THE USE OF IN-SITU STABILIZATION TO PROVIDE A STABLE PLATFORM ON SATURATED COAL ASH – IMPLICATIONS FOR CCR CLOSURE ACTIVITIES

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INTRODUCTION

In-Situ Stabilization (ISS) mixes pozzolanic reagents into materials to increase their structural strength and reduce their permeability. For CCR impoundment closures, ISS technology has been considered as a methodology to:

1. improve the bearing strength of coal ash in impoundments to facilitate the operation of equipment for removal or capping,
2. construct hydraulic control barrier wall around the perimeter of the coal ash impoundments and limit the movement of water into and out from the impoundments, or
3. increase the structural integrity of the impoundment berms and improve their factor of safety.

As part of the closure of a large coal ash impoundment, Great Lakes Environmental & Infrastructure (GLEI) utilized ISS to create a stable working platform on saturated coal ash. Portland cement was mixed with the top 5 feet of saturated coal ash over an 8 acre area to produce the working platform that could be accessed by construction equipment within 48 to 72 hours after ISS treatment. This working platform allowed the construction equipment and personnel to safely conduct the placement, compaction, and capping activities necessary to complete the closure of the impoundment.

This successful application of ISS treatment to saturated coal ash confirms that ISS treatment could be an effective part of coal ash pond closures.

BACKGROUND

A large (approximately 280 acre) coal ash impoundment was undergoing in-place closure. Following the removal of free water from the impoundment, the contractor was
working across the impoundment, utilizing relatively dry ash to bridge over the saturated ash surface. The placed ash was compacted and graded to the final elevations. Geomembrane liner and cover soil was placed on top of this ash surface. The placement, compaction, and capping work was sequenced from the edges of the impoundment toward the impoundment’s discharge point. This allowed the continual and effective removal of stormwater and drainage from the impoundment during closure.

As the work neared the discharge point, it was noted that the saturated ash in these approximately 8 acres was no conducive to bridging over with dry ash or native soil and that typical constructive equipment could not safely be operated on the placed material. To maintain schedule, the contractor engaged GLEI to explore whether ISS may offer a solution. GLEI personnel evaluated the situation and agreed that ISS could be utilized to produce a stable working platform over the saturated ash. The purpose of the working platform was to provide a stable, safe work environment for construction equipment and personnel to place and compact ash material to the established final grade and to construct the capping structure, all while working on top of the saturated ash.

ISS TESTING

Based on testing conducted by GLEI, the saturated ash material could develop unconfined compressive strength values exceeding 10 psi, which is considered sufficient to support construction equipment, within 3 days of treatment and would continue to increase UCS with increasing curing time. At 3 days, the ISS-treated material would have a wet unit weight within 5% of the untreated saturated ash, a bearing pressure in excess of 10,000 psf and an elastic modulus in excess of 144,000 psf. The bearing pressure would have a factor of safety (FS) of >6 under the tracks of an 100,000 lb excavator, while the elastic modulus would suggest less than 2 inches of elastic settlement from the excavator working on top of it. GLEI considered that the ISS-treated saturated ash could be safely operated on top of with 3 days of treatment, given this testing data.

ISS METHODOLOGY

The ISS methodology selected by GLEI involved dividing the 8 acre area into 1,800 square foot treatment cells. Each cell would contain 333 cubic yards of saturated ash with the 5 foot treatment depth.

GLEI mobilized a crew consisting of a superintendent and three equipment operators to the Site. All personnel had current OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER)\(^1\) training and medical certification, along with the required job-specific training.

25-26 tons of Portland cement was added to the surface of each treatment cell. Due to availability issues with pneumatic trucks, the Portland cement was added either with placing seventeen 3,000 pound supersacks or by pneumatically off-loading a truckload
(25-26 ton load) of Portland cement onto each of the treatment cells. The supersacks were transferred from delivery truck to the treatment cell (Figure 1). The supersacks were then punctured and cement spread on the treatment cell surface. For the pneumatic off-loading, dust boxes (Figure 2) was utilized to minimize dust emissions during the off-loading of the cement. The dust box was a sea-land container with the bottom removed, four 25-inch by 20 inch vents installed in the sides, and wrapped in geofabric. The excavator placed the dust box on the treatment cell while the truck driver delivering the Portland cement off-loaded the Portland cement from the hose connected to the dust box. Dust control during off-loading was controlled by minimizing the air pressure used to pneumatically off-load the Portland cement to between 5 and 10 pounds per square inch (psi).

The excavator operator would then use the excavator to mix the wet ash and the Portland cement until visibly homogeneous or for at least 60 minutes (Figure 3). The ash became thixotropic during the mixing, increasing the ability to thoroughly mix the ash and the applied cement. Each day, up to 9 treatment cells were treated.

The ISS work was sequenced to treat the perimeter cells and then work inward toward the center of the area (Figures 4a and 4b). Immediately after treatment, the treated material was still plastic and could not support foot traffic. Within no more than 3 days of treatment, ISS equipment could operate on the ISS-treated material, using crane mats. The construction equipment placing and compacting dry ash on top of the ISS-treated material could safely access treated areas within the same time frame.

