>
<td>Engineers</td>
<td>UP IRRIGATION DEPARTMENT</td>
</tr>
<tr>
<td>Owner</td>
<td>UP JAL VIDGUT NIGAM LTD.</td>
</tr>
<tr>
<td>Products Used</td>
<td>CONCENTRATE, PATCH’N PLUG, MEGAMIX II, ADMIX C-2000</td>
</tr>
<tr>
<td>Project Type</td>
<td>DAMS</td>
</tr>
</tbody>
</table>

Rihand Dam is located in the state of Uttar Pradesh in India and is the largest dam in Asia by reservoir volume. Construction began in 1954 and was completed in 1962 with a reservoir holding capacity of 10.6 billion cubic meters. The length of the dam is 934.45 meters with a height of 91.46 meters, consisting of 61 independent blocks. The powerhouse is located at the toe of the dam and has a generation capacity of 300 MW.

Rihand Dam provides critical hydro-electricity to a vast region including the aluminum industry in Renukoot and the nearby industrial belt. Being one of the oldest dams in India, the concrete of the dam body has experienced deterioration due to ageing and AAR (Alkali Aggregate Reaction) resulting in cracking and surface loss. The dam has undergone various maintenance and repair work over its life.

**In-depth Studies**

In 2014, on the recommendations of the Rihand Dam Structural Behaviour and Monitoring Committee, the engineers of Uttar Pradesh Irrigation department prepared a proposal for the extensive rehabilitation of the Rihand Dam. The findings of the 12 months research conducted by Central Soil and Material Research Station (CSMRS), a Government of India laboratory under Central Water Commission (CWC), examining the efficacy of Xypex Crystalline Technology to mitigate the effects of ASR/AAR was one of the prime considerations in selecting the suitable product and technology for the rehabilitation of Rihand Dam. Xypex’s unique crystalline technology was chosen as the preferred repair solution due to its cementitious nature and compatibility with concrete along with other technical reasons. Due to the critical importance of the project, the scrutiny and review process by various technical teams took almost 3 years.

The spillways suffered deterioration of the concrete surface, structural cracking as well as spalling at the crest.
Significant Spalling

Alligator cracking in the piers indicated the occurrence of AAR.

**Three Critical Structures**

The three critical areas of the dam’s structure were identified as the Spillway, Piers and Dam Top.

The problem areas identified included deteriorated concrete surfaces, loose construction joints, structural cracks, alligator cracking due to AAR, corrosion of embedded reinforcement, spalling, voids in concrete elements, and deteriorated brittle epoxy repairs of cracks in the piers from earlier maintenance. The evaluation report established specific criteria for the repair solution, namely, it should be integral and become a permanent part of the concrete matrix, provide protection of embedded reinforcement steel, resist chemical attack, suppress AAR and ASR, self-heal existing cracks and provide long term waterproofing and protection to the structure.

**The Repair Solution**

Xypex’s unique crystalline technology was chosen as the preferred repair solution. Xypex’s proprietary chemicals react with the natural by-products of cement hydration in both new and existing concrete, forming a non-soluble crystalline structure within the inter-connected cracks, capillaries, pores and voids in the concrete. In this way, the crystalline formation becomes a permanent, integral part of the concrete matrix itself, preventing the ingress of water and other liquids even under hydrostatic pressure and protecting the concrete in harsh, aggressive conditions. The four major products used in this rehabilitation project were all based on Xypex Crystalline Technology:

In the spillway, cracks and construction joints were chipped out as per the specification to repair it with a first layer of Xypex Patch’n Plug followed by a second layer of Xypex Megamix II. Nozzles were also fixed along the cracks, construction joints and honeycombed concrete which were grouted with a specified mix of Xypex Admix C-2000 NF, cement and fine silica.

The top of the dam showed severe deterioration.
Xypex Megamix II was then applied to the entire surface of the spillway and a two coat application of Xypex Concentrate was applied to the mortar repaired surface to provide extra protection.

The same technique was used in both the piers and the top of the dam. A total of 57,000 kg of Xypex Patch’n Plug were used to repair cracks and joints. Xypex Megamix II was applied at a thickness of 12.5 mm to resurface 14,000 m² of deteriorated concrete surface. Xypex Concentrate was applied to an area of over 21,000 m² to provide final protection to the concrete.

