

COAL ASH BARRIER SYSTEM



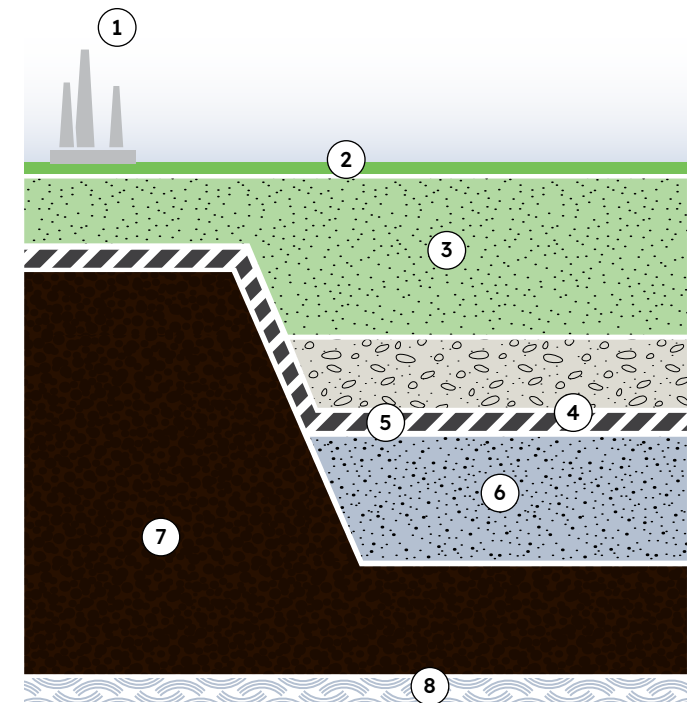
Facing the challenge

In recent years, the storage of coal ash has become an increasing concern. Power facilities and utility companies have yet to understand the consequences of inadequate coal ash containment, and the potential of contaminated groundwater.

In 2015 the EPA established the Coal Ash Rule, a set of regulations for CCR landfills and CCR surface impoundments established under Subtitle D of the Resource Conservation and Recovery Act. Currently the EPA is actively constructing plans for future regulatory actions to further ensure coal ash impoundments meet stringent environmental and safety standards.

In light of pending regulations, utility companies are attempting to better contain coal ash using EPA Subtitle D minimum guidelines, but are facing multiple challenges, including:

- Investing time and resources into the management of coal ash containment
- More stringent assessments of groundwater and the risk of third party issues
- Difficulty finding sites for disposal or gaining permits to build new facilities
- Increased scrutiny by state officials
- Availability of suitable earthen materials and the economic and environmental impacts of borrowing materials
- Addressing opponents and concerned communities
- Managing impact to power costs and consumer rates.



Minimum EPA Subtitle D requirements

- ① Plant
- ② Top cover
- ③ Coal combustion waste
- ④ Gravel
- ⑤ Geomembrane
- ⑥ Compacted clay/Mineral barrier
- ⑦ Existing soil
- ⑧ Groundwater