The contractor supplied water trucks and personnel to provide dust control during the reagent off-loading and the mixing activities. Water cannons were found to be effective at dust control during these activities.

Over the course of the ISS treatment, 54,000 cubic yards of saturated ash was treated in 30 working days. Since placement and compaction of dry ash and capping activities were done concurrently with the ISS treatment, the capping was complete over the saturated ash area within 7 days of ISS completion (Figure 5).

SAFETY

Due to the inherent safety concerns when operating equipment on saturated coal ash, even when the surface has been treated with ISS, GLEI utilized a full-time supervisor with extensive experience in working of coal ash to constantly assess and discuss operating conditions with any operator working on the ISS-treated material (Figure 6). The major observations centered around crack development when excavators were working on top of ISS-treated material while mixing the next row of treatment cells (Figure 7). The cracks, which were typically 6-12 inches deep, were formed due to the saturated ash being mixed becoming thixotropic. Also of concern were the mudwaves which developed in front of freshly treated material (Figure 8). These mudwaves were likely a result of the higher density of the ISS-treated material. The size of the mudwave was thought to correlate with potential instability; the larger the mudwave, then likely
more potential for unstable conditions. Constant observation and communication kept all operators working on the ISS-treated material apprised on the conditions.

LESSONS LEARNED

Curing Time
Initially it was thought that equipment would be able to operate, using timber mats, on top of treated ash material within 2-3 days of treatment. Early on in the ISS treatment, equipment could operate on ISS-treated within 1-2 days of treatment. However, as the ISS treatment moved out onto more saturated ash, it became more prudent to wait 2-3 days before attempting to operate equipment on top of the treated ash material.

Pneumatic Off-Loading
During the ISS treatment, all truck drivers were advised to avoid pressurizing their tanks, and utilize more of their compressor’s capacity to generate an airstream in the transfer line capable to conveying the product to the dust box. Most drivers were successful in off-loading their cement load in under 1 hour. While this was partially due to the driver’s aptitude, even capable drivers occasionally had a load that required up to 2 hours to off-load. Off-loading time was found not to be correlated to driver, trailer, temperature or humidity, suggesting that the variability in off-loading may be due to the characteristics of the Portland cement itself. Attempts to engage the Portland cement supplier in exploring the root cause of the variability in the off-loading time were not successful. Since the off-loading time affects the ISS work schedule, a better understanding of factors affecting pneumatic off-loading of Portland cement from transport trucks is needed.

Dust Control
Dust control during reagent off-loading and during mixing was provided by water trucks using water cannons. While there were initial concerns that water cannons would not be effective for dust control, the water cannons were very effective in the control of airborne dust, while keeping the surface of treated material moist.

APPLICABILITY TO CCR IMPOUNDMENT CLOSURES

For the closure of CCR impoundments, ISS technology has been considered as a methodology to:

1. improve the bearing strength of coal ash in impoundments to facilitate the operation of equipment for removal or capping,
2. construct hydraulic control barrier wall around the perimeter of the coal ash impoundments and limit the movement of water into and out from the impoundments, or
3. increase the structural integrity of the impoundment berms and improve their factor of safety.
The successful completion of the stable working platform at the Site confirms that ISS of coal ash could produce treated material that facilitates the operation of equipment for ash placement and compaction or capping. ISS can allow equipment and personnel to safely access and work on saturated ash areas of CCR impoundments, allowing placement, compacting, and capping activities to continue on schedule.

CONCLUSIONS

As part of the closure of a large coal ash impoundment, approximately 8 acres of saturated ash material was impeding progress. GLEI conducted ISS treatment, with Portland cement, of the top 5 feet of the saturated ash in this area. 25-26 tons of Portland cement was added to each 33 cubic yard treatment cell. An excavator was used to thoroughly homogenize the saturated ash and Portland cement within a treatment cell. With 3 days of treatment, the treated ash could safely support construction equipment and personnel. Over 30 working days, GLEI treated 54,000 cubic yards of saturated ash. As the ash placement and compaction and capping activities continued concurrent with the ISS treatment, the capping of the saturated ash area was completed 7 days after the completion of the ISS treatment.

The results from the successful completion of this ISS treatment confirm that ISS of coal ash could be of benefit in the closure of coal ash impoundments.

REFERENCES

FIGURES

Figure 1. Portland cement application using supersacks

Figure 2. Pneumatic application of Portland cement
Figure 3. Mixing of Portland cement and saturated surface ash

Figure 4a. ISS progression along perimeter treatment cells
Figure 4b. ISS progression along perimeter treatment cells.

Figure 5. Capping activities conducted on top of ISS-treated material.
Figure 6. Safety observation of work on top ISS-treated material

Figure 7. Cracking of ISS-treated material during ISS progression
Figure 8. Mudwave in front of ISS-treated cells