



SYNTHETIC SLURRY USED FOR FOUNDATION WORK AT BALTIMORE /WASHINGTON INTERNATIONAL AIRPORT

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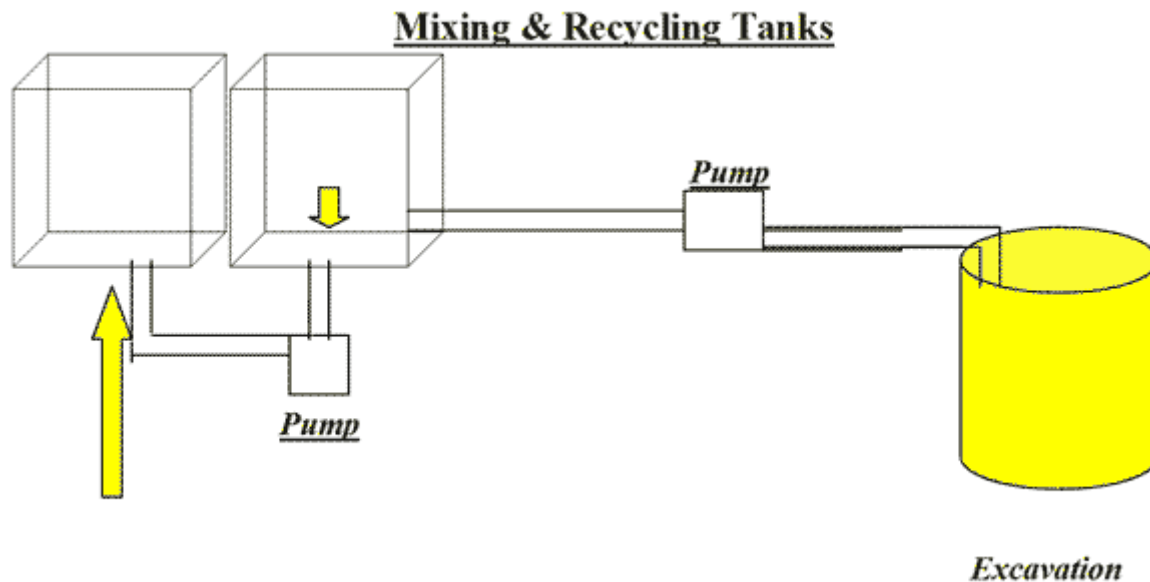
Baltimore, Maryland – The Baltimore/Washington metropolitan area has experienced a surge of population growth resulting in greatly increased traffic at the Baltimore/Washington International Airport (BWI). As part of a major expansion of BWI, Atlantic Caisson Corporation of Glen Rock, Pennsylvania recently completed constructing the cast-in-place concrete pilings for the curbside extension at the airport for the first two stages. 95 of 142 caissons have been installed and the project is 67% complete. Diameters of the shafts range from 48” to 60” with average depths of 38 lineal feet. Atlantic Caisson utilized a Watson 3100 CM HP to drill all 95 shafts in 74 days.

Drilled Caissons Reduce Construction Footprint

Shallow footings were considered for support of the upper level roadway structures; however, calculations showed that to support the required loads would have resulted in large footings at least 15 feet square. Due to the presence of numerous utilities and the need to maintain traffic during construction, drilled caissons were selected as the preferred foundation system. The project plans called for an allowable shaft end bearing of 30 kips per square foot.

Slurry Installation of Caisson Foundations

Atlantic Caisson Corporation introduced the synthetic slurry method of drilling foundation shafts into the Baltimore area in the fall of 1998, the state of the practice has gradually changed from the telescoping dry method to the slurry displacement method. Shore Pac slurry improves construction economics in many ways. The polymer slurry requires less mixing/processing equipment, reducing capital investment, jobsite congestion and fuel costs. It is highly concentrated so small quantities of the dry polymer are required.



Consequently, Atlantic Caisson proposed this method to the General Contractor, Kiewit Construction, and the slurry displacement method was accepted due to past success using slurry in the Baltimore area.



First the slurry equipment is set up on-site. Atlantic Caisson owns two 10,000 gallon slurry tanks, skid-mounted and fitted with platforms, which reduces tank rental costs. Hoses and pumps have been fitted with valves allowing slurry to be pumped from the tank holding fresh slurry into the caisson under construction. As concrete is poured into the drilled caisson, the slurry being displaced is recycled back into the second slurry tank for reuse on the next hole. Air compressors run the Sand Piper diaphragm pumps used to pump the slurry. Diaphragm pumps are preferred over centrifugal pumps, which can shear the polymer, break its molecular chains, and reduce its viscosity.



