MPS System
Frequently Asked Questions

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Hydrotech

Frequently Asked Questions – Hydrotech's MPS System

Q1. What is the most common and probably the most difficult problem to solve in a basement or an underground structure?

Water ingress is the most common and the most difficult problem to solve permanently. It can be a result of poor design, workmanship or maintenance. Water ingress can still occur even in very dense concrete, in fact, the denser the concrete the stronger are the suction forces within the capillaries.

Q2. How does water ingress occur?

Water penetrates the concrete fabric by three primary mechanisms: Capillary action, temperature differentials and hydraulic pressure. Capillary action is much more powerful than the force of gravity, as demonstrated by "rising damp" in buildings.

Q3. What is Capillary action?

Capillary action is the tendency of a liquid to rise in a narrow tube. It is a result of the cohesion[1] force between water molecules and the adhesion[2] force between those molecules and the solid material forming the walls of the tube. The more narrow the tube, the greater the rise of the liquid.

[1] Cohesion, the mutual attractive force that exist between the like molecules of a particular liquid.
[2] Adhesion, is the attractive force between two unlike materials, such as liquid and a solid container,

Q4. What is Electro-osmosis?

Electro-osmosis or Electro-osmotic flow is the motion of ions in a solvent environment through very narrow channels, or capillaries, where an applied potential across the channels cause the ion migration.

Q5. What is the MPS System?

The Multi-Pulse Sequencing (MPS) System is a highly advanced form of electro-osmosis technology that uses low voltage and low current to ionise water within the capillaries of the concrete or masonry lining and actively repels water out of the structure.

Q6. What is the history of the MPS Technology?

- In1807, the German professor Russ discovered the theory and principles behind the movement of liquids in capillary structures.
- In 1930, the Ernst brothers in Switzerland discovered how to move fluids in capillary structures through applying an electrical charge between positive and negative electrodes.

- In 1962, the theory behind the effect was established by E Franke. Subsequent experiments by Prof. Andreas Fourie at Newcastle University over a 10 year period failed to move water through concrete effectively, because there was no efficient control system.

- In 1987, the Norwegian inventor Kjell Aage Utklev discovered that a pulsating current would continue to transport water in concrete for as long as the current was applied.

- In 1988 this discovery was patented. The inventor Kjell Aage Utklev is a shareholder and consultant to Hydrotech International.

Q7. What are the basic components of the MPS System?

The basic components are anode (Titanium wire), cathode (copper rods or stainless steel plates), a junction box and a Control Unit.

Q8. How does the MPS System work?

The Control Units of the MPS system produce a low voltage electric current which is passed through anode wires which are installed on the roof, interior walls and floor surfaces of the structure.

Water within the capillaries in these concrete linings will be ionized and the water molecules will travel towards the cathode which is placed in the ground outside the concrete lining. Thus an electro-osmotic force field will be created around the positive electrodes that will prevent water and moisture from intruding back into the structure.

Q9. Why does the MPS System use Titanium wires?

Based on research carried out by our development team in Norway, Titanium wire has been selected due to its high strength, high resistance to corrosion and good electrical conductivity.

The spacing of the Titanium wires will be selected by our designers depending on the site conditions, grade and thickness of concrete wall or slab being treated, and other factors such as age and alkalinity.

Q10. Where is the best location for the cathode?

The cathode should be placed at locations where we want the water ingress to be directed. Therefore, they should be placed at locations where the conditions are always damp. They can be placed in the ground at the back of the wall being treated and/or embedded below the on-grade floor slab. Site testing is required to determine the appropriate locations for the negative electrodes.

Q11. How much water pressure can the MPS System repel from the concrete capillaries?

The electro-osmotic force acting on the ionised water in the capillaries is stronger than both gravity and capillary action. The MPS System has proven successful in preventing the penetration of water in the turbine chamber of a dam structure against a pressure of 600 metres head (60bar).

Q12. Can the MPS System be installed in both existing and new-build structures?

Yes, the MPS System can be installed in existing structures by saw-cutting small grooves in the interior surfaces of the walls, floors and ceilings as required. For new-build structures, the titanium wires can be installed in grooves which can be pre-formed in the concrete, or by saw-cutting grooves as for existing structures. Installation in new-build structures will generally cost significantly less due to better accessibility.

Q13. What is the scope of MPS applications?

The MPS System can be installed in the following structures:

- Underground projects such as railway stations, car parks and all other basement structures.
- Tunnels such as road and rail, pedestrian subways, cable and gas tunnels.
- Hydroelectric and dam projects.
- Marine structures, underwater foundations and embankments.
- Bridges and viaducts

Q14. What are the limitations of the MPS System?

The system can only be applied to capillary structures such as concrete, block work, brickwork and masonry structures.

Q16. Can the MPS System be applied on roofs?

Yes, the MPS System can be applied on roofs without the need to cut chases on the ceiling below the roof deck level.

Q17. Can the MPS System be applied on reinforced concrete elevated water tanks?

Yes, the MPS System can be applied both on new build and existing corroded water tanks installed on roof deck levels.

