URETEK ICR

Concrete Lifting and Soil Stabilization

URETEK ICR

The URETEK Method®

to CONTROL Concrete, Soil, and Infrastructure Problems

WHITE PAPER

The Relationship Between Concrete Asset Problems and Underlying Soil

For many properties, slab settlement problems caused by soil movement can result in potential damage to the structure, potential accidents, and loss of real estate value.

The stability of a building's foundation or concrete slab is based largely on the properties of the soil it is built on. When concrete foundations in industrial, commercial, or residential structures settle and move, it can be the result of several soil-related circumstances that include: building on expansive clay, compressible or improperly compacted fill soils, or improper maintenance of the grounds around a foundation. When settlement occurs, it can destroy the value of the building and even render it unsafe.

Water is the basic culprit in the vast majority of expansive soil problems. Specific components of certain soils, especially those located in regions that receive a substantial amount of rainfall, tend to swell or shrink with variations in moisture. The extent of this movement varies from soil to soil. For example, soils that are the highest in clay content are generally more susceptible to water while the soils lowest in clay content tends to be the least affected. In some areas the movement is insignificant; in others, it is quite pronounced.

When unstable soils are used as a base for concrete foundation systems, some structural movement will inevitably result. If all the soil beneath a foundation or slab swells uniformly, there usually is no problem. Problems occur, however, when only part of the concrete substructure settles. Then, the differential movement of the soil causes cracks or other damage. For many properties, slab settlement problems will result in damage to the structure, potential accidents, and loss of real estate value. Poor drainage, tripping hazards, rough floors, unsightly cracks, and equipment malfunctions may also result from these types of concrete settlement problems.

Traditional methods of addressing such problems have provided less than ideal results. These older systems and the materials that are used with them often require lengthy installation times and do not stabilize the underlying soil, which is at the heart of the problem. As a result, these approaches yield a temporary fix which often result in a short life expectancy for the repair, and higher costs down the road to find a more permanent solution.

Traditional Methods of Addressing Asset Settlement Problems

Over the years, an assortment of "less than ideal" remediation efforts have included:

1. Cementitious Grouting ("Mud-Jacking") – This process involves the use of a water/soil/fly ash/cement mixture injected by hydraulic pressure into the underlying soils to void fill and support the damaged or settled areas of the asset. Unfortunately, the cementitious material is slow to cure, and, shrinks as it hardens creating new voids. Once this material cures, it lacks sufficient tensile strength for long term effectiveness.

When cementitious grouting is used to fill subsurface voids in an effort to stabilize the asset, significant amounts of the material must be pumped into the soil to ensure the underground space is completely filled. Once this material hardens its inherent weight of 140 lbs/ft3 adds an excessive burden to an already distressed base soil condition. In addition, this added weight can also complicate adjacent utility conduits and piping located beneath the surface of the building structure. If enough force is applied, the pressurized grout can move existing utilities out of alignment or force its way into cracks that exist within the underground pipes or lines.

2. Concrete Removal and Replacement – The process of removing an entire concrete asset and replacing it can take several weeks or months to complete and restore. For commercial businesses, foot traffic around the project area must be avoided during the replacement and curing period, contributing to greater amounts of dust and debris, longer business delays, disrupted workflows, and lower productivity, to say nothing of the higher cost that is incurred.

Traditional Methods of Addressing Asset Settlement Problems (cont)

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3. Inferior Polymer Materials – The use of polymer-based resin as a lifting and stabilization material has been available within the construction and asset restoration industry for several years. Unfortunately, a number of inferior polymer materials are now appearing on the market that are lacking the important hydro-insensitive properties that are so essential in wet soil conditions. When such inferior (and often cheaper) materials are used, the polymer formed will be soft and spongy, unable to lift and stabilize the slab for long term service. The original settlement problem will quickly return leading to subsequent rounds of restoration, replacement or repair.

In comparison, the URETEK ICR advanced 486 Star/684 Star expansive polymer resin is the only material with a patented hydro-insensitive capability. This essential quality provides outstanding results in wet or dry conditions. It drives out standing water located within underground voids, stabilizing the soil from further water penetration while sealing the concrete asset or infrastructure component from further water intrusion.

4. Do Nothing – In times of unforeseen emergencies and/or tight budgets, many decision makers often choose to do nothing, even when the problem is visually apparent. But the URETEK option can now offer tremendous savings for long term solutions.

Since 1989, URETEK ICR has provided viable solutions to industrial, commercial, and residential customers to solve their asset settlement problems. Subsequent sections of this white paper will discuss the benefits of the URETEK ICR Method, and how it provides a superior solution for repairing concrete settlement problems as compared to more traditional approaches.