Each phase of the repairs of the Spillway, Dam Top and Piers was constantly monitored and guided by the engineers of the UP Irrigation Department (UPID) and UP Jal Vidyut Nigam Ltd. (UPJVN). Various senior officials from Government of Uttar Pradesh, the Indian Institute of Technology (Kanpur) and the CSMRS (New Delhi) also inspected the ongoing works. As a result of the collective efforts, the rehabilitation works of Rihand Dam, by Xypex Crystalline Technology resulted in the strengthening and durability enhancement of Rihand Dam requiring no further major rehabilitation in the long term.
REGIONAL RECOGNITION

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Like most federal governments Hungary’s central government is housed in several buildings within Budapest. Two primary building complexes are the Parliament building and the Parliamentary Offices building that contains the offices of parliamentarians and their staff. As might be expected there is constant pedestrian traffic between these buildings and the sometimes harsh winter weather as well as the need to cross a main downtown arterial road make travel between these buildings inconvenient and time consuming. The connection of these building with a climate controlled pedestrian tunnel was deemed a priority.

High Water Table
The key challenges in building this pedestrian tunnel were the high water table created by the close proximity of the Danube River and addressing the need to prevent interruption of traffic flow on the street between the buildings. The street is both a major thoroughfare for cars as well as a streetcar line. The tunnel needed to be water tight to create a comfortable pedestrian space and the traffic needed to be maintained throughout the construction phase.
The design team settled on the use of both cast-in-place and precast sections to create the tunnel. Precast was used below the road surface itself to speed construction and thus reduce the time that the full road surface was closed. Both parts of the tunnel had similar dimensions utilizing 20 cm (8 inch) thick walls and ceiling with a 40 cm (16 inch) thick base slab. The base slab was thickened to support the tunnel and overhead loads as well as to provide ballast to keep the tunnel from floating in the high water table environment.

**Standalone Waterproofing Solution**

The concrete of the tunnel is solely waterproofed with Xypex products. The concrete of the walls, ceiling, and slab of both the precast and cast in place are waterproofing with Xypex Admix C-1000 NF dosed at approximately 1% of the cementitious content of the mix. The joints of the cast in place section are waterproofed using typical bentonite and steel plane composite waterstops as well as a slurry coat of Xypex Concentrate.

The joints in the precast section were waterproofed using both expanding waterstops and a mortar made of a blend of Xypex Patch’n Plug and Xypex Concentrate powders. These two combined systems provided redundancy to the waterproofing at these critical joints between the precast sections.
The conclusion of the project is a bright, dry and comfortable pedestrian tunnel between these two buildings that was constructed and waterproofed against ongoing hydrostatic conditions.

The project was completed on time to the satisfaction of all involved, with a minimal of impact on the travelling public and at a cost that was very competitive compared to alternate waterproofing strategies.
With more than 7,000 animals the Pairi Daiza Zoo in Brugelette, Belgium offers the experience of visiting several “Worlds” or ecosystems that house birds, mammals, fish and reptiles from around the globe. Actively involved in the preservation of endangered species, Pairi Daiza participates in thirty scientific programs and other initiatives as a commitment towards creating awareness about sustainability.

The Land of the Cold
In May 2018, Pairi Daiza was building new polar bear and penguin enclosures in the “Land of the Cold” as well as a new enclosure and training facility for the Steller sea lions in the “Last Frontier”. These structures needed to be built using waterproofed concrete, to prevent the pools from leaking into the adjacent hotel rooms, and to provide protection of the reinforcing steel from chlorine corrosion. Additionally, repairs were needed in other areas of the zoo as some structures exhibited leakage due to honeycombing and cracking around water pipes.

Xypex Megamix II and Xypex Patch’n Plug products were chosen to repair those deteriorated concrete structures.

Xypex Admix C-1000 NF was used for waterproofing and to provide chemical protection for the concrete walls and slabs of the various
new animal enclosures (two pools for polar bears, a penguin pool, a sea lion pool, technical areas and a training facility). 26,500 kg of Xypex Admix C-1000 NF was used to protect 4,400 m$^3$ of concrete (walls and slabs).

**Waterproofing Underwater Hotel Rooms**

Xypex Admix was critical in maintaining the water inside the enclosures and ensuring that there was no leakage into the hotel rooms. The concrete walls of these enclosures form a separation between the animal shelter and the rooms, so the guest has the feeling of being under water with the animals. While waterproofing was essential, chemical resistance was equally important due to the water containing chlorine that could potentially corrode the concrete structural reinforcing steel. Xypex’s Crystalline Technology ensured that the concrete was waterproofed, durable, and chemically resistant.
Rod el Farag Axis Bridge
Cairo, Egypt

The Rod el Farag Axis Bridge, inaugurated in May 2019 by Egyptian president Abdel Fattah El Sisi, is the final element completing a critical new 600 km (373 mile) travel corridor that links the Red Sea to the Mediterranean. A key project goal is to reduce traffic congestion in central Cairo by linking eastern Cairo to the country’s northern regions without passing through the center of the capital city.

