Sustainable geomembrane recycling and *downcycling*

By Timothy D. Stark, Jennifer Miller, David LaFiura, and Scott Fought

Introduction

Pennsylvania's Department of Environmental Protection (DEP) and Department of Community and Economic Development (DCED) officials have welcomed the recent emersion of companies that collect and reprocess geomembranes used in various aspects of Marcellus Shale oil and gas drilling, development, and production.

The geomembrane uses include well pad liners, above ground impoundments, secondary containment, and floating covers. Well pad liners are placed over a large area (usually 200ft × 200ft) around the drill well to contain drilling fluids, provide an antislip surface for drill workers, and contain oil and gas products **(Figure 1).** Above ground containment ponds are used for a variety of containment purposes, e.g., drill pad water, well flowback water, and shale derived liquids **(Figure 2).** Secondary containment geomembranes are used around oil and gas storage tanks to contain any leaks from these tanks **(Figure 3).** Floating covers are used to prevent contact with the environment and wildlife of various liquids associated with the shale play.

The DEP estimates that more than 200 million pounds of geomembrane have been installed at Pennsylvania shale drilling sites since 2010. In 2012 alone, about 81 million pounds of geomembrane were installed at Pennsylvania gas drilling sites. Drillers use 10,000 to 20,000 pounds of geomembrane per drilling site and these geomembranes are damaged and replaced at each site from two to seven times during the life span of the well.

In 2012 about 4,100 new natural gas wells were permitted in Pennsylvania. This means a substantial amount of additional geomembrane material is being installed in Pennsylvania and eventually all of the geomembrane must be collected and either landfilled or reprocessed.

Currently, Ultra-Poly Corp. estimates that it has reprocessed more than 2.4 million pounds of geomembrane since July 2012, which means at least 2.4 million pounds of geomembrane has been diverted from landfill disposal. The potential for reprocessing a substantial amount of additional geomembrane is available at the Ultra-Poly facility in Berwick, Pa. because it is currently using only about 20% of its capacity.

This article highlights the potential for geomembrane reprocessing and the environmental, economical, and sustainability benefits that are derived from reprocessing discarded geomembranes.

New entity

A new entity in Pennsylvania is pursuing the potentially lucrative market for collecting, shredding, grinding, and pelletizing geomembranes discarded from Marcellus and Utica Shale drilling, development, and production activities.

Tim Stark is a professor of civil engineering, University of Illinois at Urbana-Champaign, and the technical director of the Fabricated Geomembrane Institute.

Jen Miller is the membership coordinator for the Fabricated Geomembrane Institute.

Dave LaFiura is vice president of Ultra-Poly Corp., Portland, Pa.

Scott Fought is vice president/director of operations at WellSpring Environmental Services LLC, Orangeville, Pa.

The new venture is a partnership between WellSpring Environmental Services, headquartered in Orwigsburg, Pa., and Ultra-Poly Corp., based in Portland, Pa. This is a first-of-its-kind venture, according to the Pennsylvania Recycling Markets Center Inc. (RMC) executive director Robert Bylone Jr.

This new partnership can process a substantial amount of plastic, can reduce the consumption of landfill space, and can lessen truck and roll-off container traffic around drilling sites. This venture has built a reprocessing plant in a building leased from the Berwick Industrial Development Authority in Berwick, Pa., to reprocess the discarded geomembranes from nearby shale drilling activities.

Figure 4a shows a pile of discarded geomembranes in the plant from nearby shale drilling projects prior to grinding, melting, and extrusion into polyethylene strands and then pellets **(4b).** The resulting pellets are being used to mold railroad ties **(Figure 5, p. 37)**, structural beams, and other products at the Berwick plant. If the pellets are used for geomembrane production, the process is termed recycling. If the pellets are used for railroad ties, structural beams, or other noncontainment products, the process is termed downcycling. The term reprocessing is used here to encompass both recycling and downcycling.

Ultra-Poly also ships the resulting pellets **(Figure 4b)** to domestic and international manufacturers. The company estimates that 15 new jobs were created

FIGURE 1 Well pad liner installation around drill rig and other containment areas.

FIGURE 2 Above ground drill pad water containment pond lined with a fabricated geomembrane.

FIGURE 3 Secondary containment for steel oil and gas storage tanks.