Understanding The URETEK Method®

The URETEK ICR advanced polymer technology solves complex concrete asset settlement projects that are the result of water intrusion and poor soil consolidation. URETEK ICR is the industry's fastest, most cost effective, safest, and longest lasting solution to solve these challenges.

In summary, The URETEK Method® is a unique process and material designed to identify and facilitate the repair and restoration requirements of problems associated with industrial, commercial, and residential concrete assets.

Step 1: Locating the Problem Area

At URETEK ICR, locating the source of a concrete settlement problem is a function of deploying experienced people, efficient processes, and state-of-the-art equipment for the task. URETEK's highly-trained and experienced field personnel are able to quickly identify specific problem areas and isolate the exact location where corrective action needs to be taken.

First, a complete elevation schematic is generated which will determine the exact point of the settlement within the ground soil. In addition, extensive background research is conducted on the building or residential structure to determine any prior ground repairs that may have taken place. For example, this research will uncover any previous problems such as a broken sewer or water pipe that may have resulted in the ground voids and soil displacement. Computer-generated laser levels are also used to determine the degree of concrete movement, providing accuracy of up to a 1/10 of an inch.

Finally, URETEK ICR deploys on-site dynamic cone penetrometer testing equipment which will measure the comparative strength of the base soil layers beneath the concrete. This information is used to determine the exact locations and quantities of the URETEK expanding polymer material that will be used to strengthen and densify the problem soil strata.

In the rare instance where a settlement problem presents a unique or unusual circumstance, URETEK ICR has relationships with several specialty engineering firms that can be brought in to assist with completing the repair and facilitating a resolution to the asset problem.

Understanding The URETEK Method®

Step 2: Repairing the Problem Area

Next, surface profiles are generated to properly identify any differential settlement of the pavement. At this point, one of two expansive polymer materials will be used, URETEK 486 Star or 684 Star, which is based on the type of underlying soil and amount of densification required. The material is precisely injected in layers via small (5/8") diameter holes drilled through the concrete, where it fills in any existing void spaces (see image on next page). Once injected, the polymer resin begins to expand to 20 times its original liquid volume and forms a stable, strong, lightweight replacement base material. Because the polymer-resin material is extremely light, any additional overburden weight is kept to a minimum. The properties of URETEK polymers are carefully matched to typical base material compressive strength characteristics.

Expansion reaches 90 percent of its full compressive and tensile strength within approximately 15 minutes

In addition, the polymer resin cures very quickly. Expansion reaches 90 percent of its full compressive and tensile strength within approximately 15 minutes. As a result, the time requirement for an entire repair project is reduced to a matter of hours instead of the days or weeks that alternative techniques require.

Finally, since the URETEK polymer resin is hydro-insensitive, any surrounding ground water and/or wet soils have no detrimental effect on the material's structural integrity or performance. As a result, the trapped subsurface water is forced out and the wet soil densified. The injection of the polymer material is repeated into each of the drilled holes until the entire area is sufficiently filled and sealed.

Understanding The URETEK Method®

Step 3: Monitoring the Repair Process
As the concrete asset is lifted, its movement is precisely monitored on the surface using a laser-level measuring device. If the concrete surface needs to be further leveled or raised, this is achieved through a series of additional monitored injections, and analyzed once again

The URETEK Method®

The Environmental Impact of The URETEK Method®

Many customers are concerned whenever a chemical-based material is injected into nearby ground soil. Others want to understand the impact that these materials have on both the environment and adjacent water supplies.

The URETEK 486 Star/684 Star Material has been extensively tested by independent laboratories to meet all EPA Standard Environmental tests. The results show that all URETEK 486 Star/684 Star polymer-resin materials are environmentally benign and have no detrimental effect to ground soils as a result of either decomposition or degradation of the polymer. In addition, its use does not lead to the pollution of surrounding groundwater supplies.

Once the URETEK expanding polymer material has been fully cured and hardened to a rigid form, it becomes inert, chemically neutral and does not contribute to soil or water contamination, leaching, or pollution. The material is also impervious to mildew and fungi and neither appeals to or provides nourishment for insects or rodents. When exposed to sunlight, ultraviolet rays cause a yellowing of the foam and a slight pitting of the hardened surface, which poses no environmental threat.

In addition, the chemical and solvent resistance qualities of the URETEK polymer material are quite good, and its ability to resist grease and oil is excellent. The material is also stable in water solutions of common detergents, salts, acids, and bases. However, strong acids and bases will attack the rigid foam and result in chemical degradation. The table on the next page provides an overview of the resistant qualities of the URETEK expanding polymer to a variety of chemical substances.

