Coal Combustion Residuals Management Using Geotextile Containers- Considerations for Various Options

Randall V. Wilcox, P.E.¹, Gregg E. Lebster¹, Bryan Hamilton², Thomas Stephens²

ABSTRACT

In response to EPA regulations and site specific requirements, coal fired power plants have formulated new and innovative methods to manage and dispose of coal combustion residuals (CCRs). For many reasons outlined in this presentation, geotextile containers have been an integral part of these management and dewatering technologies.

This presentation will describe the different ways that geotextile containers have been used for CCR management and will describe the differences in the approach to assist with the development of the various applications. For example, the use of geotextile containers for management of the residuals in a direct sluicing application at a peak load power plant is very different from the use of geotextile containers to dewater CCR dredged from a surface impoundment closure at a large active facility.

In order to optimize the implementation and operations, the development of the applications need to be tailored to meet the specific objectives. The owner or consultant should work with a company experienced with geotextile container dewatering to:

- Recommend the most effective polymer(s) and dose(s)
- Base the evaluation on realistic flow rates and durations
- Estimate the number and size of geotextile containers
- Potential placement in permanent disposal location
- Evaluate excavation and hauling considerations

Specific project development considerations for CCR management with geotextile containers and example projects will include:

- Clean Closure of Surface Impoundments
- Direct Sluicing
- Increasing Capacity of Ash Storage Impoundments
- Structure Building
- Smaller CCR projects

KEYWORDS: Geotextile, container, combustion, residual, sluicing, impoundment

¹ WaterSolve, LLC- 5031 68th Street, SE, Caledonia, MI 49316
² TenCate Geosynthetics Americas- 3680 Mt. Olive Road, Commerce, GA 30529
INTRODUCTION

Geotextile tube technology has been around since the 1960s and was originally used for creating shoreline protection structures and dewatering hydraulically dredged sand from harbors, lakes, and rivers. Geotextile tubes are manufactured from high strength polypropylene fabric and designed to allow effluent water to escape, while retaining the solids. Recent chemical innovations have allowed a wide variety of sludges, sediments, and residuals to be dewatered and contained in geotextile tubes with the addition of dewatering polymers. The proper chemical conditioning can drastically increase the dewatering performance, improve the filtrate quality, and ultimately allow greater solids consolidation inside of the geotextile tubes.

Long before geotextile tube technology existed, civilizations all over the world have relied on coal fire power plants to supply their nations with electricity. The process of converting coal to electrical energy generates a large amount of industrial waste and its impact on the environment is always a concern. Potentially harmful by-products called coal combustion residuals (CCRs) in various forms such as fly ash and bottom ash are generated and utility companies are continually looking for better disposal options as governmental regulations change to better protect the people and environment.

PROJECT PLANNING AND CONSIDERATIONS

Geotextile tube technology can be an economical solution to dewater and contain CCRs in various forms and applications. As with any successful project, the planning and development process needs to be tailored to meet the specific project objectives. The owner or consultant should work with a company experienced with geotextile container dewatering to ensure all aspects of a project are designed properly. The following considerations are critical to the success of a project.

RECOMMEND THE MOST EFFECTIVE POLYMER(S) AND DOSE(S)

In order evaluate various chemical conditioning programs, samples of CCR must first be collected. Sampling comprehensiveness and methods depend on the type of residual and application but generally should be as representative of the residual to be dewatered and contained in the geotextile tube as possible. This step is critical to the development of a project as many assumptions are made from these samples. For example, the sediment characteristic and solids concentration often change throughout a large surface impoundment and changes to upstream processes can affect a direct sluicing application.

Once representative samples are collected, bench-scale jar testing is performed where several polymers and combinations of polymer(s) are evaluated based on water release rate, water clarity, and flocculant appearance. Once a polymer or combination of polymers is recommended, additional jar testing is performed. This is when optimal solids concentration and the required mixing energy after chemical addition can be evaluated.
Chemical conditioning for CCR materials typically involves one of the following:

- Single cationic flocculent
- Single anionic flocculent
- Organic coagulant followed by anionic flocculent
- In rare cases, an inorganic flocculent followed by a flocculent.

**BASE THE EVALUATION ON REALISTIC FLOW RATES AND DURATIONS**

To evaluate the performance of the chemically conditioned samples in geotextile containers, small-scale tests are performed by pouring a chemical conditioned sample through the geotextile fabric and measuring filtrate release rate, filtrate quality, and the solids concentration of the residuals captured on the fabric. This data can be used to predict the achievable dewatered solids concentration inside a geotextile container and also allows for testing of the filtrate water if there are discharge requirements.

Larger scale testing is recommended to estimate the dewatering times and to evaluate other dewatering parameters, such as repeated fills and re-fills, stacking potential, geotechnical information, and other parameters. These tests include the Geotube Dewatering Test (GDT), Pressure Geotube Dewatering Test (P-GDT) and pilot testing. Hanging bag tests are sometimes completed, but the other tests listed above are recommended in place of the older hanging bag procedure.

**ESTIMATE THE NUMBER AND SIZE OF GEOTEXTILE CONTAINERS**

Estimating the quantity of geotextile containers required is often one of the most challenging components of developing a project. Several factors including solids volume, project timeline and space limitations influence this estimation. Accurate surveying, sampling, and testing are critical. Software tools are available and should be used to evaluate various sizes and configurations.

