

Much faster than a jackhammer, hydrodemolition equipment produces a better surface for concrete repair and protective coatings

Hydrodemolition

By Joe Nasvik

Hydrodemolition is best described as a fast-growing niche market. Five manufacturers make and sell the pumps used for removing concrete and coatings on steel, cutting concrete and steel, scarifying concrete, and concrete hydrodemolition. A half dozen contractors work throughout the United States and together own about 60% of the 65 or so pumps owned by all contractors. Regional contractors own the other 40%. Most of the industry's work is on parking garage and bridge deck restorations. But concrete restoration work is increasing on condominiums, high-rise buildings (especially in salt environments), silos, and tunnels. The use of water-jetting equipment is appealing because it's fast, worker friendly, and nonpolluting—an increasing OSHA concern.

Thirty years ago Heavy Duty Hydro-Blasting in Florida manufactured equipment for scarifying and sandblasting concrete surfaces. After 5 years it started a contracting business, too. Later, when hydrodemolition equipment was introduced, it became the first hydrodemolition contractor in Florida. "I spend a lot of time in the field because that's how I learn about problems," says president Al Sader. "And that helps us manufacture and modify waterjetting accessories and equipment to do a better job."

Sader isn't alone in being both a contractor and a manufacturer. American



RAMPART

Hydro Demolition, Newcastle, Pa., and Rampart Construction Services, Coraopolis, Pa., also do both. Bob Nittinger, president of American Hydro, reports that his company buys high-pressure pumps and engines separately and assembles them on large trailers, which it also fabricates. American Hydro also designs and builds its own hydrodemolition cutting robots. "Typically two or more high-pressure pumps supply water to one robot. The combination of volume and pressure creates the horsepower required to remove concrete," he adds.

Removing coatings

Removing paint, epoxy, and other coatings from concrete surfaces is easy

Using ultrahigh pressure, the Oregon DOT contracts for the removal of 3 inches of concrete for a bridge deck overlay repair.

with hydrodemolition equipment. By changing the nozzle from a single jet to a multijet and setting the time of travel for the spray tip with computer software, an operator can remove unwanted materials with minimal damage to the concrete surface.

Sometimes coatings can't be removed by any other means. One project, for example, required the removal of a hot applied asphalt waterproofing membrane on a large concrete deck. The replacement membrane engineers had specified was a PVC, sensitive to all petroleum-based products, so the concrete deck had to be absolutely clean. The contractor tried scraping and scari-fying but was unable to meet the requirement. Though hydrodemolition

was regarded as expensive, it became the only alternative. The process was fast, and no remedial work was required afterwards.

Cutting with water

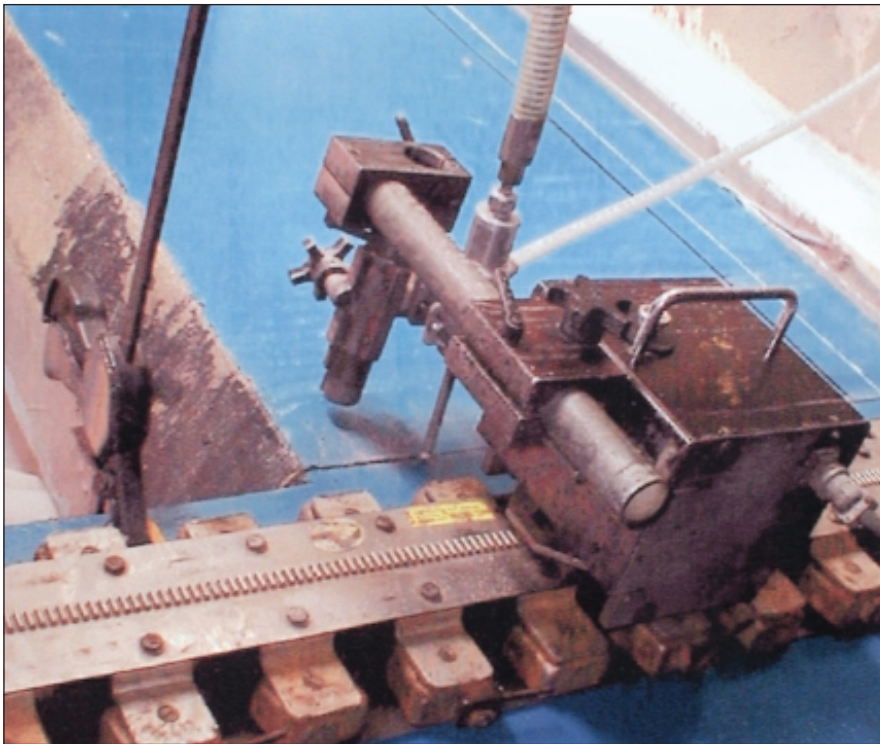
According to Sader, water pressures for cutting concrete and steel are close to 40,000 psi at 7 gallons per minute. This produces precise, controlled cuts. A fine aggregate (usually garnet) is fed into the high-pressure stream of water at the nozzle to assist with cutting. Concrete as thick as 5 feet can be cut in one pass with water-jet cutters. Costs typically run between \$200 and \$400 per hour, making this a more expensive option than sawing. For this reason, cutting with water is