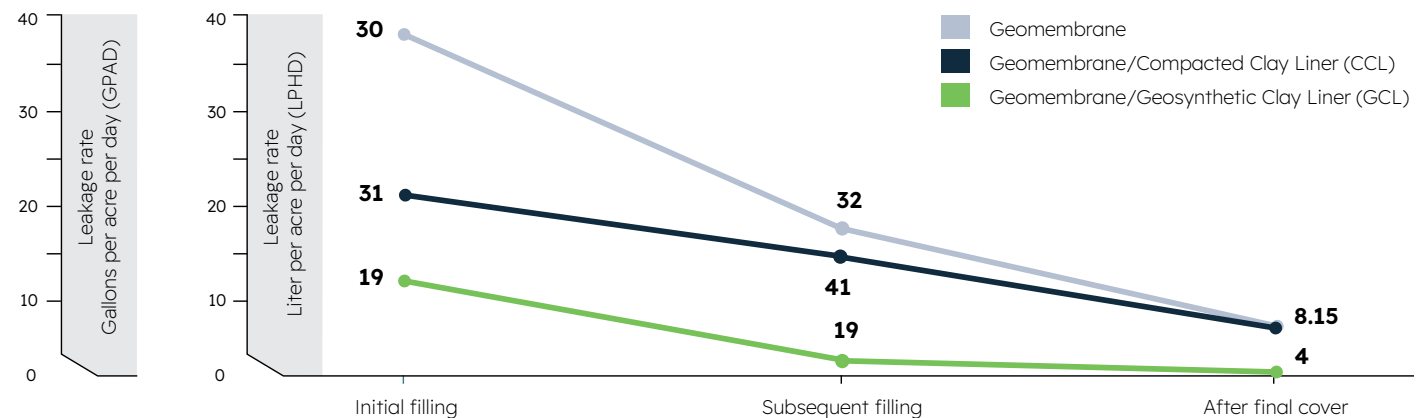
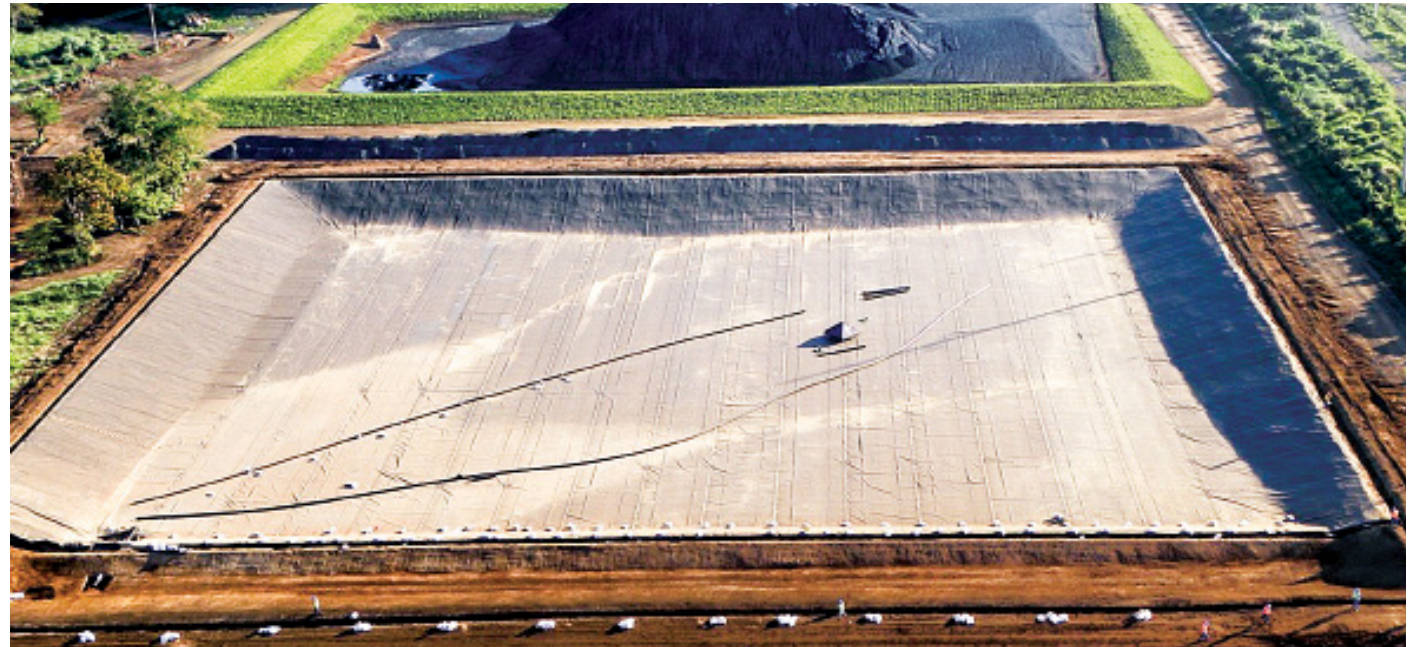
Laying the groundwork

The use of geomembranes in coal ash impoundments has been proven to provide superior protection compared to non-lined repositories. There is, however, still a significant risk of leakage when only a single barrier system is used.

