

Emerging Trends in the Liner Industry



Geomembrane Liner System Trends



Characteristic	Trend
Care/concern from operators regarding liner projects	Increase
Project Costs	Increase
Pond Sizes	Larger compared to prior ponds used in oil and gas
Water Quality	Fresh Water → Produced Water
Project Designs	More intricate engineered designs, features and specs moving towards landfill and environmental industry standards



Geomembrane Liner System Trends



Characteristic	Trend
Dirt Work	Increased requirements for compaction testing by Modified Proctor and Optimal Water Content
Liner Systems	Single Layer → Multilayer → Multilayer with Leak Detection
Lining System Complexity	Include Primary and Secondary layers accompanied by Leak Detection systems (increased environmental concerns)
QC & Testing Requirements	**Non-destructive (vacuum and air) **Destructive (samples cut and tested on tensiometer)
Field Testing	Use of conductive materials and spark testing to add another level of assurance and understanding to operator

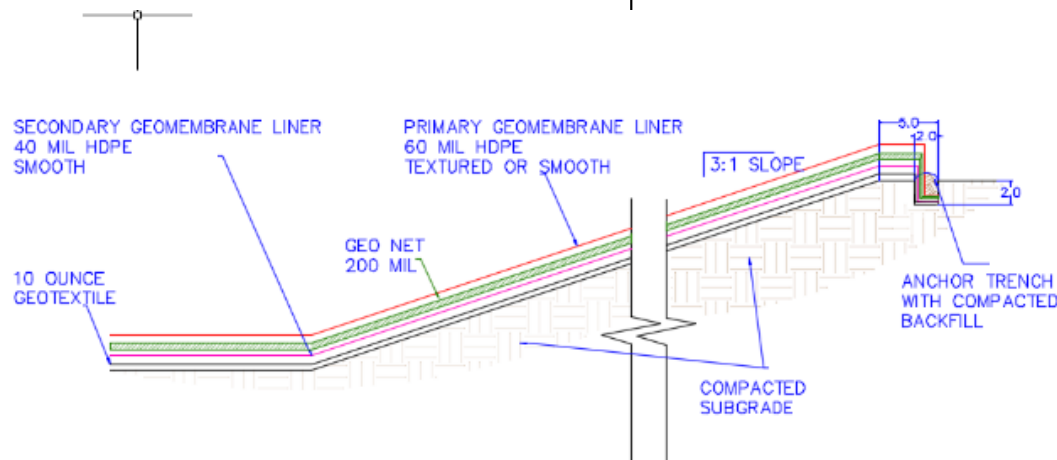




Industry Concerns



Industry Concern	Trend
Fresh Water usage minimization	Minimizing the use of fresh water instead of recycling/reusing existing frac/brackish/produced water
Increased focus on water	Result: enormous level of importance for lining requirements for impoundments and storage facilities
Increased environmental care and concern	Produced water being stored in ground impoundments



The Different Layers

▶ Primary Layer

- ▶ Primary Leak Prevention Layer- in contact with stored water
- ▶ Typical Thickness Range from 40-80 Mil

▶ Geonet Layer

- ▶ Drainage Layer
- ▶ Typical Thickness Range from 150-250 Mil

▶ Secondary Layer

- ▶ Last Layer Of Defense- Allows for Post Install Leak Collection
- ▶ Typical Thickness Range from 40-60 Mil

▶ Textile Layer

- ▶ Helps Ensure Cleaner Welds, Cover Inconsistencies in Subgrade
- ▶ Typical Weights Range from 6oz-16oz



Industry Concerns



Industry Concern

Trend

Engineering improvements in impoundments trending towards landfill specs



Prior: push-up walls w/12-mil scrim liner

Now:

**engineering of ponds to very detailed specs

**installing an entire system of 40- 60-, or 80-mil liner with geotextile, geonet, and leak detection systems

**Specs/designs are on a completely different level than anything seen in the recent past

Increase in operators lining all ponds with multilayer systems

Provides long-term flexibility to store fresh or produced water, regardless of the short term plan

Operators view on Term of Investment

Prior: short term hole in the ground to hold water

Now: more as a long-term investment

Multi-Layer Water Liner System



➤ What is a Double Lined System?

