Mirafi® H_2Ri Research Summaries

TenCate Geosynthetics recognizes the value of research. Quality research advances the industry, validates product performance and provides data that can be used in design. Over the past several years, several research projects were initiated and published which described the positive benefits Mirafi® H_2Ri contributes to civil structures. These research projects combine to tell Mirafi® H_2Ri's unique story and are summarized below.

University of Alaska Fairbanks

Use of H_2Ri Wicking Fabric to Help Prevent Frost Heaving in Alaska Pavements (2009)

Soil column tests conducted comparing the following Mirafi® products: H_2Ri, HP570 high-modulus woven geotextile, FW402 monofilament geotextile and G-Series composite. Results show that H_2Ri removes 2% to 4% more moisture than the other products. This is important for two reasons: (1) The difference in moisture content distributions in the soil columns are caused by **unsaturated** water flow induced by suction head difference (capillarity) provided by H_2Ri. (2) According to Budhu (2008), the undrained shear strength of fine-grained soils can increase about 20% for every 1% reduction in moisture content. This means by using H_2Ri, the undrained shear strength of a soil can be 40% to 80% higher compared with soil treated with the other geosynthetics.

Use of H_2Ri to Prevent Frost Boils in the Dalton Highway Beaver Slide Area, Alaska – (2012)

The Beaver Slide area of the Dalton Highway suffered severe road damage through (1) frost heave and subsequent thaw weakening which occurred every spring and (2) upward pressurized water flow to the road surface during lengthy rain events. This instrumented test section was monitored for temperature and moisture content through the placement of sensors in 22 locations within the road cross-section. The H_2Ri successfully eliminated the frost heave and thaw weakening in the pavement surface. The authors determined that "*the H_2Ri is a good material for draining water out of the pavement structure… The material itself has high ability to absorb water from surrounding soils.*"

A Bio-Wicking System to Mitigate Capillary Water in Base Course (2016)

This research involved an investigation into the possibility of a bio-wicking system that addresses these potential concerns: (1) degradation of daylighted H_2Ri due to UV exposure; (2) mechanical damage to H_2Ri due to grass mowing operations; (3) loss of function in high suction conditions due to air intrusion into drainage yarns. The H_2Ri was buried in topsoil at the road shoulder, which was then hydro-seeded to establish vegetation. The vegetation worked as a "pump" to vaporize water from the soil, while the H_2Ri served as a water conduit. Small and full-scale testing indicated that this bio-wicking system is more effective at mitigating capillary water within the base course than exposing the geotextile to the open air. In addition, authors concluded that "in comparison with conventional geotextiles under unsaturated conditions, H_2Ri… is more efficient at laterally draining out capillary water".

Development of Design Method for H_2Ri Wicking Fabric in Pavement Structures (2016)

In this preliminary project dedicated towards the quantification of the hydraulic benefits that H_2Ri brings to flexible pavements, the researchers concluded the following: (1) By incorporating H_2Ri into a roadway and maintaining the post-compaction water content at optimum levels, the resilient modulus of the granular base course can be increased by a factor of 3 and permanent deformation can be reduced to half. (2) H_2Ri has the ability to continuously remove water out of the pavement structure in unsaturated conditions. (3) Clogging effect is not a major concern regarding the drainage efficiency of the H_2Ri.

The University of Texas at Austin

State Highway 21 Test in Expansive Clays

Expansive soils are a recognized problem that plague roadway systems, causing edge cracking due to the swelling and contraction of these soils due to repeated wetting and drying. This problem is due to the difference in subgrade moisture content between the shoulder area and further into the road section. Removing this variability in moisture content will eliminate this cause of edge cracking. In instrumented test sections on State Highway 21 near Austin, researchers found that H_2Ri reduced the moisture content spread in these types of soils by up to 75% in comparison to soils that were not treated with H_2Ri. The researchers concluded that "H_2Ri appears to have the ability to equilibrate moisture in areas beneath it when there are significant differences in moisture content".

GeoTesting Express

Several full-scale laboratory cyclic box tests to quantify the benefits of H_2Ri in a variety of subgrade conditions. These results were also used to calibrate H_2Ri for inclusion in the Giroud-Han (2004) Design Method for Geosynthetic Reinforced Unpaved Roads as well as the 1993 AASHTO Flexible Pavement Structural Design method.

FPInnovations

Mitigating Edge Cracking on Low Volume Pavements in the Yukon with Wicking Geotextile (2018)

In this instrumented field trial, researchers determined that H_2Ri reduced moisture content by approximately 2% and also greatly reduced roadway edge cracking. Researchers recommended the use of H_2Ri for low volume pavements in northern environments.

University of Kansas

Evaluation and Design of Wicking Geotextile for Pavement Applications (2018)

Quantifying the benefits of mechanical stabilization provided by reinforcement geosynthetics for unpaved roadways and flexible pavements has been an accepted practice in the Americas for several years. This research had several objectives including: (1) Quantification of the relationship between H_2Ri's ability to remove water and environmental parameters such as relative humidity, temperature and soil moisture content. (2) Evaluation of the combined drainage and reinforcement effects of H_2Ri. (3) Development of design guidelines to incorporate the benefits of H_2Ri into 1993 AASHTO Flexible Pavement and AASHTOWare Pavement ME design methods.

By quantifying temperature and precipitation data, it is now possible to quantify the benefits H_2Ri brings to a flexible pavement to a specific location anywhere. Some additional conclusions from the report include: (1) H_2Ri can transport water horizontally and against gravity; (2) The effective wicking zone of H_2Ri is approximately 200 to 300 mm above the geotextile. (3) H_2Ri significantly reduced the permanent deformation of the test section under cyclic loading compared with a control section and a section reinforced with RS580i.

In Closing

As additional research is completed, TenCate will provide further summaries like this document to the engineering and design communities. We are proud of this unique moisture management system and want to share our information with interested parties.

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