The inclusion of a secondary barrier, such as **BENTOLINER®** Geosynthetic Clay Liners (GCLs), can substantially reduce this risk, as illustrated in the graph below.

The dynamic combination of our **GSE®** geomembranes and **BENTOLINER** GCLs have been proven to provide utility companies with a solution that addresses the various concerns associated with coal power generation.

Solmax has pioneered a complete coal ash barrier system using products that comply with regulatory standards to maximize groundwater protection and minimize both risks and costs.



Landfill liner system performance

Layers of reliability

Regulations require every coal ash landfill to be sufficiently capped to prevent groundwater contamination. Solmax's durable geosynthetics ensure the highest possible level of protection and compliance possible.

A composite liner system combines the low permeability of a polyethylene geomembrane with the self-sealing characteristics of bentonite clay to provide the best leak protection in the industry. In most cases, the geosynthetic clay liner can replace the compacted clay layer.

Geomembranes

A geomembrane covers the composite liner system.

GSE's high performance white smooth geomembrane is an ideal choice for coal ash capping because its UV-stabilized upper surface reflects light, enables damage detection, and reduces wrinkles and subgrade desiccation.

GCLs

BENTOLINER CAR is a coal ash-resistant needle-punched reinforced composite geosynthetic clay liner system. It consists of a uniform layer of granular sodium bentonite and polymer blend, encapsulated between two geotextiles. Its internal shear strength, long-term creep resistance, low permeability and chemical compatibility form an effective barrier against chemical leachates found in coal ash applications.

Drainage geocomposites

The composite drainage product overlays the geomembrane and can be used to replace costly and less sustainable earthen drainage materials. Solmax offers an extensive line of **FABRINET®** geocomposite products that save time and money and provide greater consistency than natural soil materials.

Multiple layers of reliability

Solmax collaborated with leading utility companies to develop its coal ash barrier system, which outperforms other Subtitle D-like constructions. This is the only system of its kind and combines three of our innovative geosynthetic products working in harmony to provide superior results.