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SAFETY & ENVIRONMENT

The URETEK expanding polymer material has been tested to meet all EPA environmental tests and has shown no detrimental effect to ground soils or surrounding groundwater supplies.

Chemical Resistance of URETEK 486 Star/684 Star Materials

Substance Name	Resistance Rating	Substance Name	Resistance Rating
Acetone	Poor	**Regular Gasoline**	Good
Benzene	Excellent	**Toluene**	Excellent
Brine (Saturated)	Good	**Turpentine**	Excellent
Carbon Tetrachloride	Excellent	**Water**	Excellent
Ethyl Alcohol	Good	**Acids and Bases**	Poor
Kerosene	Good	**Ammonium Hydroxide (10%)**	Good
Linseed Oil	Good	**Hydrochloric Acid (10%)**	Good
Methyl Alcohol	Good	**Nitric Acid (Concentrated)**	Not Recommended
Methyl Chloride	Fair	**Sodium Hydroxide (Concentrated)**	Excellent
Methyl Ethyl Ketone	Poor	**Sodium Hydroxide (10%)**	Excellent
Motor Oil	Excellent	**Sulfuric Acid (Concentrated)**	Not Recommended
Perchloroethylene	Excellent	**Sulfuric Acid (10%)**	Good

Physical Property Testing for 486 Star/684 Star Materials

684 STAR Physical Property Testing
Lot # 032905

Density	(ASTM D1622)	2.03 LB/FT3
Open/Closed Cell	(ASTM D6226)	87.4% Closed
		9.7% Open
Compressive Strength	(ASTM D1621)	26 psi @ Yield
		24 psi @ 5% Deflection
		25 psi @ 10% Deflection
Flexural Properties	(ASTM D 790)	725.8 Flex Modulus
		42.4 Flex Strength
Thermal Conductivity	(ASTM C518-98	0.173
		BTU/HR (FT2)/F/IN)

486 STAR Physical Property Testing
Lot # 04085

Density	(ASTM D1622)	2.98 LB/FT3
Open/Closed Cell	(ASTM D6226)	85.2% Closed
		10.5% Open
Compressive Strength	(ASTM D1621)	42 psi @ Yield
		35 psi @ 5% Deflection
		37 psi @ 10% Deflection
Flexural Properties	(ASTM D 790)	922.2 Flex Modulus
		54.4 Flex Strength
Thermal Conductivity	(ASTM C518-98	0.233
		BTU/HR (FT2)/F/IN)

Applications for The URETEK Method®

There are four applications where The URETEK Method® provides a significant advantage over more traditional methods for resolving problems associated with concrete lifting and soil stabilization:

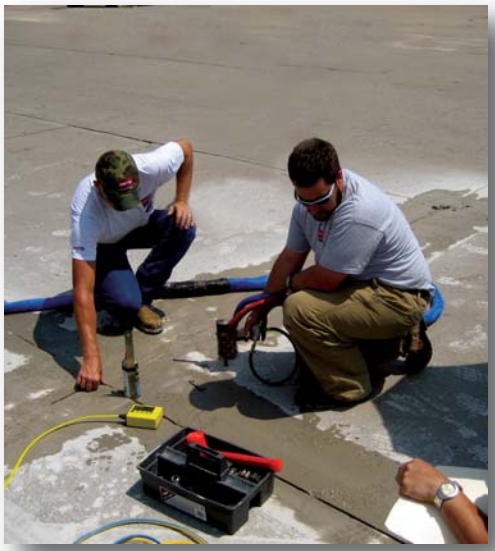
A. Void Filling – When weather conditions produce rain, snow, or severe temperature shifts, expanses such as fissures and water pockets can be created that in turn form voids just below the pavement surface. These expanses can result in foundation settlement, concrete factures, inventory liability, disrupted workflows, and productivity downtime. Occurrences such as these can destabilize concrete foundations, slabs, and patios as well as a host of additional industrial, commercial, or residential assets.

The URETEK Method® is very effective in addressing these situations. The expansive, hydro-insensitive polymer material, which is at the core of the URETEK ICR Method, drives out any standing water and aggressively fills voids. It also densifies the soil and prevents the expansion and formation of new voids in the future.

B. Stabilization – By undersealing and void filling, The URETEK Method® stabilizes above-ground assets and prevents any further differential settlement. The URETEK Method® effectively fills, compacts, and stabilizes the base soils beneath the asset and seals the underlying area from further water intrusion that can contribute to degradation of the asset. The URETEK Method® is the only process that combines the benefits of sealing, stabilizing, and asset protection, with a rapid curing time that allows the repair area to be quickly restored and returned to service.