- Liner System composed of two polyethylene (PE) liners (Secondary Liner and Primary Liner)
- Typically also uses a GeoTextile and a GeoNet
- Multitude of Product Combinations to best Suit Customer Needs

➤ What Makes a Double Lined System Different?

- Gives Customer Option to Store Produced or Fresh Water
- Additional Protection for Environment and Land Owner

➤ Why Use Double Lined Systems?

- Allow for installation of leak detection system

➤ Use of Conductive Liner

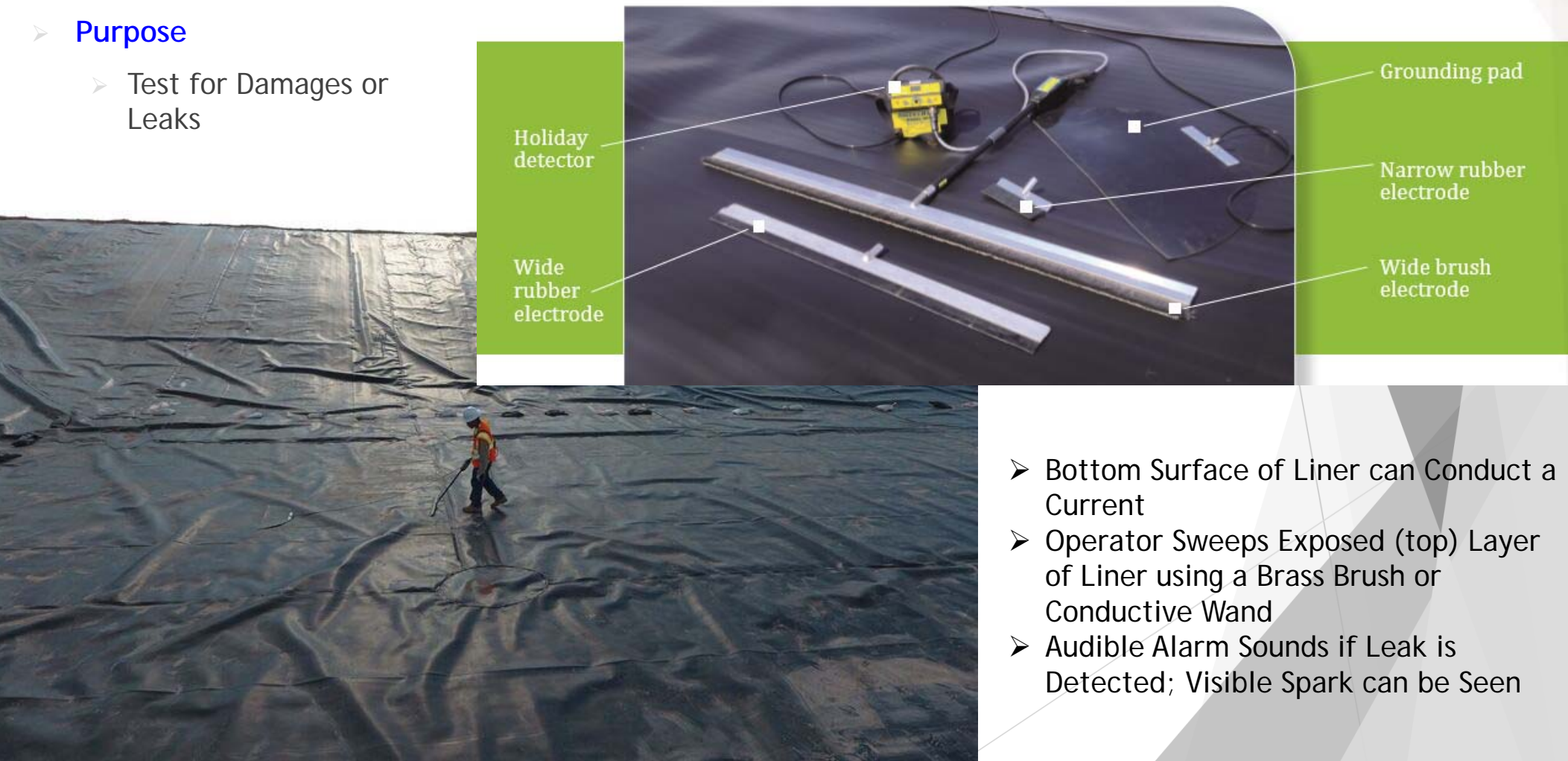
- Spark Testing to Detect Accidental Installation Damage
- If Leak Occurs, Simplifies Leak Location Process



