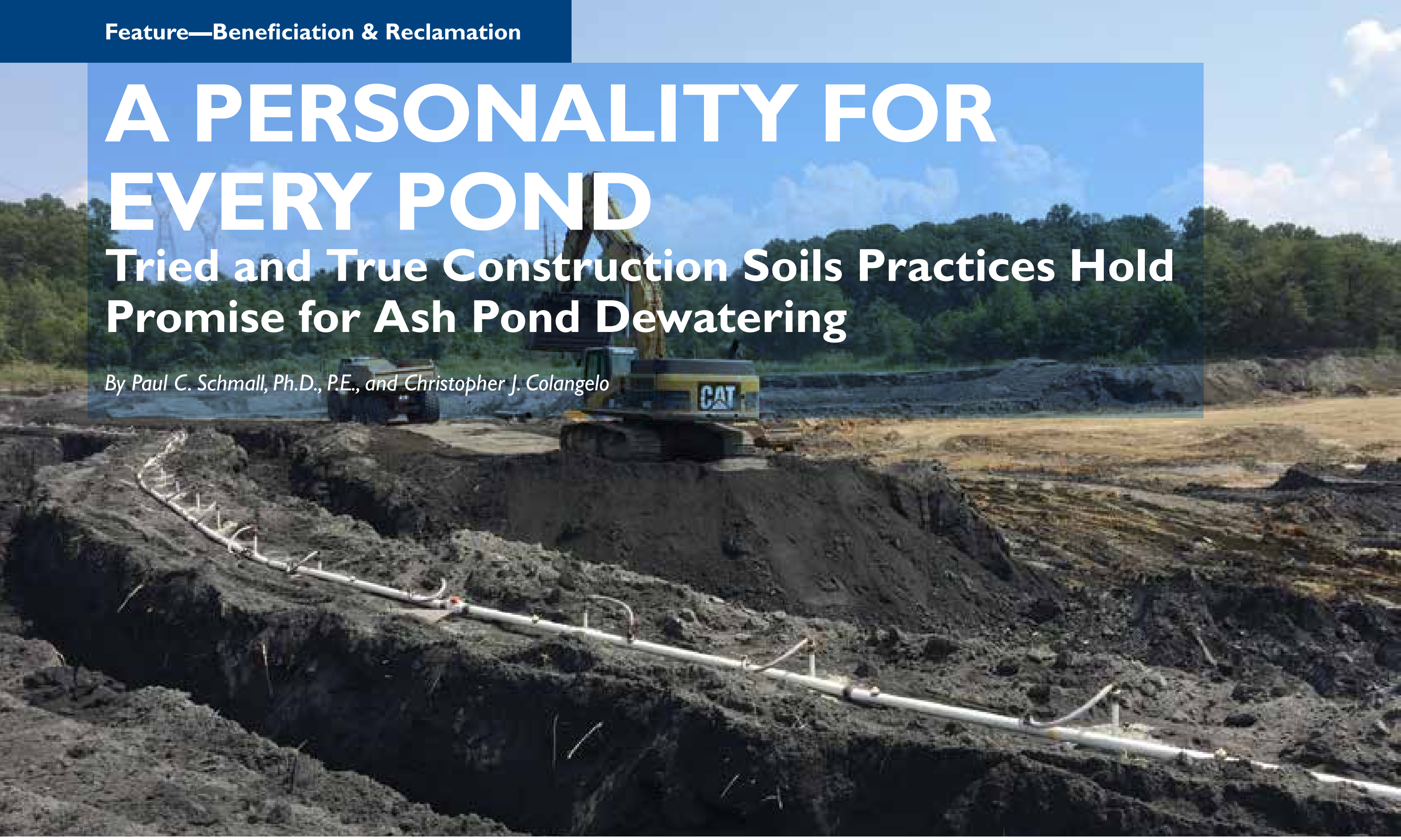

A PERSONALITY FOR EVERY POND

Tried and True Construction Soils Practices Hold Promise for Ash Pond Dewatering

By Paul C. Schmall, Ph.D., P.E., and Christopher J. Colangelo

As the clock ticks down toward mandatory compliance with the Environmental Protection Agency (EPA) coal combustion residuals (CCR) ruling, facility owners and their engineers must rapidly move ahead with developing plans for the closure of wet ash surface impoundments and landfills.

For decades, there has been no reason to physically perform work on the ponds, and the methods of doing so have remained rudimentary. Albeit slowly, the ash will drain with rim ditching and sumping. This will eventually provide enough "dry crust" on the surface of a pond to permit equipment use—typically low ground pressure or amphibious. The material consists microscopically of very fine ball-bearing-like spheres that are highly unstable when wet. Rim ditching is like digging a hole at the beach—you don't get too far below the water before the material runs and sloughs in. The rim ditches can incrementally lower the water table, like slowly peeling an onion.

