

Technical Note

Geosynthetic Clay Liners made from Powdered or Granular Bentonite

Hydraulic Conductivity

Assuming similar bentonite quality, the ultimate hydraulic conductivity of Geosynthetic Clay Liners made from granular bentonite or bentonite powder is similar. Granular bentonite has superior down slope erosion stability and is less subject to piping.

Bentonite dust may be more susceptible to contaminated liquids in the short-term because the finer particle size has a larger surface area. This would allow contaminants dissolved in the water to reach the exchange sites faster. However, in the long-term, the chemical compatibility of granular and powdered bentonites (assuming equal bentonite quality) is expected to be similar.

Hydration

When hydrated with water bentonite swells to form an impermeable gel. The low permeability of the bentonite gel reduces the escape of leachate into the surrounding soil.

Bentonite clay seals around penetrations, punctures, and overlaps. This self-healing ability relies on the swelling properties of the bentonite clay.

Bentonite dust swells very fast, whereas granulated bentonite can take over 30 minutes to seal after hydration. However, given the lifespan of GCL liners (over 100 years), this delay is insignificant.

Mechanical Properties

Bentonite granules are tightly held by needle punching within the GCL structure. They do not move during handling and installation, thereby providing consistent hydraulic performance. On the other hand bentonite dust is easily displaced, both laterally within the product and through the geotextiles. This causes localized variation in the thickness of the bentonite, and variability in hydraulic performance.

Under similar manufacturing conditions, GCLs made with granules have higher internal shear strength and better long term creep resistance than those made from bentonite dust.

Granulated GCLs can be installed under wet conditions.

Bentonite dust may also contaminate the welded seams of geomembranes and therefore must be diligently removed prior to welding to avoid seam failure.

Occupational Health and Safety

Escaped bentonite dust is at best a nuisance and at worst a health hazard due to the presence of respirable crystalline quartz. Bentonite is not classified as carcinogenic but some bentonites contain respirable crystalline silica, a recognized human carcinogen.

Dust released when GCLs made from powdered bentonite are unrolled can cause significant air pollution, especially near urban areas. **GCLs made from granular bentonite with a PE membrane bonded to the nonwoven fabric of the liner release significantly less dust than GCLs made from powdered bentonite that have the PE membrane applied to the carrier side.**

Elcoseal Geosynthetic Clay Liner made from bentonite powder is classified as hazardous in New Zealand, according to the Hazardous Substances (Classification) Notice 2017EPA Approval No: Construction Products (Toxic [6.7]) – HSR002551.

In order to minimize the health risks from bentonite dust, only GCLs made from granular bentonite are allowed to be used on construction sites in Australia.

Epidemiological studies have shown that the principal pathway of concern is inhalation of respirable bentonite dust by workers and local communities. Exposure to bentonite dust increases the risk of developing diseases of the respiratory system; such as pneumonia, chronic obstructive pulmonary disease and allergic rhinitis. Other research has shown that bentonite particles have a cytotoxic effect on human lung fibroblasts.

- Ingestion of the product may irritate the gastric tract causing nausea and vomiting;
- Inhalation of bentonite dust may irritate the respiratory system and may aggravate pre-existing upper respiratory and lung disorders such as bronchitis, emphysema and asthma. Chronic exposure to this material may aggravate existing respiratory disorders and lung disorders such as bronchitis, emphysema and asthma. Onset and progression are related to dust concentrations and duration of exposure. Repeated exposure to respirable crystalline silica dust may lead to silicosis, or other serious delayed lung injury. The onset of silicosis is usually slow and lung damage may occur even when no symptoms or signs of ill-health have occurred. Silicosis can develop to a more serious degree even after exposure has ceased, and may also lead to other diseases including heart disease and scleroderma;
- Skin contact may cause mechanical irritation resulting in redness, itching and swelling. Repeated exposure may cause skin dryness and cracking and may lead to dermatitis; and
- Eye contact may cause mechanical irritation and result in mild abrasion.

Prudent project management, choice of product and limiting occupational exposure to bentonite dust are considered important in reducing these risks.



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