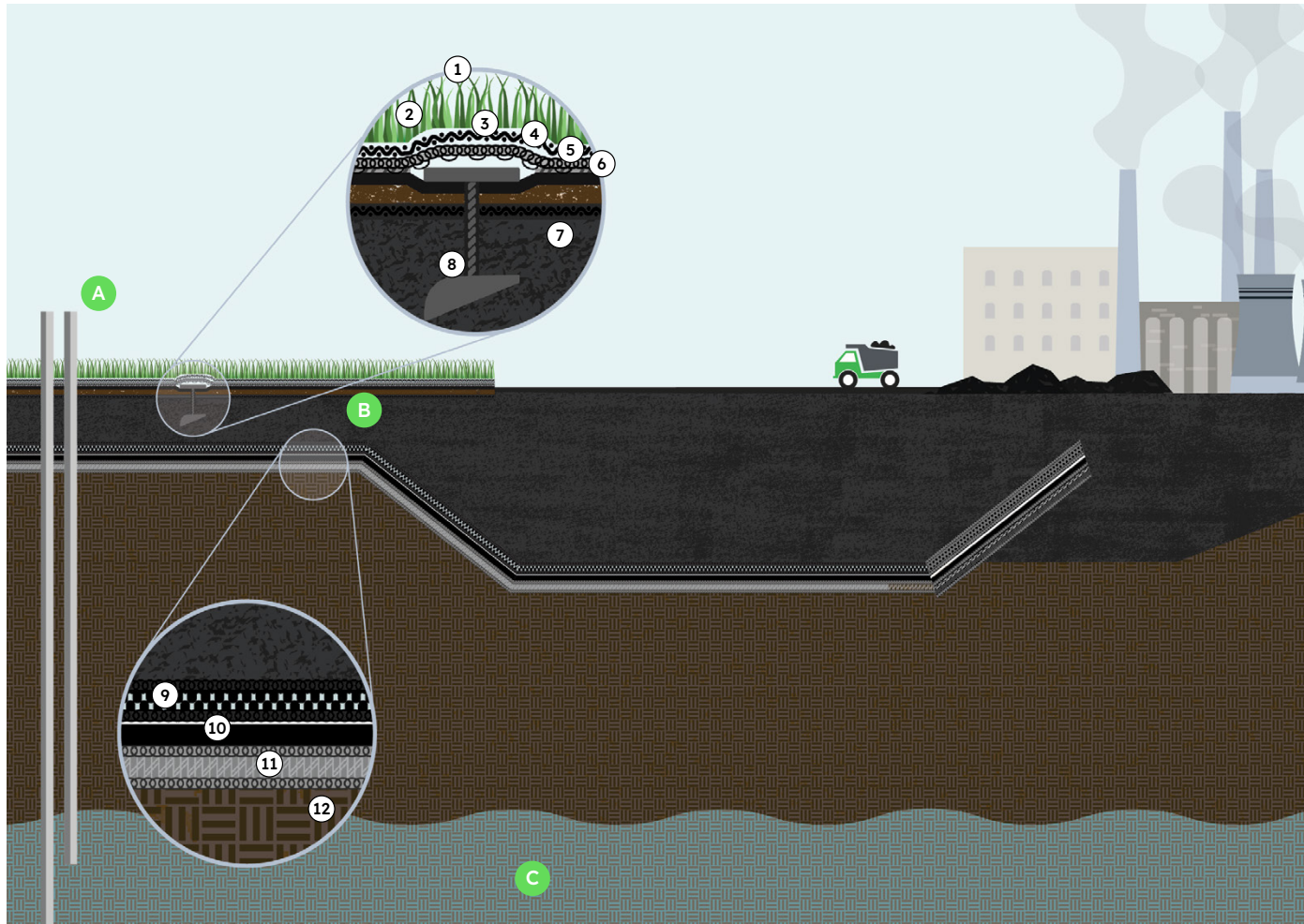
Benefits over minimum Subtitle D

- Provides greater durability, consistency and reliability than standard Subtitle D liner systems at a lower cost
- Reduces risks of groundwater contamination
- Ensures compliance with current and future government regulations
- Increases landfill capacity and optimizes land use
- Easier and quicker to install, so you stay on schedule.

Protecting land and communities

Effective management, containment, drainage and closure of coal combustion residuals are imperative to protect the environment and surrounding communities from potential hazardous materials.

At Solmax, our geosynthetics create effective, long-term barriers to protect soil and water for future generations.



Solmax coal ash barrier system

Flexible testing

This durable liner maintains its physical properties during long-term exposure in mining applications that demand protection against solution loss and environmental damage.

- A** Groundwater monitoring well
- 1** UV stabilized synthetic grass
- 2** **MIRAFI® CR-Series**
- 3** **MIRAFI S-Series**
- 4** Adhesive
- 5** **GSE LL geomembrane***
- 6** Leveling soil
- 7** Earth anchor
- 8** Coal combustion waste
- B** Coal ash barrier system
- 9** **FABRINET Coaldrain geocomposite geotextile***
- 10** **GSE Leak Location Conductive geomembrane***
- 11** **BENTOLINER CAR**
- 12** Existing soil
- C** Groundwater

* See Solmax representative for full selection of colors.