The rate of draining or partially draining a pond with rim ditching may be very slow, but the greater concern is the compromise in safety. The rim ditching and sumping approach will always keep the equipment (and operators) just slightly above the water level in the ash. This is the place of greatest vulnerability. The ash may appear to be stable, but will completely give way under the vibration or motion of a piece of equipment. A more confident operator would consider it very unstable soil. But it's not soil. It doesn't behave quite like soil. It's ash. There needs to be a better, safer way, and there is—the installation of a pre-drainage dewatering system using wells or wellpoints. However, in the past, this has proven to be problematic with regard to ash, not because dewatering in and of itself is ineffective but because the approach and methodology used has been misapplied.

DEWATERING WORKS

The number of successfully pre-drained, clean-closed ash ponds can be counted on one hand. There are not enough fingers or toes to count the failed attempts to pre-drain ash, and failures are what people remember. Ash is peculiar. It's like soil in some regards, but very different in others. Building effective dewatering devices such as wellpoints or wells in ash is tricky. For example, the traditional well filter pack design used in conventional construction dewatering doesn't always apply when the particles resemble ball bearings. Previous use of fabric filters in lieu of conventional sand filters has proven to restrict water flow and resulted in plugging of the wells or wellpoints. In fact, traditional dewatering methods improperly applied have been problematic to the point where many people believe that pre-drainage techniques just don't work in ash. But with proper geotechnical analysis of the site-specific conditions, pre-drainage dewatering can, and does, work extremely well.

Moretrench has completely dewatered the ash for three full (and large) pond clean closures now, and numerous smaller-scale projects. We have gone through the learning curve(s). And it works, to the point where near-vertical cuts can be made in the ash. The transformation is astounding: the drained material can be cut vertically or near-vertically. Simply put, what occurs is this: when the "free" water is drained from the ash, it transitions from a soup to a very nice soil-like material with apparent cohesion and "stand-up time". Geotechnical engineers recognize that as the point where the pore water pressure goes from positive to

Fig. 1: Typical ash pond rim ditch construction. The shallow rim ditch permits slow drainage from the ash.

negative. It's the point where the water transitions from a lubricant into a glue. This apparent cohesion is what is needed to get equipment out on a pond, whether it is for excavation or regrading for a cap.

What makes pre-drainage dewatering so much more advantageous than the old-school method of rim ditching and sumping? First, by installing dewatering devices such as wells or wellpoints deeper into the ash, the water can be lowered a lot further than can be done with a rim ditch. Lowering the water further means that a higher gradient (groundwater pressure differential) can be created and thus induce a greater water withdrawal rate from the ash. This speeds up the process. Secondly, the water is lowered below the surface of the ash BEFORE excavation equipment sets out onto the pond (that is, PRE-drainage).

EVERY POND HAS ITS OWN UNIQUE "PERSONALITY"

Whether a site is slated to be clean-closed or capped, the goal is to execute the work plan safely and efficiently. And there is no "one-size-fits-all" solution. The more we work in the ash, the more we realize that every pond has a unique personality. And yes, some are better than others. The personality of the pond is built up from the source of the coal, the characteristics of the burner, the manner in which it was transported, the proportions and frequency of mixing bottom and fly ash, the shape of the pond, the location(s) of the sluice pipe(s), the thickness of the ash, and the pH of the water. The variables are seemingly endless. What ultimately matters is how the ash behaves under the tracks of an excavator. Every pond has a certain "dry crust" thickness needed for safe passage of equipment. We need to understand how all of the variables interplay to demand 5 ft of dry crust on one pond and 10 ft on another.

PILOT PUMPING TESTS ARE CRITICAL

The pervasive lack of geotechnical information on any of the ash ponds adds another level of uncertainty to the work. Most ponds are not stable enough to support even a small cone rig, so the data is more or less nonexistent. Historic knowledge of a pond is therefore extremely beneficial. This could be pre-ash topographical maps, perimeter borings, or knowledge of borrow sites for the construction of the perimeter embankments.

With or without geotechnical information, the key to effective "boots on the ground" stabilization of a pond lies in the ability of the dewatering contractor to thoroughly understand the behavior of the ash, the hydraulic connection to the soils below pond bottom, the groundwater conditions, and how both

Fig. 2: Stable, near-vertical cuts along a line of wellpoints illustrates the "apparent cohesion" that ash exhibits when it is pre-drained.
Courtesy of Glover Construction Company.