Q18. What are the other benefits of the MPS System?

The MPS System reduces the corrosive environment for steel reinforcement thus reducing ongoing cracking of the structure.

The MPS System reduces the relative humidity in basement areas, reducing the corrosive environment for mechanical equipment and other fixtures.

Dry-wall construction with drained cavities is not required, resulting in improved space utilization and reduced construction cost.

Pumping out of water from the basement is not necessary, saving energy and maintenance costs.

The MPS System can be installed from the interior side of the structure, removing the need for expensive exterior excavation work to existing basements.

The MPS System prevent s peeling of paint, and unpleasant odors

The MPS System prevents mould and mildew, thereby reducing the incidence of water and air-borne bacteria.

The MPS System stops efflorescence, which is a whitish, powdery deposit on the surfaces of structures, formed when mineral-rich water rises to the surface through capillary action and then evaporates.

Q19. How long will the MPS System protect the structure?

For as long as the Control Unit is activated, MPS System protects the structure 24 hours a day, 7 days a week for its design life.

Q20. Is there any maintenance required after installation?

The MPS System utilizes high grade materials, has no moving parts and is virtually maintenance free. Once installed, apart from periodic checking of current levels, there is no need for ongoing maintenance. The system is essentially self-regulating and will continue to operate for many years without requiring any intervention.

We can provide an on-going maintenance service, essentially to read and report on the current levels in the system, or alternatively, we can provide training for the client's staff to monitor the operation of the system.

Q21. What is the voltage and power consumption of the MPS System?

The Control Units of the MPS system produce 20 to 40 volts electric current at a maximum of 10 amperes. The MPS Control unit will be activated 24 hours per day (24/7) and the approximate power consumption will be 40 watts per 1,500 square metres of area treated.

Q22. What is the capacity of a single MPS Control Unit?

One MPS Control Unit will control the water ingress for an area of approximately 1,500 square metres.

Q23. How does the MPS System handle large areas?

For large areas, one Control Unit will be provided for each area of 1,500 square metres. Thus the technology is the same for large or small areas.

Q24. How long will the structure take to dry out after the MPS System is installed?

From the time that the MPS System is energised, it usually takes about 4 to 6 weeks on average to dry out the concrete. Once the concrete is dry, it will remain in a dry condition providing the power is not switched off. The time taken for drying out can vary with the thickness and condition of the concrete and its degree of saturation, porosity, pH level and other factors.

Q25. What if the electricity supply fails when the MPS System is in operation?

In the event of a power cut, it will take at least as long for the water to get back into the concrete, as it did to dry it out in the first instance, and since it is unlikely that the power will be off for more than a few hours under normal conditions, the concrete will therefore still be protected from the problems of water ingress. (The MPS System employs circuit breakers and the system will need to be turned on again if there is a sudden power surge causing the circuit breaker to trip).

Q26. What are some MPS reference projects?

Hong Kong Projects

- Central Station Pedestrian Subway (MTRC)
- One IFC Lift Motor Room (Henderson Land)
- Cityplaza 4 (Swire Properties)
- International Plaza, Warehouse Basement, Kowloon Bay
- Hang Seng Bank Headquarters
- Wo Hop Shek Crematorium, Fanling (ASD)
- Oi Man Estate, Homantin, HK Housing Authority
- Tin Ka Ping Lecture Theatre, HK Institute of Education, Taipo NT
- Commercial Basement at 181 Gloucester Road, Wanchai

China Projects

- Tengmieshan Highway Tunnel, Xishuang Banna, Kunming Yunnan
- Zhengzhou Electric Cable Tunnel, Zhengzhou Cable Authority, Henan
- Residential Basements, Green Rivers Manor Beijing
- Hydro-power Dam, Guiyang Guizhou Province
- Shanghai Villa and Ping Hu Villas in Zhejiang Province

London, Norway & New Zealand Projects

- Walthamstow Station Pedestrian Subway (London Underground)
- Oslo Central Railway Station
- The Norwegian National Museum
- Oslo Housing Society
- Oslo Ullevall Hospital
- Tafjord Dam, Norway
- Tonstad Power Station, Sira Kvina, Norway
- The Norwegian Building Research Station
- The Norwegian National Hospital
- St George's Hospital, Christchurch New Zealand

Q27. Can you provide testimonial letters from reputable companies and developers?

Yes, we have testimonials from Hong Kong Mass Transit Railway (MTR) and major Hong Kong property developers Henderson Land and Swire Properties. Copies of these testimonials can be provided upon request.

Q28. What are the advantages of MPS Technology over existing methods of water proofing?

Membranes require great care in installation to avoid failure. One tear during construction can be enough to compromise the essential continuous integrity of a membrane and render the system ineffective. Membranes are applied to the outside of a basement wall and are costly to retrofit. Excavation is often not feasible and membranes cannot solve seepage through the walls and slab if they are breached.

External drainage (tanking) systems alone are not sufficient in most cases to protect against water intrusion, and will, over time, deteriorate, usually in 25 years or less.