The new bridge—also known as the Tahya Masr Bridge (‘Long Live Egypt Bridge’)—was built in just four years by a consortium of Egyptian firms led by the Arab Contractors Company under the supervision of the Armed Forces Engineering Authority. The 540 m (1,772 ft) bridge features six traffic lanes in each direction and, at 67.36 m (220 ft 9.6 in) wide, it has been deemed the widest cable-stayed bridge in the world by Guinness World Records.

More than one million cubic meters of concrete was used to build the bridge, which was used in the bridge decking, girders, and six 92 m (302 ft) tall concrete towers that support 160 steel support cables. One of the key challenges for the bridge designers was how to adequately protect the critical concrete structures from the effects of air pollution and the moist riverine environment.

ACE Moharram-Bakhoum, consulting engineers for the bridge project, recommended that Arab Contractors treat the main concrete towers with Xypex Concentrate in order to provide integral, lifetime protection from natural and manmade elements.

Xypex Concentrate consists of Portland cement, finely graded sand and active proprietary chemicals. Concentrate was applied by brush as a cementitious slurry to 1,000 square meters of pre-saturated concrete surface on the six bridge towers.

The active chemicals within Xypex Concentrate diffuse into the substrate and react with moisture and the constituents of hardened concrete to cause a catalytic reaction. This reaction generates a non-soluble crystalline formation throughout the pores and capillary tracts of the concrete that permanently seals the concrete and prevents the
Penetration of water and other liquids from any direction, even under high hydrostatic pressure.

Xypex Concentrate not only permanently seals the concrete and can heal hairline cracks up to 0.4 mm, it also provides chemical resistance properties that mitigate the attack of chlorides, sulfates and the effects of carbonation and alkali-aggregate reaction.

The 1,000 kilos of Xypex Concentrate required for the Rod el Farag Axis Bridge project were provided by the Xypex distributor for Egypt, Beton Alexco, of Alexandria, Egypt. “Xypex Concentrate was applied at a rate of one part water to 2.5 parts Concentrate powder,” explains Xypex representative Amr Saad, when reached at his office in Alexandria.

It took the Arab Contractors crew just 24 hours to treat the six main columns of the Rod el Farag Axis Bridge with Xypex Concentrate. The huge towers support 160 cables, requiring 1,500 km (870 miles) of steel wire. The towers are built on more than 6,000 pilings.

“We have worked with the ACE consulting engineers on this and other projects in the past,” Saad notes. “The consultants have had excellent experiences with Xypex on several important projects. They recognize that there are other alternatives—perhaps even less expensive than Xypex—but only Xypex delivers true crystalline waterproofing technology that has been proven in high profile projects around the world for more than 40 years.”

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The Xypex Concentrate will provide protection for this historic bridge for the lifetime of the structure without any further maintenance or renewal,” says Amr Saad. “Our market here in Egypt is gradually growing to understand the difference that Xypex crystallization technology provides. No other product on the market has the proven experience and research results that we do. When customers want the best, they come to us.”
The principal motive for using Xypex products was to achieve a completely watertight 5 level basement, at the same time reducing construction time. Xypex Admix is added to the concrete during mixing so that the concrete is completely waterproofed without waiting for the placement, de-forming and curing necessary for surface-applied waterproofing systems.

Xypex Concrete Waterproofing by Crystallization was the sole technology used in this project and no other system such as membranes, drainage layer, or drainage assembly was applied. The decision to use Xypex was based on the successful use of Xypex in other Tunisian projects despite the severe hydrostatic conditions.

Other details for the project are: The project occupied an area of 5,000 m². Xypex Admix was dosed at 1% of the weight of cement in both the slab and the walls. The ribbed slab contained ribs 1.60 m wide and 1.20 m thick. The slab itself was 0.60 m thick and, using a split slab method only the upper 20 cm of the slab contained Xypex Admix. For the walls, the lowest 5th level wall was 0.50 m thick and the higher walls were 0.25 m thick. Xypex Patch’n Plug was used to repair joints, tie-holes and certain cracks. 18 tonnes of Xypex Admix were consumed along with 10 tonnes of Xypex Concentrate and 1.25 tonnes of Xypex Patch’n Plug.