Fig. 3: Wellpoint pre-drainage dewatering. Ash removal began approximately 5 weeks after groundwater pumping was initiated and completed 5 weeks later.

ash and underlying soils react to dewatering. This knowledge can only be obtained from inside the pond itself. The degree of stratification and layering of the ash alone has proven to be highly influential to the ease or difficulty of draining ash. This is a condition that can only be evaluated in place.

It is therefore best practice to conduct pilot pumping tests to evaluate the hydraulic conductivity of the ash, the radius of influence, and the achievable well (or wellpoint) yield from properly built and representative production wells (or wellpoints). The hydraulic conductivity dictates the rate at which the pond can be drained. The spacing between devices is based on the radius of influence. And a representative dewatering device provides a good indication of how many of them will be needed for full-scale dewatering. The pilot pumping tests should be performed with multiple wells (wellpoints) because single borehole permeability tests can be highly misleading.

The ultimate demonstration with a pilot pumping test is to dig a test pit or walk a piece of equipment out onto the ash. Water levels, pore water suction, in-place shear strength, and so on, can be measured, but the successful use of a real piece of equipment is the proof of the pudding.

NEED TO MAP THE POND

The typical pond has a finer and a coarser end depending on the location of the sluice pipes and the outfalls. The coarse end is bottom ash, which may be drained simply with sump wells. The finest end will be so fine that the ash appears to be like clay with no "free" water, and cannot be improved by dewatering techniques. The bulk of the pond will be typically wet, runny, unstable fly ash. This material may be considered the problematic material, but the good news is that this material is typically highly responsive to dewatering techniques. The rule of thumb is if it will run, it will drain. It is key to map those transitions within the pond when evaluating what can be achieved and how.

Once the hydraulic conductivity, radius of influence, and yield of properly constructed dewatering devices can be determined, a more specific plan can be formulated. Wellpoints will typically be used when the thickness of the saturated ash is relatively thin or the ash is relatively fine and closely spaced; lower yielding pick-up points are warranted. Wellpoints are relatively inexpensive on a unit price basis, but they are limited by their suction lift or the depth to which they can lower the water beneath the surface header pipe.

Wells may be used when the ash is relatively thick and permeable and the dewatering devices can be spaced further apart. Wells are more expensive, but they can yield significant quantities of water. Where there may be coarser strata with depth, wells may be very effective in tapping those "sweet spots" to accelerate drainage of a deeper pond.

Ejector wells may be used for conditions somewhere in between. Ejector wells are appropriate where closely spaced dewatering devices are warranted, but the depth of groundwater lowering is beyond the suction lift capability of a wellpoint system.

Fig. 4: Installed pilot wellpoint system. Pilot pumping tests provide critical information pertaining to the hydrogeological behavior of the pond necessary for developing a pre-drainage plan.

Fig. 5: Typical runny behavior of wet fly ash. This behavior is actually a good sign. If the material behaves in this manner, it will be responsive to predrainage dewatering.

Fig. 6: Deep well installation from pond perimeter to provide deep pressure relief to sandy alluvial soil that immediately underlies the ash. If this source of recharge is not depressurized, it will result in resaturation and subsequent destabilization of the ash at depth.

Fig. 7: Excavation to natural pond clay bottom, achieved safely and on schedule with pre-drainage dewatering. Courtesy Glover Construction Company.

Regardless of the type of system used, variability of the ash conditions must be considered in the design. Ash varies from site to site, but also varies significantly within each pond. The dewatering devices must be built with the water transmitting capacity to pump whatever the ash will yield. On a recent clean closure, Moretrench installed wellpoints that yielded generally between 0.5 and 15 gpm. In coarser areas of the pond, where the ash will give up as much as 15 gpm, it is imperative to pump it. Time is of the essence. What that means in the context of pre-draining ash ponds is simply this: pump as much water from the ash as you can every day. Don't let the dewatering devices restrict you if the ash will release the water.

The excavation/grading plan must mesh well with the dewatering installation. The ultimate goal is not to dewater the ash, but to excavate or grade it. The dewatering system must conform to the bigger site picture. Plastic pipes and excavators don't coexist well. The best approach is to install the system, let it do its work, and remove it immediately prior to excavation. This approach needs time for the installation of the dewatering system, drainage of the ash, and excavation/grading of the ash to occur linearly, not coincidentally. If time is available, say, while the cap or closure plan is still under design, that is time when you could be draining water out of the ash. Use the time wisely.

CONCLUSIONS

With a properly conducted evaluation of the ash and the subsurface conditions and pilot testing, appropriately designed and installed watering devices, and comprehensive monitoring and evaluation of the results, pre-drainage dewatering works very well. If it can run, it will respond nicely to predrainage techniques. But while considerably faster than rim ditching and sumping, dewatering still takes time. As the clock continues to tick, plan early and use time to your benefit. ❖

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