Applications for The URETEK Method®

C. Lifting - The URETEK ICR Method is quickly and economically applied to solving the densification, lifting and realignment of industrial, commercial, and residential concrete assets. The expansive, hydro-insensitive properties of the URETEK 486 Star/684 Star polymer material and its 10-year guarantee ensure that settlement problems are properly corrected. Since the material is injected in layers, the amount of lifting can be controlled to within one tenth of an inch, which assures highly accurate lifting profiles for the asset.



D. Sealing – Sealing joints and cracks from water leakage and seepage into or below concrete slabs, is one of the most important and frequently recurring problems facing many concrete assets. If left unattended, leaking joints and cracks can grow, further damaging the surface of the asset and compounding void and settlement problems.

To underseal assets in these situations, the patented URETEK expanding polymer material is strategically injected just below the surface of the area that poses the greatest problem. As the material is injected, it begins to expand, seeking out and filling sub-surface cracks, leaks, voids, and joints, providing a strong, stable and long-lasting seal which also resists further water intrusion into the area.

The Advantages of URETEK's Expanding Polymer Material

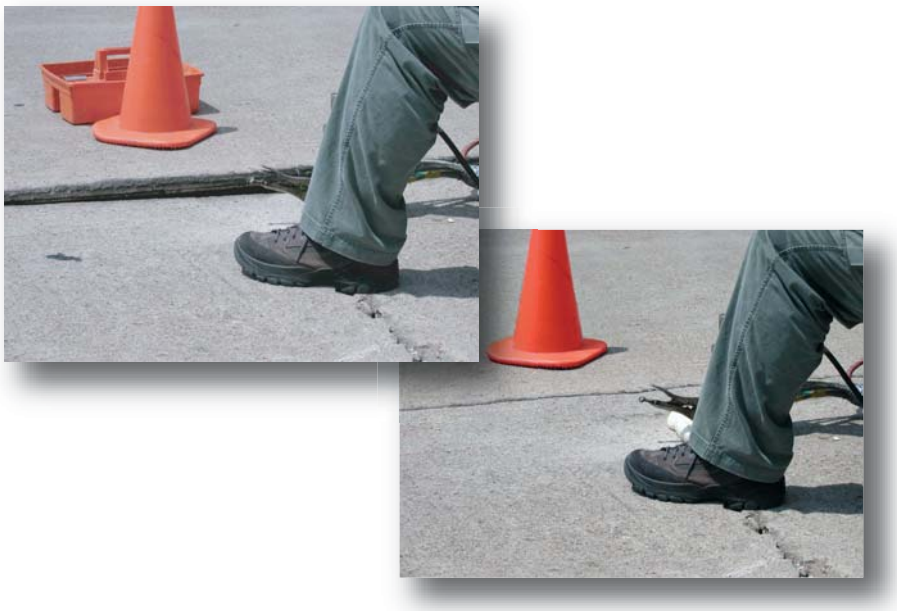
URETEK ICR effectively puts property managers, structural/geotechnical/civil engineers, homeowners, and a host of other specialists in control of their deficient industrial, commercial, and residential assets by saving both time and money. Using the URETEK soil stabilization and concrete lifting technology, property owners can now choose an accurate, prompt and cost effective asset repair solution.

To summarize, the URETEK 486 Star/684 Star material is:

- **Expansive** – When the URETEK 486 Star/684 Star polymer material is injected into a subsurface layer, it expands up to 20 times its original liquid volume, filling any voids or fissures in its path while further compressing and densifying the surrounding area.

- **Hydro-Insensitive** - The patented URETEK 486 Star/684 Star polymer material displaces trapped water and is not compromised by wet conditions during or after installation. Once the curing process is complete, the hardened material retards further water infiltration. The material is excellent for sealing pavement cracks or joints.

- **Faster Installation** – Using the URETEK ICR Method and the URETEK 486 Star/684 Star polymer material, time requirements for the repair process are reduced to hours instead of the days or weeks for alternative techniques. As a result, projects are completed on time and on budget, minimizing the impact on productivity.



The Advantages of URETEK's Expanding Polymer Material

• **Lightweight** – The URETEK 486 Star/684 Star polymer material is extremely lightweight, weighing less than 10% the weight of a comparable cement-based grouts or asphalt materials. The polymer thereby adds only a minimum amount of overburden weight into a project area which may already have distressed base and sub-base soils.

• **Long Lasting** – The URETEK 486 Star/684 Star polymer is guaranteed for ten years against any loss of dimensional stability or deterioration. The longevity of the material means the repaired system remains in service long after other methods have failed.

