In our first newsletter of 2017, we expand on another crucial aspect of concrete durability: Freeze – thaw resistance.

While not applicable to all climate zones, freeze-thaw deterioration is a significant cause of major damage to concrete structures yearly. As such, protecting concrete against deterioration from freeze-thaw cycles, and ensuring the integrity of structures in severe environments has an enormous economic impact. Read below how the addition of PENETRON ADMIX can help prevent freeze-thaw damage in concrete mixes.

Check out also the PENETRON Worldwide section below where we profile projects from some of the 105 countries where PENETRON is now present – that benefited from our crystalline solutions.

I hope you enjoy reading our industry updates. Feel free to share them with your colleagues and forward to others interested in this information (use the SEND TO A FRIEND BUTTON).

Jozef Van Beeck  
Director, International Sales & Marketing
Protecting concrete against freeze-thaw damage

New Museum of Modern Art (Goulandris Collection), Athens, Greece

Unilever Savory Foods Plant, Durban, South Africa

Petronas Lubricants Global Research Center, Santena, Italy

State Farm Headquarters, Atlanta, USA

Queen Beatrix International Airport, Oranjestad, Aruba (Dutch Antilles)
Concrete damage caused by freeze-thaw cycles is one of the main reasons for concrete deterioration.

Water trapped in the capillaries and micro-cracks of concrete expands when it freezes. Without any free space to compensate for this expansion, internal pressure builds, slowly widening existing capillaries and creating new cracks in concrete. When temperatures rise, the frozen water in the concrete thaws and travels deeper into the capillary matrix, where the process is repeated during the next freeze cycle.

Freezing water in the capillaries and micro-cracks of concrete exerts an internal, expansive pressure; this leads to cracking of the concrete.
Freeze-thaw damage negatively affects durability and the service life of concrete since it increases permeability over the course of repeated freeze-thaw cycles.

Some symptoms of freeze-thaw damage include spalling and scaling of the concrete surface, exposure of the aggregates, parts of the concrete coming off as well as D-cracking. Such damage accelerates the penetration of additional water and harmful chemicals into the concrete matrix, increasing the deterioration of the concrete.

The problem is significant and costly. The United States alone spends tens of millions of dollars every year to repair and maintain concrete structures affected by freeze-thaw damage.

In order to enhance concrete’s resistance against freeze-thaw damage, air entrainment additives are commonly applied. While these additives create additional voids in concrete to compensate for the expansion of freezing water, they also increase the concrete’s permeability and subsequently, reduce its compressive strength and durability.

A more effective way to combat freeze-thaw damage is the inclusion of PENETRON ADMIX into the concrete mix. Not only does PENETRON ADMIX seal existing capillaries, voids and cracks, it also enables self-healing of future cracks once they occur. This prevents water from entering the concrete in the first place.

Recent durability studies have shown that PENETRON ADMIX-treated concrete samples (without air entrainment admixtures) significantly reduce the risk of freeze-thaw damage and stay well below the limits for concrete exposed to severe environments (see diagram below), which completely eliminates the need for air entrainment additives.

Click here to read more.
The New Museum of Modern Art in Athens is a modern 12-floor museum located in Pagrati, close to the Agios Spyridon Church. With a total exhibit area of 7,300 m² (8,731 square yards), it is home to the fabulous Goulandris collection of 19th and 20th century masterpieces.

Half of the exhibition floors are located underground at a depth of -26 m (-85.3 feet). One of the major difficulties of the project was to ensure permanent waterproofing and protection of the concrete against water ingress due to the high groundwater table on-site. Having worked successfully with PENETRON products in the past, the project engineers specified PENETRON ADMIX, a third-generation crystalline permeability-reducing admixture, which is added to the concrete at the time of batching. In combination with PENETRON ADMIX, PENEBAR SW swellable-type waterstops were used to seal all construction joints in the substructure.

Post-pour concrete defects were rectified using PENETRON coating and PENECRETE MORTAR.
Unilever’s Savory Foods Plant in Durban is the company’s fifth facility in South Africa. It is also the first green manufacturing plant in the city of Durban.

The US$81.8 million project was named Indonsa (“Morning Star” in Zulu) and is regarded as one of the largest private investments in South Africa since the 2010 FIFA World Cup. Spread over 22,000 m² (236,806 ft²) on a 78,000 m² (839,585 ft²) site located in the Riverhouse Valley in Durban, Indonsa is the company’s largest dry foods manufacturing site globally.

The planned production capacity of the plant is 65,000 tons (130 million pounds) per year, which can be expanded up to 100,000 tons (200 million pounds). The company produces savory food products for its Knorr, Robertson’s, Knorrox, Aromat and Rajah brands in Durban.