Conductive Liner- Spark Test

➤ Purpose

- Test for Damages or Leaks



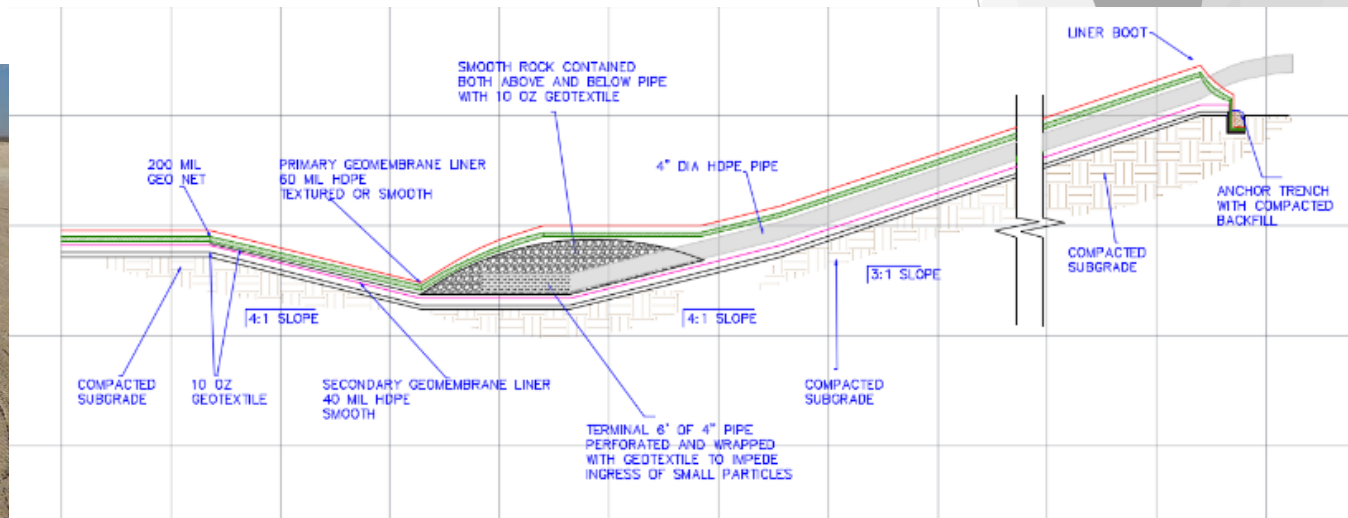
Leak Detection System

Purpose

- Leakage in Primary Layer Accumulates in Sump For Periodic Removal and monitoring

Design

- 6-12" Poly Pipe Runs Down Wall of Pond into Sump
- Pipe End is Perforated, Covered with Aggregate and Wrapped in GeoTextile
- Bullet Pump in Sump for Water Removal



Best Practices

Best Practice	Detail
Innovative personnel- both management and laborers	<ul style="list-style-type: none"> **On-site Management **Have experience with multilayer installations **Structure with personnel and implement practices that far exceed current industry standards
Thorough quality control packages	<ul style="list-style-type: none"> **Track all testing, repairs, seams, welds etc. **QC documents and As-Built Drawings provided to Client at completion of project
Conductive liner with the ability to spark test	100% testing of surfaces, including wrinkles and under seams

