Large Scale Puncture Resistance Performance (ASTM D5514) of PRECIDIUM™ ECS™ Sprayed on Conductive Foil Compared to HDPE

Introduction

The ability to resist puncture failure from a protruding object in the subgrade is a critical performance parameter for a geomembrane. The ability to lay a geomembrane over imperfect subgrade, without geotextile protection can lead to significant savings in the overall cost of a project. In an effort to best simulate actual service conditions in the field this study evaluates large scale puncture resistance of **PRECIDIUM™ ECS™** (**ECS™**), a proprietary spray-applied polymer, which has been sprayed onto a conductive foil backing. A substrate bed composed of a base of small diameter aggregate with specifically sized larger gravels placed intermittently on top of the base was prepared. Sixty mil **ECS™** sprayed on a foil backing was pressed over the subgrade up to a maximum pressure of 300 Kpa, which equates to 100 feet of water, following ASTM D5514. Sixty mil HDPE was also tested for comparison. This study used crushed gravel with effective protrusion heights of 1.5” to 4.0”; the gravel is shown in the picture below and contained some sharp edges which would cause quite a bit of abrasion on the geomembrane as it was stretched over-top. HDPE was tested with a protective cushion of 8 oz. non-woven geotextile as this is how it is generally installed in the field. The 60 mil **ECS™** membrane was tested with, and without, the 8 oz. nonwoven as **ECS™** is generally installed without a protective nonwoven geotextile.

Background

The Standard Test Method for Large Scale Hydrostatic Puncture Testing of Geosynthetics (ASTM D5514) has methods for testing over rock subgrades or manufactured truncated cones of various heights. The truncated cone method has been more widely used and published results for many types of geomembranes are available. Marcotte et. al. 2009, found that truncated cone results for HDPE closely mimicked results for stone aggregate, as the sharp edges of the aggregate don’t cause failure as much as the inability of HDPE to stretch elastically over protrusions. In this study we wanted to compare **ECS™** and HDPE, as **ECS™** offers much more elastic stretching potential. In truncated cone studies, HDPE gives much weaker results than **ECS™** sprayed on foil. However we felt it was important to compare the two geomembranes under conditions which more closely relate to actual service conditions. All of the testing done in the **ECS™**/HDPE studies was completed by a third party laboratory, Sageos/CTT Group in Montreal.

Gravel Subgrade

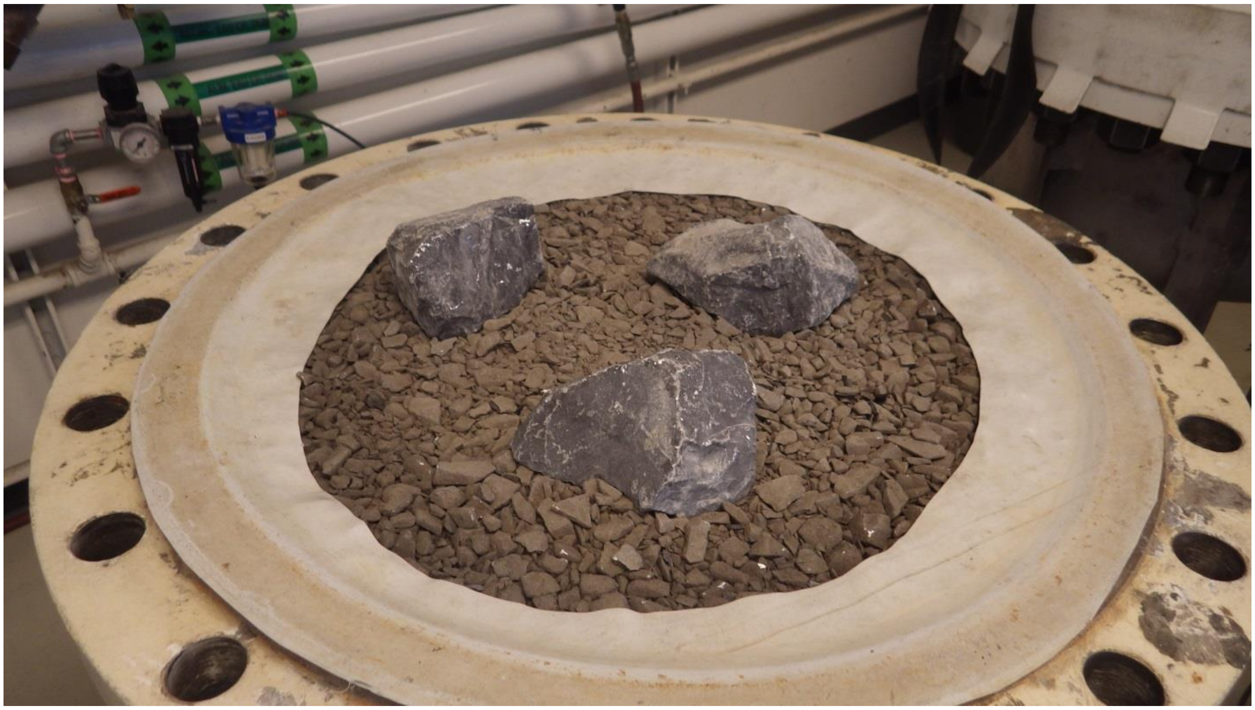

Figure 1: Example of The Subgrade Constructed for the **ECS™**/HDPE Comparison.