View of the slurry tank, diaphragm pumps, hoses, valves and air compressor required to run a Foundation slurry drilling project.

The slurry Shore Pac is an easy mixing, water-soluble, polymer supplied as a granular powder. When mixed into a stream of water directed into the excavation the Shore Pac yields into a viscous clear liquid that holds the hole open by hydraulic pressure and forming a membrane along the sidewalls of the borehole. This polymer has been designed specifically for drilling large diameter foundation caissons and it has been approved by Caltrans.

The polymer slurry is pre-mixed by adding it through a Venturi jet mixer connected in-line to the discharge side of a centrifugal pump which is plumbed to discharge the polymer/water mixture into the slurry tank. Agitation is accomplished with compressed air delivered throughout the bottom of the tank.

Prior to mixing the slurry, the pH of the make-up water is adjusted by adding 5 lbs of soda ash per 1,000 gallons mix water. Chlorine from municipal water is neutralized by adding ½ lb DE-CHLOR per 1,000 gallons mix water.

Slurry Mixing Procedure

1. Pre-treat water with soda ash 5 lb per 1,000 gallons mix water for a pH of 8-10.
2. Pre-treat water with DE-CHLOR ½ lb per 1,000 gallons mix water.
3. Add Shore Pac GCV through Venturi type mixer @ 2.8 lbs per 1,000 gallons if pre-mixing in surface tanks, (if mixing directly within excavation sprinkle into stream of water slowly as the excavation is filled.)
4. Monitor marsh funnel viscosity maintain at 54-60 sec/qt. Depending on soil conditions.



The crane lifts the rebar cage lowering it into the finished drilled shaft



Soil & Water Conditions at the Site

Water levels encountered at the site can were erratic and unpredictable. This was due to irregular interbedding of impervious silts and clayey silts with highly permeable sands. Shallow water levels were encountered, representing perched water that when drilled into would flood the shaft and dilute the slurry. Jim Hunt, Drilling Superintendent for Atlantic, compensated for his problem by starting with a viscosity of 100 sec/qt. “The water trapped in the sand between the tight silt layers flowed into the hole when we drilled through it, as though under pressure. The only way to prevent sidewall collapse was to maintain a high viscosity,” Hunt said.

Slurry Recycling

Mark Suchy is a believer in maximizing the use of the Shore Pac slurry by recycling. After the slurry testing has been completed and the rebar has been placed, a suction line is dropped just inside the excavation for recycling of the slurry. When concrete is tremie pumped into the bottom of the hole, the displaced Shore Pac GCV slurry is pumped from the top of the excavation into the holding tank. The last three feet of slurry above the concrete interface is not recycled, this slurry is contaminated from contact with the concrete. The impacted slurry can be identified by its oatmeal-like appearance and is pumped to a waste tank.

The recycled Shore Pac GCV slurry is tested for viscosity and pH. While adding water to restore the original volume, additional soda ash is added to adjust the pH. More Shore Pac GCV is added to restore the slurry to full strength. Typically one-fourth the original amount of Shore Pac added to the water filling up the holding tank is required to restore the slurry to its initial strength.

Disposal of Slurry

Shore Pac slurry fluids are non-toxic and are readily degradable upon completion of a slurry job to facilitate disposal. Upon completion of the project, any remaining Shore Pac can be broken down with a chemical oxidizer. The most common oxidizer for this purpose is 5% Sodium Hypochlorite solution (household bleach).

Hypochlorite solution is added to the slurry at a rate of 1 gallon per 100 barrels (4,200 gallons) of slurry to be treated. After the hypochlorite breaker is added, it is necessary to ensure complete oxidation of the polymer molecules. This can be accomplished by pumping the slurry back into a holding tank or breaking it down in the hole and agitating with the auger.

Atlantic Caisson can re-use the slurry, thereby minimizing disposal costs, and maintaining a cleaner, more manageable construction site. Shore Pac GCV is a dry synthetic granular polymer manufactured by CETCO Drilling Products. The polymer offers greater frictional load bearing capacity (skin friction) in bored piles and higher success rates on load tests.

For information on drilling caissons using the slurry displacement method with polymer slurry , and for information on equipment and products mentioned in this article, contact John H. Berry, P.G. Hydrogeologist/Product Manager with CETCO Drilling Products.



View of spoils spinning from auger. The polymer can be seen flying off the auger. Notice how dry the spoils stay.



Photo shows the entrance to BWI Airport and the expansion for additional gates.