The concrete and joints were completely dry and leak-free so the project stakeholders were happy with the performance of the Xypex technology used in this foundation.
WOQOD Petrol and Service Station
Qatar

Qatar Fuel Company Q.P.S.C. (also known as WOQOD) is a Qatari oil and gas company focused on the distribution and sale of refined petroleum products supplied by Qatar Petroleum. It is the only fuel retailer in Qatar. A budget was allocated in 2018 for the construction of 35 new petrol filling stations and the rehabilitation of existing ones within 2020. As of March 2020, the company has a total of 104 petrol filling stations throughout the country. By 2022, WOQOD will have 150 petrol stations all over Qatar.

WOQOD had been using conventional waterproofing systems (membranes) for underground structures for many years. After experiencing the effective application of Xypex Concentrate and Patch’n Plug during rigorous repair work of a leaking lift pit without any operational interruption at WOQOD Head Quarters, Xypex is being considered as the primary waterproofing material for future petrol stations.

Environmental and Operational Concerns
WOQOD, as a premier fuel distribution company in Qatar has very stringent quality standards. The most critical underground structure is the fuel storage enclosure where humidity sensors are installed to preserve the quality of the stored fuel and to prevent contamination. The petrol stations are located in various parts of Qatar, and often have severe groundwater conditions and high sulfate

Presented by Hanson Doha Trading Co. WLL
content soils. It is an essential requirement to achieve a high level of waterproofing and chemical resistance for the below ground enclosures. In 2018, following a successful pilot project at Old Ghanim Petrol Station, Xypex Crystalline Technology was introduced in project specifications as the standalone waterproofing system for the future WOQOD expansion program.

Xypex has so far been used in 35 new petrol stations in 2018, with Xypex Admix C-1000 NF used in below grade structures, footings, on-grade slabs, wet areas, waste fluid tanks, sump pits, sludge tanks, and more. Most notably, fuel storage containment tanks have been cast with Admix C-1000 NF for fuel spillage protection and concrete durability. Xypex Admix C-1000 NF is now an integral part of WOQOD specification as the primary waterproofing material for all ongoing and upcoming projects.

Construction Schedule Savings
The use of Xypex Admix as a standalone waterproofing product has proved to be a turning point in the design and construction of WOQOD petrol stations. With tight schedules, the use of Xypex Admix saves nearly 3 weeks of critical project time. Additionally, the cost of dewatering was significantly reduced since Xypex waterproofs concrete during the concrete hydration phase itself. Xypex-treated concrete has also demonstrated its ability to self-heal hairline static cracks even under high hydrostatic conditions. By replacing the conventional waterproofing system with Xypex, WOQOD is able to meet its exacting environmental and operational standards saving both time and expense in the process.

Fuel tanks cast with Xypex Admix C-1000 NF
Located in Tel Aviv, Israel, the Midtown Towers are a pair of skyscrapers recently built in one of Tel Aviv’s main thoroughfares, Begin Road. The office tower, standing 197 m high, has 50 floors and is the third tallest building in Israel. The residential tower has 43 floors, 338 apartments, and is the tallest residential tower in Israel at 183 m. The towers are part of a complex that includes a large shopping center and 2,100 parking spaces in 6 underground floors. Construction began in June 2013 with excavation work, and the towers were completed in February 2018.

**7 Below Grade Levels**
Concrete waterproofing was needed in the construction of the Midtown Towers for the foundation of the building, the 7 underground floors, the water tanks, swimming pool structures, and the rain drainage tunnel. Some of the challenges faced on this project included: high hydrostatic pressure, seven different concrete mix designs and, casting concrete in a busy, congested area. Clearly, a solution was required to address these challenges, most importantly providing waterproofing and durability to the concrete.

Xypex Admix C-500 NF and the Xypex Concentrate coating system were chosen above traditional methods of waterproofing, such as membranes, due to Xypex’s unique and effective crystalline technology. Xypex Admix is blended into the concrete mix at the time of batching to waterproof and protect concrete from the start and has been proven to outperforms other methods; it becomes an integral part of the concrete matrix.
Slurry Wall Waterproofing
Xypex Admix C-500 NF was applied to the foundation of the towers and the 7 different floor castings of the underground parking levels. As part of the process of construction for the below grade levels, a slurry wall was built and strengthened with a “Trapeze” solution. The “Trapeze” solution consists of cutting an inverted trapezoidal space into the slurry wall joints and then filling them with concrete treated with Xypex Admix. This strengthens the wall and joints to resist hydrostatic pressure. The “Trapeze” method proved to be successful in reinforcing the slurry wall in an area with soft earth and high groundwater.

