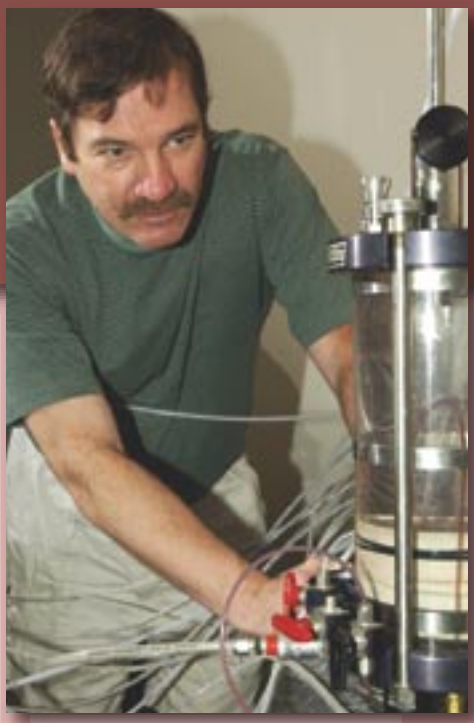


Helping to Protect Groundwater

Charles Shackelford, professor of civil engineering at Colorado State University and director of the Rocky Mountain Regional Hazardous Substance Research Center, is concerned about nitrate and other dangerous substances seeping into groundwater from animal feedlots. Shackelford, along with civil engineering assistant professor Kenneth Carlson, is investigating whether manufactured geosynthetic clay liners (GCLs) are a better way of lining animal waste lagoons than traditional compacted clay liners.

Lagoons typically contain animal waste for periods ranging from 6 to 24 months. They allow waste to partially decompose before it is applied to fields. At present, most animal waste lagoons are lined with compacted clay. A pit is excavated for the lagoon, and either natural clay near the pit is recovered and re-compacted to line the pit, or if natural clay is not available locally, a suitable alternative clay is shipped to the site to line the pit. "This approach leads to a great deal of inconsistency in clay liners from region to region because of the natural variability in the available clays," Shackelford says.

In contrast, GCLs are manufactured, which results in more uniform properties. As a result, the use of GCLs has the potential for establishing more uniform standards for lining animal waste lagoons throughout the country. GCLs have been manufactured since about 1990, but only recently have they been marketed for use in lining animal waste lagoons. GCLs consist of a thin layer of naturally occurring, high-swelling clay called sodium bentonite, sandwiched between two textile-like materials, referred to as geotextiles. The GCL typically is held together with glue or by stitching or needle punching through the geotextiles. The product is shipped in rolls and simply is rolled out to line the excavated pit. When the product is shipped, it is only about 5-6 mm thick, but when water is added, the bentonite swells, resulting in thicknesses typically of 10-15 mm.

Unfortunately, bentonite also can contract significantly when exposed to certain chemicals and chemical concentrations, resulting in increased leakage. Therefore, Shackelford and his research team, using funding from the Agricultural Experiment Station, are testing the product's stability against contraction using a simulated animal waste stream containing 147 mg/L of calcium, 679 mg/L of sodium, 1756 mg/L of chloride, and 415 mg/L of ammonium-nitrogen. The composition of the waste stream is based on literature characterization of a wide variety of actual animal waste streams. Clint Brown, a graduate student working with Shackelford, is permeating a GCL using the simulated waste stream as well as tap water processed to remove ions under both aerobic and anaerobic conditions to evaluate the effects of the simulated waste stream. The results of these tests indicate that the simulated solution had little impact on the hydraulic conductivity of the GCL. The GCL was able to maintain a low hydraulic conductivity throughout the tests, and the hydraulic performance of the GCL essentially was unaffected by whether the tests were conducted under aerobic or anaerobic conditions. Although the simulated animal waste stream apparently does not have a high enough chemical strength to pose a threat to the stability of GCLs, Shackelford warns that more research needs to be done on

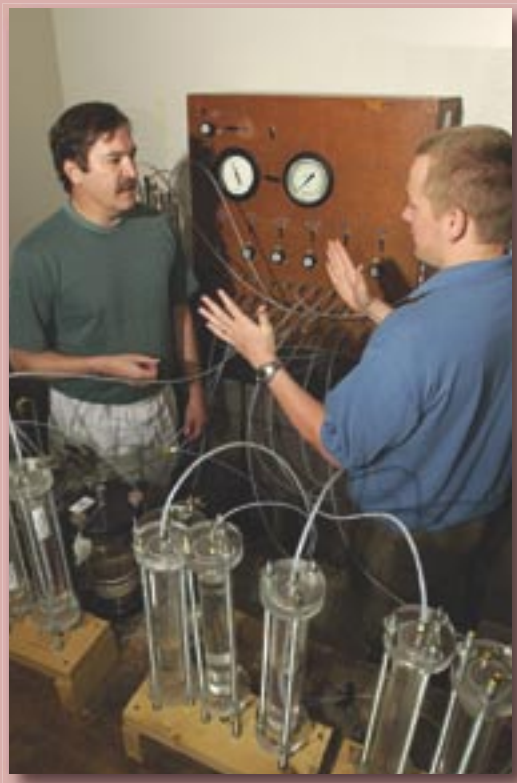
"The natural variability in clays leads to inconsistency in traditional compacted clay liners."

Colorado State University

Knowledge to Go Places

using GCLs to store other types of wastes, including actual animal waste streams.

Now Shackelford is conducting tests to determine the potential for adsorption of chemical constituents to the bentonite and geotextile of GCLs. The results of these tests will provide a partial assessment of the ability of the GCL to delay the migration of the waste stream constituents. At the same time, Carlson, Shackelford's co-investigator, is analyzing waste samples from lagoons, groundwater, and surface water around Colorado to detect the presence and concentration of three categories of antibiotics widely used in animals across the United States.



GCLs are becoming increasingly popular in the feedlot industry because they are economical and easy to repair. Ultimately, Shackelford hopes to determine whether GCLs can be used as a safer alternative to current lining systems in animal waste containment lagoons. He hopes that his research will be instrumental in developing a set of design guidelines pertaining to the use of GCLs in animal waste disposal practice.

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The Many Uses of Bentonite

Since being discovered in 1890 near Fort Benton, Wyoming, the clay known as bentonite has been quarried for a variety of uses. Bentonite's volume increases several times when it comes into contact with water, making it valuable for a wide range of applications.

In addition to its use in GCLs, bentonite is used in industry to create molds for casting iron and steel and as a mud constituent for oil and water well drilling. Bentonite is also crucial to paper making, where it improves the efficiency of conversion of pulp into paper as well as the quality of the paper. In paper recycling, bentonite offers useful de-inking properties.

At home, bentonite can be found in the medicine chest in pharmaceuticals like calamine lotion, wet compresses, and anti-irritants used for eczema. Mud packs, baby powders, and face creams may also contain bentonite. In the kitchen, bentonite is an ingredient crucial to the processing of edible oils and fats (soya, palm, canola oil). It also is used as a clarification agent in drinks like beer, wine, and mineral water and in products like sugar or honey. Bentonite is an essential ingredient in laundry detergents and liquid hand soaps where it removes the impurities of solvents and softens fabrics.

However, cat owners may most readily recognize bentonite. Due to bentonite's ability to absorb refuse by forming clumps, the clay is a common ingredient in cat litters.