(a)

(b)

FIGURE 4 (a) Piles of discarded geomembranes with excavator for materials handling at the Ultra-Poly plant in Berwick, Pa., and (b) polyethylene pellets extruded from discarded geomembranes from nearby shale drilling projects.

immediately by the Berwick plant and there are long-term plans to employ about 45 people. This new plant has revitalized an old manufacturing space and has contributed millions to Berwick's tax base. To date, WellSpring and Ultra-Poly have invested approximately $4 million each in research and development for the recycling and downcycling processes.

Ultra-Poly is a large recycler of polyethylene and polypropylene plastic and has developed a proprietary procedure for reprocessing the discarded geomembranes. After the discarded geomembrane arrives at the Berwick facility, it is processed through a rotating cylinder that removes dirt and debris from the geomembrane. The geomembrane then goes through a second trammel that separates remaining rock from the plastic. After the material is shredded down to small pieces, it is melted and molded into plastic strands. The strands are cut into small resin pellets.

WellSpring Environmental Services specializes in drill site decommissioning and waste hauling. As a result, WellSpring teamed with Ultra-Poly to facilitate collection and navigation through the various regulatory hurdles for handling and processing geomembranes that may have been exposed to hazardous materials.

To facilitate collection and transportation of the discarded geomembranes, WellSpring developed special equipment for on-site separation of well pad liners from landfill waste. In particular, geomembrane pieces from a well site are separated and transported to the Berwick reprocessing plant while the other waste is delivered to a landfill in the same trailer load.

Previously, excavators would tear well pad liners into large sections for landfill disposal, which required 8-10 landfill trips with filled roll-off containers to remove the drill pad liner and transport it to a landfill. To reduce the time and truckloads involved in removing and disposing of the geomembrane material, WellSpring

developed specialized equipment—modified sod cutters, that slice, clean, and tear the drill pad geomembrane to facilitate transport and initial processing at the Berwick facility.

Jonas Kretizer, president of Well-Spring, believes the recycling program is not only good for the environment but good for the financial bottom line, as well. "We can do liner removal more efficiently, at less cost, while reducing truck traffic, protecting the environment, and generating commercially reusable material," Kreitzer said.

Table 1 shows several categories of geomembrane related material being used in shale oil and gas development, each of which presents a different set of challenges to reprocessing.

(a)

(b)

FIGURE 5 (a) A stack of downcycled railroad ties that were fabricated at the Berwick, Pa., plant, made from discarded geomembranes and (b) close-up of downcycled railroad ties at the Berwick facility (manufacturing by Axion International).

TABLE 1 Recyclable materials and potential recycling value

Collected Material	Ability to Grind and Repelletize Geomembranes	Ease of Transportation to Reprocesser	Value of Material for Reprocessing
HDPE Sheet Material	Medium-High	Medium-High	High
HDPE Geomembrane with Polypropylene Scrim	Medium-High	Medium-High	Medium
HDPE Geonet (cross hatch)	Medium-High	Medium-High	Medium-High
Reinforced Liners (HDPE and LLDPE with Polyester Scrim)	Low	Low	Low
Non-woven Polypropylene (felt)	Low	Low	Low
Felt/Sheet Composites	Medium	Medium	Medium

>> For more, search **liners** at www.geosyntheticsmagazine.com

Other beneficiaries

The DEP and gas companies are also benefitting from the reprocessing of discarded geomembranes by reducing material stockpiles, providing an environmentally friendly process to the controversial hydraulic fracturing procedure, creating a beneficial use, and eliminating future environmental liability when the geomembrane is reprocessed instead of retaining liability after the geomembrane is placed in a landfill. Based on the success achieved in Pennsylvania, this entity is investigating expansion into Ohio, West Virginia, and Texas where shale oil and gas development is increasing rapidly. Of course, the ultimate goal is to reprocess 100% of the geomembrane material used in the shale oil and gas field.

Summary

Because eventually all of the geomembranes associated with shale oil and gas development must be collected and either landfilled or reprocessed, it is prudent to develop recycling and downcycling opportunities for this material. In 2012 alone, about 81 million pounds of geomembrane were installed at Pennsylvania gas drilling sites, so this large amount of material should be reused in an environmentally friendly manner instead of landfilling. This process will provide environmental, economical, and sustainability benefits to this burgeoning field of geomembrane usage.