

## Technology Brief

# SOIL STABILIZATION FOR IRRIGATION CANAL LINING

Each year, irrigation canals in Washington and other states suffer tremendous water losses. A substantial portion of these losses is attributed to the failure of canal liners. These losses represent considerable financial cost, as well as canal leakage on slopes, which can cause slope failure, and considerable hazard to people. Water losses in individual irrigation districts can cost over \$500,000 annually. Properly lining the canals can reduce water loss. Concrete or plastic film can be used to line canals to avoid such losses. The soil can be stabilized with various materials, including lime and bentonite.

## Project Overview

The Roza Irrigation District (Washington State) expressed interest in soil stabilization as a repair method for the Terrace Heights Irrigation Canal. The goal of this project was to test stabilized soil to determine if it would meet the strength and permeability necessary to line the Terrace Heights Irrigation Canal. Tests on different blends of soil and stabilization materials determined the best formulation.

## Materials Used in Soil Stabilization

Lime and bentonite are two materials that are soil additives used for soil stabilization. Applications include roads, hillside stabilization, reservoir lining, or irrigation canal lining. For this project, tests used a product called Econolime™ to provide the lime for the soil stabilization. Econolime™ is a by-product generated during the lime-production manufacturing process and is also generated by some pulp and paper mills.

## Key Words

**Materials:** Lime by-products (Econolime).™

**Technologies:** Soil stabilization.

**Applications:** Irrigation canal lining.

**Market Goals:** Use of lime by-products as a lower cost method to line irrigation canals.

**Abstract:** Test soil mixtures to determine the appropriate formulation based on the soil composition.

The purpose of this limited study was to determine the reactivity of Econolime™ blends with soil samples taken adjacent to the Terrace Heights Canal.

The estimate for the amount of Econolime™ produced at two Washington plants generating this by-product is 7,800 tons per year. One plant has approximately 30,000 tons of the Econolime™ stockpiled.

Although Econolime™ was the soil stabilizer selected and used for this project, another potential lime source includes a by-product from controlled atmosphere warehouses that store apples.

## Formulation and Testing

The soil samples tested were obtained along the slope of the Terrace Heights Irrigation Canal. The samples were obtained from at depths just below the topsoil to



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a depth of 12 to 14 inches. The upper layer was approximately six inches thick and consisted of damp, soft, reddish-tan silt. Immediately below this layer was a damp, blocky, hard tan silt. Characterization tests of the samples included natural water content, soil pH, Atterberg Limits, and grain size distribution.

Stabilized soil samples were prepared using different amounts of Econolime™ and other additives, such as dical (a by-product of magnesium manufacture). The following mix designs were tested (all concentrations were by dry weight of soil):

- 20% Econolime™ + 4% Quick Lime + 1% Cationic Starch;
- 10% Econolime™ Slurry + 4% Quick Lime + 1% Cationic Starch;
- 20% Econolime™ + 4% Quick Lime;
- 20% Rehydrated Dical; and
- 20% Hydrated Dical

Samples underwent two types of testing:

- strength test (for 3 days and for 7 days); and the
- permeability test.

After initial testing, the best-performing formula was mixed again for additional strength and permeability testing.

The formula that produced the best test results used the following components:

<u>Component</u>	<u>Percentage</u>
Econolime™	20
Other Additives	5
Soil	75

The local water district requires a minimum strength of 100 psi. The strength after 3 days was 297 psi and, after 7 days, was 305 psi. The permeability showed a hydraulic conductivity of  $10^{-6}$  cm/s.

## Cost Considerations

Using stabilized soil for irrigation canal lining has performance and cost advantages over concrete lining or plastic film lining. Lining canals with concrete can cost three times more than soil stabilization. Plastic lining is more expensive than concrete lining and animal migration can damage plastic lining. The low cost of Econolime™ (at less than \$10 per ton) makes its use as a soil stabilizer advantageous. However, this material is currently going to landfills or stockpiles.

## Conclusions

The soil adjacent to the Terrace Heights Irrigation Canal reacted well with the Econolime™ blends. With the exception of the slurry mix, the compressive and durability strengths obtained from the Econolime™ blends were good. The use of slurries with fine-grained soils is typically not recommended due to soil sensitivity to moisture content during construction.

The tests performed in this project demonstrated that soil stabilization using 20% Econolime™ per soil weight can produce soil strengths and permeability acceptable for use in irrigation canal lining. The testing performed was for a specific regional soil content. Soils from different regions would need additional testing.

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### *For More Information*

For a copy of the report, *Soil Stabilization For Irrigation Canal Lining*, use the CWC Publication Order Form or call (206) 443-7746. For more information email [info@cw.org](mailto:info@cw.org), or visit the CWC [Internet Website](http://www.cw.org) at [www.cw.org](http://www.cw.org).

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