The drainage tunnel for directing water collected from the Begin Road to the Ayalon River was constructed through the below-grade parking structure; Xypex treated concrete was instrumental for waterproofing the on-site casting of the square-shaped tunnel located inside the parking area.

Lastly, the swimming pool and water tanks were also treated with Xypex Admix C-500 NF. Thanks to the crystalline crack-healing property of Xypex, cracks in the water tank structure self-healed and both the swimming pool and the water tanks are waterproofed thus completing one of the many celebrated qualities of the Midtown Towers.
As the largest privately owned irrigation company in the Southern Hemisphere, Murray Irrigation, Australia, continues to sustain its high performance in water delivery, security, and retention. Producing 1,000,000 mega liters of water annually and irrigating over 700,000 hectares of land, Murray Irrigation is responsible for maintaining over 4,000 bridge and culvert structures and 3,000 km of irrigation canals across the system. Since construction began in 1928, the company has built engineering feats such as The Lawson Siphon system and The Drop, Australia’s first hydroelectric plant on an irrigation canal.

Extending Service Life
After some years of use, it was evident that a large number (217) of bridge and culvert assets of varying age and stages of deterioration needed remediation. The concrete structures typically exhibited spalling and cracking. Therefore, a concrete waterproofing solution was needed that would be resistant to water erosion, cracks, and carbonation; a requirement specified in the engineering reports.

Additionally, Murray Irrigation required that there was a minimum increase to asset service life of 15 years, thus being able to continue upholding the company’s standards. Due to the size and scope of the project, application of the concrete repair products needed to be efficient and completed within 10 weeks due to the irrigation requirements of stakeholders.

Xypex Concentrate was chosen as the preferred product to meet the engineer’s requirements for an anti-carbonation coating and because of the added benefits of utilizing Xypex Concentrate. Xypex Concentrate, once applied, becomes an integral part of the substrate, it seals static hairline cracks up to 0.4 mm, can be applied to damp surfaces, and is non-toxic. All these features provide added protection and durability through the waterproofing of concrete and were necessary in the reparation of Murray Irrigation’s bridges and culverts.

Application-wise, the ability to spray-apply the Concentrate coating meant that the applicator, National Concrete Solutions, could apply the product efficiently and thus increase time savings. Furthermore, since Xypex Concentrate is permanent and does not require re-application, ongoing maintenance costs have been eliminated for Murray Irrigation assets.

Megamix II was chosen as the preferred product to meet the engineer’s requirements for a repair render for deteriorated concrete surfaces applied at a rate of 20 kg/m². As opposed to competitors’ high strength repair mortars, Xypex Megamix II contains Xypex’s unique crystal-line technology, has high strength yet low shrinkage, and adheres excellently to damp concrete.
Fast Application
During the application process for the bridges and culverts, the ability to dry spray (gunite application) Megamix II resulted in on-site efficiencies. This was a major factor in the overall project success given the volume of product which needed to be applied and the strict timeline.

As a result of using Xypex Concentrate and Xypex Megamix II, 217 structures were repaired and coated in 9.5 weeks. 11,457 m² of concrete was treated with Xypex Concentrate and 10,908 kg of Xypex Concentrate was used across the project, with an overall application rate of 0.95 kg/m². 6,661 m² of concrete was repaired using Xypex Megamix II and 134,752 kg of Xypex Megamix II was used throughout the project, with an overall application rate of 20.23 kg/m². Whilst Xypex Concentrate and Megamix II proved to be highly effective in rehabilitating the structures, the planning, productivity and application skills of contractor National Concrete Solutions were essential to the successful and timely execution of this project.
As the largest aquarium in Latin America, the Michin Aquarium, located in Puebla, Mexico is a center for conservation, research, and education. After the success of the Michin Guadalajara Aquarium in 2015, the new location in Puebla opened its doors in December 2019 to continue raising awareness, sharing marine biodiversity with the public, and celebrating the importance of protecting Mexico’s ecosystems through various activities.

The Michin Puebla Aquarium has more than 90 exhibits with different species located within one of the six ecosystems (Jungle, Forest, Reef, Mangrove, Open Sea, and Lakes & Rivers). Each section “recreates the corresponding atmosphere through sounds, colors and various elements that together create a dynamic tour for visitors.”