* **Safe** - The cured URETEK 486 Star/684 Star polymer material is inert, environmentally neutral and does not contribute to soil or water contamination, leaching, or pollution. The material is impervious to mildew and fungi.

The URETEK 486 Star/684 Star material, when combined with The URETEK Method®, provides business and residential owners with a highly effective solution for their asset rehabilitation and stabilization requirements.

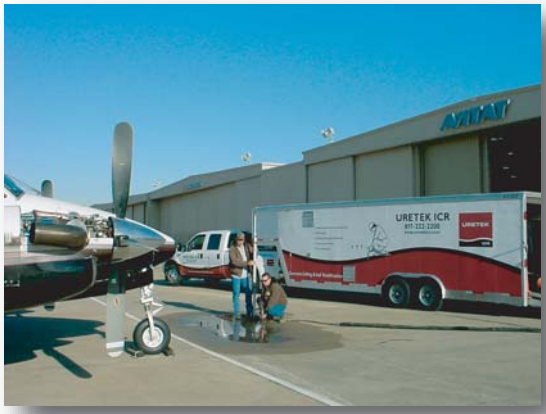
Case Study: The URETEK Method® Applied to a Concrete Apron

Customer Profile: Aviation Service, Dallas, Texas.

Customer Environment: A 500,000 sq. ft. concrete apron located outside of a jet hangar

Customer Situation: Uneven concrete slabs create a poor image and present a hazard

Aviation Services is a full service "fixed base operator" for jet aircraft based at, or traveling through, multiple Texas airports and provides parking, fueling, and repair services for private jet aircraft. Just outside one of their hangars, Jet Aviation maintains a 500,000 square foot concrete apron, where clients park and load/unload their aircraft upon arrival at Love Field. Keeping this high traffic area in immaculate condition is both crucial to their operations and essential in maintaining a positive and professional image with their clientele.



Recently, the company began to experience "ponding" problems across their concrete aprons as the base soils beneath the individual concrete slabs settled creating an uneven surface. In fact, some of the slabs had settled to such an extent that the raised and exposed slabs presented a liability hazard for any pedestrian traffic in the area.

During a site visit immediately after a major thunderstorm, a URETEK ICR technician observed swirling water draining through the joints of several slabs. This observation led URETEK ICR to believe that there might be substantially larger voids beneath the surface of the aprons than originally anticipated. While "mudjacking" had been used to resolve a similar problem, the application had several major drawbacks. The cement grouting process that was used was very messy. It did not precisely lift the uneven slabs, and the material had a tendency to break down over time. As a result, the problem re-appeared just a few years later.

To permanently resolve the problem, URETEK ICR first located and quantified the void locations beneath the apron. URETEK ICR used state-of-the-art ground penetrating radar equipment to scan and analyze individual 12.0' wide sections of the pavement. With the data captured from the scan, URETEK ICR determined the exact locations where the URETEK 486 polymer injections were required. URETEK ICR technicians then went to work, filling the identified voids and lifting the uneven concrete aprons.

Because of the precise manner in which the URETEK ICR Method disperses the polymer material, the concrete slabs were lifted and accurately realigned to the adjacent slabs. This created a more professional appearance and restored proper drainage to the area. Most importantly, the project was completed on time and within budget, with no disruption to Aviation Service's busy maintenance operations.

"URETEK ICR was able to complete the task of fully restoring the apron both quickly and cleanly, with no interruption to operations. Plans are underway to utilize URETEK ICR on additional apron areas later this year."

Concluding Summary

The URETEK Method® provides a cost effective, fast, and safe solution to for the stabilization, repair, lifting, and restoration of a variety of industrial, commercial, and residential assets. As a pioneer in this area, URETEK ICR delivers a "no disruption" cure for repairing a variety of asset settlement and stabilization problems such as sunken loading docks, warehouse floors, building foundations, and concrete slabs. URETEK ICR also can be used for depressed patios, driveways and concrete patios.

With the URETEK Method®, owners of industrial, commercial and residential properties can make the most cost effective use of limited budget resources while dramatically improving the quality and longevity of their existing concrete assets. In addition, the rapid cure rate of the patented URETEK 486 Star/684 Star polymer material used in the URETEK Method®, accelerates the repair of settled or depressed concrete assets, minimizes work disruption and restores the asset to full use in a fraction of the time required with other traditional repair and maintenance methods.

Since 1989, with over 75,000 successful worldwide jobs, URETEK ICR focuses on resolving complex concrete lifting, soil stabilization and infrastructure rehabilitation projects for industrial, commercial, and residential properties, infrastructures, and assets.

For more information about the URETEK Method®, please visit our website at www.uretekicr.com or call 1-800-240-7868.

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