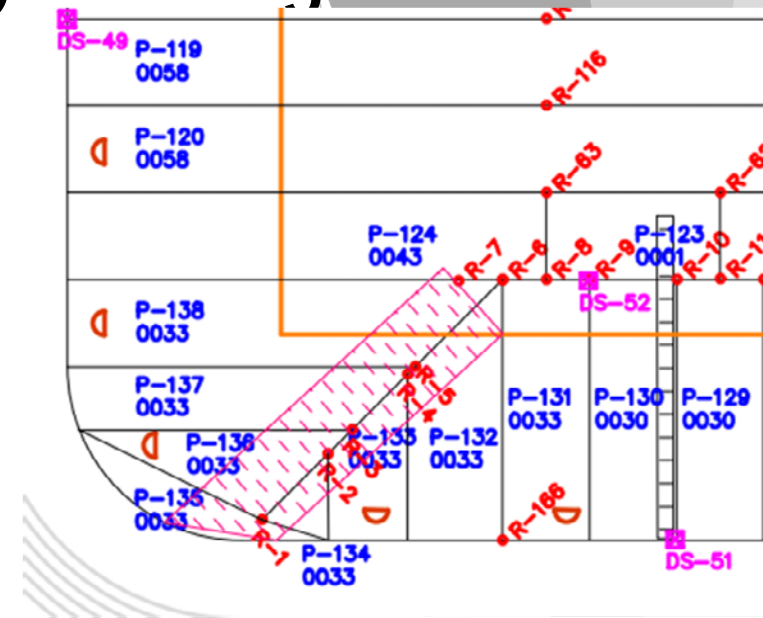
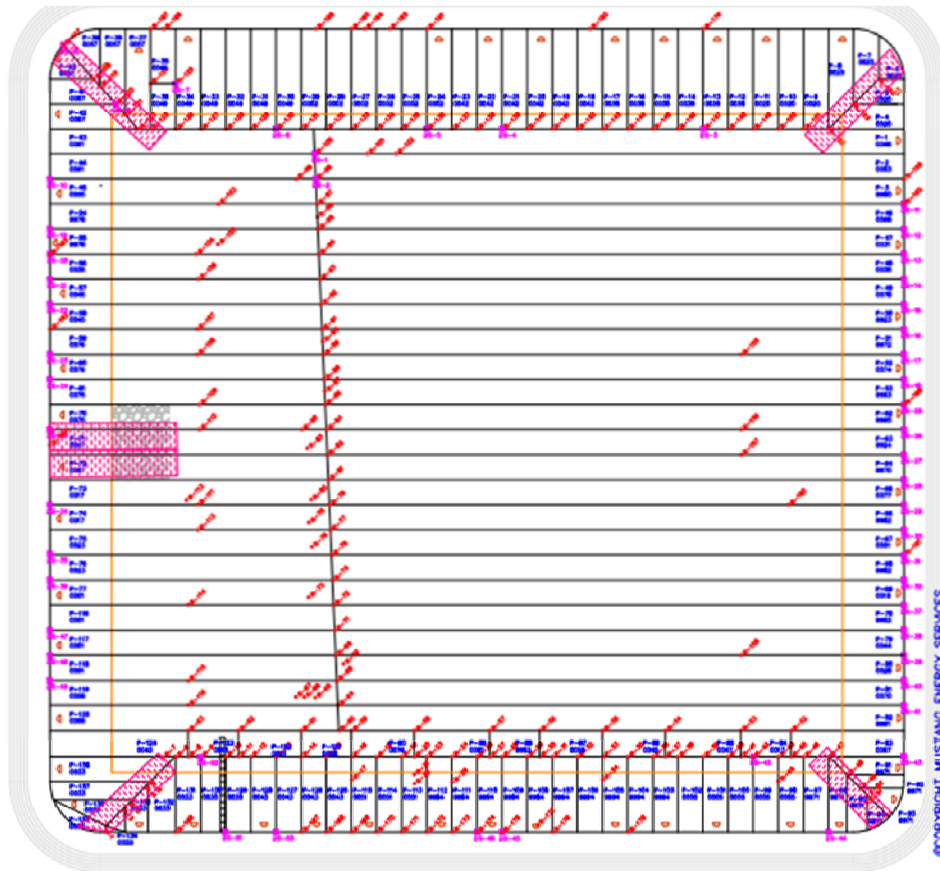


Best Practices

Best Practice	Detail
Quality materials and equipment for streamlined installation	<p>**Experienced in and Access to Various Consistencies, Colors & Kinds</p> <p>**Newer, Reliable & Well Maintained Equipment</p>
Superior Safety Standards	Priority requirement for any job- big or small
Focus on Environmental Sustainability	Providing solutions that allow for long-term solutions to changing storage requirements
Correct Anchoring Practices	All liners must be properly anchored to ensure lasting and continual system integrity