Zero Leakage

Due to the nature of aquariums, a waterproofing solution was needed for the various tanks and exhibits that were to be built in the new Puebla Aquarium. These tanks and exhibits would remain filled for more than 30 years, so the owner needed a guarantee that there would not be the slightest possibility of leakage and therefore no maintenance in any concrete element of the aquarium. Furthermore, as some of the tanks would contain salt water, the concrete needed to withstand the effects of marine environments.

Despite being specified to use surface waterproofing, the owner and contractor decided that Xypex’s crystalline waterproofing technology was the best solution. Due to the fact that Xypex Admix C-1000 becomes an integral part of the concrete, the crystalline structure within the concrete prevents the ingress of water and other liquids even under strong hydrostatic pressure. In contrast, barrier-type products function only at the surface of the concrete. Xypex’s crystalline matrix also protects...
the concrete from chemical attacks, such as chlorides, sulfates, acids, or industrial chemicals, and self-heals cracks of up to 0.4 mm, thus extending the durability of concrete in the various aquarium tanks.

**Construction Schedule Savings**

Furthermore, since the crystalline waterproofing is added directly to the concrete mix there is no installation time involved. Contrastingly, the typical installation rate for PVC membranes can be 85 m²/shift and 250 m²/shift for spray-applied membranes. By choosing to use Xypex Admix, the Michin Puebla Aquarium was able to reduce the amount of labor and time necessary in application as well as eliminate the future need for maintenance or reapplication.

Xypex Admix C-1000 was used in the concrete for the Cistern, Shark Tank, Manta Ray Tank, and Quarantine Tank. With a capacity of 600,000 litres, the Shark Tank concrete was dosed with Xypex Admix C-1000 during a two-stage casting construction. Cold joints, cracks, and tie holes were repaired with Xypex Concentrate and Xypex Patch’n Plug. The Manta Ray and Quarantine Tank used Xypex Admix C-1000 in a monolithic casting and no consolidation problems or major cracks were detected. The concrete used in this project for the various tanks and cisterns is now fully protected, thus managing to extend its useful life and allowing habitats within the aquarium to have the best conditions of quality and safety.
SPECIAL RECOGNITION

2020 BEST INTERNATIONAL PROJECT AWARDS
The National Centre of Infectious Diseases (NCID) is a 330-bed purpose built facility to strengthen Singapore’s capability in infectious disease management and prevention. Composed of two blocks of institutional buildings with four levels of basement substructure and three underground pedestrian/vehicular underpass links, NCID was officially opened in September 2019. With state-of-the-art technologies, the health center provides enhanced ability to respond effectively to potential infectious outbreaks and houses Singapore’s first high-level isolation unit for highly contagious patients.

**Technical Specification**

Xypex’s crystalline system for concrete waterproofing and durability was proposed, approved, and accepted to provide protection to the four levels of underground substructure (basement base slabs and perimeters) and three underground pedestrian/vehicular underpass links.

Prior to selection, the Xypex Technology was tested to EN12390-2 (Water Penetration Under Pressure). The project specification required a maximum water penetration of less than 15 mm and the Xypex Concentrate and Admix treated samples achieved average water penetration of 5 mm and 10 mm respectively at 29 days.

The original specification had also required the installation of a membrane on the mud slab but this was replaced by the application of Xypex Concentrate resulting in cost and time savings. An additional waterproofing measure was included at the interface of the bored tension piles and the raft slab whereby an additional coating of Xypex Concentrate was applied to minimize the incidence of cracking and water transmission.

In order to provide a single and integrated waterproofing system, the specification for a diaphragm wall was changed to contiguous bored piles with a skin wall, treated with Xypex Admix, cast directly against it. At the interface of the raft slab and the bored piles, an additional layer of shotcrete was sprayed against the piles and then a coating of Xypex Concentrate applied to provide additional protection at this critical area.
Both Xypex Admix C-1000 NF and Xypex Concentrate were used in the 19,000 m² 4th level basement slab and skin walls as well the underpass link base slab, walls, and roof. A total of 58,500 m³ of concrete were treated in all. Construction joints were treated with Xypex Concentrate.

