

CASE STUDY



DRYING AND COATING CONCRETE AT THE NATIONAL AQUARIUM

BACKGROUND

After several years of wear, the coatings on the famous Atlantic Coral Reef Tank and the Open Ocean Shark Tank at the National Aquarium failed, allowing seawater to penetrate the concrete. The tank linings were replaced in order to protect the reinforcing steel from corrosion, which would have weakened the concrete structure.

To improve the replacement coating life, the engineering consultants selected a five-part lining system, including primer, epoxy undercoat, fiberglass matting and two top coats. To ensure good adhesion between the concrete and the primer, the consultants specified a maximum moisture content for the concrete. Drying the concrete was left to the contractor, who used Munters Moisture Control Services to ensure that specifications could be maintained at all times.

Above: At the National Aquarium in Baltimore, Munters Moisture Control Services let the contractor dry out wet concrete quickly, improving adhesion and keeping the project on-schedule and on-budget.

THE PROBLEMS

In lining duty, nearly all concrete coating systems have been known to fail prematurely. Coating manufacturers identify excess moisture as a contributor to these failures in two ways. First, surface moisture prevents the primer from bonding and curing properly. Then second; as the concrete warms during hot weather, heat drives the concrete's interior moisture into the coating from behind. This disbonds the primer.

Such problems can be avoided by drying the concrete before coating. But to achieve the low moisture content required, the air above the surface must be dry. That way the air can absorb the moisture as it is released by the drying concrete.

Also, during humid evening and morning hours, amine epoxy coatings will react with atmospheric CO₂ when moisture is present to form a thin layer of "blush." This surface contamination interferes with adhesion unless it is removed before the next coat is applied. Munters all-season climate control proved to be the solution for both drying the concrete and for avoiding the occurrence of blush.



THE SOLUTION

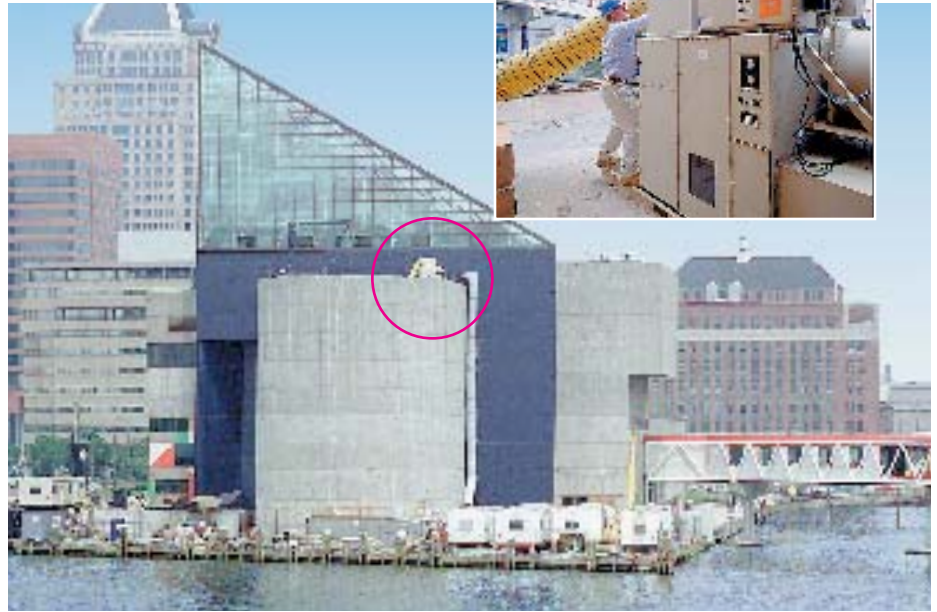
The contractor, Structural Preservation Systems Inc., evaluated several alternative proposals. Munters was used because the proposal reflected experience in drying seawater tanks at other aquariums. The contractor's initial confidence was well placed. Steve Mainello, the project manager for SPS explained that: "Munters had the technical understanding of what equipment we would need, and they worked with us week-by-week as those needs changed. Munters' fast response and their flexibility made me feel like I was their most important customer."

On-site logistics were a particular challenge because the aquarium is located on a short pier, with essentially no space around the building for climate control equipment or for generators. Munters provided a solution with equipment small enough to use on-site power and light enough to be placed on the roof. Dry air was brought through flexible hose down into the tanks. Duct runs of more than 100 ft. were common as the requirement for dry air moved throughout the building.

The contractor accelerated drying time using heaters in combination with dehumidifiers. However, care was taken not to over-dry the concrete in the process of combining the technologies.

The moisture content of the concrete was measured throughout the tank using the equilibrium moisture content method. By quantifying and monitoring the concrete moisture content continuously, the drying process could be tracked section-by-section. Dry air and heaters were repositioned often, because parts of each tank dried more quickly than others. This technique allowed the use of smaller, more cost-effective dehumidification equipment than has been used in the past for concrete drying.

After instruments read 75% RH in all the holes drilled for moisture measurement (about 5% moisture in the concrete), the coatings were applied. Munters desiccant dehumidifiers were then used to keep the dew point 20 degrees below the surface temperature,



Handling a difficult site problem — Normally, large dehumidifiers would have been used to dry the 130,000 cu. ft. tank at Baltimore's National Aquarium, but limited on-site space required a more flexible solution. Munters versatile fleet provided combinations of lighter and smaller dehumidifiers which could be positioned in available locations. Shown above is Alan Britt, District Manager, Elkridge, Maryland office, locating a dehumidifier on the tank roof. Yellow duct delivers the required dry air to lower levels.

while each layer cured. Without that level of dryness, atmospheric humidity can exacerbate the coating's reaction with CO₂ to form the familiar amine "blush" that interferes with adhesion. With the Munters equipment on the job, amine blush was not a problem.

As cleaning, blasting and coating operations moved from tank to tank, humidity control requirements changed. Munters flexible approach recognized this reality, helping to keep costs down without risking coating quality. Steve Mainello explained: "Munters would bring in additional equipment and accessories as we needed it, and allow the equipment to go off-invoice when we finished with it, even if it was still on the site. That trusting attitude and fast response really helped the job go easily. I could always count on Munters—they were always there when I needed them. Our overhead on this job was \$5,000 per day, and the project lasted about seven months. Munters' reliability has saved us at least a week over those months, which means we've saved tens of thousands of dollars."

BENEFITS

- **Tens of Thousands of Dollars Saved**
Keeping on schedule in spite of wet concrete and the exceptionally humid weather, Munters allowed operations to go uninterrupted—downtime would have cost \$5,000 every day.
- **Fast Drying of Concrete**
Excess moisture was removed from the 130,000 cu. ft. concrete tank in less than three weeks. The smaller pretreatment tanks were dried in four to six days. Fast concrete drying keeps projects on schedule, ensuring profits for the contractor and improving job quality for the owner.
- **High-Quality Coating Adhesion**
With no excess moisture in the concrete, the primer adhered firmly to the tank surface, so the primary mechanism for lining failure was held in check.
- **Flexibility to Fit the Need**
Munters made sure the right equipment was ready at all times. Extensive inventory and ability to modify equipment made sure that the job could proceed under humidity control in spite of the unusual site limitations.

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