SOLMAX

TECHNICAL NOTE

UV resistance for GSE geomembranes

Weathering of geomembrane lining materials continues to be a major interest to those seeking long-term protection against ultraviolet exposure. In general, weathering and other environmental effects which cause lasting material changes are classified as aging. Changes in a material can be determined by studying the changes in the material's mechanical properties. Under certain conditions, a change in mechanical characteristics can permit an estimation of the material's life span.

Polyethylene geomembranes are manufactured from first quality polyethylene resins. To combat causes of aging, such as ultraviolet exposure, properly selected and dispersed carbon black is added to geomembranes at a rate of 2 - 3%. Carbon black is universally accepted as being resistant to significant deterioration caused by weathering for 50 years or more. In fact, AT&T Bell Laboratories (Polyolefin Longevity for Telephone Service, H.M. Gilroy, AT&T Bell Laboratories, ANTEC, '85) set out many years ago to demonstrate that the resistance to ultraviolet exposure and weathering for polyethylene is in excess of 45 years.[1] The predicted half life (50% reduction in strength and 50% reduction in elongation) of 1.5 mm thick HDPE geomembranes conformed to GRI-GM13 specification exceed 90 years for field test in the hot and dry climate of Phoenix, Arizona. (GRI-GS20).[2]

In addition to a high quality carbon black, Solmax utilizes highly effective chemical UV stabilizers which further extend the life of the material to which it is added. These additives absorb incident radiation and/or terminate free radical production, thus protecting the polyethylene against leaching effects, and possible chemical reactions with surrounding materials. Polyethylene resins, chemical stabilization components and carbon black dispersions have all been improved as a result of research and testing. As a result, properly formulated PE may have an estimated projected life in excess of 100 years.

Not only is the quality of additive packages important, but the integrity of the polyethylene resin itself plays a vital role in UV resistance. There are various properties of the resin package which can be adjusted to improve the UV resistance of a material. It has been determined that reducing the density of the polyethylene base resin reduces both the weathering and chemical resistance of the resin and the effectiveness of chemical stabilizers and carbon black.

There are, however, other factors which affect the potential UV resistance of a material and thus any lifetime predictions determined in a laboratory. Some items which effect or cause variation in the resistance of a material to UV degradation are:

- Average density
- Geomembrane thickness
- Carbon black type,content and dispersion
- Density range or distribution
- Chemical stabilizer system
- Catalyst type and amount of residue
- Copolymer type
- Combined chemical exposures

Essentially all liquid containment and exposed geomembrane applications leave some portion of the slope liner exposed to weathering. Testing results from some exhumed sample left exposed for up to 30 years has shown that the geomembranes are still functioning as intended.[3] Therefore proper resin and additive formulations are very important to enhance the material's resistance to UV degradation.

References

[1] Gilroy, H.M., "Polyolefin Longevity for Telephone service", AT&T Bell Laboratories, ANTEC, 1985.

[2] GRI-GS20 (2019), Standard Practice for "Exposed Lifetime Prediction of Geosynthetics Using Laboratory Weathering Devices".

[3] Tarnowski, C. & Baldauf, S., "Ageing resistance of HDPE-geomembranes - Evaluation of long-term behavior under consideration of project experiences", published in 2009.

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