Test Results

Table 1 shows the results of the 60 mil **ECS™** sprayed on foil comparison to 60 mil HDPE.

Status Under 300 kPa (100 foot Water Pressure) Hydrostatic Conditions

Substrate Gravel Diameter in Inches	60 mil HDPE with 8 oz. Nonwoven Cushioning Layer	60 mil ECS™ Polyurea on Foil	60 mil ECS™ on Foil with 8 oz. Nonwoven Cushioning Layer
1.5	Pass	Pass	Pass
2.0	Pass	Pass	Pass
2.5	Fail	Pass	Pass
3.0	Fail	Pass	Pass
3.5	Fail	Pass	Pass
4.0	Fail	Pass	Pass

Figure 2: ECS™/Foil Composite Conforming Completely to Subgrade of 3.0” Aggregate

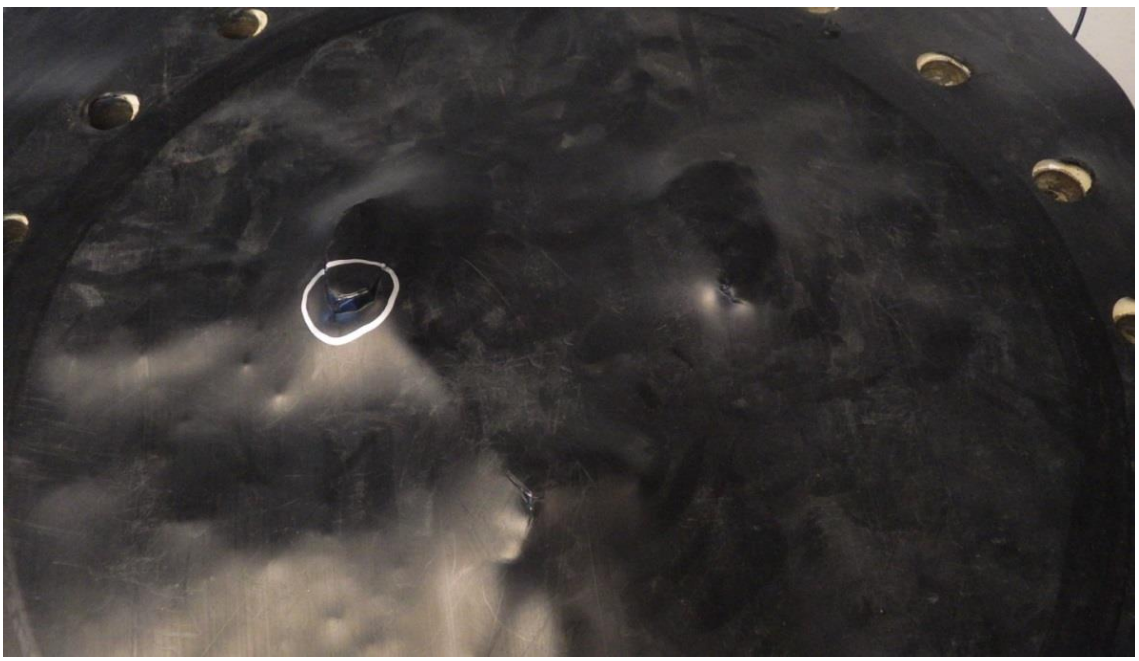

Figure 3: HDPE Puncture Over 2.5” Gravel Substrate

Discussion

Sixty mil **ECS™** clearly outperforms 60 mil HDPE in terms of resisting puncture and stretching over stones in the subgrade. As shown in Figure 1 (3.5" diameter Gravel) **ECS™** sprayed on foil was able to elastically stretch over some very substantial stones with or without a nonwoven cushion. In this study, the limit of **ECS™** was not found. Comparatively HDPE (accompanied by an 8 oz. nonwoven cushion) failed at a gravel height of 2.5".

Conclusion

ECS™ is a proprietary spray-applied polymer designed specifically for primary and secondary containment. **ECS™** sprayed on a foil backing offers a unique set of properties amongst the range of geomembranes available in the marketplace such as leak detection and leak location. It is clear that **ECS™** can be placed over larger protrusions than HDPE and will avoid puncture over less than ideal subgrade conditions. When factoring in surface preparation, the cost of a geotextile cushion, and the large financial and environmental costs caused by a geomembrane failure, **ECS™** appears to be the most cost-effective option available currently.

ECS™ is the result of 15 years of evolution of this type of proprietary chemistry. With its elastic behaviour and durability, combined with installation advantages of a spray-applied system, **ECS™** is a cost-effective candidate for both primary and secondary containment projects. As an added advantage the application of **ECS™** to a metallic (conductive) foil allows for inexpensive and accurate leak detection surveys of the entire containment.

For further information on this testing and other **PRECIDIUM™ ECS™** properties, please contact Western Engineered Containment Ltd. or Quantum Technical Services Ltd.

Sincerely,

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References

Marcotte M., Denis R., and Blond E. (2009) Design Algorithm for Puncture Resistance of PVC Geomembranes for Heap Leach Pads. Proceedings of Second Middle East Geosynthetics Conference, Dubai, UAE. Nov. 2009.