Geotextile containers can be manufactured in various sizes and customized for individual projects. The size of geotextile containers is typically described by the circumference of the geotextile tube and the length of the container. For example, the footprint of an unfilled 18.3-meter (60-ft.) circumference by 61.0-meter (200-ft.) length geotextile tube is 9.1-meter (30-ft.) x 61.0-meter (200-ft.). Larger circumference geotextile tubes, 36.6-meter (120-ft.) circumference or greater, are often the most economical for larger projects, but are sometimes not recommended for CCR material based on testing because the distance from the center to the outside can delay the consolidation and dewatering for certain residuals. Stacking geotextile tubes is often a solution to limited lay-down area or for disposal in a landfill or other disposal area.

**POTENTIAL PLACEMENT IN PERMANENT DISPOSAL LOCATION**

A solution to avoid excavation and disposal costs is to place the geotextile tubes at a permanent disposal location. Geotextile tubes can be arranged to create a containment structure such as an embankment or to create a berm around a surface impoundment. Geotechnical evaluations of the laydown area should be considered especially if stacking geotextile tubes.
EVALUATE EXCAVATION AND HAULING CONSIDERATIONS
If the filled geotextile tubes cannot be left in place, disposal options of the dewatered residuals need to be evaluated. Heavy equipment for excavation needs to be sized appropriate for the anticipated production rates. Haul roads or routes need to be established and capable of supporting the necessary weight and traffic.

APPLICATION SPECIFIC CONSIDERATIONS

CLEAN CLOSURE OF SURFACE IMPOUNDMENTS
As regulations and methods for handling coal ash waste change, many coal fired plants need to remove the ash contained in surface impoundments. Hydraulic dredging and dewatering using geotextile tubes is often the most economical option. Below is a list of considerations for this specific application.

- Relatively large volume with high solids concentration
- High production rate is required to keep project economical
- In-situ solids vary but typically 40-60% dry weight solids
- Need to know the mixture of bottom ash, fly ash, Flue Gas Desulfurization (FGD) residual, etc.
- Polymer selection varies depending on site specific location. Normally either a single cationic flocculent, single anionic flocculent or dual (organic or inorganic coagulant followed by anionic flocculent)
- Typical polymer dose – 0.25 to 0.75-kg/dry metric ton (0.5 to 1.5 Lbs./Dry ton)

DIRECT SLUCING
Diverting the coal ash directly to geotextile tubes is another option for coal-fired plants. Below is a list of considerations for this type of geotextile tube application.

- High flow rates with low solids
- Geotextile tubes need to be sized to handle high water flowrates as well as solids volume
- Chance of material variability due to process or production changes upstream
- Polymer selection varies depending on location. Typically a dual treatment (organic or inorganic coagulant followed by a anionic flocculent)
- Typical polymer dose (total) – 0.1 to 1.25-kg/dry metric ton (0.2 to 2.5 Lbs./Dry ton)

INCREASING THE CAPACITY OF ASH STORAGE IMPOUNDMENTS
Ash impoundment capacity can be increased by hydraulically dredging into geotextile tubes. Some considerations for this application are listed below.

- Similar to clean closure considerations
- Relatively larger volume with high solids
- High production rate – need a high flowrate to keep project economical
• In-situ solids vary but typically 40-60% dry weight solids
• Slurry percent solids 10-15%
• Laydown area is typically more restricted compared to clean closure projects
• Polymer selection varies depending on location. Normally either a single cationic flocculent, single anionic flocculent or dual (organic or inorganic coagulant followed by anionic flocculent)
• Typical polymer dose – 0.25 to 0.75-kg/dry metric ton (0.5 to 1.5 Lbs./Dry ton)

STRUCTURE BUILDING
Geotextile tubes can be used to create structures. Here are some considerations for this type of application.

• Similar to clean closure for pumping and chemical conditioning
• Relatively large volume with high solids
• Geotextile tube placement and alignment is critical
• Filtrate flow needs to be directed / controlled
• Highly specialized operation. Need experienced company / crew
• Slurry percent solids = 10-15% (consistent heavy slurry)
• Hybrid project – Dewatering application and structure building
• Typical polymer dose – 0.25 to 0.75-kg/dry metric ton (0.5 to 1.5 Lbs./Dry ton)

SMALLER CCR APPLICATIONS
• Tank/ small basin cleaning
• Flushing / wash-down operations
• Need to sample and test each residual / waste stream
• Slurry solids vary but normally relatively low
• Laydown area is typically more restricted compared to clean closure projects and sometimes the use of geotextile tubes inside dumpsters or dewatering boxes are a cost-effective option
• Typical polymer dose- 0.25 to 1.25-kg/dry metric ton (0.5 to 2.5 Lbs./Dry ton)

CONCLUSIONS
Geotextile container dewatering for coal combustion residuals can be used effectively for a wide variety of applications. It is important to keep in mind that each type of application has its own set of considerations. The geotextile container dewatering system needs to be tailored to meet the project objectives.

Geotextile container dewatering technology offers effective alternatives for plants to manage coal ash in various forms and applications. In addition to dewatering for volume reduction, geotextile container dewatering offers other beneficial uses, such as creating structures, increasing heights of impoundments, land reclamation and other uses.