The Indonsa savory foods plant is designed with advanced green features to create an environmentally sustainable manufacturing site; this helps Unilever reduce its CO₂ emissions from manufacturing and logistics by about 5% a year. The company’s target is to reduce CO₂ emissions by more than 40% by 2020 (from 1995 base levels).

To achieve this target, the design of the Indonsa plant integrated sustainability features such as controlled zone lighting throughout for efficient use of energy, building insulation to reduce heat due to sunlight and lower power consumption for air conditioning units. The mixed air compressors in the plant are run by super-efficient motors, which consume less energy than typical motors.

Further, the plant harvests rainwater that is conveyed from its roofs to storage tanks with a capacity of 1.5 million liters. The water is then treated and used in the plant.

All water in the plant is recycled from time to time, a process that recovers about 70% of the water for reuse.
Excess product waste is converted into energy by an on-site conversion plant. The energy gained is fed into the national grid.

Due to a high contamination risk and close proximity of the Indonsa plant to the Umgeti River, PENETRON ADMIX was added to approx. 800 m³ (1,046 cubic yards) of concrete for the attenuation tanks. Construction joints were sealed using 240 m (263 yards) of PENEBAR SW-55.
Petronas Lubricants International (PLI), the global lubricants manufacturing and marketing arm of Petronas, has begun the construction of its new global research and development center in Santena, Italy, which is scheduled to be completed by the end of 2017.

The facility will boast state-of-the-art laboratories, equipment for lubricants research and development projects as well as automotive and industrial technology testing capabilities and expertise. Once in operation, the global research center in Santena will serve as the heart of research and development initiatives around the world and play a key role in PLI’s growth strategy.

It will further act as a global hub linking technological and technical requirements of PLI’s business in Asia, Africa, Latin America and North America and even allow PLI’s customers access to the company’s technical competence first hand.

The project asked PENETRON Italia to help protect this important and iconic building. Since the ground water level posed a potential threat to the underground concrete structures and other crucial areas, protecting them from any form of water ingress was essential.

Subsequently, PENETRON ADMIX was added to protect 3,700 m³ (4,839 cubic yards) of concrete on Petronas’ latest facility.
The first stage of construction – including the below-grade structures treated with PENETRON crystalline technology – for the Atlanta region’s largest office development project was completed in July 2016. The PENETRON ADMIX-treated concrete is now permanently protected from any water penetration.

Park Center is a commercial campus developed by KDC in Dunwoody, Georgia, just north of Atlanta. It is the biggest development of its kind in metro Atlanta since the early 1990s. The project developer, KDC Realty, has completed the first stage of a “multi-functional hub,” with three of the office towers dedicated as a new State Farm headquarters. State Farm is an insurance and financial services company and one of the largest insurers in the USA.

Conceived by Cooper Carry, a design firm of architects, interior designers and landscape architects, Park Center’s just-completed phase of construction encompasses a 13-story office tower atop a seven-level parking deck, including 585,000 square feet (54,350 m²) of office space. The campus also features a fitness center and street level retail stores and restaurants, with a direct connection to the MARTA (public transportation) station adjacent to Perimeter Mall.

The office towers are built into a hillside, which resulted in a considerable amount of belowground structures, an ideal application for PENETRON technology. Subsequent construction phases for Park Center are now in progress. In total, the entire development will include 2.2 million square feet (204,390 m²) of office space and 100,000 square feet (9,290 m²) of retail, restaurant and entertainment space. The development is pursuing LEED Silver Certification.

Holder Construction, as the general contractor, was able to streamline the construction schedule by using concrete treated with PENETRON ADMIX for the foundation walls and slab of the parking deck.
Last month’s renovation of Aruba’s main airport terminal building included a new passenger arrival hall, expanded administrative and ticket sales offices, new terminal signage and improved baggage handling systems. The VB 225 moisture barrier system from PENETRON Specialty Products (PSP) was chosen as an underlayment for the new flooring in the main arrival hall.
The Prouco Group, the project’s general contractor, was responsible for the repair and renovation of approximately 11,000 square feet (1,000 m²) of concrete flooring in the main terminal, where the existing concrete slab had a “humidity problem” and needed to be renewed.

As a moisture reduction solution for high-traffic areas, VB 225 is formulated to prevent floor failures on concrete slabs containing elevated levels of moisture. Used together with cementitious leveling materials or as a stand-alone moisture reduction solution, VB 225 provides permanent protection for the final floor covering from moisture vapor and also keeps adhesives from contact with the high pH in the concrete. The final flooring cover of epoxy terrazzo included inlaid figurative brass medallions representing the island’s aquatic fauna.

Originally built in 1972, Aruba’s Queen Beatrix International Airport has undergone numerous expansion and upgrade projects over the years. The airport’s passenger handling capacity has more than doubled over the past 20 years.