Coal ash barrier system

Ohio State University's Olentangy River Wetland Research Park, in collaboration with the Department of Civil and Environmental and Geodetic Engineering, conducted a laboratory and field-testing program to evaluate the performance of Solmax's FABRINET Coaldrain geocomposite. In this test program, FABRINET Coaldrain was tested under the exact same conditions as would exist in an actual CCW disposal site. The research performed by Ohio State University showed that Solmax's Coal Ash Drainage geocomposite effectively allowed for the unimpeded flow of liquids and did not let coal ash particles pass through.

FABRINET BP Coaldrain benefits

- Replaces up to two feet of earthen material for filtering and drainage
- Easier and less costly to install than earthen material
- Because large equipment and natural materials are not used for installation, damage to the liner system is greatly reduced
- More accurate estimation of installation cost
- Consistently meets requirements, while earthen material can be inconsistent
- Lower quality assurance costs
- An engineered system that is more effective and consistent than natural systems and other geocomposites with no clogging or piping
- Installation is less time consuming than natural materials and is not impeded by weather conditions, so you stay on schedule
- Installation interferes less with the surrounding community





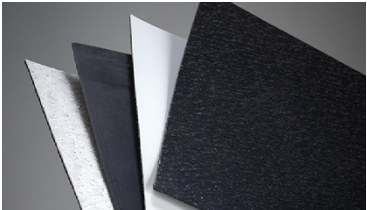
FABRINET Coaldrain geocomposite

FABRINET Coaldrain replaces the filter layer and the leachate collection layer in a typical Subtitle D liner system. It uses a highly engineered geotextile that has been developed specifically for CCRs. The filter and drainage performance of **FABRINET Coaldrain** has been verified through laboratory and field-testing.



BENTOLINER CAR

Our **BENTOLINER CAR** geosynthetic clay liner (GCL) combines geosynthetics with sodium bentonite clay to form a highly impermeable barrier that often replaces thick layers of expensive compacted clay liners. Solmax has added polymer-enhanced sodium bentonite clay to our standard GCL to provide superior coal ash resistance.



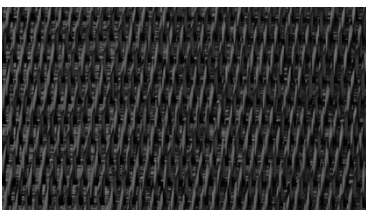
GSE HD

A high-performance co-extruded high-density polyethylene (HDPE) geomembrane specifically designed for use in the most stringent applications. This product has a UV-stabilized upper white surface that reflects light, enables damage detection, and reduces wrinkles and subgrade desiccation in addition to an electrically conductive bottom layer, which can be tested for leaks in a safe, effective and cost-efficient manner. It decreases risks of leaks and mitigates groundwater impact.



GSE LL

GSE LL Series is a linear low-density polyethylene geomembrane that exceeds the requirements of the GRI GM-17 specification standard for **GSE LL** geomembrane liners. **GSE LL** geomembranes are flexible and able to conform to the soil subsidies that may occur below the capping. The unparalleled performance of Solmax **GSE LL** geomembranes is well represented by their high multiaxial strain performance.



MIRAFI CR-Series

MIRAFI CR-Series was designed specifically for the pond capping market. These high-performance products feature engineered seams to efficiently install a stable capping system. The **MIRAFI CR-Series** facilitates the complete and efficient closure of storage basins and ponds.

About Solmax

Solmax is a world leader in sustainable construction solutions, for civil and environmental infrastructure. Its pioneering products separate, contain, filter, drain and reinforce essential applications in a more sustainable way – making the world a better place. The company was founded in 1981, and has grown through the acquisition of GSE, TenCate Geosynthetics and Propex. It is now the largest geosynthetics company in the world, empowered by more than 2,000 talented people. Solmax is headquartered in the province of Quebec, Canada, with subsidiaries and operations across the globe.

Uncompromised quality

Our products are manufactured to strict international quality standards. All our products are tested and verified at our dedicated and comprehensive laboratories which maintain numerous accreditations. We offer our partners a wide scope of testing according to published standards to ensure products delivered to sites meet specified quality requirements.

Let's build infrastructure better

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