Xypex products successfully waterproofed and protected the various underground structures in a timely manner. Following the fitting out of the construction, The National Centre of Infectious Diseases was thankfully operational before the outbreak of the Covid-19 pandemic.
One of Ethiopia’s new hotels, this privately-owned Boutique Hotel has a footprint area of 500 m², an underground level, and ten above grade floors. The hotel began construction in January 2015; however, it was initially being built without sufficient technical supervision of the concrete placement causing concrete defects such as honeycombs in numerous locations. These defects, especially in the basement and on slabs, resulted in extensive water leakage.

To mitigate these issues, 2,200 kg of Xypex Concentrate, 1,700 kg of Xypex Modified, and 2,500 kg of Xypex Patch’n Plug were used. These products were applied to various concrete structures of the hotel, and, following extensive concrete repair works, all structures were completely rendered waterproof by the end of construction. The Xypex product applications were undertaken over a three-year period, in tandem with the “Master Schedule” of the overall project, and were completed in January 2018.

The basement walls and floors, the roof, terraces, elevator pits, and concrete gutters were all waterproofed with a two-coat system of Xypex Concentrate followed by Xypex Modified. Xypex Patch’n Plug was used for concrete repair work in previously built structures and effectively sealed cracks to stop leaking within seconds.

Xypex’s unique crystalline technology works by filling the capillaries present in concrete with a non-soluble crystalline structure. This integral structure fills capillary tracks rendering the concrete waterproof. In the case of the Boutique Hotel, all structures have now been waterproofed and protected resulting in no further leakage.
A new transformer substation was built beside the Hungarian-Ukrainian border, on the outskirts of the village of Szabolcsbáka and is the largest transformer substation in Hungary.

The new 750/400 kV electrical transformer substation transforms and feeds electricity coming from the 750 kV transmission line (from Ukraine, Munkács) into the domestic 400 kV transmission network, and forwards energy to neighboring countries. The planned service life of the electrical transformer substation is of at least 50 years.

The transformers relocated from Albertirsa to the new Szabolcsbáka station were 40 years old, so the owner MAVIR ZRT decided to renovate and modernize the transformers for cost efficiency and environmental reasons. Specifically, Xypex products were selected to renovate the fire protection water storage tanks and the transformer bases.

The fire protection water storage tanks needed reliable and durable waterproofing. Xypex Concentrate and Modified were applied in two layers inside the storage tanks, permanently integrating the crystalline technology within the concrete structure. 650 kg of Xypex coatings were successfully used to waterproof concrete in the tanks.
One of the characteristics of transformers is their use of transformer oil. Transformer oil is a type of oil that is stable at high temperatures and whose primary functions are to insulate and cool a transformer. In the case of the Szabolcsbáka transformer station, Xypex Admix C-1000 NF was added to the concrete mixture of the 2,000 m³ base slab in order to protect the surrounding environment from potential transformer oil leakage.

The planned cost of proofing and chemical protection was reduced by almost 50%, almost US$ 75,000, and construction schedule savings of 3 weeks were achieved by using Xypex products instead of traditional coatings. Since Xypex Admix is blended into the concrete mix at the time of batching to waterproof and protect concrete from the start, no additional workers, coatings, or application time is needed.
The Thames Tideway Tunnel is London’s new “super sewer” running from Acton to Abbey Mills. It is being built to prevent millions of tonnes of pollution reaching the River Thames. Xypex was used within the west section of the tunnel and is the sole waterproofer for the Hammersmith Connection Tunnel.

The western section runs from Acton in West London to Fulham in South West London and is constructed by the BAM Nuttall, Morgan Sindall and Balfour Beatty joint venture.

**The Waterproofing Challenge**

During the design phase, technical discussions were held between SMR Projects and Morgan Sindall Underground Professional Services the JV designers. This was to explore how Xypex’s crystalline technology could assist in reducing the permeability of the concrete. This was especially important across the construction joints.

Trials were undertaken in conjunction with a ready mix company to establish how the crystalline technology behaved within the very specific mix design. In addition, this was to prove its water tightness over standard tunnel construction methods. A number of trials were set up using with and without Xypex products for a clear comparison.

**Successful Trials**

The trial results proved that the addition of Xypex Admix C-Series to the concrete gave the greatest protection against permeability. The growth of the crystals across the joint gave a seal in excess of what was thought possible. When tested across the 45 degree “day” joint, cores were taken through the joint in 3 axis to test for water permeability and the results were more than enough to confirm that this technology was superior.

**Change of Design**

The west section was originally planned to be constructed using a sprayed concrete primary liner and a cast in situ secondary liner with a waterproof membrane placed in between the two layers.