often reserved for difficult projects where other solutions are impractical or not possible. One such project involved enlarging porthole windows in a 12-inch-thick concrete aquarium tank belonging to the Florida Department of Parks & Recreation in Key Largo, Fla. Sawing was attempted but had to be performed from both sides of the wall, and was slow and inaccurate. Heavy Duty Hydro-Blasting set up guides in both the *x* and *y* directions and controlled the cutting by computer. The steel reinforcement in the aquarium walls posed no problems, and the cuts were fast and precise.

Scarifying concrete

Scarifying is becoming more popular with contractors, partly because many major paint and coating manufacturers, concrete finishers, restorers, and waterproofers are insisting on it before providing a warranty for their

HEAVY DUTY HYDRO-BLASTING



Above: Twelve-inch concrete is being cut with a 40,000-psi water jet that has fine garnet aggregate fed into the water stream at the nozzle. The nozzle is guided on a rail.

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AMERICAN HYDRO

Left: Many years ago concrete was placed as a fireproofing material for the steel structure of the Holland Tunnel in New Jersey. Hydrodemolition was used to remove this concrete (3000 cubic yards) to lighten the weight of the structure and prepare the steel for painting. A single nozzle was set up to move in and around girders. Above: Hydrodemolition removes all deteriorated concrete, creates an ideal surface for bonding overlay cement, and does not harm or bend steel reinforcement.

The benefits of hydrodemolition

- Hydrodemolition is faster than chipping, so construction schedules can be shortened (approximately 100 to 1000 square feet per hour, depending on the depth).
- Water blasting removes all deteriorated concrete.
- Hydrodemolition provides better mechanical bonds for repair materials.
- No dust is created.
- Water does not chip, cut, or damage reinforcing steel.
- Hydrodemolition provides a uniform depth of removal on sound concrete and can remove all deteriorated material on other slabs.
- The noise level outside the work area is less than concrete breakers. Hydrodemolition noise does not transmit through the structure being worked on.
- Fractures in sound concrete are eliminated.
- The process is very controlled and can stay within exact perimeters.
- The process can be performed in remote areas where no other removal system is possible.

Disadvantages

- Water runoff, if not properly controlled, can cause major problems.
- City water and sewer depart-

- ments often have special requirements that must be met.
- Staging areas for equipment must be close to the jobsite. This means noise can be a problem.
- Water entering structural concrete may become a problem for post-tensioning tendons, ducts, joints, etc.
- Water passing through the structure can damage lights, conduit, fire sprinkler lines, and architectural elements.
- Vertical and overhead work must be shielded to protect workers from flying debris.
- Hydrodemolition can be more expensive than other removal methods.

product. A single-jet nozzle traveling at a rate faster than that for hydrodemolition provides a good bonding surface for new concrete. The rough, irregular profile cut by the water produces a superior mechanical bond, and there is no microcracking (or bruising) caused by the demolition. Costs for both scarifying and coating removal range from \$1 to \$2 per square foot. Pricing is determined by the total square footage, type of coating, compressive strength of the concrete, and access to the work area.