Quality Package



Repairs

Panel Number and Roll Number

Rub Sheets

Destructs

Vents

Floor Perimeter

Ladders/Depth Gauges



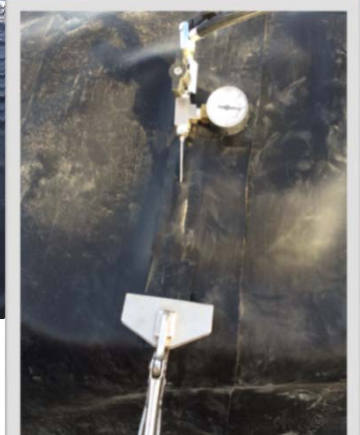
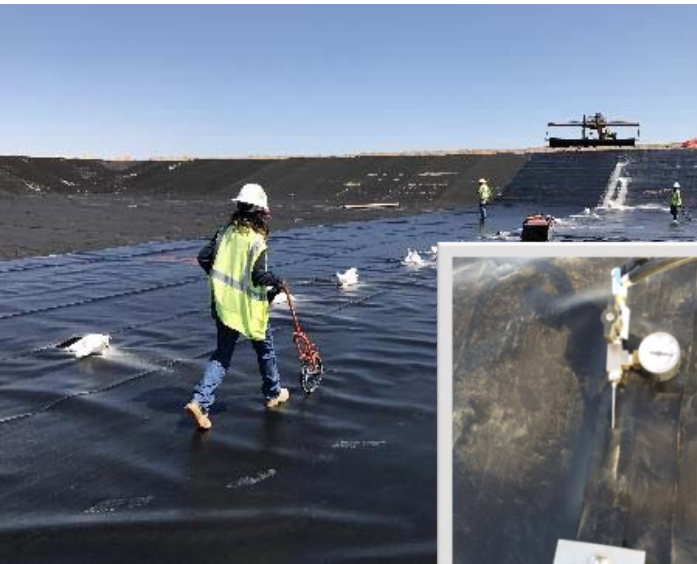
Quality Package

Pre Weld

DATE	TIME	MACHINE				PEEL		PEEL		PEEL		SHEAR	
		#	TEMP	PRE-HEAT or SPEED	TECH								
8/10/17	0720	3	800	9.0	SL	74	/ 74	79	84	66	/ 72	88	92
8/10/17	0739	6	800	7.0	NY	73	/ 81	76	/ 77	85	/ 83	89	87

Destructs

SAMPLE #	SEAM				PEEL		PEEL		PEEL		SHEAR	
	DATE	#	MACH #	TECH								
1	8/10/17	1/2	3	SL	79	/ 73	81	/ 74	73	/ 77	79	84
2	8/10/17	3/4	6	NY	77	/ 72	82	/ 76	75	/ 73	77	79
3	8/10/17	16/17	3	SL	73	/ 71	82	/ 77	74	/ 68	85	89
4	8/10/17	1/19	2	AC	77	/ 72	69	/ 70	77	/ 74	88	89



DATE	PANEL #	ROLL #	IN-PLACE		Corner	Vent	PAY AREA
			LENGTH	WIDTH			
8/10/17	S- 1	0735		530	22.3		11819
8/10/17	S- 2	0735		250	22.3		5575
8/10/17	S- 3	0733		305	22.3		6802
8/10/17	S- 4	0733		475	22.3		10593
8/10/17	S- 5	0732		75	22.3		1673

Panels

Repairs

REPAIR							VACUUM TESTING	
#	PANEL(S) or SEAMS(S)	DATE	MACH #	TECH	LOCATION		TECH	DATE
1	6/7/8/9	8/11/17	3	SA	T		XM	8/11/17
2	6/9/10	8/11/17	3	SA	T		XM	8/11/17
3	1/6/10	8/11/17	3	SA	T		XM	8/11/17
4	1/10/11	8/11/17	3	SA	T		XM	8/11/17
5	1/11/12	8/11/17	3	SA	T		XM	8/11/17
6	1/12/13	8/11/17	3	SA	T		XM	8/11/17

Air Tests

SEAM				TEST		PRESSURE	
#	DATE	TECH	MACH #	DATE	TIME	MAX	MIN
1/2	8/10/17	NY	6	8/10/17	0812	30	30
1/3	8/10/17	NY	6	8/10/17	0850	30	30
1/6	8/10/17	AC	2	8/10/17	0835	30	30
1/10	8/10/17	AC	2	8/10/17	1000	30	30
1/11	8/10/17	AC	2	8/10/17	1002	30	30

Questions?

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