The addition of Xypex Admix C-Series meant that following the trials, the stake holders were satisfied enough to remove the membrane in the Hammersmith connection tunnel. The benefits of Xypex Admix C-Series was in addition used throughout the whole of the west section.
**Added Benefits of Xypex**

The Xypex Admix C-Series waterproofed the concrete and the joints during the hydration period of the concrete. It also provided additional benefits over and above non-active pore blocking admixtures by having the ability of self-heal cracks up to 0.4 mm.

Furthermore, Xypex provides a significant further benefit for sewer projects — durability against many aggressive chemicals.

Microbial induced corrosion is common to sewage collection and wastewater treatment structures. Moreover, it is a challenge well known to engineers as they address the ever increasing demand for structures that will meet the growing demands of industry, the environment, economics, and the need for improved water supply and sanitation.

Xypex is proven in new sewage and wastewater treatment structures. It is excellent at handling chemical attack in severe biochemical conditions.

**The Final Specification**

SMR Projects supplied 100,000 kilograms of Xypex Admix C-Series. This was used on the primary liner incorporated within the sprayed concrete, awaiting the secondary liner to be cast directly against it.
Located in Bodrum, Turkey, The Voyage Hotel Torba has magnificent views of the Aegean Sea. With rooms overlooking the sea, swimming pools, and restaurants, the hotel is an attractive vacation location.

In December 2019, construction began for new buildings and sections of the resort, some of which were just 7 m from the sea. It was to be a challenging construction due to the soil type, the proximity to saline water, and winter weather conditions. Additionally there was a strict deadline of 4 months for completion.

Instead of opting for membranes, Xypex products were chosen to waterproof and protect concrete structures in the Voyage Hotel. Xypex Concentrate, Xypex Patch’n Plug, and Xypex Admix C-1000 NF were used to protect the new amenities.

One of the challenges faced in construction was the proximity to the sea. Sea water was present in the first 60 cm of excavation and posed a corrosion threat to the concrete. However, Xypex’s technology forms in-soluble crystallized structures within the concrete matrix. This prevents water born chloride ions from entering the concrete and corroding the reinforcing steel thereby ensuring that the concrete meets its service life expectations.

Another challenge faced was the weather conditions, December-March being Turkey’s wettest months of the year. Due to scheduling constraints, no drainage system was used during construction meaning that the concrete was placed under water throughout the building process. Despite these conditions, construction was not delayed since, as an integral part of the concrete, Xypex Admix C-1000 NF does not need to be applied to dry surfaces as do traditional membrane and coating technologies. This reduced the construction schedule by 45 days.

Additionally, since Xypex Admix C-1000 NF is added to the concrete mixture, less labor is required during application. In fact, only two Xypex workers were needed to accomplish the waterproofing of the concrete, increasing efficiency and bringing cost savings during construction.

Ultimately, Xypex assisted the contractor, Botam Yapi, in delivering a watertight project on time without penalty despite harsh weather conditions and tight construction schedules.
A 28 ha development, the Tun Razak Exchange (TRX), also known as the Kuala Lumpur International Financial District, is located at the heart of Kuala Lumpur for the purpose of international finance and business. Consisting of 26 buildings and over 2 million m² of gross floor area, TRX buildings include office, residential, hotel, retail, and cultural offerings as well as multiple vehicular tunnels and two light rail tunnels. This project also forms part of the government’s Economic Transformation Program.

The karst land surrounding the TRX development meant that waterproofing of the below grade structures was critical. Xypex Admix C-1000 NF was chosen to waterproof the concrete used in the vehicular tunnel slab, drainage sump pit, and the basement car park. 130,000 m³ of concrete were mixed with Xypex Admix C-1000 NF.

Prior to using Xypex Admix C-1000 NF on TRX’s structures, the compressive strength of trial mixes was tested. After 30 days, the concrete cubes containing Xypex Admix C-1000 NF measured 61.83 MPa compared to the control cubes 57.16 MPa, an 8% increase in strength.

Because of Xypex’s unique crystalline technology, capillaries and pores in the concrete are sealed by the non-soluble crystalline structure preventing leaking under high hydrostatic pressure, protecting the concrete and increasing the durability of the structures.

With workforce and space constraints in the tunnel construction, Admix C-1000 NF was able to save time and manpower as it is simply added to the concrete mix during batching. Additionally, since Xypex Admix C-1000 NF is integrated permanently within the concrete, the crystalline technology will remain active to heal hairline cracks throughout the service life of the structure, requiring no future maintenance.