Hydrodemolition

Hydrodemolition to prepare concrete for restoration work has been available for about 20 years in the United States. Water pressures ranging from 10,000 psi to 40,000 psi at 15 to 100 gallons per minute provide the cutting power. New pumps use higher water pressures with lower water consumption. Sader thinks the ideal pump for the future will have 45,000-psi pressure with a discharge rate of 20 gallons per minute. The advantage to the contractor will be faster and more controlled work with fewer peaks and valleys in the finished surface. Along with stronger, more reliable pumps has

been the development of robots guided by computer software and remote operator controls. This makes it possible to do demolition work in tunnels and tight spaces where workers can't go. Vacuum heads have also become available to pick up the water and small aggregate from the blast. Looking ahead, productivity is expected to increase with the continued development of robots and software.

A typical hydrodemolition project requires 2 to 4 inches of concrete removal. That depth can easily be cut by one pass of the water nozzle, which reduces the concrete to slurry and aggregate. Most applications are still horizontal, but more recently columns and beams, walls, and ceiling surfaces are being prepped for restoration by hydrodemolition. Beth Newbold, president of Rampart, reports that Rampart is currently removing $\frac{1}{4}$ inch of concrete destroyed by acid-producing bacteria in containments for a large sewage treatment facility in California. An acid-resistant topping will replace the deteriorated topping.

Cleanup

Cleanup and water disposal are the biggest problems of hydrodemolition. Though the contractors interviewed for this article are quick to point out that OSHA is coming down hard on dust caused by other demoli-



At the Secondary Waste Treatment Facility in Carson, Calif., a Programmable Logic Computer (PLC) was used to guide the nozzle to remove approximately $\frac{1}{4}$ inch of concrete surface destroyed by acid from the sewage bacteria. A microsilica mortar was used to reconstruct the surface.

tion techniques (which can cause silicosis), treating huge volumes of wastewater is the challenge for hydrodemolition contractors.

Each part of the country has its own standards regarding how the water must be treated for disposal, and in some areas, where the water will be drained into sanitary sewers, the requirements can be very detailed. In parking structures, the contractor responsible for water disposal diverts the wastewater into a tank where particulate matter quickly settles to the bottom. The water then overflows into a second tank, if required, where it's adjusted for pH by using acid to neutralize alkalinity. Finally the water is released into sewers. Either the hydrodemolition or the general contractor can be responsible for this process. Often restoration contractors are the ones to contract the hydrodemolition process and prefer to take responsibility because they are experienced with treating wastewater.

Should you use hydrodemolition on a post-tensioned structure?

Unfortunately the jury is still out on this issue. An International Concrete Repair Institute (ICRI) task group has worked on a guideline statement for hydrodemolition over

Specification documents should include

- who provides water and is responsible for obtaining permits.
- the depth of cut requirements. Typical language relates to depth of cut below steel reinforcement but should also allow for the variable depth of the reinforcement.
- water disposal requirements and who is responsible for handling this.

the past 4 years. At present there is no consensus whether or not this process should be performed on

post-tensioned structures. There are strong feelings on both sides of the issue. The concern is that water can penetrate the waterproof shielding around the cables and cause corrosion. However, many post-tensioned structures have been hydroblasted successfully. One of the earliest structures (if not the first) is a parking garage in Syracuse, N.Y., restored using hydrodemolition in 1988. Nittinger said, "I walked the structure last year and saw no sign of damage or corrosion." The issue may come down to the care exercised by the hydrodemolition contractor. Rick Winkler, vice president of Rampart, adds that some specifiers are more concerned about damage caused by jackhammers when they encounter post-tensioned cables.

What specifiers want

Larry Church, a project manager for Walker Parking Consultants, regularly specifies hydrodemolition. The issues he wants addressed in contracts include controls for supply water and discharging waste—including the protection and replacement of items that are damaged by water during the process. The depth of demolition is another sensitive area requiring better definition. Some contractors file claims for extra work whenever they are required to make more than one pass. "Specifiers also want dependable schedules," he says. "This can require backup equipment and crews in the event of breakdowns or other problems that come up." And there must be understanding, before the job begins, about how to handle noise from the truck-mounted pumps and demolition nozzles if and when it becomes an issue. ■

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