Pumping equipment is sometimes installed inside or outside a structure for the purpose of regulating the level of inflowing water. Although pumps remove water, they do not remove humidity existing in the surrounding structure. A wet wall promotes the growth of organisms, such as moulds and mildew and promotes corrosion of rebar which leads to spalling and break-down of the concrete cover.

Q29. What is the cost of MPS Technology?

The cost of an MPS system can be considered in two parts, Hydrotech's cost and the Installation cost.

Hydrotech's cost covers the site evaluation, testing, system design, supply and delivery of materials, site supervision, commissioning, and a license fee to cover the use of our MPS technology. Hydrotech's per sqm cost to cover this scope will vary with the site location and the size of the installation.

The Installation cost covers the cutting or forming of the grooves for the titanium wires (including supply of labour and cutting equipment), placing and grouting of the titanium wires, installation of cathodes, electrical wiring, etc. The Installation cost also includes liaison with the client re approvals for the installation works, and compliance with all local safety, labour and working regulations, and insurance requirements.

The Installation costs will vary widely depending on whether it is a new-build application with 24 hour unobstructed access for the work, to the other extreme such as installation in an operating railway tunnel with restricted working hours, difficult access, obstructions from other services and stringent safety requirements. The client is able to have good control over the Installation Costs by using his own contractor to carry out the Installation Works under Hydrotech's supervision.

The cost of installing an MPS system in a new-build application can be offset by savings in deleting the costs of a conventional membrane system, as this will not be required if an MPS system is installed.

Also the installation of an MPS system will result in permanent dry conditions in the structure, which will result in extensive savings in long term maintenance costs.

Q30. Does Hydrotech provide a guarantee for the MPS System performance?

Yes, we provide a guarantee against water ingress for 10 years. Conditions for our guarantee are stated in our Guarantee Certificate, a copy of which can be provided upon request.

Q31. Will the MPS System affect the existing rebars?

No, this has been confirmed by independent tests carried out for stray current levels in the steel reinforcement by CAPSIS Report, Reference no. AH5541 Rev. 3 dated May 2007.

Q32. Will the MPS System affect the signaling or other control systems for Underground Railway installations?

No, this has been confirmed following extensive tests carried out for Electro-Magnetic Compliance (EMC) by York EMC Services Ltd, Document No. 2285CBR1 dated 9 January 2007. The MPS technology has been granted a full European EMC compliance certificate. It has also satisfied all the stringent requirements for London Underground and Metronet in the UK in connection with EMC compliance for railway systems.

Q33. Are there other Independent Reports on the MPS System?

Yes, we have an Independent Technical Report from the Australian Centre for Geomechanics dated 10 May 2007. A copy of the report can be provided upon request.

Q34. How does the MPS System differ from Cathodic Protection?

The MPS System is completely different from Cathodic Protection for the following reasons:

- Cathodic protection has sacrificial mesh whilst MPS System does not.
- Cathodic protection connects directly to the existing rebars whilst the MPS System does not.
- Cathodic protection does not dry out the concrete structure.
- Cathodic protection is many times more expensive than the MPS System.

Q35. Can the MPS System be installed in combination with sheet membranes for tunnel projects?

Yes; experience shows us that we cannot rely solely on a sheet membrane system as when the sheet membrane behind the concrete lining is punctured, torn or split, this will allow continuous ingress of ground water through these breaches under hydraulic pressure. The MPS System can either completely replace a sheet membrane system or can also be used as a back-up system to control water ingress due to breaches in the membrane system.

Q36. Can the MPS System be installed where the interior concrete lining was sprayed with shotcrete?

Normally yes, depending on the permeability and the porosity of the shotcrete material. Water ingress may be more rapid in the areas constructed of shotcrete than of insitu concrete. Hydrotech will conduct insitu and/or laboratory tests to determine the condition of the shotcrete lining prior to the determination of the required spacing of positive electrodes suited for these conditions.

Q37. What are the performance objectives of the MPS System? What values of relative humidity can be achieved? What is the corresponding electricity consumption?

The performance of the MPS System can be measured by monitoring the electrical current readings in each circuit and the insitu relative humidity levels at or just below the concrete surface.

As an example, our installation at Cityplaza 4, Taikoo Shing showed that the initial relative humidity reading in Nov 1998 was 100% and the current reading was 200 milliamps. In Dec 1998, the relative humidity had reduced to 95% and the current reduced to 40 milliamps. The reduction in current results from the increased resistivity of the concrete as the moisture level drops.

Q38. How can the MPS System intelligently monitor the structure against water ingress?

The MPS System is essentially self-regulating. Should there be any increase of moisture content in the concrete for any reason, the electrical current flowing through the MPS system automatically rises proportionally to counter-act the water ingress penetrating into the concrete structure. That means that more current is being drawn from the Control Unit to counter the increased rate of water ingress into the capillaries.

Q39. Can the MPS System provide a permanent solution to water ingress problems?

Yes, the MPS System provides a permanent solution to water ingress because the electro-osmotic force field generated from the Control Units actively repels the water within the concrete capillaries, dries out the concrete structure, and protects the existing rebars from corrosion.

Q40. How can we contact Hydrotech International?

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